Negotiating of the Site Towards Creating an Architectural Expression

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Architectural design involves a negotiation of a designer's built intentions within, among, and beyond the contextual site. Engaging in play with a site requires a designer to question any preconceived notions of the ground, as a sacred surface or uncompromising mass, and instead strategize how he/she might approach the earth effectively to sculpt space, generate form, and employ structure. Thoughtful consideration of the ground as a pliable surface and soft forgiving mass can lead to new forms of architectural expressions that further encourage play towards the creation of complex geometries that blur the demarcation between the earth and the sky. This paper proposes a divergent view: that ground and architecture should be considered as inter-reliant, and susceptibly accommodating entities. Examining various theories of tectonics and stereotomic processes offers persuasive strategies that can be integrated and celebrated throughout the design process as a means to promote an impressionable dialogue between site, structure, and architectural form.

In 2018, second-year architecture students at Ball State University researched, critiqued, and formulated informed interpretations of the terms *tectonic* and *stereotomic* from writings by various authors. These terms served as a basis for a methodological approach to architectural design that both urged students to directly engage and manipulate the site's surface and mass (through additive, subtractive, and displacement processes), and consider strategies for how to devise, detail, and resolve conflicting material assemblies towards creating an architectural expression. The design work of these students, through the lens of their applied interpretations of tectonics and stereotomics over the course of two sequential design exercises, was observed and is presented in this paper.

INTRODUCTION

Architectural students beginning their initial studies within the design studio sequence habitually struggle with *'where to begin?'* as they search to formulate an authentic voice and establish a viable design process. As an approach to developing a solution to a given project, students may initiate the design process by first conceiving an overarching concept, or 'big idea,' as a reaction to a given project's prompt or provided programmatic theme. When students are asked to visit, record, and analyze the project's site, its existing conditions are at risk of unfairly being deemed as a given and impermeable constraint. This can unfortunately guide students to surrender to the existing site conditions as part of the design process; therefore, urging students to maneuver his/her design solution in an insensitive manner that avoids any interference with undesirable existing conditions, obstacles, and/or obtrusive land formations that they discover.

The aforementioned process can lead to a missed opportunity to integrate the earth's substance as a valuable attribute and instigating body within the design process. Students should be asked to reconsider the extremities of their projects and the potentials of a site, specifically how any solid/void inter-*PLAY* of their designs may extend beyond the preconceived boundaries of architecture and absorb the ground's surface or mass as a negotiable entity. As an alternative perspective for introducing a project, motivating students to contest the peripheries of their designs by acknowledging the ground as a tolerate body, able to communally exchange its conditional mass in dialogue with architecture's desires and needs, can lead to a richer and more thoughtful positioning and integration of architecture among its proposed site. Here, the ground would no longer be viewed as a subordinate element to architecture but instead, may be expressed as cooperative in its capacity to support and achieve a thoughtful design solution whereby site and building are closely aligned and dependent upon one another. As a means to persuade students to consider play among form, structure, and the earth, the terms tectonic and stereotomic are formative and descriptive in their ability to inspire students to consider various approaches of form creation, site integration and system deployment for architectural design.

TECTONIC, STEREOTOMIC, AND THE HARMONIC JOINT

Tectonics, as it applies to architecture, is generally accepted as the art of construction, through its ability to reveal constructability techniques and the expressions of members through their joints within a frame. Examining how tectonics is introduced among architectural theory reveals that explicit explanations slightly differ among various authors pertaining to how this idiom is immersed as an approach to architectural design processes and applications. Through his writings, Gottfried Semper grounded his theory of architecture upon the classifications of raw materials, each defined by its technical procedures and material properties as a system, to achieve a constructed edifice.[1] The term framework is introduced by Semper relative to tectonics where he states, "the framework embodies the highest and most universal theme of architecture…" Semper defines the purpose of tectonic elements as "the frame with the corresponding filling, the lattice as a complicated frame, the supports, and the structure as an integration of the supports within the frame."[2] Further, Kenneth Frampton addresses the tectonic as the lightweight frame related to the sky, most notably characterized by its temporary condition and role in architecture.[3] Lars Spuybroek expands upon Semper's material classification yet challenges the separation of textiles from frame as he states, "…because textile consists of flexible elements connected by means of specific techniques to form stable elements – it is also inherently one of tectonics."[4]

