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TECTONIC EXPRESSION IN CONTEMPORARY ARCHITECTURE: THE USE OF COMPACTED CONCRETE IN PETER ZUMTHOR'S BRUDER KLAUS CHAPEL

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ABSTRACT

The present study analyzes the Bruder Klaus Chapel (1998-2007), designed by Peter Zumthor, in the light of the concepts of tectonics, with the objective of investigating how the application of compacted concrete was resignified by the architect, associating construction, phenomenology and poetic expression. Starting from an interdisciplinary approach, anchored in complexity, the study is justified by the need to deepen the understanding of the theme and to explore how Zumthor transcended the functional use of the material, integrating constructive and sensorial characteristics in a remarkable work. To this end, a theoretical review is carried out on the historical trajectory and physical properties of compacted concrete, complemented by a detailed case study of the Bruder Klaus Chapel. Technical aspects, such as the artisanal use of layers of compacted concrete, and phenomenological aspects, such as the manipulation of light and materiality to create a unique atmosphere, are analyzed. The results show Zumthor's ability to transform compacted concrete into an expressive resource, capable of creating deep sensory experiences. The relationship between texture, light, and spatiality not only evokes memories and emotions, but also demonstrates how traditional methods can be reinterpreted to respond to current demands, while dialoguing with existential and cultural issues. It is concluded that the Bruder Klaus Chapel represents an intersection between technique and poetics, reaffirming the relevance of tectonics as a means of alternative architectural expression for contemporary design processes. The study contributes to the revaluation of ancestral methods and proposes paths for the dialogue between architecture and phenomenology, suggesting that Zumthor's legacy offers promising perspectives for architectural practice, by valuing essential qualities of construction and promoting a discourse that goes beyond the local and reaches the universal.

Keywords: Project Process. Compacted Concrete. Bruder Klaus Chapel. Peter Zumthor. Tectonic.

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INTRODUCTION

In the field of architecture, the term *tectonics* has acquired multiple meanings over more than two millennia, being commonly described as the art of construction. When analyzing works by Gregotti (2006) and Frampton (2006) on the subject, Kate Nesbitt proposed tectonics as "[...] the sensorial and intellectual experience of construction" (2006, p. 536). Based on some definitions by Frampton (2006, p. 559; 560), it is possible to define it as the poetic manifestation of structure, considering poetics "in the original sense of the Greek word *poiésis*, as the act of creating and revealing." Or even, as "a poetics of building", which establishes expressive relationships between structure, form and matter. In addition, according to Torrent (2000), tectonics can be presented as "the ability to contain meaning that the construction itself has, as a practice that in each act reveals accumulated knowledge" (p. 25).

In this context, the Bruder Klaus Chapel (2001-2007), designed and built by the Swiss architect Peter Zumthor in Wachendorf, Germany, stands out as a valuable and representative case study to expand the understanding of the subject. Starting from a hybrid bias, which combines interdisciplinarity and complexity, the analysis of the Chapel in the light of the concepts of tectonics allows the integration of different approaches, articulating the study of the construction technique and the physical properties of matter to the phenomenological perception of the work.[5]

With regard to the construction system and the properties of the materials used by Zumthor, the text seeks to observe how the architect rescues and applies the secular technique of *rammed concrete*, or compacted concrete. Although the Bruder Klaus Chapel has been widely publicized, this technique remains practically unknown among contemporary architects, even though it is used in large infrastructure works, where it is widely known as Roller Compacted Concrete (CCR).

On the other hand, Zumthor's use of compacted concrete goes beyond the physical experimentation of the material, assuming a deeper dimension that, according to Amaral (2009, p. 162), can be understood as "[...] a phenomenon that participates in the complex experience of man on Earth."

[5] All these perspectives of approach are permeated by the interpretations of Edgar Morin's (2010) theories of complexity, which allow the integration of various types of simultaneous contributions, including themes without correlation or similarity, sometimes competing or even antagonistic, but which, when associated by complexity, become complementary.

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In this study, we present an interpretation of the Bruder Klaus Chapel from the perspective of tectonics, highlighting its ability to associate technical and phenomenological aspects. From the application of compacted concrete and its properties, we seek to understand how Zumthor resignified this constructive practice, transcending its functional use to reach a poetic dimension that expands his possibilities of investigation in a broader context.

