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Tectonic character in Tadao Ando's Church of the Light: Structure, space, and form

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Abstract

Tadao Ando is one of the most important figures in modern architecture, combining minimalist design with traditional Japanese aesthetics, and is known for the use of light in spatial and spiritual contexts. The Church of the Light is one of his well-known projects, reflecting his architectural philosophy and design approach. This paper primarily examines the relationship between the structural form, architectural space, tectonic character, materiality, and detailing in the Church of the Light. Particularly, the paper analyzes the use of materials and the interplay between structure and architectural space in Ando's design. This analysis is based on the taxonomy proposed by Chad Schwartz in his book "Introducing Architectural Tectonics: Exploring the Intersection of Design and Construction", which includes Place, Precedent, Space, Anatomy, Stereotomic, Tectonic, Representation, and Detail as the primary principles constituting the concept of tectonics. The analysis sections and the findings discuss how Ando's tectonic sensibility transforms raw materials and the use of light into an experiential and spiritual architectural space. Additionally, the study offers a deeper understanding of Ando's architectural approach by examining the Church of the Light.

Keywords: architectural space, Church of the Light, concept of tectonics, structural form, Tadao Ando

1. Introduction

Tadao Ando is one of the most important figures in the history of modern architecture, who benefits from a minimalist approach and Japanese aesthetics in his buildings. His architectural design language emphasizes elements such as the use of light, structural integrity, and the emotional impact of space. Through his use of raw concrete and glass (mass and light), Ando attempts to create architectural spaces that foster communication between humans and nature, rather than constructing a shell that isolates people from nature. The key distinction between his work and Western architecture lies in this different approach to nature. According to Ando, three fundamental elements define architecture: material, simple geometry, and nature (Şahbaz, 2010, p. 31). The Church of the Light, one of the clearest examples of Ando's tectonic approach, embodies this architectural philosophy. In this building, Ando utilizes the play of light and shadow to transform spatial perception through the use of simple geometric forms.

Although numerous studies exist in the architectural literature on the spatial and aesthetic qualities, as well as the phenomenological and philosophical dimensions of Tadao Ando's buildings, there has been limited in-depth analysis of Ando's specific buildings, particularly in relation to tectonic principles. Particularly in buildings like the Church of the Light, which demonstrate how light, material, and structural elements interact in the creation of space, the evaluation of these relationships from a tectonic viewpoint has not been extensively explored.

This paper aims to fill this gap in the literature and reveals Ando's distinctive approach to spatial design by employing the tectonic analysis framework proposed by Chad Schwartz (2016).

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Methodologically, the paper adopts a qualitative approach grounded in Schwartz's taxonomy, including place, precedent, space, anatomy, stereotomic, tectonic, representation, and detail. Unlike Frampton's general tectonic culture analysis, this study is the first in-depth case study to apply Schwartz's eight-fold taxonomy in a detailed and systematic manner to Tadao Ando's Church of the Light. These categories are individually analyzed to interpret the contextual, spatial, structural, tectonic, and material characteristics of the Church of the Light.

To achieve this aim, the paper begins with a literature review on the concept of tectonics in architectural theory, followed by a brief discussion of Ando's architectural philosophy and basic information about the Church of the Light. Then, the building was analyzed thoroughly using Chad Schwartz's tectonic framework. Finally, the results obtained from the analyses are listed and discussed.

2. Literature Review

2.1. Concept of Tectonics

The concept of tectonics is the totality of lines, masses, and volumes encompassing a work of art (Armağan, 2011). The term has been used since Ancient Greece, meaning "to build" or "to establish"; but it has gained different meanings over time (Schwartz, 2016). Tectonics, as a fundamental concept in architectural history, is based on a perspective that encompasses the components of a building from both technical and aesthetic perspectives.

The concept of tectonics, explored by various philosophers, architects, and theorists across different periods, has evolved in new dimensions and meanings over time. Immanuel Kant (1724-1804) indirectly contributed to architectural theory through his theories on aesthetic judgments and beauty. According to Kant, beauty contains "purposeless purposiveness," a notion that raises the question of how aesthetic values can be balanced with functionality in architecture (McCoy, 2009). Arthur Schopenhauer (1788-1860) expanded upon Kant's ideas, arguing that buildings, beyond their structural functions, leave a profound aesthetic impact on humans. For Schopenhauer, tectonics extends beyond a building's physical stability to encompass an internal order and perceptual effect (Schwartz, 2017).

Friedrich Wilhelm Joseph Schelling (1775-1854) argued that forms and structures in nature carry an inherent "spirit", suggesting that in architecture, aesthetic and structural form should be integrated. Karl Friedrich Schinkel (1781-1841), who saw tectonics not only as a structural necessity but also as a representation of idealism, is one of the important architects who brought all these ideas to life. Schinkel's work can be cited as an example in emphasizing the importance of aesthetic value in load-bearing structural systems. Karl Bötticher presented an important theory regarding integrating structural logic and aesthetic elements in tectonic architecture. Bötticher defined tectonics as the understanding that a building's structural elements and aesthetic values must coexist and be in harmony, and presented this approach as a significant contribution to architectural theory (Jodidio, 2012; Rasmussen, 1992). Karl Bötticher (1806-1889) divided the building into two main categories: Core-form (Kernform) and Art-form (Kunstform). Core-form represents the functional and technical aspects of the building, while Art-form encompasses the building's artistic and aesthetic values (Bötticher, 1992). Bötticher says that a successful architectural work results from the harmonious combination of these two forms. These two distinctions constitute one of the important fundamental elements of tectonic discussions in architectural history (Akgün et al., 2022).

