A Taxonomy of Architectural Tectonics

Chad Schwartz
Southern Illinois University - Carbondale

Abstract[1]

> [O]ne might argue that a building is intensified through the elaboration of its own medium – *a language of sticks and stones* – to induce a state of architecture. The “material” that underlies architecture is somehow rooted in construction and its details, and yet beguilingly, the devices that engage the building practice are most often in tension with the seemingly direct necessities of fabrication. Herein lies one of the most fertile and debated topics in architectural theory: the subject of tectonics.[2]

Architecture is often described as the intersection of art and science. These two distinct realms, however, cannot be set in opposition; they must be cooperatively utilized in the creation of the built environment. Architecture is an integrative art, one that combines the design of productive space with the tangible realities of gravity, material properties, and assembly sequences. The study of architectural tectonics can help to illuminate the partnership between these elements in the creation of the built environment. Tectonics has many definitions, but they all tend to focus on the relationships between those architectural elements we tend to hold apart: space and construction, structure and ornamentation, atmosphere and function. It seeks a relationship between the design of space and the reality of the construction that is necessary for it to exist.

This paper outlines a framework for examining the core concepts ingrained in the history and evolution of architectural tectonics. Each of the following topics examines a particular characteristic of the theory drawn from different lines of historical and contemporary thought:

- **Anatomy** | the study of the primary components and systems of a building
- **Tectonic + Stereotomic** | the study of the means and methods of construction as well as the materiality of the built environment
- **Detail + Intersection** | the study of the joints and other critical conditions that make up the smallest scale of a work of architecture
- **Place** | the study of the impact of a specific place or context on the tectonic makeup of a building.
- **Representation + Ornamentation** | 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.
- **Atectonic** | the study of conditions that run contrary to typical tectonic ideas

The tectonic theories of Karl Bötticher, Gottfried Semper, and others have evolved over time to be able to successfully integrate into contemporary society, but this “transformation, adaptation and above all the reduction of and simplification of an extremely ambitious theory of tectonics was in fact ineluctable.”[3] Despite its shifting, its transforming, and its adapting, architectural tectonics remains a central tenet of both the study of architecture and the practice of its design and construction. The lessons available to all students of architecture that have arisen from this linage of architectural thought have the potential to positively influence our built environment for the foreseeable future.

Introduction

In his 1844 work *Die Tektonik der Hellenen*, architectural scholar and archaeologist Karl Bötticher wrote the following words:

> We conceive of tectonics in the more narrow sense: the activity of building or of making objects of use, as soon as this activity is *ethically suffused*, and can rise to the charges placed upon it by intellectual or physical life. At that point, this activity not only seeks to satisfy mere needs by *forming a volume* in accordance with material necessity but instead may elevate that volume to a Kunstform.
>
> Thus, we conceive of the tectonic activity in two groups: the group of the pure built work, or the architectonic; and that of the smaller forms, of the *tectonic of useful objects*. Both are based upon the same principles of formal constitution. The architectonic, because of the scope of its duties and the compass of its means, requires that these principles be described more broadly and drastically.[4]

This manifesto on architecture provides key insight into the origins of tectonic thought. Bötticher, along with Gottfried Semper, is widely regarded as a founding father of the theory of architectural tectonics. His ideas about architecture originate in the study of Hellenic building and the principles with which the Greeks designed their greatest works. Bötticher claimed that this era of architecture was unmatched in its ability to convey the underlying essence of an architectural work though the expressiveness of the ornamentation with which it was clad.

As an example, take the Greek column (Figure 1). The structural function of the column is relatively simple; a beam above transfers gravity load generated by the overhead structure to the top of the column, which in-turn transfers the load through its mass to the base. The base then evenly distributes the load to the ground or structure below. When the ornamentation of a Greek Order is applied, the two points of primary transfer are also the points adorned with the most intricate elements of the design, highlighting or revealing the work underway below the surface.

