Design/Build in Architectural Education: studying community-focused curriculum

Matthew K. Sutter
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DESIGN BUILD IN ARCHITECTURAL EDUCATION:
STUDYING COMMUNITY-FOCUSED CURRICULUM

A Thesis Presented

By

MATTHEW K. SUTTER

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

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May 2015

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DESIGN BUILD IN ARCHITECTURAL EDUCATION:
STUDYING COMMUNITY-FOCUSED CURRICULUM

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Stephen Schreiber
Chair, Department of Architecture
DEDICATION

To all the Design/Build teams I have worked with that provided me with the experience and motivations to further this movement

&

My Family.
ABSTRACT

DESIGN/BUILD IN ARCHITECTURAL EDUCATION: STUDYING COMMUNITY-FOCUSED CURRICULUM

MAY 2015

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Design/Build education in architecture schools is growing in popularity across North America. I have researched the development of this movement, particularly as it has influenced educational programs. This paper begins with a review of the history of design/build at the University level. These historical precedents chart the course of several major benchmarks that have influenced design/build in the United States over the past 100 years. The second part of the study features a matrix highlighting seven current academic programs with long-term success in design/build. Then, I highlight my own design/build experiences within this format.

After determining successful design/build programming, I used this information to develop a new curriculum. To test this new system, I led the development and realization of a local design/build project involving a Five College undergraduate team. This small-scale project was chosen in January and the physical build occurred in March, 2015. Completion of this project allowed for a critical analysis of this new method. This paper compares my results with the initial definition of program successes in an attempt to determine best practices for design/build curriculum moving forward.
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CHAPTER 1

BACKGROUND

The role of the architect has changed throughout recorded history, from a religious figure in antiquity to the image held by contemporary theorists (Kostef, 1977). In the 21st Century, the architectural profession continues to evolve, with design/build surfacing as a relatively new opportunity. This new model for practice reconnects the architect with the builder, as in older times.

This investigation addresses the role of the architect in today’s society, as well as opportunities for service within the profession. Moreover, practitioners may be able to respond best to the end user through design/build techniques. I define “design/build” in architectural education as the process of simultaneously designing and constructing in the classroom through experiential education. Moreover, design/build is a group process in education.

A design/build project provides this forum of learning while at the same time creating a usable product. The process of design/build can enhance engagement and ownership for all involved. There are precedents of this concept of community building throughout history. Building projects require logistics and energy. Currently these are provided by professional organizations with and by financial institutions. Incorporating the end user in through design/build is a way of increasing social capital in the community. To change this system that is motivated by profit and not the end user, a critical analysis must be made of the design/build teaching method.
Moreover, I propose that the use of design/build in architectural education can be a necessary and important teaching tool. The study of design/build addresses the decision-making process, techniques for collaboration, fabrication skills, and logistical planning. As educators look for new ways to engage experiential education in the classroom, design/build curriculum offers a way forward.
Design/build education varies across states, eras and program types. However, valuable lessons can be learned from each of these historic examples. The following precedents demonstrate the breadth of the design/build movement and offer useful information for future practice.

**Black Mountain College**

The design build program at Black Mountain College opened in 1933 and ran until 1957. Located outside of Asheville in North Carolina, the program focused on design and craft using experiential education curriculum. The school was based on John Dewey’s progressive educational model, and founded by John A. Rice, an outcast from Rollins College, Florida. ¹(Harris, 2002)

According to Mary Emma Harris, the “Black Mountain College was fundamentally different from other colleges and universities of the time. It was owned and operated by the faculty and was committed to democratic governance and to the idea that the arts are central to the experience of learning. All members of the College community participated in its operation, including farm work, construction projects and kitchen duty.”² Black Mountain College became a significant thought incubator for the design/build movement

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² {Citation}
in the United States, as many educators involved with the college moved on to other institutions and brought ideas from BMC with them.

Image 1: Student constructing the new student center designed by Lawrence Kocher in 1940. (North Carolina State University Image)

Yale University

In 1966, Yale University instituted the first formal University-based design/build program in New Haven, Connecticut. After replacing Paul Rudolph as director of the department, Moore changed the direction of the curriculum. Developed by Charles Moore, the First-Year Building Project was required for all of the University’s architecture students.

Richard Hayes has documented the entire 40 years of the program captures Moore’s vision writing “As a believer in simple tectonics and basic technologies, he (Moore sic) hoped students would be inspired by the mechanics of building. In the midst of the student unrest of the 1960s he saw the project as a way for students to commit to positive
social action by building for the poor.” The program has continued to run as the Building Project, and increasingly has prioritized socially responsible architecture in addition to design/build.

The Farm

Located at the University of California, Irvine, the Farm ran three short years between 1967 and 1969. The Farm was a social research program that focused on the indigenous crafts of non-native cultures. The college imported men, women, and children from Pacific and Central American regions to work and live with undergraduate students of various majors. The experiment was documented and analyzed using the latest DARPA technology of punch card data collection for computing. The program evolved into a social commune, or hippie enclave, and soon shut down due to programmatic differences with the administration. 4

However, the community designed and built the structures they studied from indigenous groups, using the materials and techniques of the native instructors. They also incorporated a communal lifestyle into design/build education. In this way, the program stands apart from other design/build endeavors associated with universities.

Yestermorrow Design Build School

In 1980, a group of architects led by John Connell started the Yestermorrow Design

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3 {Citation}

Build School to make hands-on learning available to a wide variety of students. Located in Waitsfield, Vermont, the program attracts students from all over the world, and offers academic credit through a number of different institutions. Starting with eight students enrolled in the first class, Yestermorrow currently offers 150 courses on a variety design/build topics. From a full semester college program to a two-day skill-building workshop, the remote location of the school promotes an immersive learning experience in which students and instructors work and sleep on campus, sharing meals and collaborating as a group. As a result, Yestermorrow’s educational experience is reinforced by out-of-class dialogues and informal group discussions.

Image 2: Students fabricating skid plates for an outdoor children’s teaching play structure. Yestermorrow Vermont 2014. (M. Sutter Image)

The Rural Studio

The Rural Studio also offers a study-away, immersive design/build program. The program was started by D.K. Ruth and Samuel Mockbee in 1993, and sited itself in Alabama’s remote Hale County as a means of finding solutions for social problems. The
program involves both second-year design students and thesis students, and produces a wide range of built projects.

With more than 150 completed projects and more than 600 architecture students trained for practice, this program has become a model for hands-on education combined with public interest design. According to their website “The Rural Studio philosophy suggests that everyone, both rich or poor, deserves the benefit of good design.” In recent years, the program has evolved from providing individual housing for families to much larger community projects.

**Solar Decathlon**

The Solar Decathlon is a competition sponsored by the United States Government Department of Energy. This program exhibits the juried work from multiple schools every two years, in Washington D.C. Originally started in 2002, the competition stands out as a significant generator of design/build work, inspiring many U.S. architecture programs to develop their design/build curriculum.

The solar-powered houses showcase the latest technologies and products available. Often financed by corporate sponsors, the entrants rarely address a social mission. Indeed, ten categories define the criteria for judging, including architecture, market appeal, engineering, communications, affordability, thermal comfort, appliances, home life, commuting, and energy balance. While this program stimulates progressive design/build skill-building, the products are varied and largely performance-driven. Many teams have 90 or more students and faculty working on one structure.

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CHAPTER 3
DESIGN BUILD TEACHING METHODS

There is not one current process for teaching design/build. Instead, there is a wide range of types of programs, with all of the attendant diversity in curriculum and structure. For instance, programs have timelines that vary from one week to three years, they are in different geographic locations with distinct climate and cultural contexts, they accommodate students including graduate students, undergraduate students, and non-University affiliates, they work with non-profit, private and sometimes undetermined clients, and they have widely different budgets and goals.