Gottfried Semper (1803-1879) considered architectural elements not only as structural components but also as forms of cultural and aesthetic expression. Semper proposed that a building consists of structural-technical components, which include elements related to its static and durability aspects, and structural-symbolic components, which express its cultural and aesthetic meanings. Semper stated that the elements that make up the building's surfaces originate from textile arts, arguing that traditional techniques, such as those used in carpets, curtains, and knots,

were important sources of inspiration in façade design. He noted that the knot motif, in particular, is one of the most fundamental details used in architecture. (Schwartz, 2017).

Gottfried Semper explained the origins of architecture with four basic elements: the hearth, the earthwork, the frame, and the surrounding membrane. The heart represents the central element of the building and the focal point of social life. The earthwork anchors the building to the ground and forms its foundation. The frame provides the load-bearing structural system, and the surrounding membrane forms the building's surface, defining its aesthetic and symbolic identity (Semper, 1989). In Semper's theory, these components correspond to the functional and cultural dimensions of the architectural form. From the end of the 19th century onwards, modern architecture was influenced by Semper's theory, which significantly enhanced the expressive power of façade design and architectural elements.

Otto Wagner (1841-1918) emphasized that modern materials (steel, concrete, glass) introduced new tectonic understandings in architecture, asserting that these materials should not only be functional but also carry an aesthetic language. Adolf Loos (1870-1933), in his manifesto "Ornament and Crime", argued that ornamentation was unnecessary and that modern architecture should be simple and functional. Loos' views encouraged a minimalist and functional approach to tectonics (Loos, 1982). Eduard Sekler (1910-2007) considered tectonics not only as a structural issue but also as a concept based on the observer's perception. According to Sekler, tectonics goes beyond the accuracy of a building's structural system; it also concerns how this system is visually and experientially perceived (Sekler, 1965).

Kenneth Frampton (1930-) is one of the leading figures who has addressed the concept of tectonics in architectural theory from both ontological and representational perspectives. Frampton views architecture not only as a functional and structural discipline but also as a cultural form of expression with its own unique meaning inherent in the act of construction. In his work "Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture" (1995), Frampton examines the tectonic practices in architectural history in detail, presenting his thoughts on how tectonics should be reinterpreted in modern architecture. In his book, while addressing the evolution of tectonic understanding in 19th- and 20th-century architecture, he discusses tectonics under two main categories: As the first category, ontological tectonics focuses on how the being of a building, through its materials and structural systems, is not only functional but also sensually and experientially perceived. For Frampton, building components are not merely structural elements but serve as fundamental components of architecture. The second category, representational tectonics, refers to the idea that a building must have cultural meaning(s) related to materials and the construction process. Frampton examines how modernist architects used materials not only for technical requirements, but also as aesthetic and symbolic elements. For instance, Le Corbusier's use of concrete as a plastic form of expression, or Mies van der Rohe's use of steel and glass as a narrative of purity in architecture, can serve as good examples in this context (Frampton, 1995).

Frampton's concept of tectonics highlights the honest use of materials and the clear expression of structure in architecture. He believes that good architecture should reveal its construction, with structural elements also contributing to the design narrative. Architects like Louis Kahn, Carlo Scarpa, and Alvar Aalto are key examples for him. Kahn gives meaning to materials, Scarpa focuses on detailed craftsmanship, and Aalto organically utilizes natural materials. Frampton argues that after the mid-20th century, industrial production weakened this tectonic quality. He criticizes how early modernism's material honesty gave way to postmodernism's decorative and superficial style (Frampton, 1995).

2.2. Tadao Ando's Architectural Philosophy

Tadao Ando, born in 1941 in Osaka, Japan, is an architect whose work blends traditional Japanese aesthetics, phenomenology, and modernist principles. Although Ando received no formal architectural training, he developed his design talent, perspective, and philosophy through

extensive self-education (Nazik, 2020). Tadao Ando's architectural approach is shaped by three basic elements: material, simple geometry, and nature (Güzer et al., 2000). His curiosity about natural elements, such as light, shadow, and wind, has formed the basis of his architectural approach, enabling him to create spaces that enhance sensory awareness and invite thought (Yıldız, 1995). Ando was internationally recognized for his ability to create immersive spaces using powerful design strategies, alongside his minimalist approach, and received the Pritzker Architecture Prize in 1995 (Jodidio, 2012).

Ando's refined use of raw concrete in his architectural approach echoes Japan's carpentry traditions, transforming spaces into smooth, tactile surfaces (Gündüz, 2019). Ando, with his attention to detail, transforms concrete into more than just a functional material, making it a tool of expression. (Baek, 2017). His interactive use of concrete, glass, and wood in his buildings combines tradition and modernity, enriching the spatial experience. The balance between enclosure and openness is fundamental to his architectural philosophy. His thick concrete walls define and separate spaces while emphasizing the inner world (Rasmussen, 1992). In his designs, Ando goes beyond functionality, aiming to create spaces that stimulate the senses and enhance awareness of one's surroundings (Haristianti & Murdowo, 2019).

Influenced by Le Corbusier's architectural approach, which is evident in his works, Tadao Ando designs dynamic spaces that transform perception by blending geometric forms with organic elements (Schwartz, 2016). One of the techniques that stands out in Ando's architectural philosophy is his use of natural light not only as a means of illumination but also as a transformative element of space (Cengiz, 2022). Through the carefully placed voids, openings, and slits in the structure, he utilizes the movement of light and shadow throughout the day to create constantly changing and transforming spaces (Erzen, 2004). Ando considers space not merely a space to be lived in, but a reality to be experienced. He does not separate nature from the design process, preserving its interaction with nature and the environment in his designs. In this way, he transcends time as an abstract concept and transforms it into an element that can be experienced, felt, and perceived (Seçer, 2016).

