Learning from the Masters: Promoting the Use of Precedent Studies in Building Technology

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A precedent is a preceding occurrence, object, or event that can serve as an example for current or future endeavors.[1] Jeffery Balmer and Michael Swisher (2013) discuss the deployment of this learning strategy in architectural education in their book *Diagramming the Big Idea*. They laud the potential of students studying the built environment, but warn that "[s]ystems of order embedded within works of design are not readily evident to the novice student." To heighten awareness, they "engage beginning designers in the close visual analysis of exemplary building projects—what architects refer to as precedents." (p. 7) All precedents contain lessons that must be drawn from and studied, for "[b]oth evolutionary development and contradictory revolution depend on understanding what has gone before." (Unwin 2014: p. 5)

A critical issue with precedent study, however, is that left to their own devices, students, especially those in the formative years of their education, can treat precedent analysis as a shallow endeavor. Instead of searching for lessons, the uninitiated often focus on pretty pictures and drawings pulled from magazine articles or the internet. But what is needed is not an understanding of what the project is or what it looks like, but how and why it works. Students need be taught to excavate, to seek out the critical lessons of architecture, and to develop a library of strategies that can be repurposed in their own work. The snapshot image of a building will not be of great assistance in this endeavor. What will be useful is how a building sits on the ground, how it opens to allow for natural ventilation, how it shifts in plan to create an entrance, or how its structural system is derived from a common spacing or organizational system.

This process requires analysis, which can be defined as "a process of isolating or working back to what is more fundamental by means of which something, initially taken as given, can be explained or reconstructed." (Beaney) Analysis involves seeking out critical information, breaking it down into component parts, and reassembling the necessary elements in order to convey a specific idea about the object or situation. This paper outlines an analysis-centered research project undertaken by a group of second-year architecture and interior design students in a recent introductory building technology course. In this semester-long project, fifteen buildings were examined through a series of linked exercises that slowly built for the students an understanding of the complexities involved in the process of designing and constructing architectural works. The rigorous line of investigation required the students to engage their buildings at a number of different scales and from a variety of perspectives, enriching their understanding of the possibilities of wood as an architectural material.

Project Outline

[1] Ideas conveyed in this paragraph borrowed from Schwartz, Investigating the Tectonic.

During the first week of class the students were introduced to the assignment and the concept of precedent analysis. Shortly-there-after the students self-selected groups of three or four members and each team was assigned a precedent by the instructor. The works chosen for the assignment all utilize wood as a primary material for construction and architectural expression and are all relatively small in scale. Some of the projects assigned – the Swiss Sound Box by Peter Zumthor, Thorncrown Chapel by E. Fay Jones, the Gamble Residence by Green and Green, and Sea Ranch Condominium I by MLTW – are widely recognized (although not necessarily to this group of novice students), while others – Brixlegg Residence by Antonius Lanzinger and Slumtube by Schnetzer and Pils for example – are more obscure.[2] The variety in the collection to be studied allowed the class to be exposed to the multitude of ways in which a single material is used in the construction of our built environment. While some of the projects investigated used wood in fairly normative ways, others diverged quite substantially from what we would deem "normal" construction processes here in the United States.

As stated previously, this project was founded on a premise of rigorous and varied analysis of a given architectural work. The students were lectured on academic research practices, instructed on how to find materials in the library and online indexes like the Avery Index, and taught how to request materials not found in the campus library system. However, to account for the differing levels of information available and to compensate for the lack of research experience possessed by this group of novice students, each team was given a list of two or three primary, scholarly sources to use as a starting point for their investigation. This provision ensured that all groups would at least start the process of analysis with adequate information and not fall back to solely relying on information gleaned from online warehouses.

Task I: Initial Analysis

The project process spanned the entire semester and consisted of a number of specific tasks. The first task set upon the students was to develop a general understanding of their assigned architectural work and its qualities. The groups were given three weeks to read through the given materials, find additional sources, and perform a general analysis. The presentation format was a single 24x36 board created using an Adobe InDesign template that was provided to the students (figure 1). The layout and

[2] The complete list of precedents is as follows:
- Swiss Sound Box - Peter Zumthor - Hanover, Germany
- Orphan Housing - TYIN Tegnestue - Noh Bo, Thailand
- Slumtube - Andreas Claus Schnetzer and Gregor Pils - Johannesburg, South Africa
- Brixlegg Residence - Architect Antonius Lanzinger - Brixlegg, Tirol, Austria
- Thorncrown Chapel – E. Fay Jones - Eureka Springs, Arkansas, USA
- St. Henry's Ecumenical Art Chapel - Sanaksensaho Architects - Turku, Finland
- Gamble Residence - Greene + Greene - Pasadena, California, USA
- Final Wooden House - Sou Fujimoto - Kumamoto, Japan
- Sea Ranch Condominium I - MLTW - Sonoma Coast north of San Francisco, California, USA
- GC Prostho Museum Research Center - Kengo Kuma - Aichi, Japan
- ILMASI School - Despang Architekten - Garbsen, Germany
- Sirch Woodworking - Baumschlager & Eberle - Bohen, Germany
- Agosta Residence - Patkau Architects - San Juan Island, Washington, USA
- Ring House - Takei-Nabeshima Architects - Karuizawa, Japan
- Casa Rivo - Pezo & Von Ellrichshausen - Valdivia, Chile

format of the presentation were highly coordinated/controlled by the instructor to ensure content, not graphic layout, was given priority. The board was required to contain the following information:

- project title
- project architect/designer, location, year completed, square footage, program
- (3) images and (2) drawings that best illustrate the project
- a 400 word descriptive text that focuses on how wood is utilized in the project
- (1) diagram that graphically describes a key point illustrated in the descriptive text
- student names, course, lab section, and project information as specified
- citations for all found material including text and graphic elements

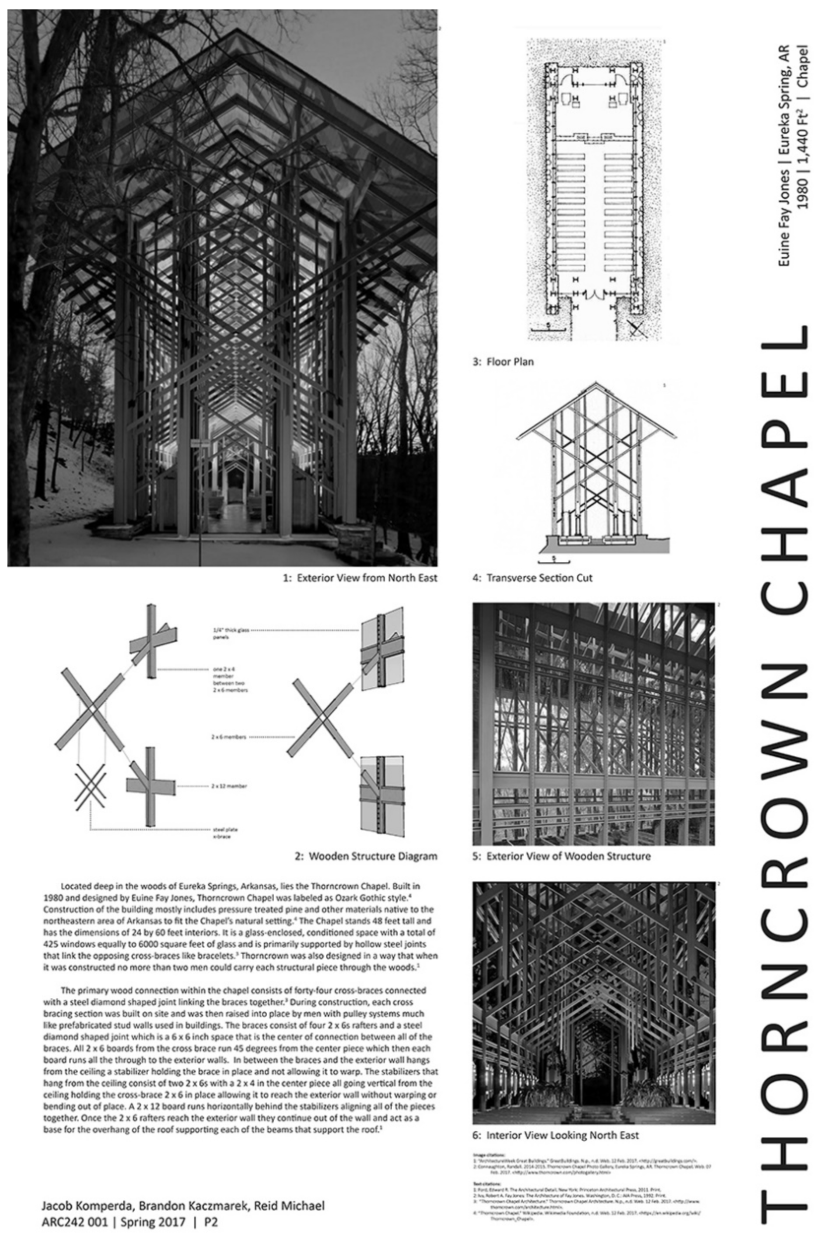

Figure 1: Final Presentation Board – Thorncrown Chapel, E. Fay Jones – Presentation by ARC242 S17 Group 5 (J. Komperda, B. Kaczmarek, R. Michael)

Every element placed on the board was required to play a role in presenting the use of wood and construction strategies utilized in the building. Particular emphasis was placed on the diagram (figure 2), which was the one element on the board that was required to be self-generated by the students. The intent was for the diagram to serve as a catalyst for the analysis process and provide a bridge to the more significant investigations to come. This requirement allowed for better evaluation of their initial study of the project as it involved analysis and not just documentation. In retrospect, the time period for this particular assignment was too long given the amount of information provided to the students and the minimal requirements. Future iterations of this type of assignment will either need to shorten the timeframe for this component or supplement the deliverable content with more diagrams and drawings that are explanatory in nature, highlighting key concepts of the project and providing a more substantial base for the following tasks.