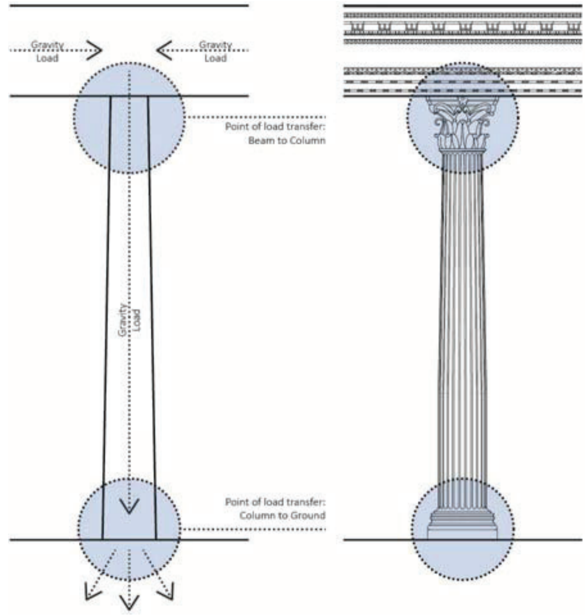

Fig. 1. Analysis of a Greek column.

Bötticher refers to the actual work being done below the surface of this “object of use” as the *Kernform*, which can be translated as core-form or the underlying ontological truth of the object. The ornamentation is the *Kunstform* or the art-form that both covers and reveals the *Kernform* below. This concept is one of the most essential and formative ideas of architectural tectonics, the notion that there is a distinct relationship between how a building works and how its visible components help reveal that truth to those occupying its spaces.

Although certainly stemming from a passionate study of Greek architecture, architectural tectonics was also responsive to popular sentiment among the intellectual community of the Germanic states in the early 1800s. A group of philosophers, including Immanuel Kant, were studying the fine arts and had come to the conclusion that the purpose-driven practice of architecture was inferior as an art to those with no functional intent such as painting, sculpture, or music. In Kant’s terms, architecture was centered on purpose, while the remaining fine arts were associated with purposiveness, a term derived to describe an act in which the concept of an object was independent of any functional value (Figure 2). Bötticher, Semper, and others reacted to this slight to the practice of architecture by introducing architectural tectonics as a way of connecting the underlying functional aspects of a building to its ornamented, visual facades. They sought a way to elevate the architectural object to a *Kunstform*.

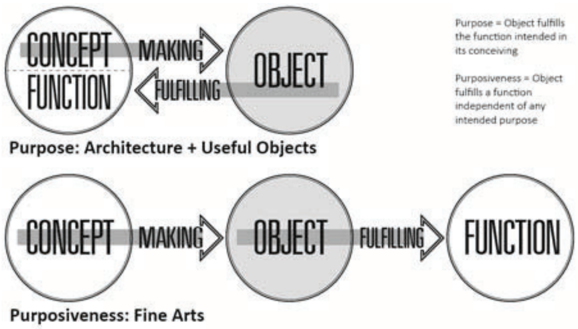

Fig. 2. Understanding of purpose and purposiveness.

Adaptation

About 150 years later, around the turn of the century, a resurgence, led by architectural theorist Kenneth Frampton, brought the ideas of architectural tectonics back into the spotlight. In his essay “Towards a Critical Regionalism,” Frampton writes:

> [T]he primary principle of architectural autonomy resides in the *tectonic* rather than the *scenographic*: that is to say, this autonomy is embodied in the revealed ligaments of the construction and in the way in which the syntactical form of the structure explicitly resists the action of gravity.[5]

This definition is paralleled and expanded in the essay “From Techne to Tectonics” by Demetri Porphyrios:

> 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.[6]

