Investigating the Tectonic
Grounding Theory in the Study of Precedents

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Abstract: The blank page can be intimidating for an architecture student. When starting a project, there are multiple devices that can be employed to alleviate the novice student of this anxiety. One such tool is precedent analysis. The study of precedents provides key lessons—relationships between components, systems of order, means of connection, and conceptual parts, to name just a few—that can be used as building blocks to form new work; the precedent becomes a spark of inspiration, a conveyor of information, and a foundation for growth. As Simon Unwin states, “Both evolutionary development and contradictory revolution depend on understanding what has gone before.” This paper presents a platform for urging students to engage with high-quality samples of the built environment. The conclusion offered is that architecture students, especially those in undergraduate programs, need more resources and activities to assist in understanding the design of architecture. Through thoughtful study of the past projects, developing students can find catalysts for their own work while also advancing their understanding of design strategies and helping them to connect design theory with the actual creation of space.

Keywords: Architecture, Design Studies, Precedent

Introduction

One of the most difficult challenges for a novice architecture student to overcome is the blank page. It is not unusual for a student to sit, stare, and ponder unproductively for hours (or even days) while attempting to conceive the first few lines on the page or in the computer. Practicing architects have developed numerous strategies for combating this initial struggle. Steven Holl watercolors; SANAA brainstorm through model making; Jean Nouvel writes; and Santiago Calatrava turns to kinetic force analysis (Krupinska 2014, 153). Although any of these techniques could be adapted to the academic classroom, another potential catalyst for design that carries significant potential in this arena is the close study of the existing built environment.

This examination is called a precedent study. A precedent is a preceding occurrence, object, or event that can serve as an example for current or future endeavors. Jeffery Balmer and Michael Swisher 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 (Balmer and Swisher 2013, 7).” Simon Unwin acknowledges, however, that architecture students can be reluctant to engage with precedent studies because they “believe that their own originality and greatness will prosper best by insulating their creative genius from ‘corruption’ by the ideas and accomplishments of others (Unwin 2014, 5).” And, of course, because they do not want anyone to think that they are copying or plagiarizing.

Drawing from an existing work of architecture is copying only when what is taken is superficial or a recreation. This is merely imitation. If, instead, the lessons the architecture has to offer—relationship of components, systems of order, means of connection, conceptual parts, to name just a few—are extracted, studied, and used as a map to form new built work, then the precedent becomes a spark of inspiration. All precedents contain lessons that can be drawn from and expanded upon; it is just a matter of bringing them to the surface. Without learning from what has come before, students have little hope of becoming innovators in the future. “Both
This paper presents a platform for urging students to engage with high-quality samples of the built environment (precedents). It begins with explanation of the analysis of precedent and of the theory of architectural tectonics, followed by an example of the meaningful and productive integration of precedent into architectural coursework. The conclusion offered is that architecture students, especially those in undergraduate programs, need more resources and activities to assist in understanding the design of architecture. Through thoughtful study of the past projects, developing students can find catalysts for their own work while also advancing their understanding of design strategies and helping them to connect design theory with the actual creation of space.

The Precedent Analysis

The first primary concern, when having students engage in the study of precedents, is that they are examining critical, not superficial, aspects of the work. Students, especially novice students, do not yet have a developed understanding of the intricacies of architectural design. Left to their own devices, precedent analysis frequently becomes a shallow endeavor, focused on pretty pictures and drawings pulled from magazine articles or the internet. That is not to say these elements are not valuable. In fact, as a catalyst for conceptual design, images of spectacular work can be the most valuable tool available outside of first-hand experience. However, in most situations, when students are analyzing a work of architecture they should be searching for lessons; lessons that can be excavated from the project and utilized in the design process without mimicking or copying the original. What is needed is not an understanding of what the project is, but how it works.

Understanding the image of the project is not enough; that tends to lead to imitation. Instead an analysis is required. Analysis 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, 2014).” Analysis involves seeking out critical information, breaking it down into component parts, and reassembling the necessary elements to convey a specific idea about the object or situation. The recreation of this analysis is important to this process as well. Architects create representations of things that are yet to be built. To be a successful architect, one must excel at communicating ideas through drawings, models, and the written word. A substantial portion of the information presented on a given project must first be converted into graphic representations to allow for dissemination to a larger audience. This audience includes a very diverse group of people, some who are experts in the field and some who are not. In the design studio (and in the professional office), diagrams are typically used to graphically convey the lessons learned from a precedent study. Unlike technical drawings that depict physical realities or images that demonstrate aesthetic conditions and spatial understanding, diagrams are exceptionally useful to demonstrate how a project works. These drawings are usually simplified, depicting a very specific idea while eliminating clutter that does not support the issue at hand. They can be made as part of the process of design to explore ideas or afterwards as descriptive or analytical tools. In this case, diagrams are used as tools to help depict the ideas at work in the precedent project.