That said, upon review of the seven completed surveys, most design/build programs have established organizational structures that suit their unique needs. (Appendix 1) However, many of these working program structures evolved organically and iteratively over time. For instance, there is not one accepted accreditation method for design/build courses. Instead, programs create a curriculum and structure based on their own needs and project requirements.

Decision Making

When moving from the design process to the build process (this can fairly fluid) the students need to have a structure for making decisions. This can be done in a variety of ways and can be determined by the school or the student group. Common methods of
Group consensus is an alternative approach that allows for maximum student buy-in. Because the group decides which scheme to build together, it often helps to build investment. Moreover, the scheme that emerges often isn’t one single design concept, but instead reflects the hybridization of a number of different student ideas, effectively creating one design owned by all.

Voting for a best scheme is a fairly standard method for making decisions. Occasionally this form of decision-making is combined with instructor input or guidance. While direct and efficient, this process can create animosity or resentment among the students in the group.

Finally, another method that is often used is to have the client or instructor select a scheme to build. This is often driven by financial constraints, or an instructor’s interest in project completion. However, this decision-making style also limits student investment and ownership.

**Collaboration Techniques**

One of the most important aspects of a design/build experience is working with other people on a team. Real world architecture projects require a group effort to be built and this class prepares students for this future certainty. Successful collaboration involves understanding group dynamics, including both positive and negative outcomes.
Design/build instructor Steve Badanes has his students create three lists about group dynamics prior to the build. These group collaboration charts document positives, negatives and finally solutions and aspirations. I was part of this process in a fourteen-person class at Yestermorrow Design Build School in Vermont. We came up with a list for each category. The positives among the thirteen ideas included both obvious and more subtle consideration, from more hands/help to the notion of greater individual accountability. Negative aspects outnumbered the positives with sixteen risks. Situations to be cautious of ranged from tyranny of the minority, to the class coined term ‘pusillanimousity’ or fear of conflict. The longest list was the solutions and aspirations, at nineteen items. This catchall list contained both techniques to prevent problems, such as defining roles and having check-ins, to advice for resolving conflicts. These lists are accurate in any group project from a two-person build to a skyscraper. (Appendix 2)

Learning to work in a group allows for the possibility of greater success for many reasons besides general productivity. The creativity generated in this non-competitive atmosphere allows individual ideas to flow freely. Combined with the varying backgrounds of the students, knowledge cross-pollination is achieved, and this can provide more thoughtfully resolved design concepts and solutions.

**Logistics**

Securing a workshop or build space is necessary for any design/build class. This usually depends on the scale of the project and the facilities available during the build. Geographic location is also a major factor in project requirements. For example, Norwich
University in Vermont is limited to building outside from April through November at most, due to snowy winters. Whereas the University of Miami Florida’s design/build studio is only concerned with tropical storms and heat/humidity and can work outside all year. Survey results showed six of the seven schools built their projects on-site or at an on-campus facility. (Appendix 1)

Relative to the site, transportation can become a major issue. Most schools surveyed preferred to have the build location near student housing and meals. This might seem trivial in the real world but the ability to have people, materials and tools on the job site, or close at hand, is instrumental in success. Uncontrollable factors such as weather and technology failure can spoil a project quickly or slowly, deteriorating team morale.

Designing a community-based curriculum requires the incorporation of a client that serves the public interest. This might seem easy but the boundaries between public and private projects combined with profit versus non-profit status often make this difficult. Indeed, the design/build process must consider the education of the client in addition to the students.

This is broken into two categories, student insurance and liability insurance on the built project. University programs traditionally cover student health insurance. While liability coverage is not a concern for smaller projects, it can become contentious on larger projects, especially those over $50,000. With trends toward larger projects in the future, the issue of insuring these projects lies between the school, client and architect of record.

Each program’s average project budget is largely dependent on their reputation in completing projects. School facilities and support also dictate the size of the project, but
capital is always a challenge. Over half of the programs surveyed get funding from outside sources, such as grants and gifts. The client has a budget which dictates insurance needed, based on the schools capabilities as well as a possible site. The budget can impact everything from the facility and insurance for the school to transportation and tools for students, or the site and built project for the client.

Individual program size varies in student enrollment and the overall project scale often depends on client and budget. Overall, the school’s facilities and reputation dictate the scope of the build and most programs are constantly morphing to match the goals and intentions they wish to accomplish. For some groups its full-scale house construction, while others are satisfied with smaller, portable projects such as bus stops and playgrounds. In design/build education, project size is less important than meeting course goals. The process and the product are equally important.
CHAPTER 4
PROJECT AND CURRICULUM DEVELOPMENT

In order to identify differences in design/build curricula, a national survey was necessary. This survey was sent to architecture schools in an effort to gather information on a number of disparate programs. In order to assure the most accurate and usable data, online survey software was necessary. This cloud-based service provided an elegant platform for the development and implementation of questions through email.

Fifteen schools were chosen based on program longevity, goals and success, as well as geographic location. Seven schools responded to the fourteen questions, ranging from program length to client selection. One finding showed all seven programs run at least a full semester and only one program is held over school breaks. Another answer revealed most programs (6 of 7) offer design/build to both graduate and undergraduate students or a combination of both. These survey results were studied thoroughly and considered in the following curriculum development.
Personal Experience

I also relied on my own experience as a design/build student and instructor. The skills, knowledge and methods developed through design/build vary depending on whether you are is student or a teacher. While these differences are not absolute, there are clear and distinctive roles in each of these realms.

My first experience at Yestermorrow Design Build School was in 2009, taking a weekend workshop fabricating concrete countertops. Having studied in traditional architecture studios, this was a revelation in learning techniques and methods I had not experienced firsthand. I was soon enrolled in another weekend workshop and eventually went on to be a student in their first college semester program. Eventually my path led me to co-instructing the concrete counter workshop for several years. During my most recent trip to Vermont, I studied public interest design/build in a two-week class with three expert
design/build instructors in an effort to understand best practices for running such a course. Yestermorrow Design Build School has taught me the importance of hands-on building as a teaching method, as well as the value of an immersive campus experience that can enhance the cross-pollination of ideas and ultimately project results.

The past year allowed me the opportunity to continue teaching through a Hampshire College building project called the Roos-Rohde House. This new student center and café has been under construction on campus, and has a student design/build component. This began in the spring of 2014, when I was asked to assist Professor Ray Mann of UMass Amherst in teaching a Five-College studio with a design/build component. Leading a small team of undergraduate students, we created bench prototypes for interior seating in the building as well as custom concrete sinks. The success of this class resulted in an opportunity over the summer to guide four additional students in continuing the interior build-out. The team worked over the month of July designing and building furniture using reclaimed lumber from a dismantled barn. The project was completed by Ray Mann, one student and myself over the fall 2014 semester and officially opened in February 2015. This UMass/Hampshire experience has taught me lessons in planning and completing a successful project, including scheduling, budgeting and client relationships.
Planning

The course syllabus and curriculum began with broad pedagogical goals. This course structure was based on sharing knowledge; open source concepts drove the curriculum in order to teach collaborative design techniques in partnership with hands-on training. The goal was to complete a real project for the community using a consensus decision-making process.

The first step was evaluating the facilities and resources available to realize the build. In this way, the institutional resources at UMass Amherst effectively defined the project size. Overestimating these physical resources can result in program failure, and they become central to the size and scope of feasible work.

The second challenge in developing a realistic design/build experience concerns recruitment. Student recruitment dictates the amount and quality of labor that an instructor can count on to produce the project. An effective curriculum for design/build
has some flexibility to address different types of student participants.

Next, a syllabus was created based on this information. Previous research and discussions with advisors showed that a build over spring break was the best opportunity for success. This decision was based on several factors: student scheduling; available space; and preparation time. The ability to have the students for full days allows for a truly immersive experience and building over the break was the only chance during spring semester. The possibility of reserving the best woodshop on campus at the Studio Arts Building, thinking it might be dormant over the holiday, was paramount. Furthermore, this timeline also gave me a month after the build to analyze the class for my final presentation.

