


Bilateral relations of tectonics through physical models: Anchoring architecture to the site

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Abstract

Emphasizing the concentric relationship between the tectonics of Earth and the tectonics of architecture, this study argues that design ideas generated through this interaction have the potential to produce spatial constructs belonging to their sites, rather than objects merely positioned upon them. It examines a conceptually framed architectural design studio in which tectonics is explored as a design tool. By primarily questioning the concept of tectonics, it is defined in terms of relationalities, dualities, and dichotomies, thus offering students a robust and flexible methodology for idea generation. Within this framework, the scope is narrowed through the use of conceptual and physical tools. While tectonics is treated as a conceptual tool, the physical model is employed as a corporeal tool of inquiry. The discussions focus on analyzing the tectonics of the site and investigating its reproduction through physical models and how this form of representation affects architectural design. The study also critiques the process of analyzing the site and then moving on to idea generation, arguing that the site itself is a powerful datum for idea generation and that these processes are both incremental and deliberative. Within the architectural design studio that forms the scope of the study, the first stage was designed to question the concept of tectonics in order to raise students' awareness of the project site. Questioning the Earth's tectonics constituted a pillar of the tectonic discussions that spread throughout the semester. The question at the center of these discussions is, "How can architecture anchor to the site?" In addressing the question, the conceptual framework of inquiry was defined as the dichotomy between tectonics and stereotomics. As a result of this inquiry process, the three-dimensional model was the medium through which the students would concretize their interpretations and findings. While the physical models constitute student-generated material, their abstraction, classification, and visual representation reflect the authors' methodological reading of the design processes. The study ultimately proposes a methodological approach in which the relationship between site and tectonics is explored through physical modeling. On the other hand, it further argues that tectonics should be understood not merely as a descriptive category but as a critical operative concept within the design process. Owing to its inherently multilayered structure, tectonics offers a robust theoretical framework through which architectural production can be both interpreted and articulated. As such, the study provides a productive foundation for future research seeking to reassess the epistemological and methodological grounds of design practice.

Keywords: architectural design education, physical model, site, tectonics, topography

1. Introduction

The concept of tectonics, as theorized by Gottfried Semper and Karl Bötticher in the nineteenth century, has often been confined to the constructional aspects of buildings, predominantly discussed within the framework of structural articulation from the twentieth century onwards. However, a more nuanced examination of tectonic theory demonstrates that it operates across multiple scales—from its relationship with the earth to spatial adjacency, and from ornamentation to detail—offering critical perspectives for developing design ideas that transcend purely constructional logic.

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The tectonics of architecture are fundamentally influenced by and coexist with the tectonics of Earth. The interplay between these two systems manifests in diverse forms. At a fundamental level, this coexistence is contingent upon the interaction between architectural artifacts and their physical contexts, often described as anchoring to the site. The engagement of architectural products with their topography is essential in defining the relationship parameters between architecture and the Earth. Their coexistence, stemming from the Earth's tectonics, determines the approach that sustains or disrupts their sequentiality.

Emphasizing the concentric relationship between the tectonics of Earth and the tectonics of architecture, this study argues that design ideas generated through this interaction have the potential to produce spatial constructs belonging to their sites, rather than objects merely positioned upon them. The research pays particular attention to the scope of tectonics as a conceptual tool, focusing on site relations through corporeal methods. It examines the miscellaneous properties of tectonics, which encompass activities related to making, producing, and designing connections to material, form, and meaning, highlighting its operation through bilateral relationalities.

Within this framework, the study examines a conceptually framed architectural design studio, in which the authors, acting as project coordinators, investigated how tectonics can be operationalized as a design tool. Focusing on student projects, the relationship between site and architecture is explored through the notions of earthwork and framework—two key components of Semper's tectonic theory—which Kenneth Frampton describes as a syntactical transition.

2. Research Design: A Studio-Based Inquiry into Tectonic Relationality

The concept of tectonics and its connection to the site involves complex and layered realities, a viewpoint supported by the literature examined. While this theoretical foundation shapes the study, the research places particular emphasis on the design phase, foregrounding physical data and the act of making as a mode of inquiry. Processes of making, understanding through making, material selection, and the relationships established take precedence. Although tectonics and sites encompass various meanings and properties, this study deliberately concentrates on their physical dimensions, with a specific focus on topography. In this regard, the interaction between the site and tectonics forms the core of this exploration, emphasizing how this interplay influences spatial design. The conceptual framework relies on an inquiry into tectonics, discussed from two perspectives: the tectonics of Earth and the tectonics of architecture. Communication between the tectonics of Earth and architecture involves complex relationships and can occur within a broad context and through various means. Therefore, it is essential to understand tectonics through relationalities, dualities, and dichotomies and to define them accordingly.

To establish this conceptual positioning, we draw upon existing literature to explain why we position tectonics as the focus of this study. Notably, alongside contemporary literature, the discussion centers on two prominent figures: Semper (1851/1989) and Bötticher (1844/2002). This literature review, combined with in-depth research into these figures' expressions and visualization of them as concepts, enables us to refine the notion of tectonics and reveal its bilateral relations. Accordingly, we also articulate our comprehension of the concept and present it visually, akin to previous works.