2.3. Project Brief of the Church of the Light

Located in Ibaraki, Japan, the Church of the Light, designed by Tadao Ando in 1989, has become one of the most important buildings in the history of modern architecture. This concrete building, designed to refurbish a Christian complex, reflects Ando's architectural style and philosophy of duality. A cross-shaped opening on its east façade skillfully admits light, creating a unique experience for the user. The predominantly concrete structure is designed with a minimalist, unadorned style. Establishing a strong interaction between nature and architecture, the building strengthens the spatial experience by incorporating contrasts such as fullness and emptiness, light and darkness, simplicity and serenity (Çeşmeli, 2019). Concrete walls and wooden seating elements are harmonized in the building (Furayama, 1996).

Devoid of ornamentation, the raw concrete surfaces foster a contemplative and serene ambiance, imbuing the space with spiritual depth. This building can be seen as a living example of the phrase “less is more” (Şimşek, 2011). The flawless finish of the concrete surfaces reflects the precision and craftsmanship inherent in the Japanese carpentry tradition. This meticulous attention to detail is particularly evident in the seamless integration of the cross-shaped void with the concrete joints. Natural light entering through the void from the east gradually illuminates the dim interior from the early hours of the day, softening the rigid concrete surfaces and transforming the space into a luminous volume. The interaction between the use of light and the material in the building alters the perception of concrete, transforming it from a solid form into a spiritual entity, thereby increasing the building's spiritual and spatial significance. The only religious symbol in the building is a cross-shaped opening, indicating that the building was designed with a minimalist perspective, devoid of ornamentation.

3. Methodology

The Church of the Light is selected as a case study building in this paper to investigate the relationship between architectural space and structural form in Ando's architecture. The analysis is based on the taxonomy proposed by Schwartz (2016). In his book, Schwartz presents a novel and systematic approach to analyzing buildings, detailing spatial experience, aesthetic elements, and structural features. This systematic approach can be categorized into eight areas: Place, precedent, space, anatomy, stereotomy, tectonics, representation, and detail. Beyond the fundamental concepts of the building, this paper also addresses elements such as material selection, building-specific components, use of light, integration into the context, and user experience. As Schwartz argues, understanding the tectonic character of a building requires much more than simply analyzing its physical components.

3.1. Place

The principle of "Place" focuses on the relationship between a structure and its surrounding context, as well as how it adapts to the environmental setting. As seen in Figure 1, the Church of the Light is situated in the Ibaraki district of Osaka, close to a dense urban fabric but almost completely isolated from its surroundings. This location reflects Ando's core design philosophy for space. In contrast to the urban environment, the building aims to provide a tranquil and spiritual atmosphere. The separation from the surrounding dense urban development and social life transforms the church into a space that invites an inner journey (Metalocus, n.d.). Ando avoids direct entrances to highlight nature in his architectural and design approach, routing routes in rural projects that must be passed before reaching the building. By doing so, he detaches users from the urban context to evoke the power of nature and make it perceivable (Çeşmeli, 2019). Upon entering the church, the user's connection to the outside world is severed. The church, situated away from the noise and chaos of its surroundings, offers a deeper, more meditative experience within its interior. The physical presence of the external urban environment diminishes once inside, and upon stepping into the space, the outside world virtually disappears, allowing an atmosphere of inner peace to prevail. This creates a tension between the environment and the building, which plays a significant role in the architectural design. As the user enters the space, they detach from the surrounding context, further deepening the spiritual experience intended within the space. The atmosphere inside the church serves Ando's goal of creating an "internal landscape." Here, the environment is not merely a backdrop but an element that reinforces the spiritual atmosphere created within the interior (Kroll, 2011).

Figure 1 Ground floor plan of the building (Reproduced from ArchEyes (n.d.) by the first author)

The most fundamental elements shaping the interior geometry in this building are the planes and minimalist concrete walls. The deliberate use of these walls represents a critical stance against the prevailing principles and approaches of contemporary architecture. While many modernist architects such as Le Corbusier and Mies van der Rohe embraced the idea of creating fluid spaces

between walls, Tadao Ando emphasizes the significance of the wall itself, thereby positioning his work in opposition to many longstanding modernist ideals. As seen in Figure 2, for Ando, the concrete wall is not merely a structural component but a philosophical medium through which the relationship between architecture and nature is questioned.

Figure 2 Environment of the building (Photographs: Nobuyoshi Araki, Hiromitsu Morimoto) (ArchEyes, n.d.)

In the design of the church, light also plays a crucial role in interacting with the surrounding context. Ando expresses existence in the art of creating surfaces by using light not only as a tool but also as a means in itself. He makes light an indispensable element of the spatial atmosphere (Üçüncü, 1995). As seen in Figure 3, light, as it enters from the outside, becomes an integral part of the space and is used as an element that conveys the spirit of the place. The cuts and angled forms in the building's walls allow natural light to penetrate the space. This light reflects off the walls, creating shifting shadows over time that produce an effect that makes the user unaware of the passage of time. This interaction erases the contextual connection, deepening the spiritual silence within the space. In its relationship with the environment, Ando's intervention in response to the surrounding context aligns with the minimalist form and simplicity of the structure. The harsh concrete material and geometric forms create a distinct contrast with the surroundings. This design isolates the space from the external hustle and bustle, allowing the user to embark on an inner journey. The Church of the Light does not merely relate to the environment; instead, it acknowledges environmental interactions and remains unaffected by them. This design choice represents a unique approach to the surrounding context and social structure. Every detail within the structure is thoughtfully designed to balance this tension with the profound sense of calm found within. As a result, the Church of the Light not only reinforces the physical and spiritual experience but also reshapes the environmental context, centering the user's experience within the space. All these elements demonstrate how Ando's architectural philosophy manifests in the relationship between the Church of the Light and its environment. The building is not just a physical space, but an atmosphere that leads the individual on a spiritual journey through its relationship with the environment, light, and time.