Exploring the writings of several authors, reveals that there are disparities in in the descriptions and methodological approaches to architectural design for the term stereotomic. Robin Evans presents the case that we should define stereotomy by its etymological derivation: the science of cutting solids.[5] For Evans, stereotomy indicates a subtractive process, concerned with the carving of voids from a solid mass as a means to appreciate the excavated voids and developed surfaces that are created to define space. Evans' explanation of stereotomics implies that architecture of this procedural approach begins with a uniform body that upon its sculpting to produce space, remains homogenous and compacted, such that all individual parts may not be discerned from the ensuing composite form.[6] Semper's definition of stereotomy, is more closely aligned to his aforementioned material classification for architecture as he describes stereotomics as the earthwork, formed out of the repetitious stacking of heavyweight units.[7] While Semper shares a common theme for stereotomics with Evans, in that both agree that this process focuses on resulting geometries to create volumes, there exists contrast between each author's rationalizations and procedural means for stereotomy. Semper focuses more on material assemblies, thus suggesting stereotomy as an additive process that uses a taxonomy of aggregated units, honest in their presentation as a self-supporting structural system and material assembly, as a means to extend the mass and strata material of the earth beyond the ground plane. For Semper, stereotomic elements provide the base for which a tectonic frame may be supported and able to successfully ascend. Frampton is more aligned with Semper as he presents an adversarial view of stereotomy in comparison to his definition of tectonics. Frampton suggests that we view stereotomics as a permanent condition in the approach and fabrication processes of architecture. Supported by his classification of material assemblies and construction processes: the tectonics of architecture relate to the formwork of the sky, while stereotomics are associated with connecting to the earth. [8]

Many of the texts that introduce stereotomic and tectonic acknowledge these terms as conflicting classifications or approaches that inform architectural design. Instead of viewing the terms as disparate classifications, consideration should be given to how tectonic and stereotomic approaches may coexist and engage one another to thoughtfully create an architectural expression. Lessons can be learned by anthropologist Tim Ingold where he proposes a theory to better appreciate life's processes of growth and movement by examining how things interact and influence one another.[9] For tectonics and stereotomy to coexist harmonically, an acceptance of each of the respective systems should be acknowledged, ingrained, and celebrated at the juncture points within each approach. Spuybroek uses the term sympathy, pertaining to the joint as a fundamental element of architecture among unrelated systems or materials. For Spuybroek, sympathy is defined as a "feeling that operates in the interstices of things," and "what things feel when they shape one another."[10] Gevork Hartoonian emphasizes that the art of construction influences our sensitivity to define space. In his writings, Hartoonian focuses on the meaning and message of the tectonic through its role as both a structural necessity and an architectural element. Here, Hartoonian beckons the importance of theatricality between the stereotomic and tectonic processes as stated, "It can be inferred that between the structural utility of architectonic elements and their analogical representation, there is a 'void,' so to speak, where the tectonic resides. This void molds architectural knowledge, that is the logos of making."[11]

PROJECT 1: THE PLINTH AND THE TOWER

The *Plinth and the Tower* was conceived as a project, introduced over the course of two phases, for students to establish and investigate their foundational understanding of the relationships between stereotomics and tectonics in architectural design. At the outset of the project, the students were asked to construct a "permeable scape" that was a minimum 10" wide x 10" long x 4" deep, using a variety of small-profile shaped wood moulding or trim pieces. The fabricated scape was required to include at least one area that swelled and one section that was depressed along the Z-axis of the created and implied surface for the scape. Due to the discrepancies of the geometric cross-sections for the various chosen linear members that were clustered and aggregated as an assembly, the realized landscape inherently contained gaps among its substance and surfaces. These gaps were essential for phase two of this project. Before phase two of the project was given to the class, students were asked to examine their created assembly, dedicate a North direction as an ordinance for their project, and document their discoveries of shadows and highlighted areas among their permeable scape through simulated daylighting strategies. The permeable scape typified a stereotomic mass of various depth and an undulating upper surface. Though created through an additive process, the resultant voids generated from the amalgamated wood members for this stereotomic scape offered students opportunities for a tectonic system to engage its substance towards the creation of an architectural expression in the next phase