THE HISTORICAL TRAJECTORY OF COMPACTED CONCRETE

Compacted concrete is a fairly old construction method. In the Roman Empire, builders used a mixture of pozzolanic ash, lime, aggregates and little water, compacted into thin layers with the use of heavy compactors. According to Veihelmann and Holzer (2012) and Collins (2004), this process was perfected in the 1820s by the French architect François-Martin Lebrun[6] and, in the 1850s, by François Coignet, both pioneers in the development of compacted concrete. The technique basically consisted of manually compacting layers of very dry concrete, with a thickness of no more than 15 to 25 centimeters, until a film of moisture appeared, thus allowing the application of the next layer the next day.

At the turn of the nineteenth century to the twentieth century, most of the foundations, retaining walls, vaulted bridges, aqueducts, dikes, dams and dams were built with this technique, due to its high compressive strength. Many of these structures remain in use, proving their strength and durability. However, with the emergence and rapid advancement of reinforced concrete structures, and the consequent reduction of the sections of concrete pieces, this method fell into disuse. The dry concrete mixture, previously easily compacted, could no longer be properly compressed in the narrow formwork now filled with steel, making it necessary to use a more fluid concrete, with a greater amount of water to facilitate concreting (Dolen, Heimbruch and Ferraris, 2008).

Compacted concrete was also widely used in the production of lintels and in masonry repairs, such as in the restoration of the walls of Carcassonne, France, under the direction of Viollet-le-Duc. In these interventions, the material was compacted in wooden molds and subjected to a curing process, acquiring an appearance similar to that of molten

[6] Lebrun publicou duas obras importantes sobre o tema: *Méthode pratique pour l'emploi du béton en remplacement de toute autre espèces de maçonneries dans les constructions en général*, Paris, 1835; e *Traité pratique de l'art de bâtir en béton*, Paris, 1843.

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stone. Later, this resource was used in buildings of the Neoclassical and Art Deco periods to imitate natural stone facades, especially in the making of elements such as balustrades, architraves and ornamental pieces, as illustrated in Figure 1 (Bennett, 2005).

Figure 1 - Production of ornamental pieces using the Compacted Concrete technique.

Fonte: Bennett, 2005, p. 9.

CHARACTERISTICS AND PHYSICAL AND TECHNOLOGICAL PROPERTIES OF COMPACTED CONCRETE TODAY

In large engineering works, Roller Compacted Concrete (CCR) stands out, characterized by low cement consumption (between 80 and 120 kg/m³), dry consistency and workability that allows its compaction with steamrollers. This process eliminates voids by compaction energy, increasing their strength. CCR is widely used as a base or sub-base in highway paving and dam construction, known as CCR dams. Due to its dry consistency (humidity between 5% and 10%) and low fluidity (zero *slump*), it is possible to pour a new layer of concrete soon after the completion of the previous one, speeding up the execution of the work.

In the context of architecture, compacted concrete can also be used in unique masonry, characterized by rustic finish and specific textures. Compression compaction prevents the formation of cracks and reduces their susceptibility to deformation, making it especially suitable for monolithic and durable construction methods, which demand rigor in the composition of the mixture, in the execution process and in the initial tests to achieve the desired effect.

Research points to the efficiency of the technique. With low water and cement consumption, compacted concrete stands out as a more economical and ecological alternative compared to exposed reinforced concrete masonry. In a study conducted by Courard, Zhao, and Hubert (2020), compacted concrete was produced with recycled aggregates. The samples, demolded after 24 hours, presented a clean and crisp

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appearance, while the compressive strength in 28 days reached, on average, 5.26 Mpa, using a composition of 10% cement, 80% aggregates and 10% water.

Compacted concrete has properties similar to those of conventional concrete. However, due to the low content of cement paste, the degree of compaction exerts a direct influence on its mechanical properties. Proper control in the field is essential to avoid non-conformities or rework. As the material does not include structural reinforcements, the walls must be designed with sufficient width to ensure the stability necessary for their self-support and provide adequate space in the form, allowing uniform compaction of the material.

Projects that use compacted concrete solutions must prioritize homogeneity within the simplicity characteristics of the process, seeking more reliable model-prototype relationships and reduced variation rates. This approach promotes cement savings and minimizes the effects of volumetric variations caused by hydration. Because the amount of concrete compacted in a day is limited, the method generates several horizontal layers. If the materials are mixed manually, variations in shade may occur between the layers, which, depending on the project, can be explored as a striking aesthetic characteristic. The limitation in daily compaction and the nuances between layers make the process quite artisanal, making it difficult to reproduce on a large scale.

According to Ribeiro *et al.* (2002), due to its consistency and workability, the quality control of compacted concrete requires that the densification of specimens receive specific care to ensure similarity with the material compacted in the field. The most commonly used solutions for this purpose include manual compaction, performed with a Kango-type hammer, or the densification of the specimens on a vibrating table, with the application of a counterweight (Figure 2). In these procedures, the appearance of mortar at the top of the specimens and the correlation between compaction time and degree of compaction are important parameters to be considered.