One difficulty architecture students face when studying a precedent is choosing the specific ideas or lessons to examine. There are relatively simple lessons that students immediately turn to when they begin a study, such as circulation patterns and program distribution. Although valuable in certain situations, these lessons tend to be relatively generic for many projects. Instead (or perhaps in addition), students need to consider the qualities of the case study that are unique to that project and those around which the project has been conceived, designed, and built. Primary consideration should be given to construction and assembly, structure, materiality,
texture, incorporation of light and air, interior/exterior relationships, relationship to the groundplane, conceptual drivers, contextual drivers, ordering systems, detail, technology and innovation, and the rest of a relatively endless list of possibilities. And, obviously, within the context of a design studio or other architectural course there are likely one or more conceptual anchors driving the course that would be essential lessons to draw from the precedent projects. It is important for students to remember, however, that each precedent has a unique set of lessons to learn. The study must be focused from the outset on the precedent’s strengths.

Architectural Tectonics

The concern of tectonics is threefold. First, the finite nature and formal properties of constructional materials, be those timber, brick, stone, steel, etc. Second, the procedures of jointing, which is the way that elements of construction are put together. Third, the visual statics of form, that is the way by which the eye is satisfied about stability, unity and balance and their variations or opposites (Porphyrios 2002, 136)

This quote, found in Demetri Porphyrios’ “From Techne to Tectonics,” illustrates a contemporary understanding of architectural tectonics. Architectural tectonics (very unlike geological tectonics) is an integrative practice. It is the study of the interwoven relationship between space, function, structure, context, symbolism, representation, and construction. No single definition exists that conveys the full meaning of the term, primarily because tectonics has evolved over time. Originating with the work of Karl Bötticher and Gottfried Semper in the early to mid-1700s, tectonics sought to give the utilitarian and constructed nature of the built environment equal consideration to the artistic presentation of the work. It attempted to set up a balance between the internal systems and the external expression. In this way, tectonics is very much a study in dualities. Those familiar with the term likely have heard it referred to as the study of the poetics of construction. Architecture is the only art form that combines artistic endeavor with significant technical knowledge. This artform is tethered to the earth and lives in a world of forces that act on it and inhabitants that rely on it for shelter, comfort, and protection. Tectonics, therefore, is a dialogue between design and construction, between representation and ontology, between assembled and massed, between the whole and the detail, and between surface and substance.

Given the breadth of topics that architectural tectonics engages, it is an ideal candidate for the central focus of a precedent study. There are a series of specific sub-topics within the theory that are especially well-suited for informing an investigation of a building or other built work (listed in alphabetical order).

- **Anatomy**: the study of the primary components and systems of a building inspired by Gottfried Semper’s proposal for four elements of architecture.
- **Atectonic**: the study of conditions that run contrary to typical tectonic ideas.
- **Construction**: the study of the means and methods of construction as well as the materiality of the built environment. This topic contains two important subdivisions: Tectonic (the study of the lightweight assembled components of architecture) and Stereotomic (the study of the heavy, mass components of architecture).
- **Detail**: the study of the joints and other critical conditions that make up the smallest scale of the built environment. This topic includes an important subdivision called Intersection which is focused on the juncture between primary building components, most notably where tectonic and stereotomic systems meet.
- **Place**: the study of the impact of a specific place or context on the tectonic makeup of a building.
• Precedent: the study of past built work for the purpose of inspiring projects yet to come. The focus here will, of course, center on the adaptation of tectonic strategies from one project to another.

• Representation: the study of the relationship between the actual construction of the building that is required for stability or enclosure and the cladding or ornamentation that is used to create the aesthetic scheme.

• Space: the study of the relationship between the creation of space and the construction and representational qualities of a building.

These topics are all rooted in the history of tectonic theory and provide a diverse set of principles under which to study a work of architecture, tapping into design, construction, and theory in the same exercise (three elements we tend to keep relatively separate in an architectural curriculum). Using tectonics as a catalyst for a precedent study gives students the opportunity to dig deeper into the meaning of the built environment. Although certainly not the only approach to the study of past work, tectonics provides diversity of engagement that should provide a solid starting point for the examination of most works of architecture.