In early January I emailed Dan Wessman, the shop technician of the Art Department woodshop, requesting use of the facilities over spring break. A phone conversation soon followed in which we discussed the possibility and logistics of this course. Dan had questions about class size, actual dates and what we were planning to build. At that time we discussed the limits and capabilities of the shop in relation to this design/build project. Not having all the answers, a maximum of six students and a four-day build, with a possible fifth day, was agreed upon.

In order to guarantee use of the shop, a formal request was made by Dan to the Art Department. The response came quickly and access for the class approved. This was an important programmatic asset, as this woodshop is well equipped and up to date. A full array of cutting and sanding tools are available, and more importantly, the space is set up for safety. All the tools are connected to a central dust collection system, including a
Sawstop table-saw and a downdraft sanding table, as well as hardwired to three “panic” buttons in the room. When a button is hit it cuts off power to all the tools but keeps the lights on. The dust collection and safety systems make this shop ideal for a design/build course. Having the build occur mid March in the geographic location of New England also requires an indoor space to realize building goals.

Image 6: The UMass Studio Arts Building Woodshop (M. Sutter Image)

With the workshop confirmed I was finally comfortable creating a syllabus for the class. The prior research, from both my personal experience and from the survey results helped me create the following goals for the course: collaborative learning; group consensus techniques; experiential learning; client relationships; and project completion. A maximum of six students was established due to a teaching “sweet spot optimization” (Appendix 3). Most design/build programs allow for either no more than six students or a ratio of four students per instructor, coupled with the woodshop size safety limits of ten people maximum. Including Dan and myself this left only two free work spots over spring break for the entire Art Department. Beyond this spatial constraint, there should
have a six-person limit, having worked in the space for two years.

A schedule was then developed. With a four-day build over spring break established, deciding what would happen between the beginning of the semester and these four days had to be figured out. Two factors helped guide me to a meeting frequency and course load. First, the credit offered by the Five College Community was limited to one credit. Because this was not an official class listed on the books, I worked with the UMass Architecture Department to offer college credit for the class as an independent study on an individual student basis. The client program was another influence on the class calendar. With a one-credit offering I was cautious about overextending the workload and losing team momentum by the time spring break arrived almost two months later. Meeting weekly on Wednesday nights from 6-8pm with a Saturday all-day team skill-building in the woodshop seemed to be the right balance, giving the group enough time to prepare for the build, but not being too demanding. That gave us six weeks from February 4th through March 11th to meet the client and create a design, all while learning hands-on shop skills and team bonding.

A diverse student pool is particularly important in a design/build class. Homogenous backgrounds can limit creative thinking, especially when reconsidering building conventions. A group of students with varied life experience can promote a better cross-pollination of ideas. This is not limited to techniques, but also addresses new ways of thinking. For this reason I decided to open the class to the Five College Community and to both undergraduate and graduate students (Appendix 4).
Recruitment

Recruitment of the student team officially started on January 25th and ran through February 3rd. A poster was designed that gave a brief description of the class and an invitation to an informational meeting on January 25th in hopes of enrolling six students. All of the five colleges were strategically marketed with this poster except Amherst College, which did not allow unauthorized flyers, but instead offered to email their design community. Locations included studio spaces and woodshops in an effort to connect with best audience. Then began a weeklong promotional period. After the Wednesday meeting there was much interest but no student commitment. The enrollment went from three to four to six to five and finally to the full six. While it was a hectic experience, in the end, there was a strong and diverse student team.
By offering this class as a one-credit independent study and working on campus, student insurance quickly became a non-issue. Although a formal woodshop training was required for all team members to be allowed to work in the Studio Arts Building shop, the project did not require insurance due to its small scale and programmatic nature (see Client Program). This was a big relief to both the client and program, and moreover, suggests an optimal arrangement for design/build programming at UMass Amherst.
Knowing the project budget, and ultimately funding, is important in planning any design/build project. Though, money is less of a concern on smaller projects as donations and sponsorships can often cover the construction costs, it is still pertinent as operational costs can add up quickly. This project was fortunate to get an anonymous donation of $1500 at the onset of the client confirmation. With this established a scope of project was determined.

The Client

In an effort to incorporate a community client on this real-world project, I turned to Ray Mann for suggestions. She had a longstanding relationship with the Nipmuc Tribe of Central Massachusetts, and they agreed to be an official client. Because they had been exposed to the design studio process in the past, they were comfortable talking about their goals and needs in order to establish a program.


I began by meeting with the clients and Ray the official client representative. The class then met with the clients to understand overall goals and intentions for the project. Using
the whiteboard students began creating a project manifesto, as well as a list of programmatic goals. The program included the following requirements: a simple assembly, a lightweight design between 200-300lbs, weather protection, a presence, multiple entrances, circulation, a maximum of a 10’ x 10’ footprint, consideration of the life cycle of the structure, locally-sourced materials, good craftsmanship and details in fabrication, incorporation of “light” and the cardinal points. The target budget for the project would need to be under $1500. Although the program was highly specific, the tribe did not specify a type of structure or exact use for the built project.

In addition to the previous programmatic constraints, the students and client worked together to identify critical design components for consideration. The first element was water: a conceptual material, flowing naturally, historically important, and through streams, lakes and rivers a medium for communication and transportation. The second element was fire: an actual incendiary and/or charred wood, and a source for heat, light, cooking and ceremony. The final element was wood: readily locally sourced, including Birch, White Oak, Locust, Willow, Cattails, and Hemlock. The team agreed that the structure should embody the tenets of water, fire and wood. A circular geometry using a modular building technique was a common thread in the design concepts of group members.
An all day skill development workshop was held on Saturday, Feb 7th. This was intended to give the students a mini-build experience; the goal was to foster group collaboration while learning woodshop tools and techniques. Designing and building a steam-box for bending hardwoods, as a one-day project, was a multi-functional teaching platform and a possible tool for use in the future build. The steam-box could be completed in one day, challenging the students, while still allowing for student design input. The students were given a program: the device requires an internal temperature of 200° F to operate and should be made from one sheet of 4 by 8 by 3/4” plywood. Five of the six students showed up at the woodshop for the day-long build.

The day started with a morning greeting and team introduction, soon followed by a steam-box design charette using the white-board adjacent to the woodshop. Soon the team agreed upon a clever dado joint on the doors and internal rack system. This was a great lesson in changing a construction technique while holding onto the design concept.
The reason for this change in plan was unexpected; the special saw-blade I planned on using was locked in the shop office. As a result, we figured out several other methods to accomplish a similar effect. This day provided our first communal meal as a team, and I structured this time together outside of the classroom environment as a means of strengthening the team’s unity.

After lunch the students broke into teams to work on sets of tasks required to complete the main box. We kept a fluid mentality throughout the afternoon, continuously making design/build decisions, utilizing the white board and the rules of team consensus. The steam-box was completed by the end of the day and ready for testing. We believed the container could reach the internal temperature of 200º F necessary to bend hardwood.

Ultimately the students were successfully introduced to the full cycle of a design/build project. Through this process they gained self-empowerment as individuals as well as a
sense of group collaboration. The project momentum was building. The only drawback of this process was in choosing such a specific project tool. It certainly prescribed the design decisions of the team moving forward and could limit design concepts and direction of the main project. On the other hand, a tool allowing wood to bend opened up new possibilities and solutions and provided a dynamic teaching tool.