Although there are some similarities to the definition offered by Bötticher in the mid-1800s, there are also some distinct differences. Bötticher was seeking to reveal the underlying forces at work through the ornamentation of the building. He was seeking representational and referential understanding of the useful purpose of building. Frampton and Porphyrios, however, are shifting that definition. They both believe that the tectonic building must demonstrate how gravity is moving through the structure and that we must be able to perceive this reality and be satisfied through our understanding of how the building is stable. The art-form, however, is not mentioned in these later definitions, pulling back from historicist modes of representation. There is also, in both definitions, a clear call for an understanding of the joining of material, the ligaments that tie the building together and help to achieve the stability that is sought. Finally, Porphyrios urges for an understanding of materials, although much more closely tied to Gottfried Semper’s studies than those of Bötticher.

What this very brief snippet of the history of tectonics illuminates is that the theory has, over the past century and a half, necessarily evolved. The “transformation, adaptation and above all the reduction of and simplification of an extremely ambitious theory of tectonics was in fact ineluctable.”[7] It has transformed and shifted to adapt to changing technologies and cultural attitudes, architectural styles and environmental needs. Despite its adaptations, however, and likely because of them, it is relevant to the contemporary architect and the contemporary architecture student. Architectural tectonics “remains a central tenet of both the study of architecture and the practice of its design and construction. The lessons available to all students of architecture that have arisen from this linage of architectural thought have the potential to positively influence our built environment for the foreseeable future.”[8]

Framework and Analysis

The evolutionary process of architectural tectonics has led, naturally, to the interweaving of a series of complementary lines of thought that have organically sprouted and grown over time. In order to best convey the full breadth and depth of the theory of tectonics, each of these ideas must be explored. To simplify the experience, like ideas can be classified into a taxonomical structure; this strategy also has the potential to make this involved theory easier to understand for those more novice to architectural theory in general, like architecture students. The following sections briefly outlines each point and provide examples of how each can be utilized in the development or analysis of an architectural work.

Anatomy

The first category is anatomy, which examines the primary components and systems of a building. This line of thought builds heavily on the concept of the four elements of architecture proposed by Gottfried Semper in the mid-1800s: the hearth, the earthwork, the roof and framework, and the cladding. The hearth is the social center, the call for gathering and society, and is protected by the other elements. Although certainly this classification system can be taken quite literally, Semper's elements can also be viewed as a foundational system open for significant interpretation as technological systems advance over time.

Although certainly a departure from Semper's system of classification, the Loblolly House by Kieran Timberlake demonstrates the use of a clear set of construction elements. This system, derived by the architects through their study of manufacturing processes, consists of seven primary building systems: site work, scaffold, cartridges, blocks, fixtures, furnishings, and equipment (Figure 3). While the site work is accomplished in the field, the rest of the components in this system are pre-manufactured off-site before being delivered and installed by the contractor.

Construction

The second category builds on the notion of anatomy by examining how these systems are constructed. Specifically, there are two significantly different ways in which we approach the construction of our built environment: tectonically and stereotomically. This pairing, outlined by Frampton in his work in the mid-1990s, separates tectonic construction – those elements which are assembled through the articulation of joints – from stereotomic construction – accomplished through the piling or massing of material. This category holds the opportunity to examine the means, methods, and materiality of the built environment.