Sample Precedent Study

Fay Jones’ Thorncrown Chapel is perched in the Ozark Mountains of Arkansas in the United States. In form it is a simple shed in the forest, but it contains many valuable lessons; its ingenious conception, design, and construction led to a Twenty-Five Year Award from the American Institute of Architects in 2006. Like all buildings, Thorncrown could be studied for its primary circulation routes, the layout of its programed space, or its massing. These points would not, however, help us understand the lessons it has to offer. Instead, this small building should be studied for its assembly, its relationship to the forest, and its tectonic makeup.

Thorncrown Chapel is a predominantly tectonic (as opposed to stereotomic) construction, built using typical stock lumber, but assembled in non-traditional ways. A regiment of trusses forms the sanctuary—supported by slender columns—and establishes the gabled profile. The use of wood signifies a departure from most historic religious construction: “The chapel rephrases the aisled, masonry, compression structure of a medieval church as a light wooden structure built of two-by-fours layered over one another in some places and jointed end to end with metal fittings in others, resulting in a frame that works in tension (Upton 1998, 127).” The assembly of wood forms a latticework that shapes your experience while visiting Thorncrown.

In addition to wood, glass dominates the tectonic expression of the chapel. Panes of glass infill between the framing components and a skylight slices along the ridge of the roof. Both glazing conditions provide transparency and dematerialize the building; they permit you to view from the forest, through the building, and back out to the forest (or up to the sky) (Figure 1). The glazing also blurs the boundary between the inside and the outside of Thorncrown Chapel. In short, the tectonic construction allows the building to develop a relationship with its environment while instilling a “unified simplicity” through an array of “interlocked, individual pieces (Ivy 1992, 35).”
This analysis should provide a number of key lessons to an architecture student that can be carried into his or her own work. First, the creative utilization of stock or inexpensive materials is at the center of Thorncrown’s construction. It is not the use of a 2x4 that is particularly important here. It is instead the concept of reinventing a material through a rigorous design process open equally to creativity, cost effectiveness, and structural soundness. Second, the development of a relationship between the quality of the site and the quality of the building through material expression and structural assembly. And third, the use of construction to enhance the programmatic experience of the space for the visitor.

At a smaller scale, detail also plays a central role in the design of Thorncrown Chapel. Here, Jones establishes two significant generative themes. These ideas manifest throughout the chapel, from the structure to the furnishings. The first theme is that of the cross. “[A] cross motif appears in the metal bar stock supporting the pews, in lanterns lining the walls, in a metal column supporting the moveable lectern, and in the chapel’s cross—a slender metal stake positioned outside the transparent altar wall, symbolically connecting man to the universe (Ivy 1992, 35).”

The second generative theme—the rhomboid—is more essential to the space. “The pattern of flat rhomboids of the door handle of the Thorncrown replicates almost exactly the design of the interior wood truss, and the rhomboid occurs in both the window mullions and in the high-backed chairs behind the altar. More critically it is the primary joint of the building, as a steel rhomboid connector [is] used at the intersection of the truss chords (Ford 2011, 112).” Thorncrown Chapel is, quite literally, constructed from this motif. Thorncrown’s defining detail is the steel rhomboid truss connector. The joint allows for a hollow at the intersection of the truss chords—a principle point of load transfer in the structure—and distorts the perception of the stability of the structure while assisting in the perception of the floating of the building’s roof. The rhomboid expresses the core characteristic of the architecture; it permeates the chapel and binds its discrete elements (Figure 2).
Again, there are critical lessons embedded in this study that would be valuable for a novice student to learn. The catalyst for detail coming from the structure and permeating through the building could be utilized in many ways in a new design project. Likewise, the negating of structural support (at least the understanding or feeling of it) is a lesson able to be built on in future works. A complete precedent analysis would require a more thorough evaluation of the building, but the quality and depth of thought necessary for an academic (or any other) study of existing works is evident in this brief discussion of Thorncrown Chapel. Students must be taught how to engage with works of architecture and pull from them lessons that can be transposed into their own design projects. These lessons must be foundational blocks of architectural knowledge rather than imagery to be pasted on the page.