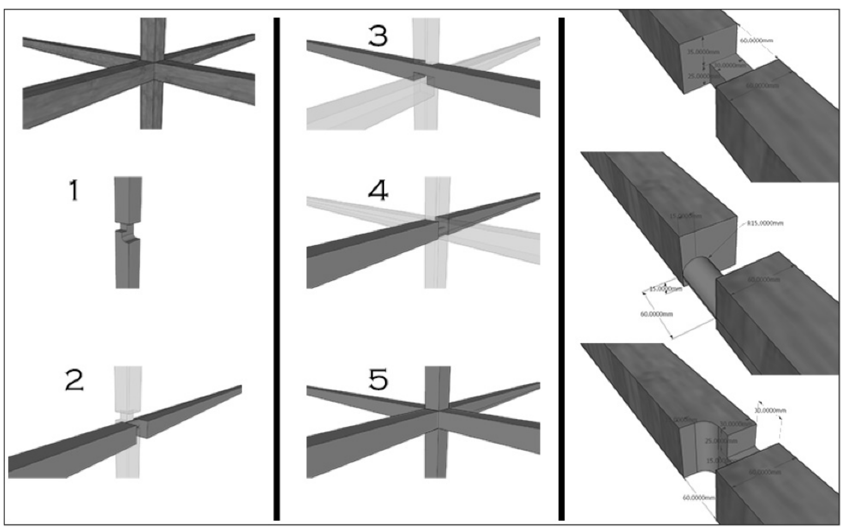

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Figure 2: Diagram from Initial Analysis – GC Prostho Museum and Research Center, Kengo Kuma – Drawing by ARCH242 S17 Group 10 (T. Hefler, B. Bangert, R. Taylor)

Task II: Storyboard

In the second task, the groups were instructed to create a storyboard that would illustrate the assembly process of a ten-foot or three-meter long section of the exterior wall of their precedent (figure 3). All components of the wall were required to be included in the sequence along with all major points of fastening/attachment/assembly. The area of inquiry ran the full height of the building, from the foundation up through the roof, and had to extend a minimum of five feet or one and a half meters into the building. Each group, in coordination with the instructor, determined the best location for their area of study, but the section chosen was required to be prototypical for the structure. The final format for this task was an 11x17 booklet with between one and four slides on each page.

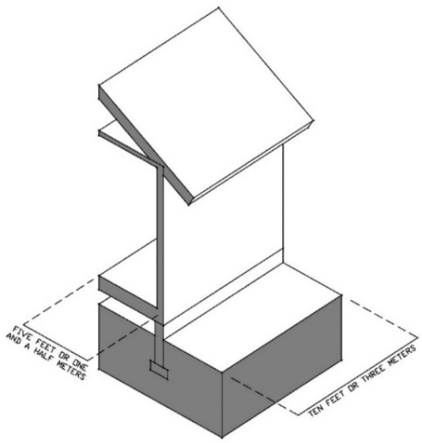

Figure 3: Diagram of Area of Analysis for the Storyboard – Drawing by Author

The storyboard is a valuable tool for analysis that focuses on sequence. Using it, students are able to not only investigate order of construction, but to also identify major systems that are often hidden beneath the surface of a finished building. The storyboard is essentially a virtual construction process used to identify all of the components of a building and the way in which they come together.

For each step or slide in the sequence, the groups created a graphic depiction of the building using 3D modeling software, which was then complemented with a detailed, written description (figures 4 and 5). The students were instructed to be as specific as possible with material types, sizes, scales, means of fastening, etc. When a gap in the available materials precluded a full understanding of the construction, the students were encouraged to use their best judgment, in coordination with discussions with the instructor, to assess the makeup of their building and how it was assembled.

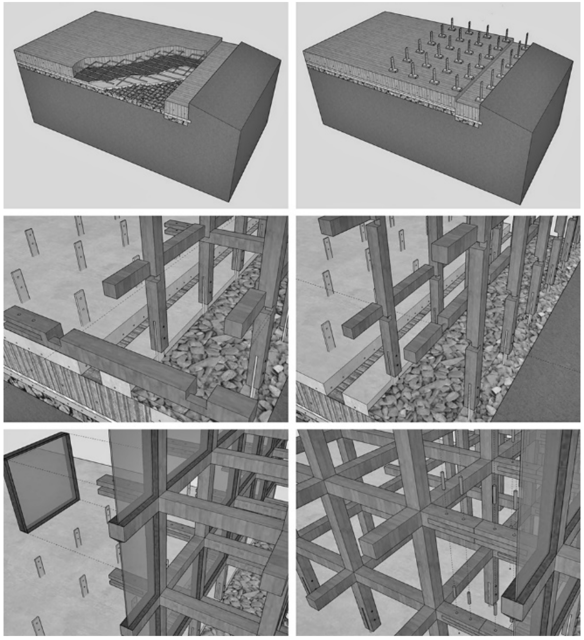

Figure 4 (left): Partial Storyboard Sequence – GC Prostho Museum and Research Center, Kengo Kuma – Drawing by ARCH242 S17 Group 10 (T. Hefler, B. Bangert, R. Taylor) (text