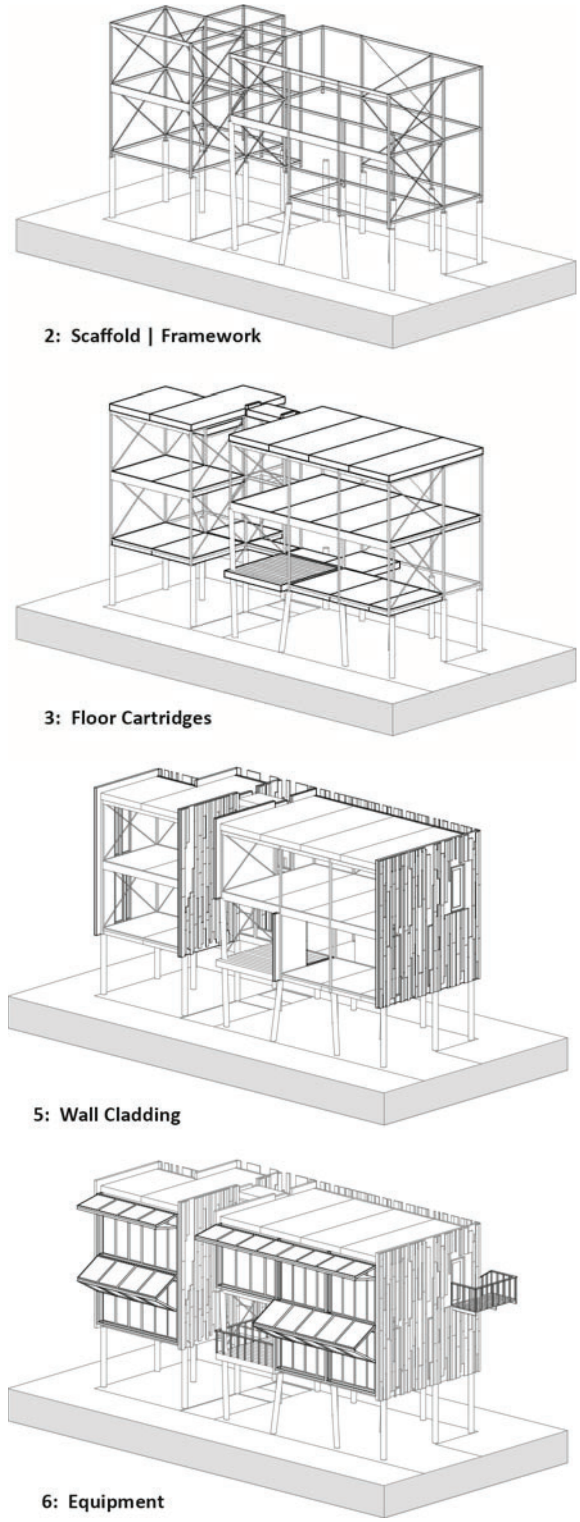

Fig. 3. Partial anatomy of Loblolly House by Kieran Timberlake.

A clear example of the pairing of tectonic and stereotomic systems can be found in the Chapel of Reconciliation, which is located in the no-man's-land formerly contained by the two sides of the Berlin Wall in Germany. This small building, designed by the team of Rudolf Reitermann and Peter Sassenroth, is composed of two nested ovaloid forms (Figure 4). The inner volume is rammed earth and is quiet, contemplative, and introverted. The outer volume is defined by an open-air wooden screen, which allows for a connection to the surrounding environment while providing weather protection for the rammed earth construction within.

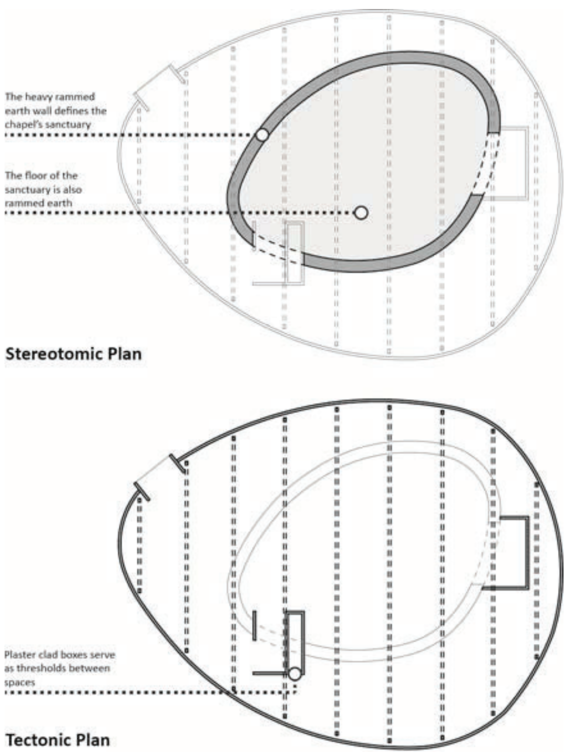

Fig. 4. Stereotomic and Tectonic plans of the Chapel of Reconciliation by Reitermann and Sassenroth.