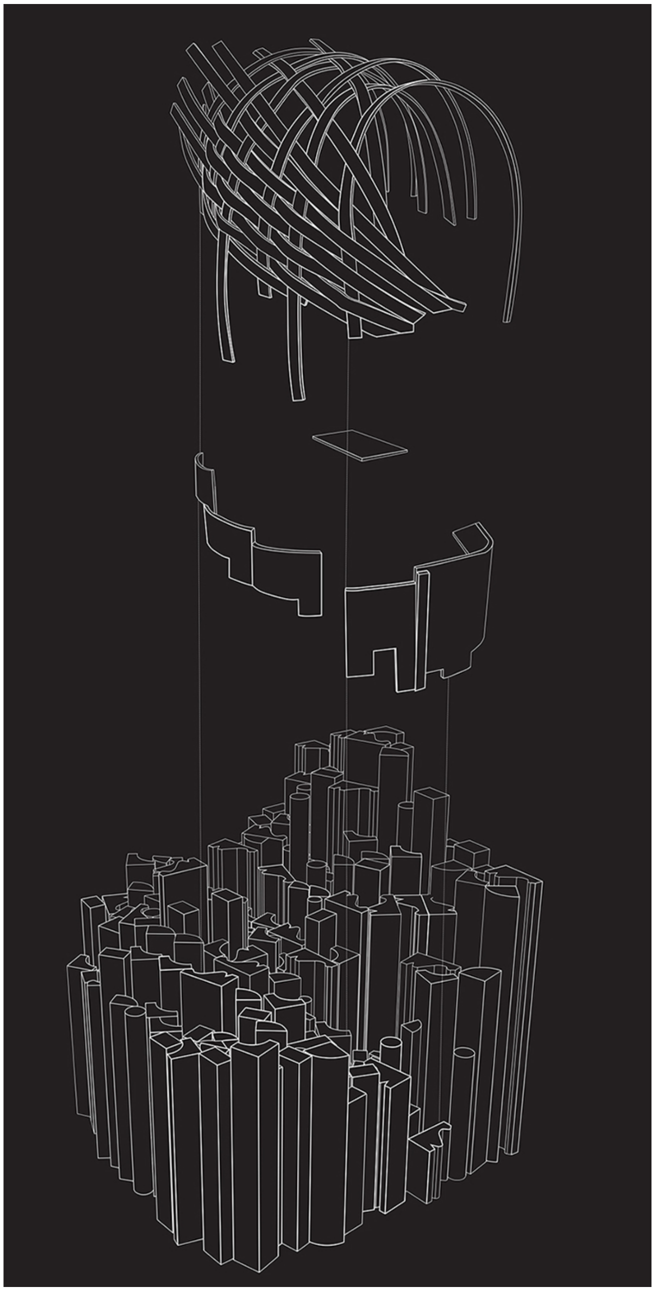

Figure 1: Exploded view 3-dimensional drawing of *"The Plinth and the Tower"* project and its engagment to the *"Permeable Scape"* by second-year architectural student Eric Peters.

of the project.

For the second phase, students were invited to approach designing an architectural intervention among and within their previously created site as a means to activate and carry forth a design language that employed stereotomic and tectonic methodologies in a thoughtful and sympathetic manner. This stage of the project introduced the terms plinth and tower, defined respectfully as: a heavy supporting base and a proud structure that accentuates its frame elements. The implied and embedded meanings of these programmatic

Figure 2: Final physical model of *"The Plinth and the Tower"* project by second-year architectural student Eric Peters. Photo by author.

components within their design were to be reflected upon for consideration as either stereotomic or tectonic elements for phase two.