Within this conceptual framework, the study, based on a speculative design process, adopts a qualitative, observational case study methodology conducted in a first-year undergraduate architecture design studio. We employ a speculative thought process, developed by the authors as an analytical framework, to convey the execution of the architectural design studio process, with a particular focus on the tectonic relationality of the site and students' approaches to it. The authors assumed dual roles—studio instructor and researcher—allowing them to closely observe the design decisions that emerged throughout the students' model-building process. The research was

structured as a studio-based inquiry, prioritizing observation and interpretation over evaluation. The analytical approach is designed to explore bilateral relations as articulated through tectonics.

The case study is situated in the first phase of a semester-long course, involving approximately 40 students who were novice learners producing their first architectural design projects. This initial phase, spanning seven weeks, focuses explicitly on site reading and tectonic interpretation through physical model production, prior to the introduction of architectural programmatic requirements. The student group had no prior experience in producing design projects explicitly grounded in site anchoring, which positioned tectonics as a critical conceptual and operational framework for the studio.

Data was generated through continuous observation of students' analyzing the tectonics of Earth and its reproduction through models, examining how this form of representation affects spatial production. The study prioritizes observable design actions and their spatial consequences as manifested in three-dimensional physical models. These models, produced and iteratively developed by students, served as the primary empirical material for analysis. Viewing these reproductions regarding tectonics reveals implications that provide students with a valuable method of inquiry.

All diagrams, tables, and categorizations presented in the study were produced by the authors as analytical interpretations of student work. While the physical models constitute student-generated material, their abstraction, classification, and visual representation reflect the authors' methodological reading of the design processes. The interpretations offered are inherently contextual and reflective, shaped by the specific studio framework and the authors' analytical perspective.

3. Tectonics over Bilateral Relations

The term tectonics is taken from geology, which indicates the study of large-scale movements and changes in the form of planet Earth. It includes ideas of disintegration, reuniting, and merging components due to natural effects such as earthquakes, temperature differences, volcanic eruptions, or aeolian phenomena. In architecture, the term is employed with an added geographical meaning, including fragmentation and reunification. In different parts of the world's surface layers, this dual action may manifest as a continuous movement—sometimes slow, at other times rapid—across various layers of the Earth's surface. Therefore, while the Earth may predominantly exhibit stereotomic features, it can also be understood as possessing its inherent tectonics.

The etymology of "tectonics" is closely linked to the term "architecture," derived from the Greek word *tekton*, meaning carpenter or builder (Frampton, 1996; Karvouni, 1999). This dual reference to both carpentry and construction is significant; in ancient classification systems of the arts, architecture was included among the seven mechanical arts (Kristeller, 1951). Although Vasari categorized architecture as being among the visual arts, before establishing the fine arts system in the 18th century, architecture consistently belonged to a category related to construction (Kristeller, 1951, p. 508). Thus, the term *archi-tekton*, meaning architect, encapsulates this connection.

A review of the current literature indicates that the concept of tectonics, originally rooted in geology, primarily denotes the physical properties and structural formations of the Earth's crust. In architectural discourse, the term is employed in a manner parallel to its geological origins. It is predominantly examined through the lens of material properties, the relationships between structural elements, and the configuration of structural systems (Chih-Ming & Yu-I, 2011; McCoy & Duffy, 2022). Within architectural scholarship, tectonics frequently appears in studies grounded in traditional analytical frameworks (Kim & Park, 2017; Wijaya et al., 2024; Manav & Urak, 2024). These works typically situate material use and structural organization within specific local contexts, emphasizing construction techniques and regional building practices. Moreover, the concept has been employed to interpret the integration of traditional materials into contemporary spatial

designs, again with a primary focus on material expression and constructive logic (Talamini et al., 2024). Although certain authors acknowledge the multidimensional nature of tectonics, their analyses nonetheless remain largely centered on materiality (Lakkala & Pihlajaniemi, 2018). In addition, several studies extend the discussion into the cultural domain, interpreting tectonics as a framework through which material and structural decisions contribute to the formation of architectural language (Lucchini & Urban, 2023; Rociola, 2017). Nevertheless, even in these broader interpretations, material and structural considerations continue to constitute the principal analytical focus. Beyond these predominantly material-oriented interpretations, the conceptual foundations of tectonics provide a broader and more nuanced interpretative framework. Although limited in number, several studies in the current literature adopt this expanded perspective. For instance, Shou and Xu (2025) examine traditional architecture through the lens of Gottfried Semper's tectonic theory, conceptualizing tectonics as the relational interplay between natural terrain, mound construction, and interior architectural space. While the study considers existing building fabric and material usage, it simultaneously reveals the multilayered character of the concept, extending the discussion beyond purely material concerns. Other scholars approach tectonics from an anthropological standpoint, interrogating the relationship between space and human experience—an inquiry that echoes Semper's own theoretical orientation (Hale, 2020; Sántha et al., 2022). In a similar vein, certain studies engage more directly with the spatial–human nexus by interpreting tectonics through the framework of the human body, thereby foregrounding embodiment as a critical dimension of spatial formation (Buck, 2006; Hürol, 2014). Taken together, these contributions suggest that tectonics may be understood not only as a material or structural principle but also as a conceptual framework capable of articulating the complex interrelations among land, body, space, and culture.

An examination of the aforementioned studies reveals that the tectonics of the site and the tectonics of the structure are generally addressed as separate domains, often within different disciplinary frameworks. In contrast, the architectural design process—particularly during site analysis and site preparation—necessitates an integrated inquiry into the relationship between structure and ground. This relational condition constitutes the central concern of the present study.