Detail

The architectural detail is the subject of the third category and is divided into two parts: the joining of elements to form a detail and the joining of critical systems to form the primary intersections of a building. The joint has been of primary concern throughout the evolution of architectural tectonics. It is examined in the intersection of the Greek column discussed previously as well as in recent literature by the likes of Edward Ford and Marco Frascari who find that the architectural detail can tasked with both creating structurally sound spaces through the assembly of the construction systems and emotively strong spaces through the character they bring to our built environment.

Created through a design/build process led by architect Anna Heringer, the METI Handmade School provides a pristine example of the notion of a primary intersection in a building. This project, which was built by a local labor force in Bangladesh, consists of a lower story of earth construction and an upper story constructed primarily with bamboo. It is the interlacing of the two building systems in the upper floor construction that unites the building as a whole (Figure 5). The bamboo is used structurally to carry the weight of the floor, while also tying the tectonic system above to the stereotomic walls of the lower level.

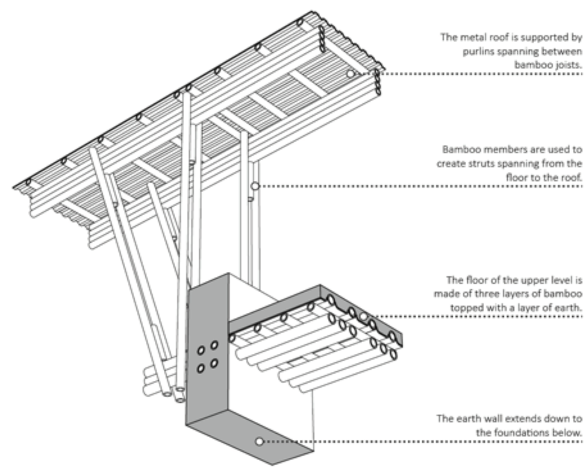

Fig. 5. Construction detail of the METI Handmade School by Anna Heringer

Place

From Semper to modern day, the role of place in how we build has played a crucial role in the understanding of architectural tectonics. This fourth category asks us to study the impact of a specific place or context on the tectonic makeup of a building. Semper understood very well the role of environment and available resources in the development of architecture by different cultures. Zooming in, we must also carefully consider the role of the site in the development of the tectonic whole. “One cannot disregard the enormous importance of the plane separating above and below. That plane is basic to the tectonics of building…It is the beginning of our taking possession of the land.”[9]

Debartolo Architects created a unique construction in the Sonoran Desert of Phoenix, Arizona that is distinctly connected to the environmental conditions of the place, albeit in an unlikely way. The Prayer Pavilion of Light utilizes multiple layers of glazing and a thermal chimney to mitigate the desert heat while allowing through the ever changing and dramatic light of this region of the country (Figure 6). By articulating the tectonics of the building, the architects were able to create a space that is conscious of the environment without removing it from the experience of the space.