Image 13: Students at the end of the day with the completed steam-box. (M. Sutter Image)

On the following Wednesday, February the 11th, the team spent two hours defining project direction. This involved brainstorming overall goals and intentions for the project. Using the whiteboard, students began creating a project manifesto. The investigation of student design precedents led the class into a design session. The objective was to gather
the team into one “mindset.” Each of the five designers expressed their thoughts based on the new findings, with active feedback from the group. Although consensus was building, it was not yet the time to split into teams; instead we agreed to work on individual concepts to be presented to the client at the following Wednesday’s class. Feeling motivated the class agreed to add extra work sessions on Saturday afternoon, starting that coming weekend.

Image 14: Students working on the consensus model. (M. Sutter Image)

On a snowy Valentine’s Day afternoon the team met for the first supplemental Saturday shop session at the UMass woodshop in order to fully complete the wood steaming-box from the previous week. In addition, a new and final team member joined the group. Molly Ackerman, a student from Smith College, would be joining in through project completion. We oriented her to the team and tools as we completed the box construction. We were able to close the up the box and drill the holes needed to push steam through the unit. The design has guillotine style doors sliding into dado slots (square grooves) replacing the traditional strap hinge and hasp closure on a steam box. Although we had
rubber gasket material to seal up the doors, the challenge of building without complicated hardware had been agreed upon by the group. We felt this was in keeping with the purity of materials and simple construction techniques desired by the client.

At this point, we also realized that Saturday afternoon shop sessions could replace Wednesday evening sessions in future course syllabi. The Saturday sessions are a great way for students to engage the shop and the team concurrently. Problem solving and solutions are arrived at through hands-on building in a relaxed atmosphere. This is unique to design/build classes, and can support the schedule of a spring break project.

We sealed up the box and plugged in the steam generator by 4:00pm and decided to run a test. The steam generator's 1/2" hose was fitted to the box using a 1/2" brass fitting. After much discussion, we decided to locate it lower on the "back" end door. A cooking thermometer was inserted through a small hole drilled in the center of the box top to register the internal temperature. Opposite of the input end, the box top was drilled to release the steam blow-off. A 1/2" rubber cork was the first of three manual valves installed to handle the extreme pressure that 212° water, or steam creates.

After one hour, the internal temperature of the box reached a steady 200° F. At 30 minutes, the plywood end connections failed and began to curl. We should have used 1-1/2" screws, with a custom deeper pocket drilled. It gives 1/8" more purchase into the plywood. In hindsight, I would use 3/4" HDO (High Density Overlay) plywood for the box walls rather than the 3/4" A/C Douglas Fir plywood at hand. HDO is waterproof-
faced plywood, used as formwork in casting commercial concrete. The lack of "waterproofing" of the interior surface allowed for the absorption of moisture into the "sealed" wood face of the A/C plywood. This transferred the steam into the larger surface area of the box rather than its contents, which happened to be 3/4" square by 48" Poplar boards, slowing the steaming process. Taking a piece out of the box to test it, we found that it was not ready for bending. Perhaps it needed another half hour in the box, or less lumber in the box, or another steam generator to boost the power. However, happy with our immediate success, we decided to call it a day.

We now had an idea of what needed to happen to make this box work and went home. Saturday open shop afternoons were a great option for students, weather permitting. A snowstorm was predicted and having to commute was a concern for everyone. Many travel by bus or by carpool, and as a design/build instructor, I needed to take this into consideration. Throughout February, Massachusetts received record snowfall, creating unpredicted logistical concerns for the project. However, every program in every climate will have unique weather challenges, and so it is important to consider this while planning.

The students met the Nipmuc representatives for the first time the following Wednesday night. Instead of the design review expected, an informational dialogue occurred between the client and student designers. As previously mentioned, this client came to the project with a strong understanding of the design process. At this meeting, David Tallpine White and Fred Freeman, both representatives of the Nipmuc tribe, were interviewed by the
team. A set of questions were prepared ahead of time by the students in order to further define the project program.

This gave the team one week to create conceptual designs. A presentation to David and Fred of the Nipmuc tribe by the class was scheduled for the following Wednesday evening. Feeling the students needed extra time to work on concepts and due to the impending inclement weather, the Saturday workshop was cancelled. This gave the students a chance to digest the first couple of weeks of the class and helped to maintain project momentum.
The student design concepts were presented to the client the following Wednesday evening, soliciting great feedback from all in attendance. It was agreed upon that the concept of a circular design using locally-sourced wood would support the tribe’s valued tenets. Programmatic concerns were addressed through a dialogue between the team and client on this night, but the actual project concept was more elusive. All agreed to keep moving forward with the designs shown and to use the consensus model for decision making that the class had established.

With the build starting in two weeks, there were two main goals. The first was to establish a solid design concept by the team in the next two Wednesday classes. The second was to prepare for the build by sourcing materials and preparing basic construction drawings of this concept.
Image 17: Working out the design using both digital and analogue tools. (M. Sutter Image)

The students accomplished the majority of the design development in the shop over the next two Wednesday nights. Having full course loads, they were asked, but not expected, to spend hours of studio time outside of class. Helping in this progression was a material sourcing field trip on the Friday, March 6th.

The day trip was difficult to schedule due to weather concerns. The client and team wanted locally-sourced lumber but calls made to local mills and lumber yards resulted in delayed responses because of repeated snowstorms. Only three of the six students were able to make the trip on less than a week notice. Although Saturday would have been a better day for students than Friday, the lumber sources as well as local fabrication shops we planned to visit were closed or had limited weekend hours.
After a quick tour of the Stone Soup Concrete Company located in the Eastworks Building in Easthampton, we headed to Lashaway Forest Products in Williamsburg, MA. Having previously contacted this sawmill over the phone, we knew they had plenty of local hardwood, and if we waited for them to dig out of all the snow, the team could handpick the lumber. Thinking we wanted local Birch or Oak, we arrived at Lashaway and met the owners and after twenty minutes of waiting in a busy paper-trail office heated by a wood stove “Old Man Lashaway” was available. Quickly discussing our design needs with yard boss, he had no time for details, but he realized we preferred wet or fresh-cut hardwood lumber, as it bends the best. Although he offered air-dried slabs of 2” thick Birch stored out back for years, a stack of fresh-cut White Ash seemed to be a perfect match. Steam bending Ash has only been bested by Oak or Hickory as a wood type.

White Ash is the material of tool handles, snowshoes and lacrosse sticks. It seemed the perfect client fit. Soon the team pulled a couple boards off the pile and were impressed by the twelve foot long and a full 1” by 6” profile. The team quickly calculated the quantity
of linear feet necessary for the project, and in the end ten boards were ordered. Back in the office I requested a price, that the lumber be picked by them, and set aside for pickup.

The lumber was twelve feet long and needed to be cut down to fit in the transport vehicle. Lashaway only delivers large quantities, as in logging trucks. Having borrowed a family member’s brand-new wagon and future stops to make, we left the lumber yard feeling a sense of closure. This fresh White Ash would be our fabrication wood for the structure.

Our field trip goal completed, we continued the afternoon in a leisurely fashion, taking lunch at a local bakery and touring sites throughout the valley.

By the end of the final Wednesday session we had as many questions as answers about the project’s definitive design. As the instructor and guide I had to adjust the team’s overall expectations. At this point we were attempting to combine several aspects of our conceptual design; a circular design using at least five identical upright structures, or bents, connected centrally by an open ring. Running out of time, I reassured the students of success if we could finalize the sectional profile of one bent by that night, and not be concerned with the central connection or the structure’s layout. Reminding them that this was a design/build class, we were able to focus and ultimately agree upon a single bent profile. This agreement might be attributed partially to the student’s exhaustion, discussing any topic, let alone individual design concepts, with a seven person group requires energy and focus. With the bent profile design completed, and the lumber procured, the team was almost ready for the four-day spring break build. For further notes on this process, see Appendix 8.
Image 19: Bent design progression. (M. Sutter Images)
CHAPTER 5
THE BUILD

Day One

The team started on Monday morning with intense shop activity. Forms for bending were built as lumber was sorted, planed and joined and split. The team ate lunch on the road to Pelham, where we picked up reclaimed oak strips for possible future use. At the end of the day we steam bent an Ash board as the front of our smallest form. Previously we had attempted four different methods to kerf the HDO plywood for use as the face of the form, with no success, lacking the material to bend to the necessary arc. It was amazing to see our 1/2" thick Ash wood bend in front of our eyes!