Within this research, tectonics is employed as a conceptual framework through which the interaction between site and structure can be systematically investigated. Specifically, the study explores how the tectonics of the site may be interpreted, conceptualized, and represented through the use of physical models. In doing so, it shifts the focus from the analysis of existing buildings or the technical development of structural systems—approaches that dominate literature—to the early stages of idea formation. Tectonics is thus examined not as a descriptive or evaluative tool applied retrospectively, but as a generative instrument in the development of architectural thought. Accordingly, the study aims to contribute to literature by proposing an alternative approach to the conceptualization and representation of tectonic relationships, particularly within the context of architectural education and design studios.

Tectonics unfolds through bilateral relationality, as previously discussed about geography and the etymology of architecture. It encompasses making, producing, and designing activities while intertwining with material, form, and meaning. According to Stanford Anderson (1981), tectonics refer not merely to the construction with requisite materials of an object or space that answers a specific need, but to the activity that raises this construction to an artform. Therefore, a holistic perspective on architectural products and their production processes would also have to account for references for meaning and aesthetics. This holistic dimension of the term can be traced in the following theoretical explanations generally articulated through relationalities, particularly dualities and dichotomies. These explanations foreground the fact that bilateral relations are what the concept of tectonics progresses through.

The 19th century, marked by a quest for new architectural paradigms in Europe, also witnessed the emergence of the theory of tectonics. Amid the eclecticism prevalent in architectural practice, theorists Semper (1851/1989) and Bötticher (1844/2002) explored fundamental principles for new

architectural production. They played pivotal roles in developing and theorizing the debates surrounding tectonics. Their ideas diverge from the prevailing understanding of the period. While both emphasize the concept of space, their proposals differ markedly. Bötticher prioritizes internal forces over external factors in his theory. According to him, the structural systems that hold the building up should not be concealed by ornament, and these two elements should be integrated in a way that they mutually reinforce each other. This concept, which he defines as structural integrity, forms the basis of his tectonic theory (Schwartz, 2017, p. xxxvii). Unlike Bötticher, Semper considers the concept of enclosure in space to be more important than structure. The concept of *Bekleidung* (dressing) is the most important element in defining space and constitutes one of the four elements of architecture. Semper contends that architecture arises from construction and the fundamental need for enclosed space (Schwartz, 2017, p. xxxviii).

Semper's classification of 'The Four Elements of Architecture' is presented in Chapter 5 of his book *Comparative Theory of Architecture*. In this chapter, Semper draws upon his extensive study of Greek, Chinese, Egyptian, Assyrian, and Persian architecture. Unlike some of his contemporaries, he does not consider Greek architecture unique in isolation. Instead, he develops his theory with a keen awareness of the interactions among various civilizations and cultures. Semper defines these four elements: the hearth, the earthwork, the framework and roof, and the enclosing membrane or cladding (Semper, 1851/1989, p. 74).

In Semper's theory, the hearth represents the essence of architecture. The remaining three elements are designed to protect and enclose the hearth. The first element, the earthwork, serves as the foundation and is elevated for protective purposes. The second element, the framework, provides structural support and defines the spatial limits. The final element, cladding, is crucial in delineating and defining the space. It establishes the boundaries and creates a sense of enclosure (Schwartz, 2017, p. 43). Although Semper's classification involves physical counterparts, Mallgrave contends that the term 'element' is often misunderstood. In Semper's theory, an 'element' pertains more to 'motive' and 'ideas' than concrete materials and forms (Mallgrave, 1989, p. 24) (Figure 1).

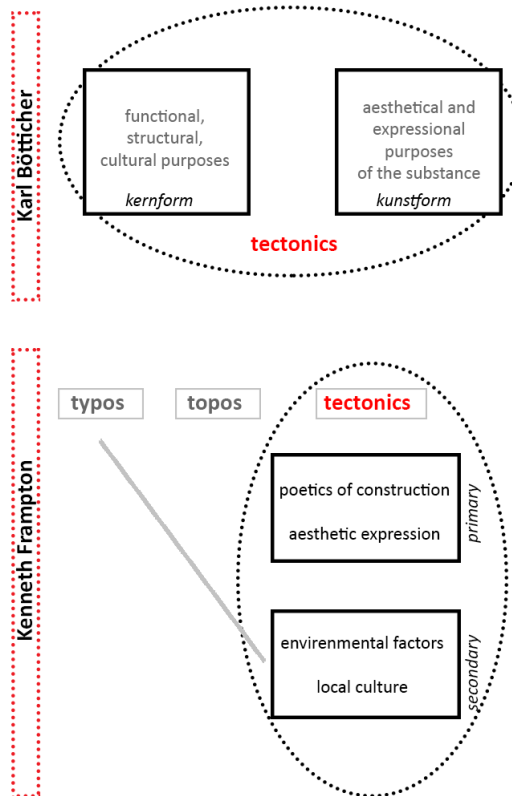


Figure 1 Semper's four elements of architecture (Authors' work)

Among the four elements identified by Semper, earthwork, and framework are particularly significant for this study. While earthwork is traditionally defined as a raised platform, accepting it as a broader conceptual framework—as suggested by Mallgrave—opens a critical dialogue about its role in design. The interrelationship between earthwork and framework underscores their inseparability; they must be considered in tandem during the design process. This article investigates how this integration can be effectively achieved within the studio process it examines.