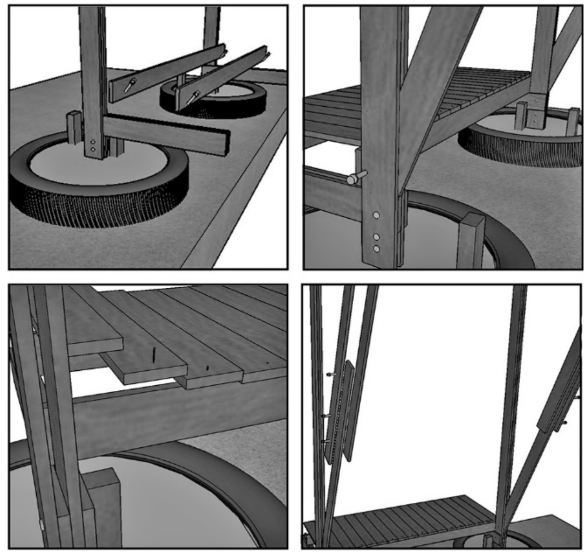

Figure 5 (right): Partial Storyboard Sequence – Noh Bo Orphan Housing, TYIN Tegnestue – Drawings by ARCH242 S17 Group 2 (K. Brewer, S. Reh, D. Riggio) (text removed for clarity)

Attention to detail was essential in this analysis, but specifics had to be balanced with the overall number of steps in the sequence. Generally, the more information provided, the better the study will be, but the students had to determine how much of that information could be contained in each slide of the storyboard. Each screw does not require a new drawing, but the assembly of a wall system would certainly warrant several slides. Balance is key to providing a full analysis, but also to maintain clarity in the graphic representation of the construction sequence. Also essential to this task was for the groups to depict the correct (or perceived to be correct) sequence of construction. Ideally, a storyboard is created in the order the construction was actually accomplished. This process starts with the manipulation of the site and ends with the complete installation of all components.

This process, which the author has utilized in a number of different ways in building construction courses,[3] is essential for students in making connections between their perceptions of the photographs of the building and the underlying reality of the building's construction systems and processes. The storyboard forces the students to slow down and think carefully and critically about each element in the project. While some students are certainly more rigorous in their analysis than others and able to better understand the assembly processes at work, each group or student (depending on the particular project) is able to infer significantly more information through the development of a storyboard than through the study of existing photographs and drawings of the building.

[3] For another example of the use of the storyboard in building technology please see Schwartz, Architectural Signs.

Whereas Task I was likely given too much time, this task, which ran parallel with Task III (see below), was very tight and became cumbersome for the students. These phases of the analysis were allotted three and a half weeks, concluding just before mid-semester. In future iterations, these processes need to be extended and probably staggered instead of concurrently executed. Two to two and a half weeks per task would be ideal for all of the groups, not just those with the most ambitious students, to do a more thorough analysis of their precedent.

Task III: Wall Section

Concurrent to developing the storyboard, each group was required to create a large-scale wall section of an exterior wall of their precedent (figures 6 and 7). At the beginning of the task, while selecting the area of investigation for the storyboard, the groups also were instructed to select a specific location for the section. Unlike the prototypical area of inquiry for the storyboard, however, the section chosen needed to contain conditions, such as windows, doors, building systems, and details, which were specific to that particular point in the building. The unique qualities of that point in the construction provided the students will the detail necessary to warrant the oversized nature of the drawings.

Typically, wall sections are drawn around 3/4”=1’-0” scale (when using imperial units), meaning the drawing is 1/16th the size of the full-scale building. This task abandoned standard practice, as the students were asked to draw their wall sections at the scale of the detail – 3”=1’-0” or 1:5 in metric – enlarging the drawing to 1/4th the size of the full-scale building. At this scale, the students were required to consider every layer, every detail, every material hatch, and every fastener. Any information they could reveal through their research and analysis could be utilized in the drawing, which re-envisioned the architectural detail as a wall section.

In addition to the analysis, issues of drawing quality were emphasized, including the development of primary lineweights, consistency of drawn elements, standards for dimensions and annotation, and clarity of intention for all linework. The final presentation of the task was a single, three-foot wide, printed board of the drawing to scale.