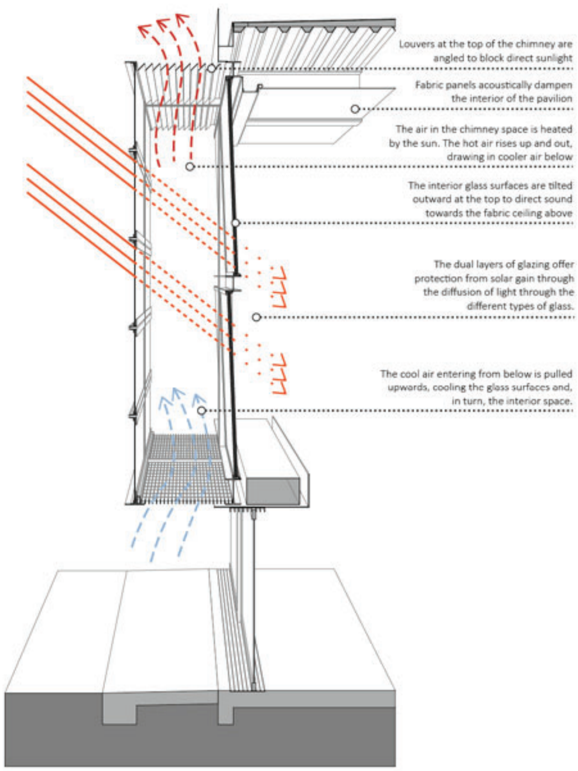

Fig. 6. Wall section of the Prayer Pavilion of Light by Debartolo Architects

Representation + Ornamentation

Perhaps the most robust of the categories of architectural tectonics is that of representation and ornamentation. This category, which can be further divided into its two intertwined namesakes, provides the original foundation for the theory of architectural tectonics (as outlined above). It seeks “a 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.”[10] Although historically, this was focused on the visual conveying of the utilitarian purpose of the building, in contemporary times we certainly can see these ideas playing out in other ways as well, including through environmental responsiveness of our building systems.

Outside Eureka Springs, Arkansas, E. Fay Jones built one of the most significant pieces of American architecture: Thorncrown Chapel. This small space is a glass box in the forest, surmounted by an expansive wooden roof and supported by a repetitive series of truss frames fabricated out of traditional dimensional lumber. The structure is a representation of the forest, which is enhanced by the glass which reflects and amplifies the surrounding landscape (Figure 7). “The glass veils the chapel in the forest itself, camouflaging it into the surroundings”[11] while the exposed interior structure is reflective of the structure of the surrounding tree canopy.

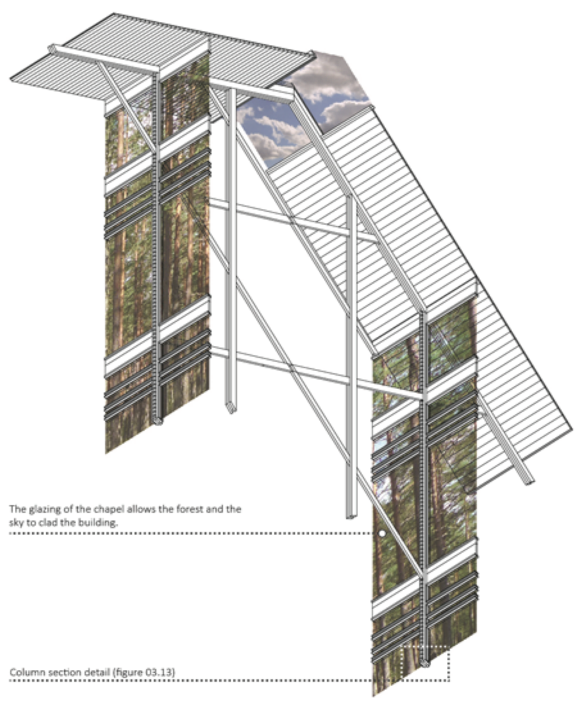

Fig. 7. Axonometric of Thorncrown Chapel by Fay Jones

Space

The sixth category examines the relationship between the creation of space and the construction and representational qualities of a building. This idea is explored by Bötticher, who wrote about designing for human need, which defines spatial arrangement. The supporting structure of the sheltering roof is then formed based on the spatial configuration, creating a correlation between space and structure. The advancing technology of construction has played a significant role in this relationship, most clearly seen in the introduction of iron as a primary structural system for architecture. As structure dematerialized, the spatial relationships of our buildings changed dramatically as well.