On the other hand, Karl Bötticher approaches tectonics from two perspectives: their ontology, that of Kernform, and their representation, as in Kunstform. In his viewpoint, Kernform was related to the object's functional, structural, and cultural purposes, while the Kunstform was all about the aesthetics and purposes of its expression, that is, its representation. This holistic perspective combines structure and material, aesthetics, and expressionist purposes (Oechslin, 2002) (Figure 2).

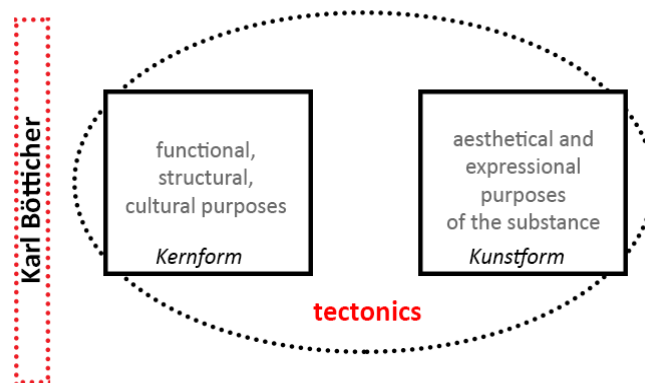


Figure 2 Reflections from Bötticher's ideas of tectonics (Authors' work)

In addition to Semper and Bötticher, Kenneth Frampton, a prominent contemporary architectural historian, has significantly advanced the concept of tectonics within architectural discourse (Frampton, 1998, p. 30). Frampton argues that “[t]he primary principle of architectural autonomy resides in the tectonic rather than the scenographic...”, defining tectonics as a path focusing on the poetics of construction and aesthetic expression. Accordingly, environmental factors and local culture are also counted among the factors that affect tectonics (Frampton, 1995). Frampton identifies tectonics as one of three essential characteristics of architecture, alongside the topos (the site) and the typos (the meaning) (Frampton, 1998, p. 25). Here, the intricate relationship between dwelling and meaning within tectonics comes to the forefront. Related to the typos, Frampton also points out an alteration in the meaning of the concept throughout history. In Homer, the tectonic “alludes to the art of construction in general”. In the fifteenth century, this meaning expanded to include “a more generic notion of making, involving the idea of poiesis” (Frampton, 1996, p. 3). After this point on, poiesis, an aspect of tectonics based on meaning and progressing at a more abstract level, emerges.

At this point, the relationship between architectural tectonics and the tectonics of the Earth becomes more explicit and operational. Toma Berlanda, quoting David Leatherbarrow and Eduardo Souta de Moura, expresses the relationship between the tectonics of architecture and the tectonics of the Earth as “preparation of the site,” and emphasizes that, according to Moura, “the preparation of the site is the project itself” (Berlanda, 2014, p. 78). This understanding reinforces the inseparability of tectonic thinking from site-specific design processes.

Alongside conceptual explorations, the operational aspects of tectonics also encompass bilateral relations. Thus, Maria Karvouni explains the basic operations of tecton as follows: “A tecton cuts and joins, divides, and connects. According to Plato, dividing and composing are the two main modes of operation by which an art (techne) proceeds. Surprisingly, the tekton is the only artist-artisan who shares the common root tek with techne (Karvouni, 1999, p. 106). From this point of

view, Karvouni establishes the connection between tecton and techne not only because of their similar origin but also because they employ a similar methodology. The relation of the tecton of the techne, thus connected to poiesis, implies a meaning beyond being a work in mechanics. This relation implies something hidden and may refer to Frampton's concept of typos-meaning. Techne is the revelation of what is hidden. From this point of view, we see that the act of doing and its stages are associated with meaning rather than the simple act of doing. This, the action of doing being strictly related to poiesis, helps us unearth the embedded relations of tectonics with meaning.

With the separation and joining operations that techne and tecton contain, the difference between the concepts of tectonics and stereotomic also surface. Semper puts forward the dichotomy between stereotomy and tectonic as being based on the physical differences between them. He classifies building crafts by the differences between tectonic and stereotomic: "the tectonics of the frame, in which lightweight, linear components are assembled to encompass a spatial matrix, and the stereotomics of the earthwork, wherein mass and volume are conjointly formed through the repetitious piling up of heavyweight elements" (Frampton, 1996, p. 5).

Stereotomic can be defined as a design activity that originates from the whole. Although Karvouni does not explicitly use the concept of stereotomic, she interprets tecton in terms of the applied operation through the duality of using a tool and producing manually, including all the interruptions and continuities the process entails. She asserts that: "A tekton's mode of working requires a tool (the axe), unlike work done with bare hands, such as molding (platto, to mould, is related to palame, palm, hand). Whereas molding involves continuity, tectonics is defined first by the discontinuity of cutting and then by joining. Tectonics deals with the arrangement of 'distinct units' that the tecton first shapes with his tools and then places and joins together" (Karvouni, 1999, p. 106). Thus, the continuity and hand-shaping present in Karvouni's dualities seem to refer to the concept of stereotomic. From this point of view, the concept of tectonics also includes the idea of dividing and uniting the parts formed as a result of this division. Stereotomic, on the other hand, refers to a more holistic approach with mass rather than parts.