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Figure 2. On the left: thickening of the specimen with a Kango Type Hammer; Right: Dense specimens on a vibrating table.

Fonte: Ribeiro *et al.* (2002).

The composition of compacted concrete is similar to that of conventional concrete, and the definition of traces follows three basic principles: meet the desired mechanical and aesthetic parameters, ensure workability compatible with compaction processes, and obtain economically viable mixtures, provided that the two previous factors are observed. In addition to these constraints, it is important to consider aspects related to the durability of concrete, with special attention to variations in particle size and volumes of the material due to autogenous shrinkage (Marques Filho, 2005).

A well-graded particle size distribution is essential for compacted concrete, as it reduces porosity and increases the number of contact points between the grains and the cement slurry (Medeiros, Lima, and Oliveira, 2018). Dosing is carried out by the method of lowest volume of voids, which seeks the best ratio between the aggregates to minimize the voids between the concrete components. The low volume of voids, combined with low porosity and a water/binder ratio close to 0.3, contributes significantly to the durability of compacted concrete.

It is common practice to produce multiple experimental mixtures to determine the desired trait. Generally, the process begins with the evaluation of the required content of sand in the mixture. The proportionation of the coarse aggregate fractions can be carried out by means of previous tests to determine the highest compacted or adjusted unit mass, varying the percentages of coarse aggregates and the sand content. This procedure can be easily performed by fixing values for the consumption of cementitious material and, for each value, developing traces with different combinations of coarse aggregates and sand contents.

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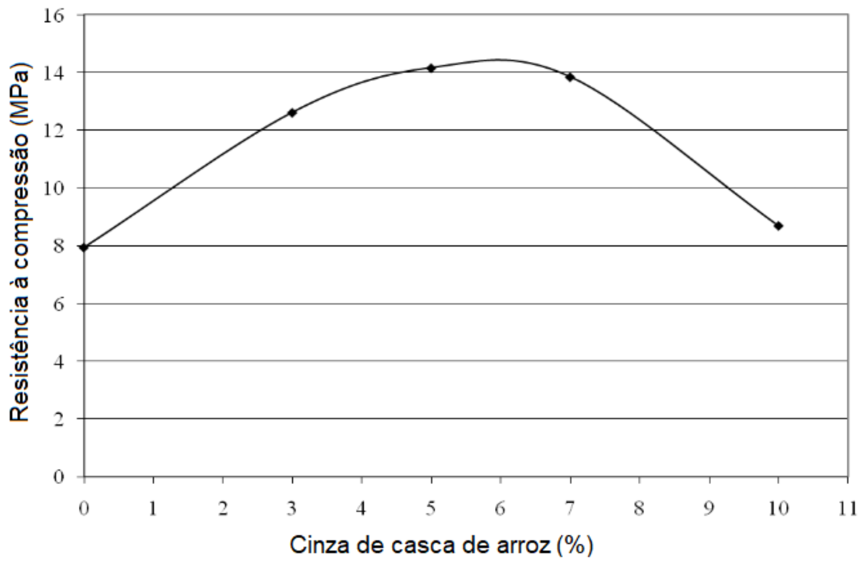
To ensure a homogeneous and densifiable material, in addition to minimizing cement consumption through adequate granular closure, the use of fine materials that improve the cohesion and workability of compacted concrete, such as mineral additions, filler or pozzolans, has become a common practice. These materials favor the necessary conditions for adequate compaction and densification.

Villena (2009) presents compressive strength values, after 28 days, for compacted concrete mixtures containing 120 kg/m³ of cement and percentages of rice husk ash ranging from 0%, 3%, 5%, 7% and 10%. Figure 3 illustrates the influence of these percentages on the compressive strength of the mixtures.

Figure 3. Compressive strength of compacted concrete with 120 kg/m³ of cement and variable percentages of rice husk ash.



Source: Villena, 2009.

Concrete is a naturally porous material, either by the use of excess water to ensure hydration reactions, by the incorporation of air in the production process or by shrinkage. The permeability of compacted concrete, as well as that of conventional concrete, varies with the evolution of hydration, being lower with the reduction of the water/cement ratio (Neville, 1982).

In addition to permeability, it is essential to minimize concreting defects in compacted concrete works. The most common cases include preferential moisture percolation paths, generated by concrete joints, and porosities resulting from insufficient densification. A precise control of compaction is indispensable to ensure adequate

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compaction, and the degree of compaction is widely used, which relates the specific mass obtained with the theoretical mass.