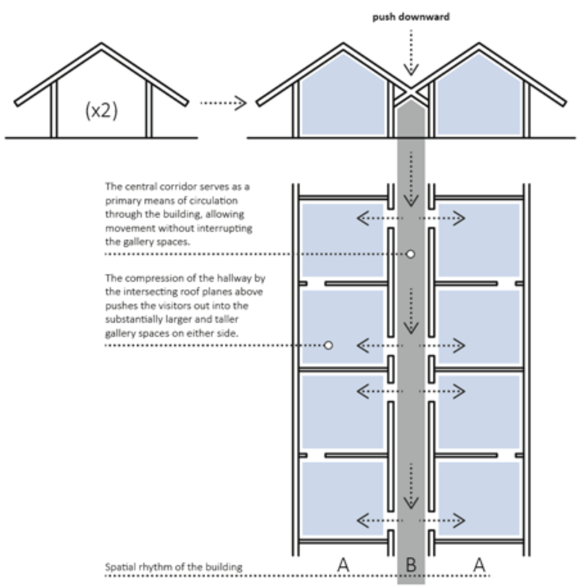

Fig. 8. Spatial plan of the Parrish Art Museum by Herzog & de Meuron

The concept of spatial tectonics can be observed while studying the Parrish Art Museum, designed by Herzog & de Meuron for a collection in New York. The building's profile consists of an extruded double-gabled roof. While this profile creates a unique building form that relates the project to a number of contextual drivers, it also has a significant impact on the qualities and use of the interior spaces of the building (Figure 8). The low, central valley pushes the space downward along its spine, encouraging circulation, while each gable extends upwards creating move voluminous space for the collections. This A-B-A relationship is, as Bötticher proposed, driven equally by spatial needs and the construction systems necessary to support the enclosing roof above.

Atectonic

Composing the final category of this taxonomy is the atectonic or the conditions that run contrary to typical tectonic ideas. Although certainly there is architecture that has been developed without the use of tectonic input, the primary concern here is with architecture in which tectonic expression has been purposely distorted in order to create a specific experience, feeling, or effect in a building or space. Eduard Sekler offers a few ideas of these tectonic abnormalities in his writings: the construction and structural principles could be out of alignment (i.e. building in one material with the detailing of another), the expression could be vague (i.e. a floating building), or the use of exaggerated building elements.[12]