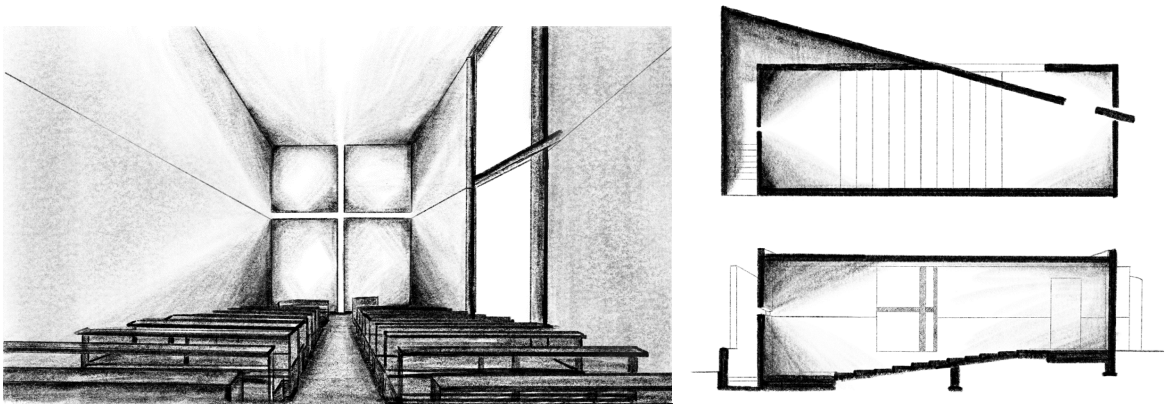

Figure 3 Interior view of the building (Drawn by the first author)

The orientation of the building and its relationship with the sun's movement constitute fundamental elements that enrich the spatial experience of the building. Ando meticulously considered the entry and distribution of sunlight when determining the building's positioning. The building is situated in a way that isolates it from the noise of the urban fabric, creating a tranquil atmosphere while ensuring maximum utilization of natural light. The openings and incisions in the main walls are strategically designed to direct sunlight into the interior at different times of the day. The varying effects of light at different times of day create distinct atmospheres within a space, influencing the perception of that space. The sunlight entering through the openings designed in the building plays a crucial role in altering the perception of space. Sunlight strikes concrete surfaces, creating shadows that depend on the angle, and enhances both the architectural expression and the interaction between the user and the space. The constant fluctuation of daylight prevents the space from remaining stagnant, offering users a different spatial experience. Through this transformation, visitors perceive the flow of time and its emotional impact, in addition to the physical aspects of the space. The way sunlight shapes the space allows users to experience it, inviting them on a journey through the space. As a result, the building is not just an isolated architectural entity, but a dynamic environment engaged in an ongoing dialogue with its surroundings. The interplay of light and time elevates the building beyond a mere physical structure, transforming it into a space that embodies both temporal and spiritual dimensions.

3.2. Precedent

The principle of "Precedent" refers to the influence of previous buildings and ideas on a design. In the case of the Church of the Light, the building draws inspiration from Le Corbusier's Chapelle Notre-Dame-du-Haut in Ronchamp, a significant modernist work. It bears a resemblance in that it creates a space of separation between the two elements through the use of light. As seen in Figure 4, the light band created on the ceilings of both buildings makes the roof appear to float, reversing the familiar load-bearing principle of the structure and eliminating the structural elements at the corners. This surprises and makes the clean structural transition, which has persisted since the Renaissance materialism, even more surprising. As seen in Figure 5, when viewed cross-sectionally, light filters into the space through the slit created in the ceiling in both buildings, freeing the roof from gravity and creating a floating impression. In Ronchamp, this visually lightens the mass and obscures the perception of the structural system. Similarly, in the Church of the Light, light enters through the line formed by the intersection of the load-bearing wall and the partition wall that enters the space, creating a guiding axis toward the center of the building.

Figure 4 Interior views of the Chapelle Notre-Dame-du-Haut (ArchEyes, n.d.) and Church of the Light (Schoof, 2021)

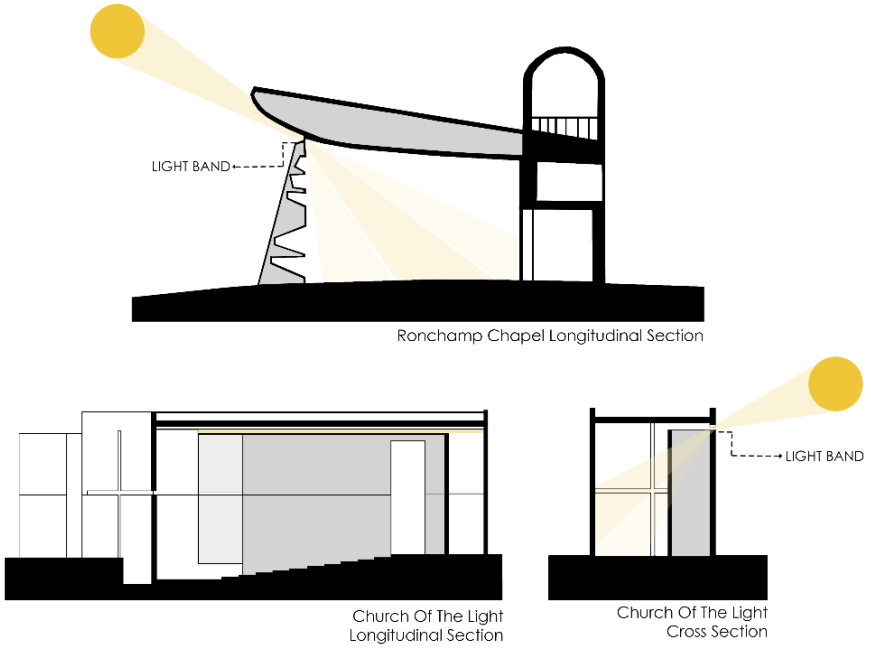

Figure 5 Sections of the Chapelle Notre-Dame-du-Haut and Church of the Light (Drawn by the first author)