Compaction is the most important phase in the construction of the compacted concrete layer, as it allows you to control parameters such as density, strength, finish, and surface texture. At this stage, it is common to use a pneumatic soil tamper for compaction in the formwork. This equipment has a robust percussion system and high compaction force. Its motor transmits energy to the system, generating high-intensity impacts on concrete. The rubber tamper, weighing 11 kgf and with a diameter of 80 mm, is capable of generating up to 800 impacts per minute.

Despite the low cement contents, the volume of concrete poured in relatively short time intervals requires special care in controlling volume variation and preventing cracks during the curing period. The compacted concrete construction method requires intervals between layers on the order of one to two days, to avoid the throwing of large volumes of concrete, minimizing shrinkage cracks caused by the heat of hydration. It is essential to ensure proper connection between successive layers, a process that becomes more critical as time goes on. The compaction control is carried out, initially, by the number of blows applied in each region of the layers and by the topographic monitoring of the settlement.

THE USE OF COMPACTED CONCRETE IN PETER ZUMTHOR'S WORK

The Bruder Klaus Chapel consists of a 12-meter-high tower, formed by 24 layers of compacted concrete, each 50 centimeters long. The concrete was crafted with a mixture of white structural cement and local Wachendorf aggregates such as yellow sand and river gravel, resulting in an inhomogeneous hue in shades of yellowish light ochre.

The Chapel was built in two distinct stages. Initially, 112 tree logs from the region were grouped together to create a central structure, similar to a Gothic hut, which served as the main mold, functioning as internal formwork for concreting. Subsequently, external wooden formwork was erected, forming a monolithic polygonal prism with five faces (Figure 4).

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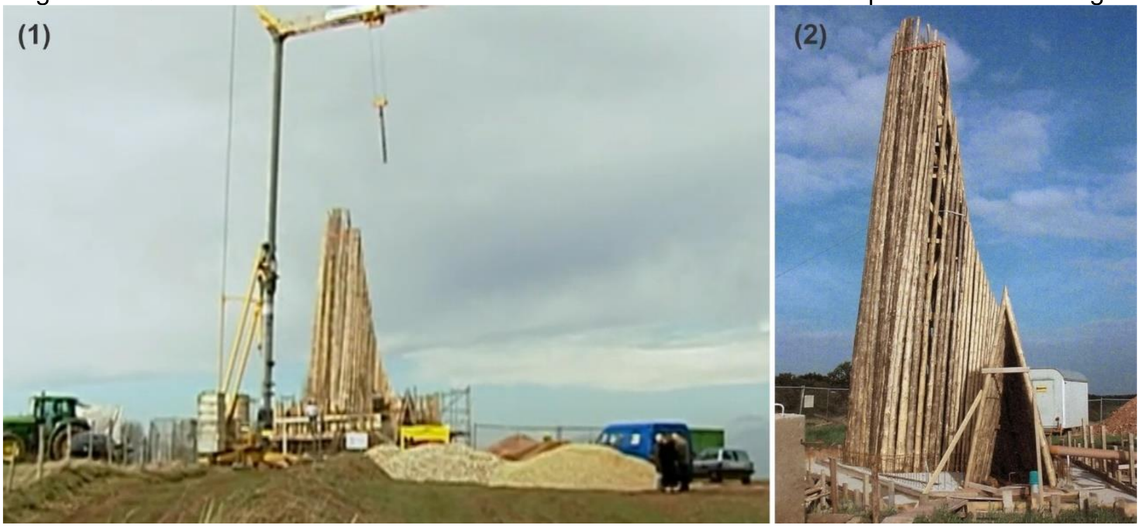
Figure 4 – Construction of the internal formwork of the Bruder Klaus Chapel with 112 tree logs.



Source: (1) SWR. Program about Bruder Klaus Field Chapel. [Video]. Available at: https://www.youtube.com/watch?v=mKdmQSngTUo&t=184s. / (2) WIKIARQUITECTURA. Bruder Klaus Field Chapel. Available at: https://en.wikiarquitectura.com/building/bruder-klaus-field-chapel/. Accessed on: 30 nov. 2024.

The formwork was filled with compacted concrete between October 2005 and September 2006 (Figure 5). A single layer of almost dry concrete was compacted per day, in a process carried out by the local community, using manual compactors, which compressed the mass until a film of moisture appeared. Due to the internal organic shape generated by the arrangement of the logs, the sections of the layers presented variations. Over the 24 days of the compaction process, approximately 70 m³ of concrete were applied, with a daily average of 2.91 m³ (Trias de Bes, 2013). The result of the concreting process is a horizontal texture, formed by the differences between the layers, which overlaps the texture of the wooden formwork used.