Image 20: Form Fabrications, Milling and Sorting Lumber. (M Sutter Image)

Day Two

On Tuesday we wrapped up the loose ends from the day before. This entailed finishing and testing the three bending forms, sorting the lumber the team had profiled to 1/2" by
4.25" stock, and into piles for each of the three forms being finished. The quality of the straight grain and lack of knots was the defining factor in deciding which piece to use. Each section allows for certain qualities of White Ash. The boards were then cut to length based on the section, and steaming ensued. After bending three pieces with desired results, it was 4:00pm. Exhausted, but with a spark in our eye, the team decided to test our most difficult form which requires two consecutive bends of 5.5" radii. The board split at the second bend on a knot in the wood. Pushing, clamping and inspiration brought the first bend before the crack to the desired curve, a 5.5' radius. Wow! With the reality of being able to double bend a piece of 1/2" material, the team had a meeting to regroup and review the progress and future goals and realities.

Image 21: Form completion and tests. (M. Sutter Image)
Day Three

The third day began with removing yesterday’s previous wood bends from the forms. They were still wet and had major spring back. We needed a drying rack for each of the three forms... but had to keep steaming the boards to keep on schedule. Research suggested another form for each piece section to set the shape. Building three curved tents 40" wide was not an option due to material and space realities. The solution is seen in the last image... blocking against the wall by 2 by 4's with the bottom face joined flat, all while our first boards of the day steamed in the box.

Meanwhile, Meg fabricated sixteen square tenons that will connect the structure: Drill, mortise drill and chisel the 4" square ply blocks of MDO ply into the connectors. We still needed to bend twenty-one pieces in within two days. We also needed to engineer the central connector ring that the upright structures require. As always, the team gained experience in critical thinking on many levels to achieve our goals.

Ultimately, the team created twenty of twenty-four pieces with success, and began to focus on the design assembly while completing the pieces. At this point we had eight of the ten extra boards we thought might be broken in the bending process. As we milled our own the local White Ash lumber, we expected to damage more boards in the process.
Day Four

The final day of building saw us completing steam bending the last four of twenty-four pieces of the "main-frame" with efficiency. While I was picking up pizza for the team lunch, the students took initiative and bent the last piece with no guidance! This independence demonstrated the empowerment that the design/build process instills. With all the pieces steamed and bent we started working on the custom mortise/tenon joint system. This involved a team drilling matching slots at the ends of each bent board. The rough openings were then cleaned up by hand-chiseling and the boards finish-sanded also by hand. I felt it necessary for the students to stay away from power tools when possible to learn the intimacies of the material.

We took on a challenging project program from the beginning in three ways: steam bending local wood, no structural foundation or base to attach to, and extreme portability. The project can be disassembled and transported to any location in a large car or small truck.
With twenty-three of twenty-four pieces bent, drilled and sanded, we miss-drilled a slot on the last piece we worked on due to enthusiasm to finish them all by days end. Fortunately, it was the easiest piece to bend and complete. A test assembly of the three parts revealed we need a secondary tension system to bring the uprights to the desired curve. We tested using nylon cord to achieve this, which gave us the arc we desired but twisted the boards out of square. As we solved one problem the solution created another.

Running out of official time in the class, the team decided to put the tools down and organize for the future. Working all night on an undetermined goal was not the best use of our time: we need to regroup and figure this out over the next couple weeks. Although the class has officially ended, the students were eager to keep involved and complete the project in their free time.

**Future**

The project continued after the build, albeit outside of class time. The students needed to get back to their normal classes and I needed to regroup for the next stage. We accomplished a great deal in the past two months in the shop. At this point twenty-three of twenty-four pieces were ready to assemble. The center ring or support system still needed to be designed, but the team had a plan for resolving this. The plan was to develop a temporary assemblage using clamps on Saturday to help understand the construction and possible problems.
The assembly process began the Saturday a month after the build. Outside the FAC at UMass, four pieces were arranged diagonally around a central hoop made of 1" PVC pipe. The hoop diameter was currently 5'-6" but is easily adjustable. The four "bents" were tied to the hoop with zip-lock ties securing them. Two people were able to hoist the structure on the concrete surface, but soon realized it needed support and moved it around the corner against a square corner of the building. The next step was to add a fifth upright to understand the scale of the spacing in real life. Using a small stepladder, the piece was easily fastened and seemed to strengthen the structure. A final intervention with a diagonal cord pattern helped in shear or side-to-side movement, as it was a major concern. The plan was to have the "sprout" with all eight bents assembled in front of the Studio Arts Building for the final design review.

Image 23: The final day of the course
CHAPTER 6
ANALYSIS OF THE PROJECT

This thesis was developed with the intention to explore and test curriculum development for design/build. While the finished design product was a major highlight of this project, it was actually only one milestone on a longer exploration. After the build, I revisited the entire process in an effort to better understand and analyze the curriculum. This work was based on a student survey, reflections throughout the process, and the experience of the instructor.

The strengths of this process included collaborative learning, the development of group consensus techniques, experiential learning and building real-world client relationships. The students specifically noted that “each idea brought to the table was valued sincerely and no one is left behind during the entire course, which I think it is quite amazing for us to obtain this with a group of this size” as most of the students had never worked on a group project. (Appendix 2) They also said that “it was so exciting to be able to work with a real client and show them our ideas on how our design would help improve their daily lives. I felt like even though this was a class I was helping not only myself but helping others which is what I want to do in the real world.” (Appendix 2) Having members of the community as a client helped to frame the design/build process.

The project weaknesses included time management, workload versus credits offered, and the organization of individual build tasks. One student felt that it was difficult “to get the job done within a certain amount of time.” (Appendix 2) Another felt that “the timeline was too tight” and that there “should have had higher value for credits.” (Appendix 2)
In suggesting improvements for future design/build classes, one student mentioned that the instructor could "plan more things ahead and make sure that we can build what we want to in an expected amount of time.” (Appendix 2) I considered these strengths and weaknesses in my comprehensive assessment of the project, and in determining best practices for future work.

Moving Forward

After completing the build, and presenting this work as a thesis, I have returned to my initial writing in an effort to create a document disseminating best practices for design/build at UMass Amherst. The goal of this thesis was to develop a curriculum that could be useful to UMass Amherst and possibly be transferable to different programs with similar needs. In the results chapter, I outline some of these suggestions.
CHAPTER 7

RESULTS

Completing this thesis process has left me with a number of recommendations for the curricular development of design/build programs. While all institutional needs are not the same, many of the lessons learned from this project will readily transfer to other places and programs. The small-scale nature of this design/build project is suitable for schools and programs looking for an introductory program, and it can serve as a stepping-stone to other, larger projects.

There are a number of specific suggestions that would help this project to work better next time. In terms of time management, there should be provisions for both the students’ perceived lack of time in a one-credit class, and for the instructor’s ability to plan effectively. One way to address this scheduling challenge would be to offer the class for three to six credits. Then students would be able to dedicate more time and invest in the course. In terms of instructor planning time, I would recommend that the main build would continue to be held over spring break. If the instructor began planning the build earlier, in the fall, this timing would be appropriate.

Additionally, I would change the weekly meetings with students from Wednesday nights to Saturdays. The shop availability and student focus on the weekend is better than during the weekday. Finally, I would recommend that the course be promoted for recruitment purposes earlier.