However, while Ando was inspired by the relationship between light and space seen in Ronchamp, he diverged significantly from Le Corbusier's design language. Le Corbusier's Chapelle Notre-Dame-du-Haut features organic, flowing forms, with its curved rooflines and sculptural volume that seem to blend with the landscape. In contrast, Church of the Light utilizes a geometric, minimalist approach. Instead of the soft curves and sweeping shapes found at Ronchamp, Ando opts for rigid concrete prisms and sharp angles. The clean, unadorned surfaces of the concrete structure in the Church of the Light stand in stark contrast to the organic, expressive forms at Ronchamp. Furthermore, while Ronchamp allows light to filter freely through irregular openings, creating a dynamic and somewhat unpredictable play of light and shadow, the Church of the Light constrains the entry of light through a cross-shaped slit in the concrete wall. This controlled entry of light serves as a subtle yet powerful architectural element, transforming the space with an almost meditative quality. The impact of light in Ando's design is far more restrained than in Ronchamp, where light floods the interior in varying, unplanned ways. The effect of light in the Church of the Light is deliberately planned to enhance the spiritual experience, making the interaction between light and shadow an integral part of the building's spatial identity.

The Church of the Light bears a resemblance to the Pantheon, another historical precursor, in that light dematerializes the environment, defining an atmospheric space entirely outside of material constraints. As seen in Figure 6, light filtered through the oculus in the Pantheon's dome moves throughout the day, creating a dynamic perception of time and space within the space. This movement alters the atmosphere of the space, revealing the building's geometric and structural essence. This temporal and spatial trace left by the light on the dome surface strengthens both the structural and symbolic essence of the architectural form. Similarly, the light filtering through the openings on the Church of the Light's surface enhances the perception of spatial boundaries through its movement on the reinforced concrete walls, making the structure's tectonic character visible. In Ando's words, the aim is not to reveal the nature of the material, but to use it to "create the purpose of the space"; by drawing light into the space, a serene and translucent atmosphere transcends the material's boundaries (Ando, 1990, p. 458). Thus, in both the Pantheon and the Church of the Light, light is not merely an atmospheric element; it transforms materiality, revealing the spirit of the building and reinforcing its tectonic character. Just as light entering through the oculus at the top of the Pantheon traces the sun's movement throughout the day, leaving a temporal trace in the space, so too does natural light in Ando's building create a planimetric transformation within the interior. This transformation, through the interplay of light and shadow,

intuitively contributes to the tectonic nature of the structural order. Thus, both structures utilize light as a tool for constructive meaning and spatial experience, transcending its mere visual element.

Figure 6 Light in the Pantheon, Rome (Gajewski,2017)

3.3. Space

The principle of "Space" concerns the interior of a building and the atmosphere it creates within. In the case of the Church of the Light, the interior is characterized by simplicity and minimalism, with a focus on creating a profound and contemplative environment for its users. The space itself is not merely a physical volume but an experiential realm that deeply affects the individual's spiritual and emotional state. The dimensions and orientation of the interior space are meticulously planned to enhance the user's spiritual journey. The space is not expansive in the traditional sense, but its proportions and directional focus direct the user's attention inward, drawing them into a deeper engagement with the environment. The use of materials also contributes significantly to the character of the interior. As seen in Figure 7, the interaction resulting from the combined use of concrete and wood creates a natural balance within the space, blending the hardness of the concrete with the warmth of the wood. This combination softens the industrial feel of the concrete and adds a tactile dimension to the interior. This allows users to establish a more intimate and human connection with the designed structure. The combined use of materials such as concrete, wood, and glass in the structure deepens the atmosphere of the space. Additionally, the interior design plays a crucial role in enhancing the overall spatial experience. The transition from smaller, intimate spaces to larger, more open spaces occurs in a balanced manner. Passing through narrow corridors or small rooms before entering a larger, more spacious space offers a layered experience of exploring the space.

Figure 7 Church of the Light Sunday School (Photograph: Hiromitsu Morimoto) (ArchEyes, n.d.)

Eduard Sekler not only views tectonics as a structural concept but also defines it as a phenomenon based on the observer's perception of it. Tectonics extends beyond the clarity of a building's structural system, focusing on its visual and experiential perception (Sekler, 1965). In this context, Ando's spatial design reinforces Eduard Sekler's concept of tectonics in relation to visual and experiential perception. Leaving the structural system open and visible alters perception through the play of light and shadow created within the building, creating spatial richness. The sharp shadows cast on the surfaces by the movement of light throughout the day give new meaning to the space. The stark clarity of the reinforced concrete surfaces and the influential band of light filtering through the narrow vertical opening transform the building's structural accuracy into the observer's temporal experience (See Figure 8).