The various meanings and forms of application that the concept of tectonics has gained over time show that this concept cannot be understood solely in ontological terms; in other words, it cannot be reduced to the issue of technical making. It can potentially produce meaning regarding the whole of the architectural idea. In addition to the bilateral relations embedded in tectonics, the relationship established with stereotomics also gives us different possibilities both in terms of way of production and approach. The dualities of discontinuity/continuity, lightweight/heavyweight, sky/earth, immateriality/materiality, and parts/mass can also be traced in the dialectical relation between tectonics and stereotomics. Considering the literature here, we also conceive of tectonics through bilateral relations but in a narrower sense: specifically relating the tectonics of Earth (the natural) with the tectonics of architecture (the artificial). This relationship can be characterized by both similarities and contrasts and is related to concepts of meaning, aesthetics, and dwelling activities, both natural and artificial. Ultimately, this activity seeks not only to satisfy basic needs by forming a volume with the necessary material but also to elevate that volume to a Kunstform. (Figure 3).

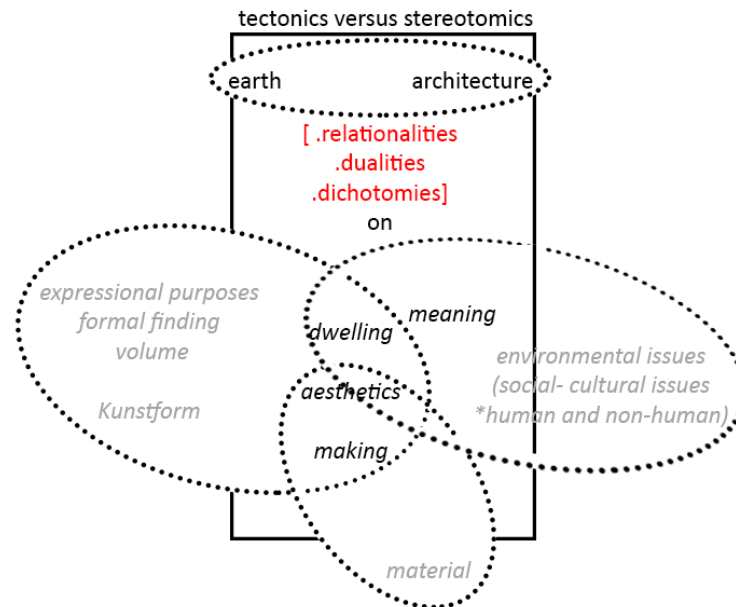


Figure 3 Tectonics over bilateral relations (Authors' work)

4. Tectonics as a Conceptual Tool: Anchoring to the Site

The literature reveals that the term 'tectonic' encompasses various sub-concepts and operations within architecture in a holistic framework. In his book *Architectural Topographies*, Toma Berlanda examines the relationship between significant buildings and their sites, categorizing these interactions into three main strategies: Interlock, Adjacency, and Separation. He notes that, with the support of technology, adjectives such as raised, stacked, inflated, vectorial, carved, and exposed are used to further define these relationships with the ground. He emphasizes that these terms align with his three primary strategies (Berlanda, 2014, p. 3).

In line with this statement and our definition of tectonics, we accept that bilateral relationalities of this concept can be discussed as the base for conveying the holistic being of architectural design activity to students, especially in their first year. This scope handles tectonics as a conceptual tool during the process. The binary oppositions and bilateral relations in the duality of tectonics and stereotomics are under discussion, along with the points where these oppositions sometimes get reconciled. Therefore, the attitude of the building at the point where it touches the ground and the effect of this attitude on the main idea of spatial organization has been one of the discussion points.

Accompanied by these thoughts, we prioritize the site's physical forces during the activity mentioned above. To reveal the physical forces of the site, in other words, its hidden features, we utilize the physical model as a tool. Thus, the physical model becomes the secondary building block as a corporeal tool. Models can both warn designers about potential future problems and spark curiosity throughout the process (Smith, 2004). The ability to construct three dimensions, test the possibilities of materials, and observe and design combinations and intersections makes the model a vital tool in the process. In essence, the model allows for an understanding of all the bilateral relations of tectonics and is a narrative tool to better convey the proposed methodology.

Within this framework, the primary position of instructors is to orient the students to reconsider these conceptual and corporeal tools. They were encouraged to analyze the site by considering the bilateral relations of its tectonics, re-representing the tectonic structure to internalize it, and then based their own designs again on the ties of tectonics. Free to choose whichever materials suited their model, the students thus explored the structure of the terrain, using different materials and methods of representation. As pertains to this research, the physical model underscores the activity

of making, highlighting how crafting and material selection deeply engage with the layered realities of tectonics and site.

The studies' contributions are processing these and adding the acquired data to the initial tectonic description with these reconsiderations in mind. In this context, the leading, production-oriented section of the study is based on the narration of these parts of the process in which tectonics are used as a primary building block, that is a conceptual tool along with the physical model, which operates as a corporeal tool.

While all components of the architectural design process are fundamentally interconnected, this study focuses specifically on revealing anchoring to the site in the context of tectonics. Our focus, though, depends on the idea that the whole process contains extensive information and interpretation that cannot be included in one single piece of research. In this context, reflecting on the role of Earth tectonics in architecture and the relationship between the two are crucial points of the process. This process consists of two main phases. The first stage is where the natural is grasped, the topography is understood and thus represented in line of subjective expressions. Then, in the second stage, the relationships are established between the natural and designed through relationalities, dualities, and dichotomies. In line with these stages, the students first understand the site and then establish a relationship with the site and the design proposal. The primary method employed in this process is to gain the ability to think in the proposed manner that belongs to the site root rather than thinking merely as a singular object. (Figure 4). Following sections present the key findings derived from the observation and analysis of students' model-making processes. These findings are structured around continuities and shifts between tectonic and stereotomic approaches, as observed throughout the studio process.