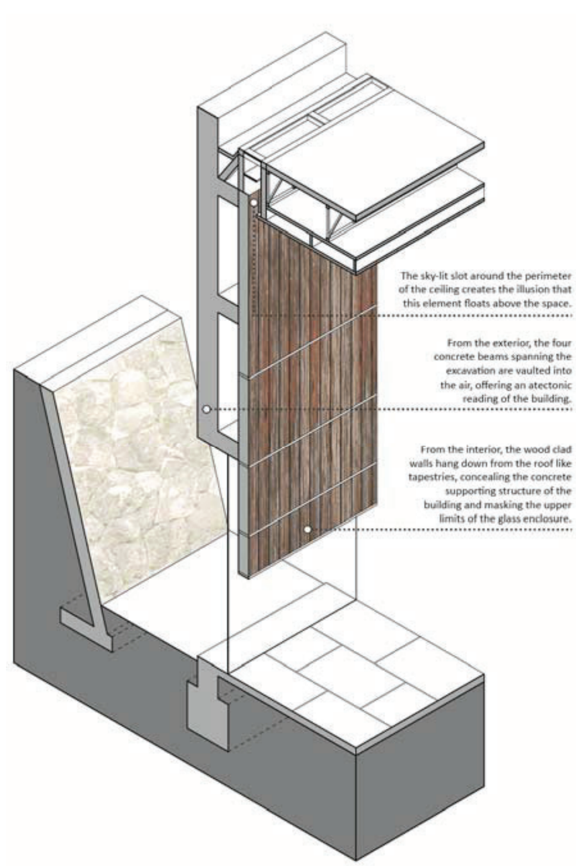

Fig. 9. Section of the Chapel del Retiro by Undurraga Devés

Within the category of atectonic buildings with a vague expression can be found the Chapel del Retiro, designed by Undurraga Devés Arquitectos in Auco, Chile. The building's mass is supported by four massive concrete beams arranged in the form of a hashtag symbol and suspended over a pit excavated into the ground. Visitors travel down a ramp and under the supporting structure to enter. Once inside the small chapel, you will find the concrete structure supports a wooden box that conceals the concrete from view on the interior (Figure 9). The wooden box hovers several feet above the floor, magically suspended with no indication of support. Here, the eye is certainly at a loss for the stability and understanding of the forces at work beneath the surface.

Conclusion

This tectonic framework has the potential to be of great value to students of architecture. Architectural tectonics is a study in dualities. As such, it has the ability to help novice practitioners begin to understand and develop connections between design and construction, between systems that are assembled and those that are massed, between the architectural detail and the building of which it is a part, and between the visible surface of a structure and the substance beneath that keeps the building stable.

In addition, this taxonomy of ideas provides an excellent way to study the world around us. The close analysis of precedents is an excellent way for the novice student to learn about the built environment. By using a tectonic lens to study great works of architecture, students have the potential to draw from these case studies critical lessons about the practice of architecture that will serve them for the rest of their education and as they move out into the professional world.

Notes:

[1] The abstract draws heavily from content outlined in Chad Schwartz, *Introducing Architectural Tectonics: Exploring the Intersection of Design and Construction* (New York: Routledge, 2016), xxvii-xxviii, lxv.

[2] Nader Tehrani, "Forward: A Murder in the Court," in *Strange Details*, ed. Michael Cadwell (Cambridge: The MIT Press, 2007), xii.

[3] Werner Oechslin, *Otto Wagner, Adolf Loos, and the Road to Modern Architecture* (New York: Cambridge University Press, 2002), 50.

[4] Karl Bötticher, "Excerpts from Die Tektonik Der Hellenen," in *Otto Wagner, Adolf Loos, and the Road to Modern Architecture*, ed. Werner Oechslin (New York: Cambridge University Press, 2002), 190. Originally published as Botticher, Carl Gottlieb Wilhelm. *Die Tektonik Der Hellenen* (Potsdam, 1844).

[5] Kenneth Frampton, "Towards a Critical Regionalism: Six Points for an Architecture of Resistance," in *The Anti-Aesthetic: Essays on Postmodern Culture*, ed. Hal Foster (New York: The New Press, 1998), 30.

[6] Demetri Porphyrios, "From Techne to Tectonics," in *What is Architecture?*, ed. Andrew Ballantyne, (New York: Routledge, 2002), 135-136.

[7] Oechslin, *Otto Wagner, Adolf Loos, and the Road to Modern Architecture*, 50.

[8] Schwartz, *Introducing Architectural Tectonics,* lxv.

[9] Carles Vallhonrat, "Tectonics Considered: Between the Presence and the Absence of Artifice," *Perspecta* 24 (1988): 125-126.

[10] Schwartz, *Introducing Architectural Tectonics,* xxviii.

[11] ibid, 43.

[12] Eduard Sekler, "Structure, Construction, Tectonics," in *Structure in Art and Science,* ed. Gyorgy Kepes (New York: Braziller, 1965), 94.

Figure Citations:

1: Chad Schwartz, *Introducing Architectural Tectonics: Exploring the Intersection of Design and Construction* (New York: Routledge, 2016), l.

2: ibid, xxxv.

3: ibid, 8.

4: ibid, 146.

5: ibid, 196.

6: ibid, 91.

7: ibid, 44. Drawing inspired by Figure 25 on page 111 of Edward Ford's *The Architectural Detail*.

8: ibid, 122.

9: ibid, 227.