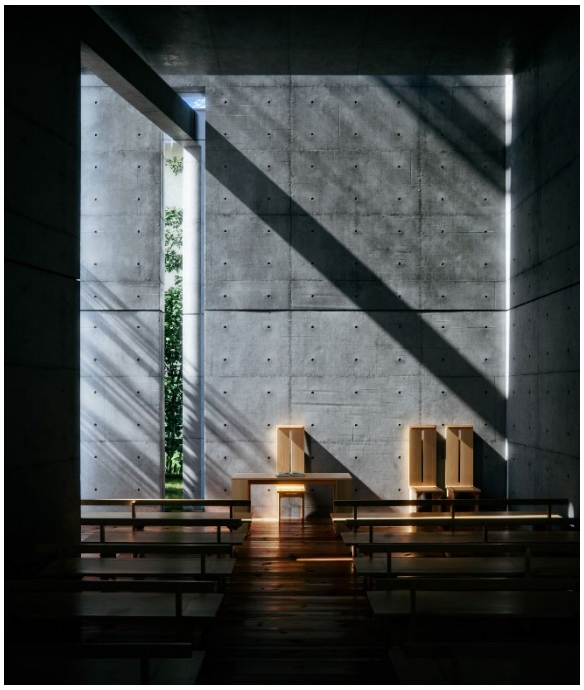

Figure 8 Church of the Light-Tadao Ando architecture (Photograph: Adrian Iliescu) (Iliescu, 2023)

The building's spatial design encourages introspection and spiritual reflection, allowing individuals to detach from the outside world and retreat into their inner selves. For example, the gently sloping floor, designed with guidance, gently guides the user toward the altar, emphasizing the ritualistic and ceremonial nature of the space. On the other hand, light plays a crucial role in shaping the space. The cross-shaped opening in the concrete wall serves as the primary conduit for light to enter the interior, casting dynamic, shifting patterns of light and shadow throughout the day. This interplay of light and shadow not only alters the appearance of the space continuously but also evokes an ethereal, almost mystical atmosphere. As seen in Figure 9, the changing qualities of light reflected on the building throughout the day create a sense of movement and transformation within the space, contributing to a fluid experience where each moment feels different from the previous. This interplay between light and space fosters a deeper connection between the user and the space, creating a meditative and ever-evolving experience.

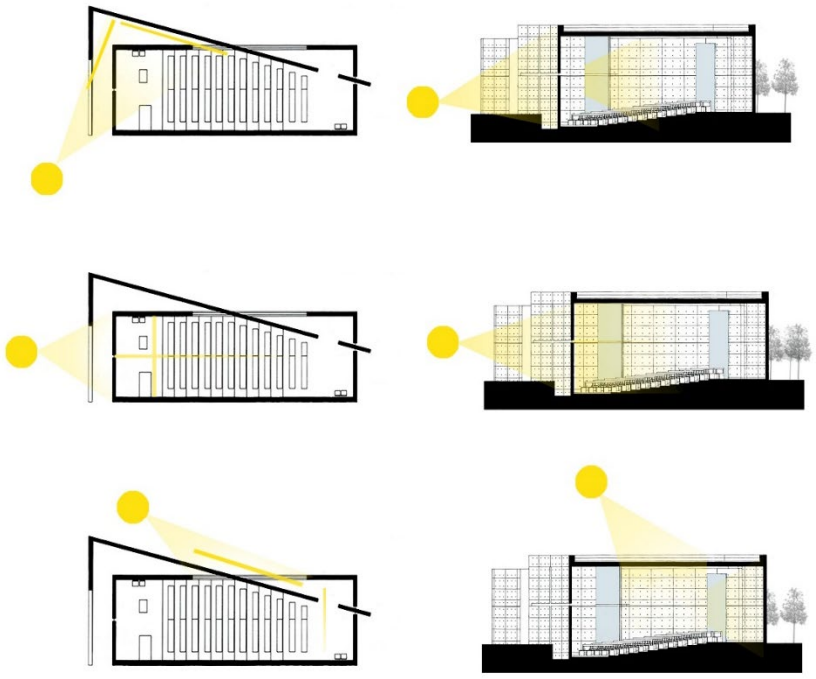

Figure 9 Distribution of light from different angles on plan and section (Reproduced from ArchEyes (n.d.) by the first author)

3.4. Anatomy

The principle of "anatomy" examines how the physical and structural components of a building are organized into a coherent architectural whole. Semper (1989) defines the four fundamental elements of architecture as the hearth, the earthwork, the framework, and the cladding. Ando's architecture considers these elements, identified by Semper, not only as structural elements but also as components that shape the psychological, perceptual, and phenomenological character of the space. In the example of the Church of the Light, this anatomical logic is clearly revealed through the sequential arrangement of building layers and tectonic openings, as visualized in Figure 10. The design develops in six distinct stages, from excavation (earthworks) to the final cladding, with each stage contributing to the creation of a systematic material and spatial composition. The "earthwork" explains the relationship between the reinforced concrete base surface and the structure's topography. The weight of the concrete symbolizes the structure's foundation in the ground and its anchorage in space. The concept of the "hearth" is associated with the symbolic and functional center that constitutes the structure's essence. In the Church of the Light, the hearth is the center of the altar, accompanied by the light reflected from the cross-shaped opening, which forms the spatial and spiritual heart of the structure, the focal point around which people gather and give meaning to their lives. This is consistent with Schwartz's definition of architectural anatomy as the internal order that gives a building its identity. In Ando's buildings, the "framework" is a combination of structural simplicity and geometry. The Church of the Light's load-bearing system is defined by reinforced concrete walls. The use of load-bearing reinforced concrete walls instead of the traditional column-beam system is the fundamental tectonic decision that defines the structure's anatomy. These constructional decisions shape the building's identity. The reinforced concrete used in the structure's framework provides a powerful tectonic expression of mass, weight, and permanence, while the load-bearing and partition walls serve as both the structural framework and spatial definition. The roof, a monolithic concrete slab that appears to float as the partition walls penetrate the space, unifies the volume and intensifies the sense of enclosure. "Cladding" is redefined in Ando's design by the simple concrete surfaces that clad the structure. Concrete, in addition to being a cladding material, becomes a "light curtain" that reflects light, defines shadow, and dissolves the concreteness of the surface. Overall, the anatomy of the church demonstrates Ando's transformation of a limited number of fundamental elements (solid concrete walls, light, and geometric precision) into a spatial organism that conveys both structural

integrity and metaphysical depth. Through its concise material logic and experiential openness, the structure exemplifies how architectural anatomy can be the basis for meaning, order, and emotion.