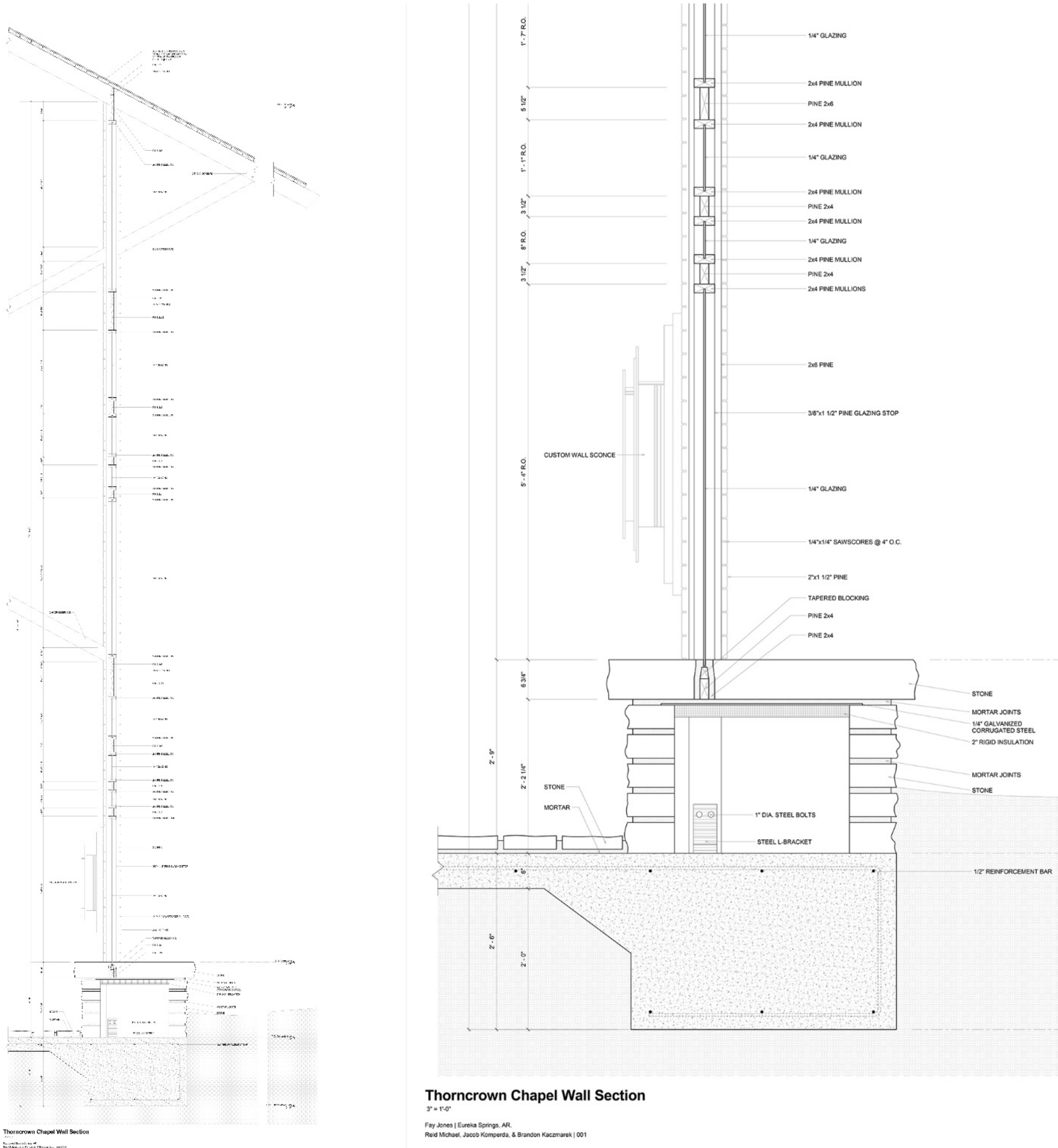

Figure 6: Wall Section (full on left, partial blowup on right) – Thorncrown Chapel, E. Fay Jones – Drawing by ARC242 S17 Group 5 (J. Komperda, B. Kaczmarek, R. Michael)