Phase two of the project commenced by prompting students to react to their light and shadow findings of their permeable scape as inspirational guidance for how, and where, to engage their stereotomic site for the design of a tower structure. Students were asked to select a shaded area along the scape as the location for their authentic designed intervention. From this point of origin, a plinth, robust in appearance and nature, was to be created that followed the geometric logic of their designed scape. The plinth element was not permitted to be glued to the permeable scape, but instead must penetrate through the voids at a significant depth determined to secure the tower to the porous scape through means of wrapping, compression, etc. Ultimately, the plinth was to be envisioned by the students as a supporting base for the tower, capable of being physically removed from the permeable scape to acknowledge its capacities to respond to the ground's mass (Figure 1).

Springing forth and engaging the plinth foundation, students were asked to design a tower structure that demonstrated evidence of a conceptual horizontal and vertical structural system. Programmatically, the combination of the plinth and the tower were to include an entrance point along the permeable scape to allow for passage within the created edifice, a defined space to effectively view the East and West horizons within the tower structure, a protective nested area below a roof enclosure of the tower from the sun at noon, and a defined space that responds to the permeable scape intangibly or through physical reengagement to offer a view of a highlighted portion of the site from their previous daylighting simulation. A 1" =1'-0" scaled figure was stipulated as a required parameter for the project.

Within the collective studio, student's permeable scape creations varied greatly in terms of the undulating patterns, degrees of intensity for areas of swells and depressions, and resulting surface permutations generated by the amalgamation of the assembled wood trim members. This fortunately presented a playful opportunity for the students to consider a vast assortment of solutions for the design of the plinth element, its means of accepting and connecting to the site, and the influence of these criterion towards the evolution of the tower structure. Both triangulation and weaving strategies were predominantly championed by the students as a means to create a tectonic formwork for the tower structure, a method that challenged the orthographic nature of generally recognizable utilitarian structural systems, as they maneuvered around the created obstacles of the permeable site to achieve the programmatic requirements for the project. Several student projects integrated portions of their permeable scape pieces as vertical barriers within their design, suggesting a reconsideration and blurring of the ground plane's extremities within their architectural creation. It is also worth noting that the concept of scale was predominantly a challenge for many of the students as they struggled to appropriately relate their permeable scape, plinth, and tower structure to the neglected scaled figure requirement (Figure 2).

PROJECT 2: STICKS AND STONES

Succeeding *The Plinth and the Tower* exercise, second-year architectural students were given a project entitled *Sticks and Stones* that introduced a specific site with detailed program requirements. The project's intent was to provide the students a playground for each of them to test their comprehension of tectonics and stereotomics, specifically how these terms might suggest systematic approaches to imagine form, define volumetric space, and mindfully engage the earth's strata, as part of their design process.

The abandoned Empire Quarry, located in Lawrence County, Indiana and formally named Sanders Quarry, was chosen for the project's site (Figure 3). Currently closed for operations, the quarry was given its moniker of Empire Quarry due to its involvement as the primary excavation site for over 18,000 tons of Indiana Limestone that were harvested for the construction of the Empire State Building. This quarry also served as a contributor of Indiana Limestone to aid in the construction of portions of the Pentagon and Yankee Stadium. The

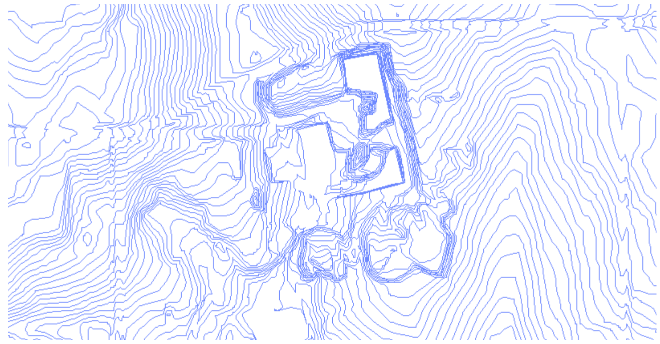

Figure 3: Drawing of current topography for the Empire Quarry in Indiana. Site was selected for the *"Sticks and Stones"* project.