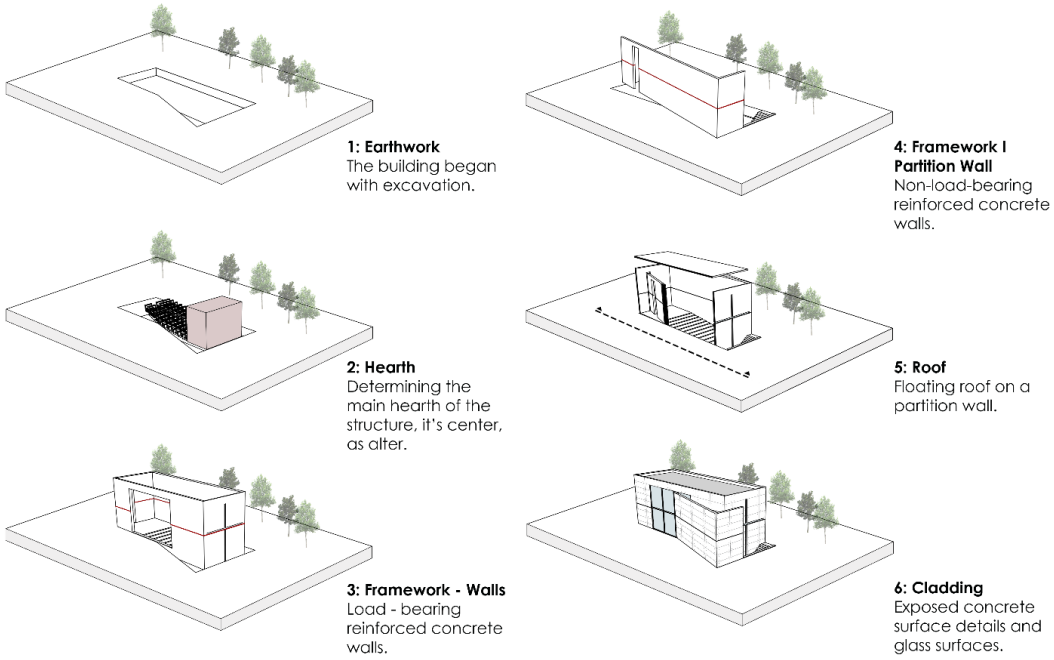

Figure 10 Anatomy of the Church of the Light (Drawn by the first author)

3.5. Stereotomic

The “stereotomic” explains how the structure is constructed and how it relates to Frampton's principle of "material integrity." The heavy and solid nature of concrete reveals how the Church of the Light is firmly anchored in the ground, creating a sense of rootedness. The structure establishes a strong connection with the ground through its concrete walls and mass elements. Concrete symbolizes the solid and uninterrupted foundation on which the structure rests. These mass structures not only ensure the structural security of the space but also strengthen the building's subterranean connection to nature. The heavy and solid nature of concrete, combined with the depth of the space, creates a spiritual atmosphere. Through this strong connection to the earth, the structure's stereotomic structure becomes a symbol representing the continuity of nature and the permanence of the building (Schwartz, 2016; Erzen, 2004).

3.6. Tectonic

“Tectonic” refers to the integration of structural elements in a building in both aesthetic and functional terms. In the Church of the Light, the tectonic principle is manifested in the combination of concrete walls and the cross-shaped light incision. As seen in Figure 11, the concrete walls are designed in a functional way to ensure both structural integrity and the passage of light into the interior. The effect created by the light falling onto the concrete surfaces and the changing shadows over time strengthens the experiential dimension of the space. The tectonic principle is embodied in the harmony of all the building's elements, combining both aesthetic and functional aspects (Schwartz, 2016; Erzen, 2004). In this structure, the use of planar elements such as reinforced concrete walls and slab-free floors instead of column-beam systems adds a unique character to the building. These elements come together without the need for traditional vertical supports, creating a sense of openness and fluidity within the space. The geometry plays a crucial role in this interaction, where the precise alignment and positioning of walls and slabs contribute to the overall harmony of the structure. Some of the walls appear to be disposed in a way that enhances the sense of simplicity and clarity in the architectural composition, offering a serene, meditative quality to the space (Schwartz, 2016; Gündüz, 2019).

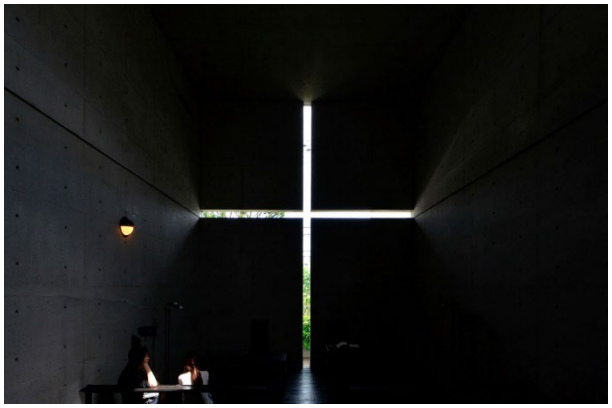

Figure 11 Church of the Light interior (Photograph: Nobuyoshi Araki, Hiromitsu Morimoto) (ArchEyes, n.d.)