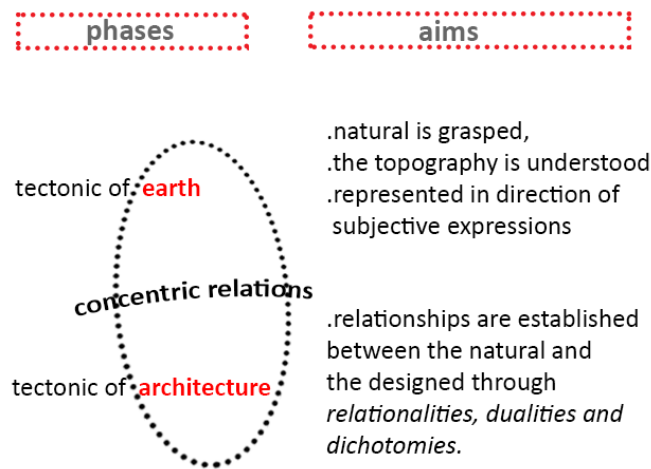


Figure 4 Phases of the process (Authors' work)

4.1. Tectonics of Earth

In the research production process, we aimed to investigate the tectonics of the topos and the relationship between spatial tectonics and these delineated tectonics of the topos. Alongside these assumptions, to conduct discussions on tectonics / stereotomics, we selected a site with a strong tectonic quality: the Mid-Atlantic Ridge on Iceland. This intriguing terrain describes a system with critical geological features indigenous to the planet. This system, mostly submerged, has many transformation faults and an axial rift valley along its length (UNESCO, n.d.). The Earth opens itself and reveals its underlying structures through these axes. The acts of concealing and revealing are observed simultaneously.

The existing dichotomies at the site include the heat of the magma juxtaposed with the cold of the snow, the pale, barren soil juxtaposed with the shine off the walls of underground caves, and the visibility of both the Eurasian and North American plates. Although most of the ridge system

there is submerged, the land forms a series of volcanic islands of various sizes that run along the Atlantic Ocean (UNESCO, n.d.). One such island, Grjótagjá, Iceland, serves as the selected site for this studio, where the ridge system reveals a series of caves. As a place where tectonic movements and the Earth can be observed from the bottom up, along with both land and water and the various continents, the site is considered rewarding in terms of interiorizing pure tectonics.

The ridge, which is the most prominent reason for choosing this area as a site, also stands as a symbolic representation of the dualities and dichotomies of the tectonics of Earth. The tectonic-stereotomic properties of the site, which we define as the place or the land for a certain given time, that is, the massive effect, appear as a predominant and given information. Anchoring to this site has defined the transition point between the existing natural tectonics of the world and the artificial ones. Thus, the problem is to design this cross-section where nothing has been built previously, and the reference is only to the natural tectonics of the site.

One remaining problem concerns the program components that require design, which are entirely alien structural additions to this place with such strong tectonics. Another challenge that students face is deciding whether to simulate these structures into being part of the natural terrain or, if deciding to establish a contrast, to create a fictional tectonic structure that increases and complements the value of the place. Accordingly, in the 1st phase, the potentials of the site and tectonics of Earth are explored, interpreted, and represented with different materials. Communication with the material progressed in the perception of topography in three-dimensional form, topography-material relationship, and then the interpretation-representation of the student with the selected material. At this point, the students reproduced (re-presented) the site in line with their unique expression and perception.

At this point, as previously outlined, we categorize these approaches according to modes of terrain internalization, using the models as the primary analytical tool. Considering the representations of the tectonics of Earth, we infer two approaches in the way the students used the material and their execution patterns: stereotomics and tectonics. A majority initially approached the site through stereotomic representations, while another group fragmented the terrain into discrete tectonic elements.

While stereotomics studies are discussed through homogenous and heterogeneous use of solids and heavy materials, they are also classified as bringing a strong monolithic effect into play. This stereotomy is gained through the design of massive, solid, rigid, and unified models, all made of heavy materials (Figure 5).

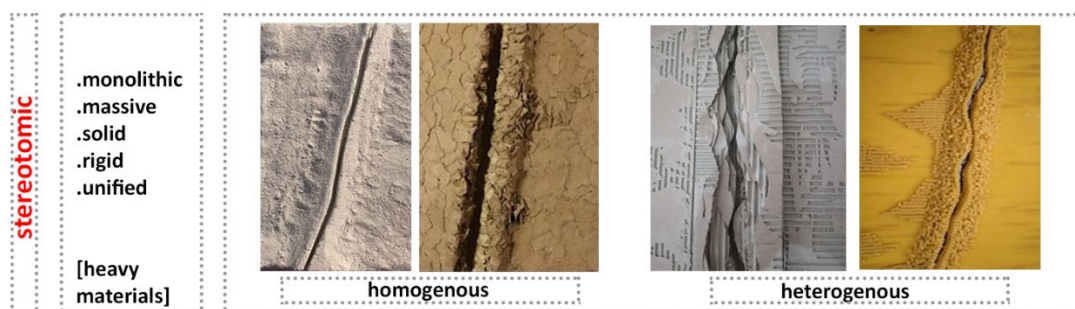


Figure 5 Representation of site: Stereotomics of earth (Student works, analytically redrawn by the authors)

However, tectonics studies progress through collating singular elements and light materials and using them in linear or vertical directions or in a way that results in a web reaching the whole. This method of execution in terms of repetition or using different forms of continuity, similar to assemblage, represents the site based on tectonics (Figure 6).