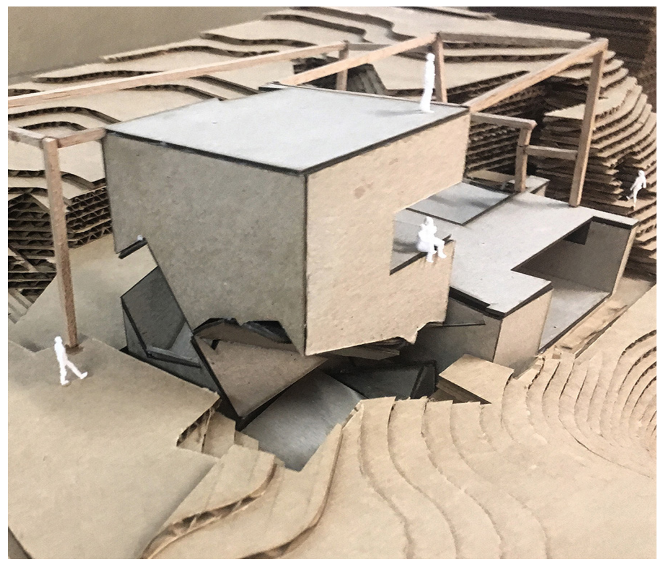

Figure 4: Final physical model of *"Sticks and Stones"* project by second-year architectural student Carlos Alanis. Photo by author.

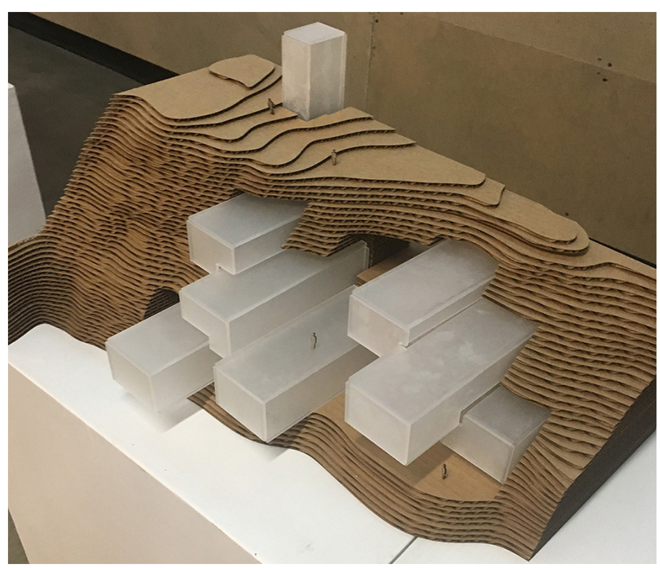

Figure 5: Final physical model of *"Sticks and Stones"* project by second-year architectural student Grace Bartko. Photo by author.