Several logistics worked fine, but were not ideal during this design/build process. Transportation for undergraduate students, especially those commuting from other campuses, was a real challenger. I would recommend that future design/build programs
be located on or near the UMass campus, preferably adjacent to the Studio Arts Building woodshop. It would have also been useful to have some provision for feeding students, so as not to disrupt the workflow of the day.

Getting the institution on board is arguably the most important and challenging factor of any design/build program. The institution has the ability to provide workshop space, legal frameworks, additional resources, credit offerings, liability, and insurance. Without these critical pieces, a design/build program can’t function. In the case of UMass Amherst, these pieces did come together to support the build.

In most design/build endeavors, a workable budget is a critical factor. This can be achieved by finding a client with money, or by incorporating a grant writing or other fundraising process into the planning stages. The funding process can be the project generator and lifeline. How the money is raised and ultimately managed can affect the project goals and intentions. Moreover, the budget does tend to impact the quality of the work.

Finally, the structure of the curriculum is a key factor in the success of the design/build program. I believe that the consensus decision-making method described in this process was critical to the project’s success. Without this structure, students would not have been motivated, invested, and connected to the end product. In addition, a six-to-one student/teacher ratio was appropriate for our space and project type; I believe that this is the maximum number of students that could benefit from this educational experience.

This thesis has addressed the complex web of forces that impact the success of a design/build experience. While design/build is a great deal of effort for both instructor
and student, it provides a deeper level of experiential education than can be provided by most traditional studio experiences. After all, the practice of architecture is ultimately connected to the community, and to the fabrication process.
APPENDICES
APPENDIX A

SCHOOL SURVEYS

A survey was sent to fifteen design/build schools in November 2014. Using SurveyMonkey software questions were created and sent via email the program heads. Fourteen questions were created to investigate the logistics and teaching methods of schools with successful design/build programs.

Upon completion of the build over spring break a thirteen question survey was sent to all six students. Both strengths and weakness were addressed by this questionnaire.

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<td>6</td>
<td>DesignBuildBLUFF</td>
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<td>7</td>
<td>neighborhood design/build studio UW, Seattle</td>
<td>11/30/2014 12:06 PM</td>
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Q2 What is the length of the Design/Build program chosen?

- **Less than 2 weeks**: 0.00% (0 responses)
- **1 Month**: 0.00% (0 responses)
- **Full semester or term**: 57.14% (4 responses)
- **Multiple semesters/terms**: 42.86% (3 responses)
- **Total**: 7 responses

Q3 Is the design/build held over school breaks such as winter spring or summer?

- **Yes**: 14.29% (1 response)
- **No**: 85.71% (6 responses)
- **Total**: 7 responses
Q4 What level of student can enroll in this program?

Answer Choices

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Q5 Does your program get sponsorship from outside sources?

Answer Choices

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<td>42.86%</td>
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Q6 What is the average project budget?

Answered: 7  Skipped: 0

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<td>$25,000-50,000</td>
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Q7 Who directs Design/Build on your campus? Please choose all that apply.

Answered: 7  Skipped: 0

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<td>in cooperation with a Non-Profit organization</td>
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<td>the instructors</td>
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Total Respondents: 7

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<td>we are a non-profit school that offers many design/build courses and partner with umass amherst on this project.</td>
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Q8 Who picks the client for the project?

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Q9 Is criteria of public welfare important in client choice?

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# comments

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<td>we discuss and hope for projects with more community impact, yet haven't found a reliable way to create this client base.</td>
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<tr>
<td>2</td>
<td>All clients are community based non-profits</td>
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Q10 Concerning building site fabrication...

Answer Choices

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<td>small components are fabricated off-site</td>
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<td>the majority of the construction is off-site</td>
<td>14.29%</td>
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<tr>
<td>other (please specify)</td>
<td>42.86%</td>
</tr>
<tr>
<td>Total</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>#</th>
<th>other (please specify)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>of the four projects that we've completed, three were completed off-site and the fourth was completed on-site.</td>
<td>1/27/2015 11:26 AM</td>
</tr>
<tr>
<td>2</td>
<td>It varies- check out our website <a href="http://proschools.norwich.edu/architectureart/designbuild/">http://proschools.norwich.edu/architectureart/designbuild/</a></td>
<td>12/4/2014 6:45 PM</td>
</tr>
<tr>
<td>3</td>
<td>varies depending on project</td>
<td>11/30/2014 12:09 PM</td>
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</tbody>
</table>
Q11 **What would you describe as the shop location where the majority of the building occurs?**

Answered: 7  Skipped: 0

<table>
<thead>
<tr>
<th>Answer Choices</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>site specific depending on the project location</td>
<td>42.86%</td>
</tr>
<tr>
<td>in an on campus shop</td>
<td>42.86%</td>
</tr>
<tr>
<td>at an off campus facility</td>
<td>14.29%</td>
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</table>

Total Respondents: 7
**Q12 Are these facilities inside or outside or both**

Answered: 7  Skipped: 0

![Bar Chart](image)

<table>
<thead>
<tr>
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<th>Responses</th>
</tr>
</thead>
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<tr>
<td>inside</td>
<td>14.29%</td>
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<tr>
<td>outside</td>
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<tr>
<td>both</td>
<td>42.86%</td>
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<tr>
<td><strong>Total</strong></td>
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</tbody>
</table>
Q13 Who provides the personal liability coverage for student workers?

Answered: 7  Skipped: 0

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<th>Answer Choices</th>
<th>Responses</th>
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<tbody>
<tr>
<td>architect or instructor</td>
<td>14.29%</td>
</tr>
<tr>
<td>organization/non-profit</td>
<td>14.29%</td>
</tr>
<tr>
<td>client/private party</td>
<td>0.00%</td>
</tr>
<tr>
<td>college or university</td>
<td>42.86%</td>
</tr>
<tr>
<td>other (please specify)</td>
<td>28.57%</td>
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<td>Total</td>
<td>7</td>
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<th>#</th>
<th>other (please specify)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>no personal liability coverage. Student sign a release form with risk management.</td>
<td>12/2/2014 12:23 PM</td>
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<tr>
<td>2</td>
<td>the university provides a certificate of insurance &amp; students also have health insurance coverage</td>
<td>11/30/2014 12:09 PM</td>
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</tbody>
</table>
Q14 Who provides the professional liability insurance for the design/build project?

Answered: 7  Skipped: 0

<table>
<thead>
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<th>Answer Choices</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
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<td>Architect of record</td>
<td>14.29%</td>
</tr>
<tr>
<td>no one</td>
<td>42.86%</td>
</tr>
<tr>
<td>other (please specify)</td>
<td>42.86%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>#</th>
<th>other (please specify)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>we cover builder's risk insurance.</td>
<td>1/27/2015 11:26 AM</td>
</tr>
<tr>
<td>2</td>
<td>University, if pro bono by faculty members</td>
<td>1/8/2015 4:20 PM</td>
</tr>
<tr>
<td>3</td>
<td>N/A</td>
<td>12/1/2014 12:57 AM</td>
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APPENDIX B
STUDENT SURVEY

Analysis chart

<table>
<thead>
<tr>
<th>STUDENTS</th>
<th>KAREN</th>
<th>OLIVER</th>
<th>AHN</th>
<th>MEG</th>
<th>BLAKE</th>
<th>MOLLY</th>
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</thead>
<tbody>
<tr>
<td>School Year</td>
<td>UM</td>
<td>Hamp</td>
<td>MHC</td>
<td>UM</td>
<td>UM</td>
<td>Smith</td>
</tr>
<tr>
<td>Part 1</td>
<td>SURVEY</td>
<td>SURVEY</td>
<td>SURVEY</td>
<td>SURVEY</td>
<td>SURVEY</td>
<td>SURVEY</td>
</tr>
<tr>
<td>1. Were expectations met?</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2. Efficient use of time</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3. Prep/organization</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>4. Workload vs. credit</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Shop facilities</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
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Part 2

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<th>Just right</th>
<th>Just right</th>
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<th>Just right</th>
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</thead>
<tbody>
<tr>
<td>2. Collaboration new successful?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>3. Architecture as a team future benefit?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>4. Individual designs addressed</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

5. Skillset ranking

| Collaboration | 4 | 1 | 4 | 1 | 4 | 2 | 16 |
| Consensus | 3 | 3 | 1 | 3 | 2 | 3 | 16 |
| Tool training | 5 | 4 | 3 | 2 | 1 | 1 | 16 |
| Cross-pollination | 1 | 2 | 2 | 4 | 3 | 4 | 16 |
| Other | 2 | x | x | x | x | 2 | 16 |

Part 3

1. What would you describe as the weakest part of the course?

Timeline was too tight. Should have had higher value for credits.