Critical Use of Precedents

In 2013, a new structure was developed for a third year architectural design studio with an enrollment of 18 students. It utilized a series of interlinked problems, each building on and connected to those preceding it. The catalyst for the semester was the first problem and, building on the philosophy outlined, it centered on the study of an architectural precedent. In this course, the goal was for the precedent study to become the critical driver of design. Each student selected his or her precedent (via lottery) from a provided lot. The collection of buildings chosen by the faculty consisted of small, but meaningful, chapels and other religious structures. As previously discussed, the students were responsible for a thorough analysis of the precedent project (Figure 3) through the lens of the tectonic. In addition to the necessary diagrams, the students were also responsible for creating their own drawings of the facility (plan and section) and building a model of a critical section of the work. Although not a traditional analysis, having to do original drawings of the buildings forced the students to study the found literature much more closely.
They had to understand scale, materiality, spatial relationships, and a wide variety of other considerations much more clearly than they would have if the drawings were plucked off the internet and dropped onto the presentation board. The creation of drawings and models helped the students better understand the work in order to uncover the lessons it was founded upon; this work was a valuable part of the process of investigation.

The second problem utilized (and required) the high level of understanding of the precedent developed in problem 1. In this exercise, the students were asked to design a component which would, at a minimum, allow an individual to pause and rest while visiting their chapel. This intervention could be located anywhere in or around the chapel, but had to respond directly to the tectonic conditions and other characteristics of the building they found in their analysis. This problem shifted the scale of investigation from that of the building in the first problem to that of the detail in this exercise. To complement the study, the designed interventions were required to be built at full scale (Figure 4). Having to not only resolve the design of the whole, but fully construct it required an attention to detail that promoted a more thorough examination of the assembly and detailing of the precedent project. Despite a lack of precision craft skills, the class admirably took on the challenge of problem 2 and most of the students were able to design and build interventions that appropriately inhabited the precedent chapels due to their conscientious study of the buildings themselves.
The third problem asked the students to locate a site for a new project within the city limits of the town in which the University resides. In groups, the students researched various aspects of the community—program, zoning, infrastructure, environmental conditions—and then individually selected a site within the approved range that they believed would appropriately house their new project. After this site analysis, the semester concluded with the students designing their own religious spaces. Inspiration for the design of this facility was drawn from the analysis of the precedent project in problem 1 and from the intervention designed within it in problem 2. In the first half of the project, the students designed the building and the site. In the second half, they zoomed in and more thoroughly investigated a small section of the building. This investigation required the students to fully understand the construction of the selected section and culminated in the building of an architectural detail at full scale. The assignment was particularly difficult for the students due to its heavy reliance on re-interpretation. The students had never been asked to draw so significantly from the study of an existing project in their past courses. In this studio they were cautioned early and often to not copy the existing architecture, but to be inspired by the lessons it had to teach. Despite some struggles, many of the students were able to successfully use the lessons of the precedent chapel to inspire their own designs; the student’s work built on central tectonic and religious themes, lighting qualities, and contextual relationships (amongst many others) (Figures 5, 6, and 7).

Figure 5: Chapel interior inspired by Studio Tamassociati’s Meditation Pavilion
Source: Project by B. Macander

Figure 6: Chapel interior inspired by the Rural Studio’s Yancey Chapel
Source: Project by P. Mckissack
Results and Conclusions

Having taught design studio for the past twelve years, I believe that precedents are frequently undervalued or underutilized by students. Many courses (including many this author has taught in the past) simply have each student (or group of students) examine a project as a sub-assignment sometime during the first half of the course. The project generally occurs in relative isolation from the rest of the course assignments, but the students are expected to refer back to this study later in the class. This method can be effective, but as work occurring later in the semester typically becomes more complex, many students either do not have time to go back and refer to the study in a meaningful way, forget to do so, or do not make the effort because they have not been convinced it is worth their time. This course attempted to make the precedent a more meaningful contributor to the overall learning experience of the design studio.

This emphasis proved to be a challenging and rewarding learning experience for the students. The student response to this avenue of investigation in the course evaluations was outstanding. The group rated the educational experience and overall quality of the course as 4.84 out of 5.0 (96.8%). The statistical data was reinforced with written responses that praised the
rigorous nature of the course, the linked problems that provided continuity through the semester, and the integration of theory and practicality in the design of the work. One student wrote that continually “referring to underlying themes throughout the semester helped [develop] understanding.” In this case the student was likely referring to the underlying theme of the tectonic analysis of building that carried through each project. Another student wrote: “I feel like other studios design without thinking about real world restrictions” and indicated that the significant links that tectonics provided to the tangible consequences of reality were of great benefit in this course.