3.7. Representation

In the "Representation" section, the mold traces and holes left clearly visible on the structure are not merely decorative elements, but indicators of the construction process and a representation of the concrete's ontological significance. This aesthetically expresses the tectonic character. The dynamic nature of the Church of the Light's surfaces is revealed by the constant changes induced by light. The concrete surfaces, especially features such as formwork marks and holes, reveal the marks of the production process, thereby enhancing the connection between the user and the space. These elements visually capture the building's attention and symbolize its identity and essence. As seen in Figure 12, the cold, hard texture of the concrete, interacting with light, undergoes a continuous transformation as shadows and signs change. This process highlights the building's dynamic and ever-changing character, gradually shaping the viewer's spatial experience. The shadows cast by light at different times of day, along with the changing appearance of the formwork marks and holes, emphasize the transformation of the space. The interplay between light and shadow significantly transforms the Church of the Light into a multi-layered and spatially complex structure. While the traces left by the concrete formwork on these changing surfaces, which also influence the ornamentation and create an aesthetic texture, are not only a decorative element but also a reflection of the building's production process. The formwork marks and holes, as part of the building's identity, carry not just a visual but an ontological meaning. These marks represent the process of formation and the material nature of the structure, while also suggesting that the building communicates through an aesthetic language. These traces within the structure imply that the Church of the Light is not only a physical but also a symbolic entity. Therefore, these elements are not intended as ornamentation, but rather as representations of the building's essence (Schwartz, 2016; Erzen, 2004).

Figure 12 Church of the Light interior (Photographs: Nobuyoshi Araki, Hiromitsu Morimoto) (ArchEyes, n.d.)

3.8. Detail

"Detail" refers to the small yet significant elements where a building's structural and aesthetic components converge. Frampton's tectonic concept emphasizes the fair use of materials and the

clear expression of structure in architecture, dictating that the construction of a building should be demonstrated. According to this understanding, structural elements should be a visible part of the design narrative (Frampton, 1995). The mold marks and holes clearly visible in the building reinforce this narrative and its tectonic character. As seen in Figures 13 and 14, the reinforced concrete surfaces forming the building's walls were cast in two pieces, leaving a clear trace of plaster running through the center of the structure. In the Church of the Light, details play a decisive role in shaping the aesthetic perception of the building. The subtle imprint marks on the cast concrete surfaces reveal the meticulousness with which the structural elements have been designed. The use of wood, both on the walls and in the flooring, creates a contrast between the coldness of concrete and the warmth of the natural material, adding a sense of intimacy to the space. These details, found in the combination of concrete and wood, not only provide the user with a sense of unity but also deepen the architectural language of the building. In the interplay of these details, the space offers not only aesthetic pleasure but also an atmospheric experience that enriches the user's interaction with the environment.

Figure 13 Church of the Light details (Photographs: Nobuyoshi Araki, Hiromitsu Morimoto) (ArchEyes, n.d.), Church of the Light-Tadao Ando architecture (Photograph: Adrian Iliescu) (Iliescu, 2023)

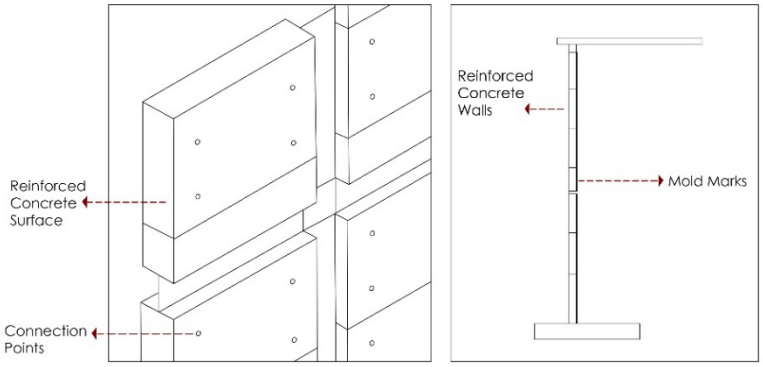

Figure 14 Details from Church of the Light (Drawn by the first author)

4. Conclusion

This study analyzes Tadao Ando's Church of the Light comprehensively by exploring how tectonic principles shape the relationship between architectural space and structural form. By systematically applying Schwartz's tectonic framework, this study offers a more in-depth analysis than previous phenomenological approaches, revealing the precise mechanisms that define how Ando's architecture achieves spiritual depth. The Church of the Light demonstrates how tectonic principles can combine expressive power with technical execution. The building's commitment to material permanence, structural clarity, and the creation of an introspective spatial landscape demonstrates a timeless architectural approach: conceptual resilience through simplicity and focus. The Church of the Light reflects Ando's architectural philosophy, combining the solid, heavy presence of concrete with the delicate play of natural light. The concrete elements serve as structural elements and tools for shaping the architectural space, creating a sense of order and calm. Each element of the building contributes to function and atmosphere, emphasizing the connection between material and meaning.

The interior's spiritual quality stems from the way light enters and interacts with the building's simple geometries and materials, offering visitors a powerful emotional experience. The shifting light and shadow change the space throughout the day, deepening its spiritual atmosphere. This creates an environment where the user's experience extends beyond mere function, fostering a deeper emotional and sensory connection with the space. The Church of the Light demonstrates how tectonic principles can guide both the technical and expressive aspects of architecture. As such, it is a notable example of modern architecture that effectively integrates structure, aesthetics, and human experience.

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CRediT Authorship Contribution Statement

Helin Bağcıvan: Writing – review & editing, Writing – original draft, Methodology, Investigation, Analysis, Data curation, Conceptualization, Data visualization. Yenal Akgün: Writing – review & editing, Writing – original draft, Methodology, Investigation, Analysis, Data curation, Conceptualization, Data 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.

Resume

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