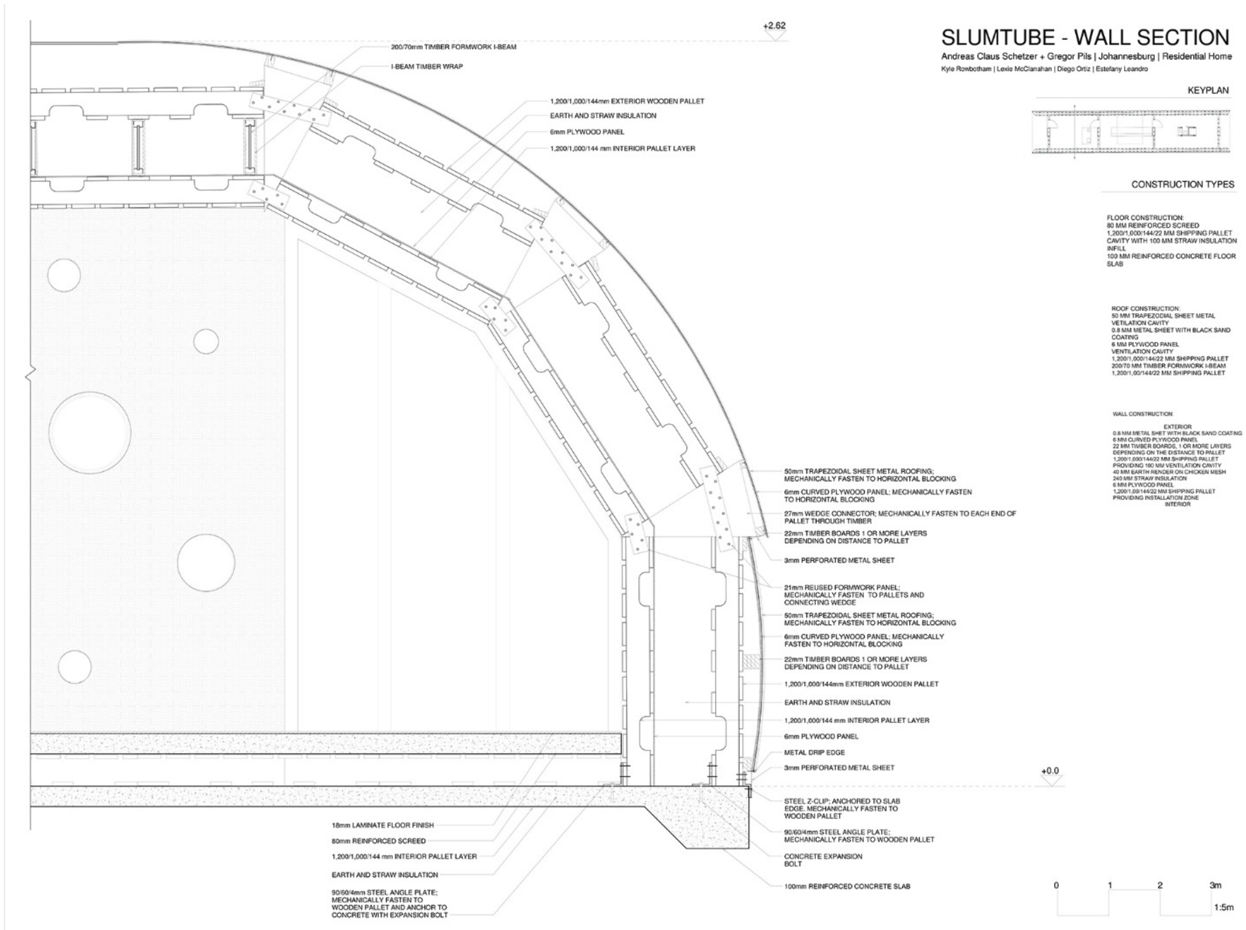

Figure 7: Wall Section – Slumtube, Schnetzer and Pils – Drawing by ARC242 S17 Group 3 (E. Leandro, L. McClanahan, D. Ortiz, K. Rowbotham)

Overall, this task was very straightforward for the students because, unlike some of the other elements they were asked to produce, a wall section was a familiar entity. The most significant issue for some of the groups was dealing with the metric system, both in the drawing of the section and in the printing of the drawing to scale. In future iterations, the relationship between imperial and metric will need to be more thoroughly covered prior to the start of the project and more clarity will need to be given to groups as to which they should be following. Additionally, the students need to be provided with concrete examples of the intended result of this task. There were ample examples of storyboards, for example, for the students to use as a go-by for their own work. At the outset of the project, however, the precise requirements for a wall section at this scale, such as lineweights, font size, print quality, etc., were lacking as this was the first time using this graphic device in the analysis sequence. When utilizing the detail-as-section technique again, more clarity will be delivered to the students up front, especially if those students are in their early years in the program.

Task IV: Detail Analysis

This next step of the precedent analysis zoomed in further and asked the students to study a particular detail of the building. Each group was required to select a section of their building measuring 4'-0" (tall) x 2’-0” x 2’-0” (or 1.2 m (tall) x 0.6 m x 0.6 m). The groups worked closely with the instructor at the beginning of the task to find the right area of inquiry for the assignment, which was not required to correlate with either of the first two technical exercises. Instead, the groups were tasked with identifying an area of the building that strongly conveys the character of wood in the project and that, of course, could be feasibly built by the group. There were several components to this task, some of which built on lessons and strategies learned earlier in the process of analysis:

1. The groups developed a set of construction documents for the detail, including plan, section, elevation, detail, and axonometric as necessary to fully understand its dimensions, scale, and material and systemic makeup (figure 8).
2. The groups created a storyboard for the detail. Whereas the earlier storyboard was documenting a process that had already occurred, this storyboard was serving as a virtual trial run for the future construction of the detail, working out a strategy for the construction prior to actually doing the physical labor. The students were encouraged to think precisely and specifically about each step. For instance, ‘Drill 4 holes in each board and bolt together with (4) 1/2” x 6” galvanized carriage bolts and matching washers and lock nuts’ is far better than ‘Attach the (2) 2x8s together.’ The general plan for the storyboard matched that of the earlier submission.
3. The groups developed a full parts list and cost estimate for building the detail at full scale. The students were required to break down their detail into its component parts and make a complete list of every item needed to build the project, including all fasteners and other accessory items. Again, specificity was essential as ‘nails’ is far less useful when standing in the fastener aisle at the local hardware retailer than ‘3” galvanized framing nails.’ After creating the list, the students created a cost analysis for their respective details. They were able to utilize any local retailer or supplier, seek donations, or salvage materials, but they were required to find sources for all of their specified products and materials. Additionally, online shopping was prohibited; the students were required to go and see the products in person at the store.
4. The groups created a minimum of one mockup, at full scale, of a particular joint in their construction that they determined would be difficult to construct