Despite the positive feedback, however, the studio posed numerous challenges that need to be addressed in future iterations of the course. First, the sequence of five projects was interrupted significantly by the selection of the site in problem 3. The other four problems generated continuity through the semester, but this problem did not fit into that sequence nearly as well and created disruption. This rift was at least partially responsible for some of the students losing traction in translating the lessons of the precedent studies into their own designs. Had the semester progressed directly from the design of the intervention piece to the development of a new space, the overall results may have been more successful. This disconnect was revised in 2013 when a similar project was undertaken in the same studio. In this version the site was chosen for the students and it felt like continuity was better maintained throughout the semester. Regardless, this issue needs to continue to be addressed in future iterations of this class.

Second, the timeframe of problem 4 was too short to expect the students to be able to accomplish a thorough integration of the precedent’s lessons into the new chapel design. The single biggest critique on the student evaluations was the rushed nature of this project. They were engaged with the work and wanted more time to refine their ideas, but the semester’s schedule did not allow for this to happen. The integration of theory and the reliance on a new course construct the students have not experienced before (generating design through precedent) requires more time to be allocated for critical thinking and reflection. A lack of contemplation and iteration was evident in the work. Reworking the schedule and perhaps removing one project all together would allow for a more successful process to develop and for a more thoughtful final solution to the problem.

Finally, the available literature on architectural tectonics is daunting and complex. Many of the third year students attending this school have had very little exposure to architectural theory and, therefore, struggled to understand some of the fundamental ideas of tectonics. The simpler concepts, such as the pairing of tectonic (lightweight) and stereotomic (massed) construction, were understood by most of the class and were demonstrated in their projects. The more complex ideas centering on representation and spatial relationships were, for the most part, non-existent in the final designs. This issue has the potential to be resolved, however, with the creation of better resources for use in the classroom.

**Future Implications**

Precedent has the potential to serve as a catalyst for design and as a means of bridging theory and practice in the study of architecture. Tectonics is ideally suited to be the medium through which we examine these past works. An essential resource to extend this line of inquiry would, first, present clear examples of quality precedent studies off of which students can pattern their own analysis. Second, it would demonstrate multiple ways of creating successful diagrams to graphically demonstrate how a building works. And finally, it would take a critical theoretical stance around which to build an analysis, in this case architectural tectonics. These investigations in the design studio are shifting towards such a publication, which will hopefully fill a gap in the literature currently available on these topics.

This methodology needs to be tested in other courses, however, to help understand its validity and flexibility. In response, a recent graduate architecture studio was completed in which
the students designed an open-air museum. This museum’s collection consisted of a series of four to six pieces of architecture of a similar theme (programmatic primarily) that were all relocated to a single site for display. The semester began with the selection and thorough analysis of the group of buildings. The museum design was then an extension of this research and built on the lessons learned from the collection itself. Again, the precedent studies guided the semester’s work.

In an upcoming semester, a group of 50+ students in an introductory building technology course will also utilize precedents in a significant way. In the course’s culminating project, groups of students will study a series of wood structures that each utilize the material in different ways as a primary medium. After analyzing the precedents, the groups will use this knowledge to reconceive a typical single family wall section using the lessons learned from the alternate construction systems. These wall sections will then be built at full scale by the groups. The hope is that the same process of adaptation that worked successfully in the design studio will also be valuable for the students enrolled in a lecture/lab based course.

More research is also necessary to properly investigate the impact of precedent-centered studio work in lieu of a more traditional methodology. In future courses, assessment tools—reflective writing, surveys, process journals, and interviews—will be implemented to help understand the learning that actually takes place through these investigations. In particular, one goal will be to track the work of students who have and have not had the opportunity to learn through precedent-centered learning in the following semesters to see if there are any marked differences. Another potential study is the analysis of the final submissions from students in a variety of studios—both traditional and precedent-centered—to see how many valuable references are made to past works that have been studied. And finally, this methodology of teaching could be examined for its viability as a curricular construct, one in which history and design are fully intertwined.

Many have stated that there are no new ideas in architecture, just revisions to already existing concepts. Agree or not, the study of the past has the ability to lead to success in the future. Perhaps we should study the history of the profession not out of fear of ‘the doom of repeating it,’ but so that we will have an encyclopedia of lessons at our fingertips that can be repeated, revised, and revisited. Imitation is to be avoided, but the fundamental building blocks of design are not. Precedent study can lead not only to an understanding of what has happened, but can serve as a catalyst for progress and innovation. This work, rooted in the study of tectonics and examined through the methodology of the precedent study, have the ability to instill within students the fundamental of the practice of architecture that can serve them not just in the given studio assignment, but for a lifetime.
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