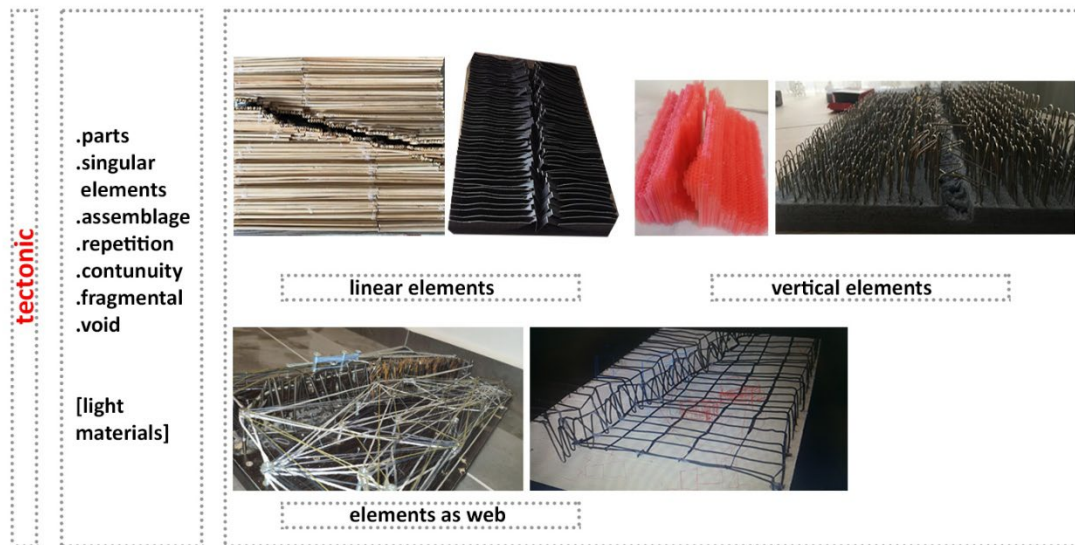


Figure 6 Representation of site: Tectonics of earth (Student works, analytically redrawn by the authors)

By identifying these two distinct approaches, we illuminate how students conceptualize their designs concerning tectonic principles. This understanding fosters a deeper engagement with the site and enhances the creative process, reinforcing the overarching theme of interaction between materiality and tectonics.

4.2. Concentric Relations in the Tectonics of (Earth and Architecture)

The styles of representation that the student perceives tectonics and topography significantly affect their approaches to the site and guide the design process. In this second stage, after grasping the natural terrain alongside subjective expressions, students derive clues and traces from the 'tectonics of Earth.' Moreover, particular attention is paid to creating open, semi-open, and closed areas in relation to tectonics and other characteristics of the site. In addition to this spatial organization, ensuring compliance with topography and correlation with the site's tectonics is essential when considering three dimensions.

The findings discussed in this section reveal that students' interactions with Earth's tectonics and architecture evolve through identifiable patterns of continuity and transformation. Analysis examining representation strategies and design practices demonstrates that tectonic and stereotomical approaches are considered relationally in anchoring to site.

Students represent the site in ways that reflect their understanding of different ideas and methods for generating spatial components. The analysis categorizes projects based on their methods, examining continuities and shifts in the relationships between tectonics and stereotomics. This engagement with materiality and form highlights how students navigate design complexities and the dualities inherent in their processes.

A key finding is that students' projects evolve through either continuities or shifts in their tectonic reasoning. While some projects progress as a continuation of their established methods, which are defined as -from stereotomics to stereotomics- or -from tectonics to tectonics-; others included alterations in expression, displaying the shift in their perceptions. These are generally categorized as -from stereotomics to tectonics-, or -from tectonics to stereotomics.

Continuous stereotomic projects emphasize themes like the mass of the site, folding, and mass dissolution. To clarify, projects that exhibit continuous progression in stereotomics are characterized and labeled by authors by expressions such as:

- 'continuation of massive being of the site to the mass';
- 'folding as a making way in both site and space' and

- ‘dissolution of the mass’.

Conversely, the projects that demonstrate a shift in perspective from the stereotomics of the Earth to the tectonics of architecture explore fragmentation and spatial relationships. These shifts are described and labeled as:

- the essential fragmentation of a whole and
- ‘spaces [in and on] land’

This stereotomics-based evaluation is also valid for tectonics. Projects that have pursued the approach of using singular elements in both tectonics of Earth and architecture, even if they include changes (such as repetition, framing, or web), are accepted as partaking in the approach from tectonics to tectonics. They are categorized as:

- repetition of vertical elements,
- framing of both site and space, and
- enclosure as a part of the web.

On the other hand, some students shifted their execution process from tectonics to stereotomy, as exemplified by phrases such as:

- ‘from fragmented pieces to monolithic pieces,’ or
- ‘from linear elements to massive pieces,’ or
- ‘web as a void forming the solid.’