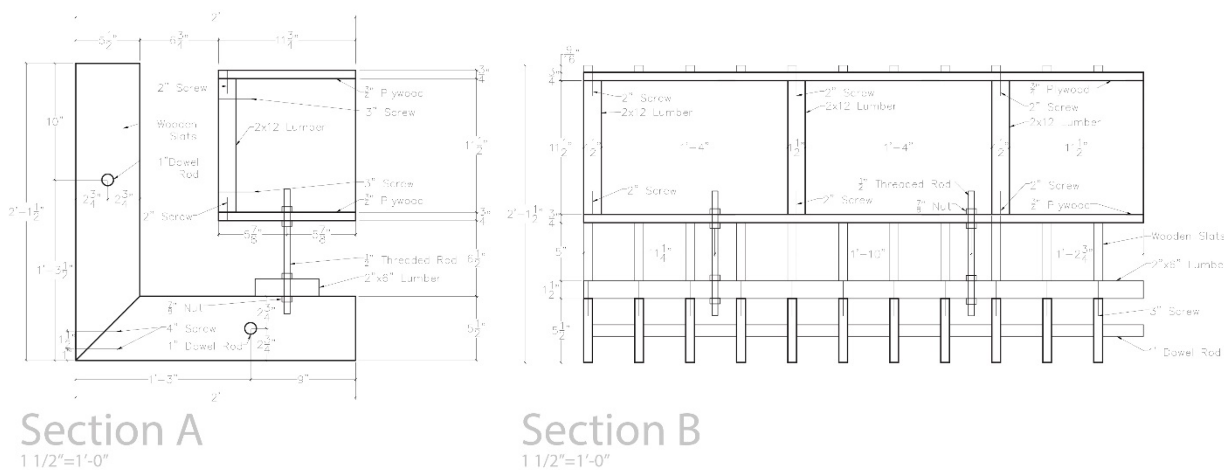

Figure 8: Section Drawings – Detail of Sirch Woodworking by Baumslager and Eberle – Drawings by ARC242 S17 Group 12 (C. Overmyer, R. Hoppe, and A. Bailey)

The final submission for this task was an 11x17 booklet that built on the storyboard booklet created earlier in the project. Three weeks after the start of the task, the students submitted an initial draft of their analysis (parts 1-3 only), which was reviewed with the group and thoroughly red-lined by the instructor. The students used the feedback to continue to develop their project; they submitted a final version of the Task IV booklet a week and a half later. The initial submissions, as could be expected, were littered with errors and issues in the assumptions about how to build the detail, in the precision of the documentation, and in the readability of the materials. The final versions, however, were a significant improvement not only over the intermediate submission, but also over the quality of the submissions made during the earlier project tasks. Two thirds of the groups by this point, had developed viable strategies for analysis and were able, with some assistance, to come to appropriate and well-founded conclusions about the construction of their precedent and how they would be able to re-create, or approximate in some cases based on available materials, technology, and skill, the techniques themselves.

Task V: Detail Construction

The final task in this project asked the students to build their architectural detail at full scale using their Task VI booklets as a set of instructions (figures 9 and10). The students were given access to the School's woodshop during several class periods and a total of two weeks to finish their constructions. In addition to the built submission, the students were also required to create a final chapter for their project booklet, which included a photo narrative of the construction process and as-built drawings of the detail. The as-built drawings demonstrated any and all changes or modifications that were made in the field during the process of construction through redline markups directly on the drawings.

Figure 9: Detail – Inspired by the Swiss Sound Box by Peter Zumthor – Construction by ARC242 S17 Group 1 (W. Debicki, L. James, C. Martino) – Photos by Author