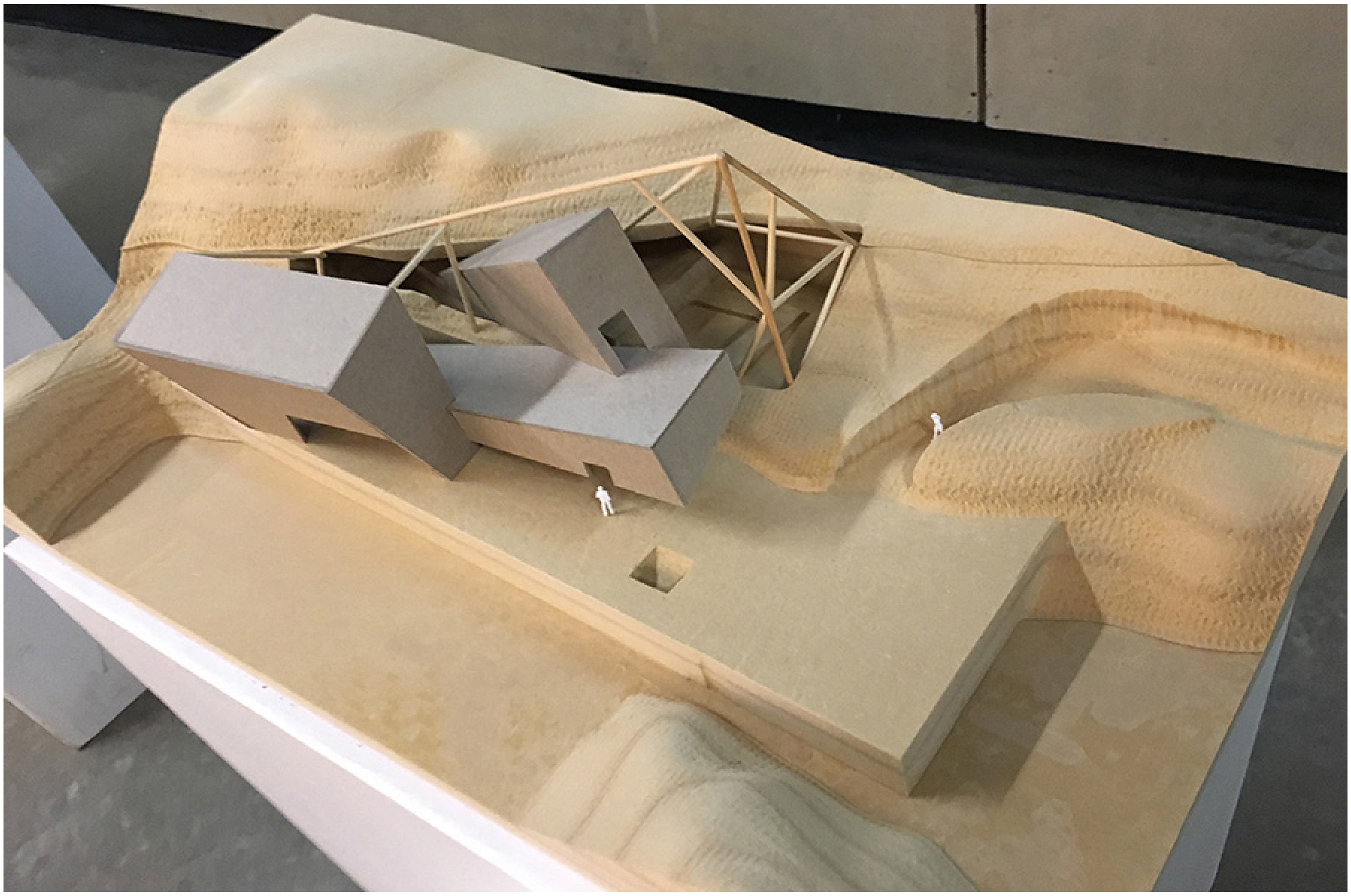

Figure 6: Final physical model of *"Sticks and Stones"* project by second-year architectural student Logan Gemmill. Photo by author.

abandoned and damaged landscape, with over 200,00 cubic feet of its original earth's mass removed and many depressed areas now filled with water, offered a site with unique opportunities for the students to consider an array of possibilities for how they might engage the ground's surface that consists of disrupted land-formations and disarranged limestone ruins.

Students were tasked to select a specific territory of the vast site and design a visitor's center intended to expose, educate, and narrate the now disused quarry's historical heritage among its resultant landforms. View opportunities, mediation of light, exposure and enclosure strategies, entry-passage-place sequence, and design languages were concerns to be addressed by each student for the project. The students were allowed to accept or disrupt the existing ground conditions as needed to accommodate his/her design, but were first asked to consider the following question when analyzing and selecting their specific location for the project: What does it mean to be within or beyond your given site?