These methods, continuities, and shifts in the relations can also be considered part of the previously discussed bilateral relations, particularly within the context of dualities and dichotomies. This analysis of projects demonstrates how students navigate the inherent complexities of tectonics in their design processes. They explore the nuanced relationships between materiality, form, and tectonic principles by engaging with these continuities and shifts.

From this perspective, the approaches in which students establish continuity between the tectonics of Earth and architecture, namely natural and artificial, and deal with both as a whole, are generally included in projects where both the material, the structural, and the construction techniques are similar to each other in all stages. These approaches are discussed as ones that border on similarities, dualities, and relationalities. In contrast, fragmentations-reunifications and interruptions—continuities are the dichotomies specified in the execution phase. Choices to conceal or reveal are more related to spatial organization, while heavy or light materials are considered fundamental decisions that are mainly subjective.

The study illuminates how students perceive and interact with site-specific conditions by investigating these relational dynamics. Using three-dimensional models at these stages allows students to transform their understanding of tectonics into tangible forms, enabling them to engage deeply with the characteristics and nuances of the sites they are studying (Figure 7).



Figure 7 Continuities-shifts in relations of tectonics of earth and architecture (Student works, analytically redrawn by the authors)

5. Concluding Remarks

The way the site is defined forms the basis of the architectural design process, while the concept of tectonics offers multiple perspectives on anchoring architecture to the site. In this study, the relationship between place and architecture is discussed in the context of representing the site and preparing it for the project, within the framework of the concepts of earthwork and framework, two of the four architectural elements in Semper's tectonic theory. The various perspectives offered by the concept of tectonics in terms of site preparation, as defined by Berlanda (2014), are presented. This positioning reframes site not as a given condition, but as an active generator of architectural thought.

Aligning with existing literature, we conceptualize tectonics through bilateral relations, specifically examining the interplay between Earth's natural tectonics and architecture's artificial tectonics. By emphasizing the holistic nature of these relationships, the research deepens our understanding of how natural and artificial environments interconnect in architectural design. To elaborate, tectonics are discussed through bilateral relations; similarities, dualities, and dichotomies come to the forefront as the relationalities surface. Alongside these relationalities, the dichotomy between tectonics and stereotomics is incorporated as part of the conceptual framework informing the design process. Thus, correlating the tectonics of site (the natural) and architecture (the artificial) through these relations marks the demarcation point of this speculative mental trial. These dialectical approaches inform concepts of aesthetics and dwelling activities, ultimately enhances our comprehension of how these relational dynamics influence design choices and outcomes.

Furthermore, as a conceptual tool, tectonics provides many possibilities while internalizing the site, generating design ideas, and creating architectural products. Pointing a direction for questioning and perceiving the tectonics of the site creates a basis for the fiction of space, which, when realized, will be what the students design. The personal perspectives that emerge in both stages reveal different possibilities regarding the production of the site, topography, and architectural product. Through a deep engagement with tectonics, students can create designs rooted in their physical contexts in both orthodox and unorthodox ways.

To further illustrate this link, the role of three-dimensional models becomes critical. In both the reproduction and design phases, the model is a flexible tool for students to express their viewpoints through the site, leading to the interpretation and formation of their proposals. As a corporeal tool, it enables students to develop different perspectives on the terrain. As with their perspective on the site, it allows the students to experience their exploration process in terms of both choices of materials and methodology of construction of the model (based on the tectonics of the site). Ultimately, the physical model underscores the importance of making, revealing how the intricate processes of crafting and material selection engage with the complex interplay between tectonics, topography, and site. Moreover, different modeling techniques lay the groundwork for working with a helpful tool in the re-representation process. Through their models, students can unveil previously hidden aspects of the site and illustrate the relationship between natural and artificial tectonics, enhancing the principles of the project through similarities, dualities, and dichotomies. Questioning and reproducing the tectonics through a physical model provides students with a base to establish the relationship of their designs with the site – whether as continuities or discontinuities.

Although contemporary architectural discourse often confines tectonics to structural relationships, this study demonstrates that nineteenth-century tectonic theory offers a comprehensive framework for understanding and preparing the site as a multi-layered construct. Importantly, the concept of tectonics enables analysis not only of physical data but also of social and cultural dimensions arising from human actions. The idea of the hearth, one of Semper's four architectural elements, exemplifies the notion of coming together—publicness and cultural differentiation—that shapes the meaning of place. Similarly, Bötticher's concept of *Kunstform*

offers perspectives extending beyond physical data, engaging with symbolism and human perception. Thus, the concept of tectonics provides a multi-layered approach to understanding a site and preparing it for architectural interventions. In this context, the study aims to contribute to literature by offering an alternative approach to conceptualizing and representing tectonic relations in architectural education and design courses.

Ultimately, the research opens avenues for future studies on tectonics in various design methodologies, advocating for further investigation into its implications across diverse architectural contexts. Additionally, it offers new methodological insights into using three-dimensional models to facilitate critical thinking and creativity in studio settings. In an era where the boundaries between natural and artificial are increasingly blurred, this study underscores that a profound understanding of tectonics enriches architectural design and cultivates a deeper connection to the environments we inhabit, shaping the future of contextually driven architecture.

CRedit Authorship Contribution Statement

Bilgen Dündar: Conceptualization, methodology, investigation, writing. Aslı Uzunkaya: Conceptualization, methodology, writing, visualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data will be made available on request.

Ethics Committee Approval

Ethics committee permission is not required.

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Resume

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