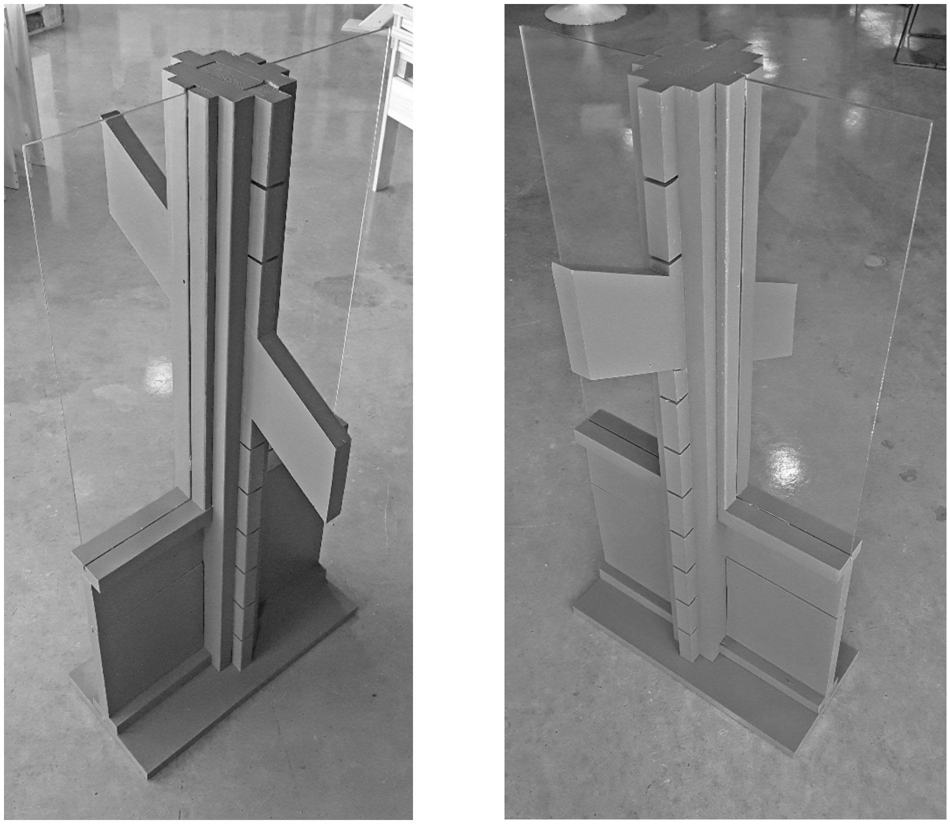

Figure 10: Detail – Inspired by Thorncrown Chapel by E. Fay Jones – Construction by ARC242 S17 Group 5 (J. Komperda, B. Kaczmarek, R. Michael) – Photo by Author

The build served as a culmination point for the project, actualizing all of the information gathered through the rigorous working process. By building the detail, the students made connections between the array of representations and the reality of putting those lines and models into real, three-dimensional space. In addition, the running documentation of the as-built drawings during the construction process helped the students understand the distinct differences between their intentions and what actually happened. Their assumptions were at some points correct and at other short-sighted with respect to how the detail should, and could, be constructed.

In future iterations of this type of project, an additional wrinkle that may be added is to have the students swap projects at the end of Task IV and build each other's details using the compiled instruction booklets. This strategy would allow for a better understanding of the relative success and legibility of the instruction tools created by the students, force the groups to engage, coordinate, and communicate with each other, and broaden the project exposure for the class.

Concluding Thoughts

Architecture students, especially those moving through the early years of their undergraduate education and certainly those who are attending Universities more distant from the architectural metropolises of the world, need inspiration; they need to be confronted with existing works that can challenge their preconceptions about how we build and how we use materials in architecture. Although much of the discussion of precedent is focused on the development of design work in the studio, the need for meaningful engagement with case studies is equally important in the technical sequence of architectural education. While one could argue that many building technology courses effectively utilize precedents as examples of technical accomplishment or experimentation, how intensive is the engagement between the students and the architectural work(s) in question? Is there a depth of examination in addition to a breadth of exposure?

After performing this self-evaluation in my own technical curriculum, I came to the conclusion that the students needed more rigor. With the image of a building becoming more prolific and certainly more accessible through the explosion of photo sharing websites and social media outlets as well as through architectural warehouses that briefly introduce countless projects with minimal technical understanding (if any), my students needed a less than subtle shove away from the scenographic and towards the tectonic, towards a true understanding of the intricacies of built architecture.

Although each group's examination was narrow, but deep, the array of projects, each utilizing different techniques for constructing with wood, provided the entire class with a broad exposure to the potential of utilizing this material in the fabrication of architecture. Precedent study can lead not only to an understanding of what has happened, but can serve as a catalyst for progress and innovation. This project, rooted in the study of tectonics and examined through the methodology of the precedent study, has the ability to instill within students the fundamentals of the practice of architecture that can serve them not just in the given assignment, but for a lifetime.[4]

References

1. Balmer, J. & Swisher, M. T. (2013) Diagramming the big idea: methods for architectural composition. New York, Routledge.

2. Beaney, M. (nd) Analysis. The metaphysics research lab, center for the study of language and information, Stanford University. Available from: http://plato.stanford.edu/entries/analysis/ [Accessed 6th March 2018]

3. Schwartz, C. (2015) Investigating the tectonics: grounding theory in the study of precedents. The International Journal of Architectonic, Spatial, and Environmental Design. 10(1), 1-15.

4. Schwartz, C. (2016) Architectural signs: translating the linework of architecture. Architectural Research Quarterly. 20(3), 193-197.

5. Unwin, S. (2014) Analysing architecture, 4th edition. New York, Routledge.

[4] Concluding sentences paraphrased from Schwartz, Investigating the Tectonic.