Throughout this process, the students were encouraged to challenge their initial impressions for any documented portions of the site that were deemed inaccessible by considering how altering the existing land formations might lead to new ways of thinking and designing for an intended architectural expression. This interrogation process encouraged the students to call into question the validity of any preconceived notions, or prejudiced rules, for how architects might arbitrate their design concept for a project at a site comprised of uninviting conditions.

Student architectural solutions, as observed by the author, varied greatly among the studio as evident by the imaginative approaches to interject and engage the design for the visitor's center among and within the limestone ground strata of the site. Many students approached the state of the quarry's existing ground as an opportunity to implement stereotomic strategies. These students chose to manipulate the current site conditions and incorporate the disrupted earth at integral moments in their design. At several of these instances, the students adopted the resulting geometries that were created from the act of excavating into the earth as finished limestone surfaces, orientated horizontally and/or vertically, within their design. Carving into the stone formations of the site was instigative as it allowed the students to negotiate the earth's substance to capture programmed volumetric spaces within the ground's mass as part of their design solution

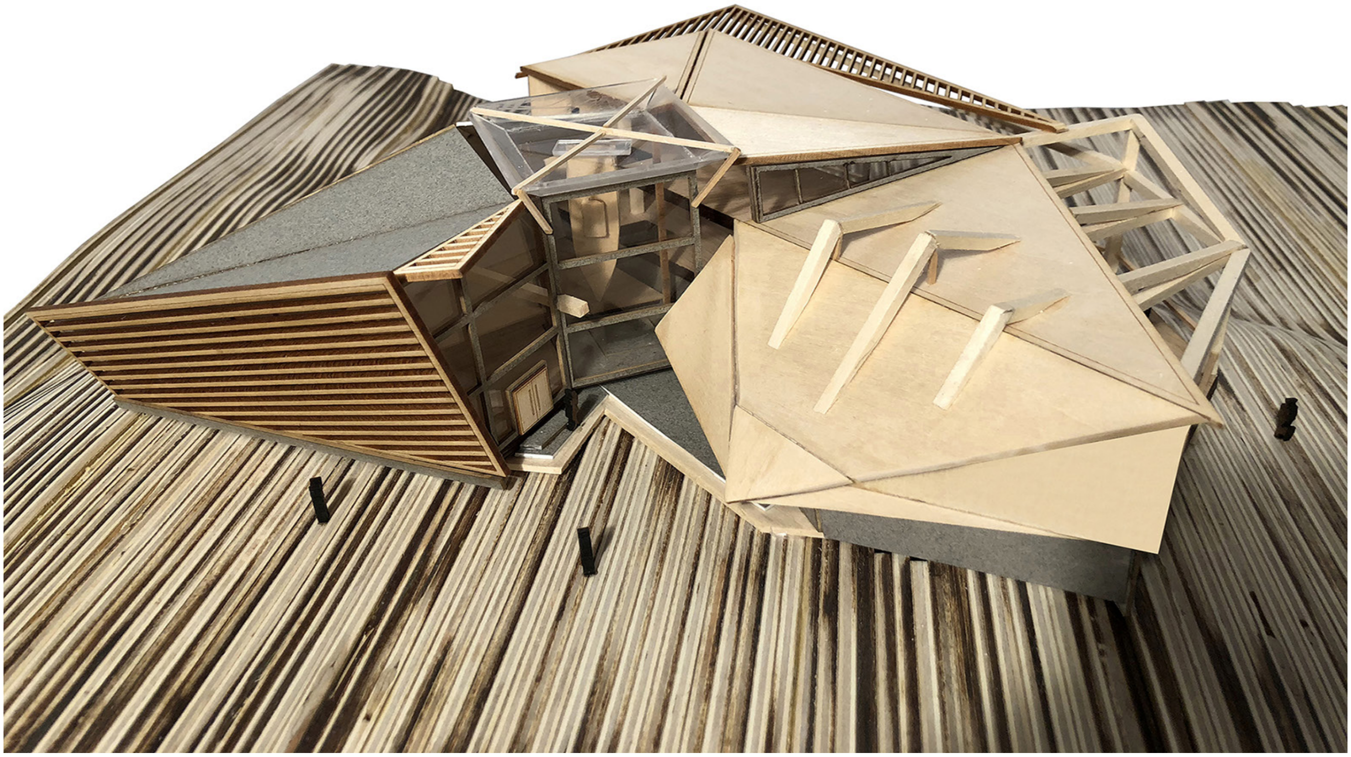

Figure 7: Student deisgn for project, subsequent to the *"Sticks and Stones"* project, by second-year architectural student Eric Peters showing evidence of tectonic and stereotomic strategies as an approach to architectural design. Photo by author.