Sometimes people were distracted => should have been more efficient

How might this be resolved?

I think this should be resolved individually. And partly a clearer role/work of the day for the person
Our ability to get the job done within a certain amount of time

How might this be resolved?

Planning more things ahead and making sure that we can build what we want to build in an expected amount of time.

I think we might waste some of the time.

How might this be resolved?

By assigning specific work

The proper distribution of the workloads should be more thought out through the course and among each team members. At sometimes, I found myself or others not knowing what were the expectations we have to meet or tasks that await us to be accomplished.

How might this be resolved?

It was understandable that the instructor could not monitor six of us all at once as we performing different tasks in various stations of the woodshop. However, a to-do list would be helpful for the group at the beginning of each meeting/day to track down what tasks is available and for whom to complete.

Meetings with the clients

How might this be resolved?
Definitely more preparation before meeting with the clients as I felt that as a group, we weren’t sure what information we were supposed to give and what kinds of questions to ask

2. The strength of this class was…

Many ideas and solutions were introduced + great teamwork

Everyone’s willingness to cooperate with each other and accept different opinions and ideas. Our flexibility and our ability to bring new ideas to the table when new problems arise.

It is powerful for me.

Collaborative process & loose organization gave space for ideas and adaptations

The absolute strength of this class was the communication established among each team member. Each idea brought to the table was valued sincerely and no one is left behind
during the entire course, which I think it is quite amazing for us to obtain this with a group of this size. Everyone is enthusiastic about the project and willing to work extra hour to make it perfect.

Strong, I really learned a lot and it was a good mix of theoretical and applied learning.

3. How were individual goals developed and/or met in this class?

It was so exciting to be able to work with a real client and show them our ideas on how our design would help improve their daily lives. I felt like even though this was a class I was helping not only myself but helping others which is what I want to do in the real world. This was one of the most interesting classes I’ve taken so far because it integrated what happens in the real world and practices in the classroom. I am a transfer student so everything around me is new to me and I am still finding my way around the campus so it was very comforting knowing I could help someone. My goal was to get hands on experience and getting to know what it’s like to be an architect. I have met that goal through the design process, PowerPoints, and meeting with the client and other teachers.

My end goals were not met because of time. Other smaller goals were met with collaboration, planning and well paced work.
I was able to do more in Design/Build, as well as learned more about wood as a material and how it could be used (steaming is really awesome!)

In this class an individual goal could be as simple as learning how to chisel or as complex as how might we design a structure speaks for the Nipmac tribe. Since each individual in the group came from a different background, it allows us to contribute diverse skill sets to the table. Beginning with the hand drafting on the whiteboard, information collecting and researching, material selection to construction method, we all share with each other and learn from each other.

“There is nothing easy” Changing the concept is easy, but the actual building are actually really hard.

Learning about the design/build process was incredibly helpful to me in coming to understand cooperative architecture and the route I want to go in this field of study. Additionally, learning how to use tools exposed me to the construction side of design, whereas most of my classes deal with theoretical teachings.
APPENDIX C

COLLABORATION CHARTS: YESTERMORROW

Design Build for Public Interest
August 2014, Yestermorrow Vermont

Group Collaboration Charts Monday Afternoon.

Positives:
1. Building Ideas Together
2. Accountability
3. Diverse Perspectives and Skill-sets
4. Camaraderie
5. Learning Compromise
6. Learning from others
7. More Productivity
8. Feedback
9. FUN = More energy
10. More hands/ Help
11. Connecting and Networking
12. Opportunity for Personal/Professional Growth
13. Greater Creative Capital

Negatives:
1. Strong Egos
2. Voices can get lost...Marginalization
3. Pigeon Holing/ Type Casting
4. Fear of Conflict/ Pusillanimosity
5. “Too many Cooks”
6. Not Listening
7. Creative Shutdown
8. Rigid Opinions
9. Festering Issues
10. Frustration
11. Different or Unclear Expectations
12. Lack of awareness of Comfort Zones
13. Tyranny of a Minority
14. Slackers
15. Wet Blankets
16. Scape goating
“Solutions” & Aspirations

1. Sweet Spot Optimization
2. Establishing Guidelines for Communication
3. Think, Pair, Share
4. Mindfulness
5. Defining Roles/ Having Check-ins
6. Speak up (Self Advocate)
7. Role switching & Mentorship
8. Be Specific/ FOCUS
9. Organizing Tasks
10. Respect and Consider All Ideas
11. Ego-checking & Openness
12. Deal with Conflict up front
13. Listen!
14. Establishing Reachable Goals
15. Solutions NOT Problems
16. Doing Over Talking
17. Don’t Take it Personally
18. Know Strengths & Weakness
19. GROUP RELEASE
APPENDIX D

COURSE SYLLABUS: MATTHEW SUTTER

Spring Break Design/Build

University of Massachusetts, Amherst Spring 2015

Course length: January 28th – March 19th
Credit hours: 1
Instructors: Matt Sutter and Ray Mann

Description:
This course is an introduction to Design/Build methodology. Students will participate in a building project with a real client. Topics of collaboration and decision-making in a team environment will be taught through the hands-on fabrication of a built structure for the Nipmuc Tribe. The class will meet every Wednesday night in preparation for a 4-day build over the Spring Break. The weeks leading up to the build involve a series of design charrettes, team building and shop training sessions. Through this process a final design will be determined and approved by the client. During Spring Break, students will build the project and present the completed structure to the client. The focus of this class will be to work through design concepts, as a group, to a final, built, design solution. Students will develop critical thinking design skills, as decision-making is concurrent with hands-on fabrication.

Recommended books:
Beyond Shelter Marie Aqualino
The Craftsman Richard Sennett
Expanding Architecture: Design as Activism Bryan Bell

Materials to bring:
• Work clothes: ones that you don't mind getting dirty
• Work gloves if you have them
• Sturdy, closed toed shoes or boots
• Rain gear
• Personal safety items optional: ear and eye protection, dust mask. If you have long hair, something to hold it back.
• Notebook and something to write with
• Camera if you have one.
### Calendar

#### January

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<thead>
<tr>
<th>Week 1</th>
<th>Wed 28th</th>
<th>Introduction.</th>
<th>1 hour</th>
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<tr>
<td></td>
<td></td>
<td>Course description</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Discussion of commitment</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Client/project identity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Registration</td>
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#### February