(Figures 4,5,6).

Second-year architectural student Logan Gemmill, who completed the Sticks and Stones project, provided a personal reflection for how tectonics and stereotomics might serve as a methodological approach to architectural design and consideration of the ground plane:

"For me, the Empire Quarry Visitor's Center project introduced, for the first time, the issue that the ground plane poses to a designer. In previous studios, the ground was seen as a base or a pedestal for architecture to rest on; a place where it can be properly viewed and seen in its best light. It was only after our exploration of the tectonic and stereotomic that I considered including the ground as an integral part my design. I explored the seamless integration of a building into its context and how that relationship could enhance the message I was trying to convey through my building. The interaction with the site, that I had been so afraid of, became the driving force of my design language." [12]

CONCLUSION AND REFLECTION

Interpreting the earth's ground as an active and persuasive agent in design is often neglected in architectural discussions and education. Instead of regarding the ground as an impervious substance or constraint that suggests architecture must be subordinate to its uninviting conditions, beginner design students should be urged to explore opportunities to engage the earth respectfully and sensitively to best express their conceived architectural creations. Emphasizing *play* with all preconceived obligatory *rules* that embrace the concept of assimilating architecture to the existing topographical conditions of a site, allowed students to instead reconsider the ground's role as an influential and communally dependent medium within architectural design. The introduction of the terms tectonic and stereotomic provided provocative messages to inspire students to reevaluate methods to create form, accentuate spatial voids, and employ structure, within and beyond the ground's surface.

The lessons learned by the students from the introduced readings and assigned projects, as explained within this paper, allowed for authentic interpretations of the terms tectonic and stereotomic, and provided students opportunities to incorporate this knowledge base as a part of the architectural design process. The intent of introducing this material to the students, in their formative years of studying architecture, was to provide a foundational understanding of architectural theories related to construction, systems, and form/space creation in hopes that the students might approach the design process with an uncorrupted view of potential capacities to integrate architecture among and within the earth. As commented by architecture student Eric

Peters related to how these lessons were influential to his approach to architectural design:

"Stereotomics and tectonics added a new layer of understanding to my design, considering the porosity and tensile nature of a structure as it occupies both the ground and the sky. For example, in my current studio project, carving out of the ground layer is crucial to the interaction with the streetscape and allows the building to be brought down to the human scale, altering the interaction. Contrastingly, as the building approaches the sky it breaks apart and becomes more of a tensile work, with tendons that splinter while maintaining their structural integrity. This concept of tectonics and stereotomics proved beneficial to addressing these issues and has changed the way in which my projects interact with their context both above and below the ground plane." [13]

ENDNOTES

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2. Gottfried Semper, Style in the Technical and Tectonic Arts. (Los Angeles, California: Getty Research Institute, 2004), 623-624.
3. Kenneth Frampton and John Cava, Studies in Tectonic Culture, The Poetics of Construction in Nineteenth and Twentieth Century Architecture. (Cambridge, Massachusetts: MIT Press, 1995), 1-5.
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6. Juan José Castellón González, Pierluigi D'Acunto, "Stereotomic Models in Architecture," CAADence Conference, (2016).
7. Gottfried Semper, Style in the Technical and Tectonic Arts. (Los Angeles, California: Getty Research Institute, 2004), 725-751.
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12. Logan Gemmill (September 4, 2018). Quote to author [e-mail].
13. Eric Peters (September 4, 2018). Quote to author [e-mail].