<table>
<thead>
<tr>
<th>Week 2</th>
<th>Wed 4th</th>
<th>First Class</th>
<th>Team building</th>
<th>2 hours</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Consensus in design/build process discussion</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project goals &amp; program definition</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Randomly split into 3 conceptual design teams of 2 students</td>
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<table>
<thead>
<tr>
<th>Sat 7th</th>
<th>All Day skills training workshop</th>
<th>8:30-5:30</th>
<th>8 hours</th>
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<tbody>
<tr>
<td></td>
<td>10:00 am Move to the shop and create 3 teams of 2 to work on each section of the Project Box.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Container</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Legs/Support system</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 Mechanics - this has to work!</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12:00 Lunch Franklin Dining Commons</td>
<td></td>
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<tr>
<td></td>
<td>Team meeting...</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Cooperation evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>New teams created, if necessary for creative fun</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1:00pm Woodshop</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Team focus on completing goals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3:00 Team meeting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaluate progress</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjust goals if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5:30-6:00pm Tools down</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Group talk through</td>
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<table>
<thead>
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<th>Week 3</th>
<th>Wed 11th</th>
<th>Design Charette</th>
<th>2 hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2 teams to present concepts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discussion and design revisions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design chosen by student group</td>
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</table>

<table>
<thead>
<tr>
<th>Week 4</th>
<th>Wed 18th</th>
<th>Group project review</th>
<th>2 hours</th>
</tr>
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</table>
Outside consultants on the panel
Nipmuc tribe, Architects, local fabricator
Student roles & tasks finalized

Week 5  Wed 25th  Final Design Review  2 hours
         Presentation to client, the Nipmucs  1 hr
         Class discussion and decisions  2 hr

March
Week 6  Wed  4th  Work Session  2 hours
         Budget Creation
         Construction Document Review

Week 7  Wed  11th  Final meeting, Logistics coordination  2 hours

Week 8  Sun  15th  Job site preparation, optional
          2 hours
Week 9  M-T  16-19h  BUILD the project  8:30-5:30
           Construct the structure at the Studio arts Building Woodshop.

Friday the 20th  Project “delivery” & Celebration.
APPENDIX E

STEAM BENDING DETAILS

1—The basic elements of a steaming apparatus are the steam generator and the box; the rest depends on ingenuity. The main considerations are insulating wherever possible, allowing condensate to drain from the chamber, introducing steam into the chamber at a point along the workpiece where the bend is most critical, and supporting the workpiece to ensure steam circulation and to avoid immersion in the condensed water.

3—When wood is bent without restraint, tension and compression stresses are balanced on opposite sides of the centrally located neutral axis. A steel strap with end-block restraints, added to the convex side of the bend, carries most of the tension stress, shifting the neutral axis toward the strap so the wood undergoes mainly compression strain.
APPENDIX F

STUDENT PROFILES

Karen Castro:

“This was one of the most interesting classes I’ve taken so far because it integrated what happens in the real world and practices it in the classroom.”

Junior in Architecture at UMass.

Oliver Martinez:

“The collaborative process and loose organization gave space for ideas and adaptations.”

Junior: Modular Housing track Hampshire College.
Meng Zhang:

“The time we spent in class was really fun. I think this design/build class has given us a great experience.” And “Changing the concept is easy, but the actual building can be really hard.”

Sophomore in architecture at UMass:

Anh Luu:

“I was able to do more in design/build, as well as learned more about wood as a material and how it could be used (steaming is really awesome!)”

Junior in Architectural Studies & Economics
Mount Holyoke College
Molly Ackerman:

“Learning about the design/build process was incredibly helpful to me in coming to understand cooperative architecture and the route I want to go in this field of study.”

Sophomore in architecture Smith College

Yunpu Ku:

“In this class an individual goal could be as simple as learning how to chisel or as complex as how might we design a structure speaks for the Nipmuc tribe.” And “Since each individual in the group came from a different background, it allows us to contribute diverse skill sets to the table.”

Senior in architecture & BCT UMass
March 10th

Hello all!

We are coming into the final stretch of the Spring Break Design/Build! That was quick...as usual. We meet tomorrow night for our final official class. The plan is to decide on major design moves for the structure so we can plan and schedule out the build logistics. At this point we need to connect three realities:

1. The stream-box limits the board size to 6 foot linear sections.

2. Material choice based on availability and best properties is local White Ash rough sawn

   1" x 5" x 12' long. Sustainable and low cost. Top 3 species to steam bend.

3. Design based on a "seedling" or sprout modular sections, arrayed in a circular pattern.

I met with Ray today to review these ideas. We came up with some possible solutions, such as having 4 legs, not 5 or 3. This represents the Cardinal Points giving it a direction and internal location. She liked the idea of "split" legs or pairs of bents at each point, therefore providing for an incorporated seat. This technique also provides shear or diagonal support which we need, while creating a more elegant and interesting design. This might give us more challenges upfront but is worth it in my mind. We questioned the leaf spring concept (two overlapping bent boards) and want to keep it in
some form. Lastly, the how it meets the ground, maybe bending the lower piece 180 degrees making a single piece bench support. Wow, a lot to think about, but there are no wrong answers, just solutions.

I will explain all this tomorrow in class as we test steam our actual Ash material.

Please let me know asap if you have any reservations on the design concept. I plan on modeling it in Revit tonight.

Otherwise, get ready for Spring Break. We officially meet Monday morning at 8:30 am to start building! I am excited. Get ready, this is an intense process with due rewards.

We meet 8:30-5:30 with a 1 hour group lunch Monday through Thursday. This is the minimum. For starters, I will be in the shop Sunday preparing for the build. We need forms to bend the wood around made from plywood. Power tools will be accounted for, tuned up and blades replaced if necessary. Unofficially we are treating this shop as our own through the build. Expect a late session or two. We will never work after midnight, just kidding, my limit is 8-9pm if needed/wanted.

Remember this is your build project and I am your guide to achieve the team's goals.

Cheers

Matt

March 14

Hello group

Some thoughts and updates...
First we have to maximize the steam-box capabilities. This involves adding a second steam unit, sealing the box better and wrapping it with rigid insulation to increase internal temperature and pressure. This should allow the extreme radius we need for the foot of the bent. Also reducing the board thickness to 1/2" will all but guarantee a successful curve.

Tomorrow I will be picking up supplies for both the box upgrade and future forms... Sheets of 3/4" A/C plywood, metal strapping, bar clamps, and bringing them to the woodshop.

Saturday I plan on being in the woodshop to prepare for the build and test wood in the newly created super-steamer. This brings up the design...

We are in agreement in the overall form and concept developed on Wednesday night.

- Crafted of White Ash, with the possible incorporation of local oak strips and a textile membrane.
- Benches connecting bent pairs.
- Center connection is unresolved but we have options

Some of you discussed meeting on Saturday. I think this is a good idea so that everyone is on board. I can meet with you [or skype] to hash out the overall "bent design".

If I have a section of the leg prototype before Sunday I can engineer it to work. We are entering uncharted territory my friends... design/build...get ready for an awesome ride.
Logistics: please let me know any concerns or problems with housing, transportation or food, considerations can be made.

cheers
Matt

March 15, 2015
Hi
attached a couple snapshots of the overlapping joint construction based on the profile Oliver sent out this morning. We can make the pegs for the joint from the reclaimed oak Carey Clouse has donated. Instead of steaming single oak pieces to bend around the top or mid section, we can cut thin 1/4" bands and stack them loose (no glue) and bind them to create one structural piece. This will allow us to install them after the main structure is in place...they will be flexible to create a shock absorption system for the primary structure. Then we can weave oak slats between the layers diagonally!
Hmm.
See you all at 8:30 am tomorrow. We have a bunch of tasks to take care of to keep the project on schedule.

Three main tasks for Monday..
1. Prepare lumber. Sort by grade and category (base/mid section/ top) A B C. Mill lumber to dimension per drawings. Make 18 boards 36 clean pieces ready for steaming (or plasticizing the scientific name for bending)
2. Fabricate bending forms for A B and C. This involves printing full scale drawings to use as templates for the plywood forms. This is my realm of expertise and the key to the bending success.

3. Field trip to Pelham to pick up the donated oak at Carey's church project. We can order take-out lunch and eat while checking out her project on site. Load the lumber and back to the shop.

Slainte,

Matt
BIBLIOGRAPHY

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