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Figure 5 – Compaction process of the concrete layers between October 2005 and September 2006.

Fonte: Openhouse BCN. Disponível em: https://openhousebcn.wordpress.com/wp-content/uploads/2013/09/openhouse-magazine-a-burnt-out-box-architecture-bruder-klaus-field-chapel-peter-zumthor-mechernich-wachendorf-germany.jpg. Acesso em: 30 nov. 2024.

The second stage of the construction process aimed to dismantle the wooden formwork. For a year, they were kept in place, waiting for the logs, which served as an internal mold, to dry before being removed. The removal of the trunks, essential for the concrete to register the negative of its volumes, was a delicate operation, since the breaking of the edges could compromise the planned result. Zumthor, while maintaining secrecy about the method used, shrouded the construction in a certain mystery. In September 2006, the process of slow burning of the logs began, which lasted approximately three weeks, probably using the external formwork itself as firewood. Subsequently, the charred logs were extracted with the aid of mechanical equipment. Once this operation was completed, the spatiality was revealed, highlighting the black and soot-impregnated texture that characterizes the interior of the Bruder Klaus Chapel (Trias de Bes, 2013; Zumthor, 2014).

Zumthor explored compacted concrete on other occasions. While building the Bruder Klaus Chapel, the architect was also finishing the Kolumba Museum (1997-2007) in Cologne, Germany. In the museum, he used the same resource on the walls of the courtyard, using a dosage of materials very similar to that of the chapel. The result presented very similar texture and concrete color in both works.

The same approach was applied to the House in Chivelstone (2008-2018), known as the Secular Retreat, built in Devon, England. Once again, the concrete was left in an apparent state, and the walls were compacted using formwork in 42 cm high bands. Each strip was filled with thinner layers of concrete, approximately 14 to 15 cm high, which after

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compaction, were 10.5 to 12 cm. Each layer was punched into the mold until the water rose to the surface, forming a light wet film. The horizontal layers resulting from this process refer to strata lines in rocks. White structural cement and light sand were used to create a more luminous appearance in the mix. The process required craftsmanship by the contractor, who had never worked with compacted concrete before and had to judge the amount of water to be added to the mix each day, based on the effect produced by kneading a concrete ball in his hand (Cousins, 2016).

THE TRANSCENDENT AND SENSORY EXPERIENCE OF THE BRUDER KLAUS CHAPEL

Two decades into the twenty-first century, the relationship between architecture and phenomenology has aroused growing interest (Pallasmaa, 2018), presenting itself as an alternative to postmodern interpretations of modernism. While the predominance of investigations on spatiality and functionality has given way to others, focused on typology and language, phenomenology stands out for prioritizing the value of human experience and sensory perception (Montaner, 2016). In this sense, it emphasizes the material, constructive and tactile dimensions of architecture, in addition to considering the use of the body as an instrument of perception and acquisition of knowledge.

The economic crisis of 2008 brought a new perception about the role of contemporary architecture in the face of exacerbated consumption and the indiscriminate use of natural resources. Since then, there has been an appreciation of the almost artisanal treatment of materials in their natural state, to the detriment of those that are more industrialized and artificial. This approach prioritized the expressiveness and rigor of the constructive logic inspired by processes that explore different textures, as well as the articulation of the whole with the detailing of its parts. This movement also boosted efforts to establish, in some way, an ethic of construction.

In the theoretical field, the analyses advanced based on phenomenology and humanistic and existential realism of the 1950s (Montaner, 2002), especially under the influence of philosophers such as Edmund Husserl, Maurice Merleau-Ponty, Gaston Bachelard, Martin Heidegger and Hannah Arendt. Contemporary authors, such as Juhani Pallasmaa, Yi-Fu Tuan, Alberto Pérez-Gómez, Karsten Harries, and Jorge Otero-Pailos, who have contributed significantly to the debate between architecture and phenomenology, have been deeply influenced by these ideas.

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In this context, Zumthor's work stands out for its singular character, dialoguing with different possibilities of reading, such as reason and subjectivity, technology and craftsmanship, essentiality and organicism, rationalism and spirituality. By developing the concept of Atmosphere (Zumthor, 2009), the architect explores how architecture can influence the senses and evoke emotions, eliciting emotional impressions (Böhme, 2013). Her work process is connected to phenomenology and finds affinities with the thought of Pallasmaa (2011), especially in the valorization of sensory and subjective experience as an essential element of connection between the human being and the architectural space. By reconciling intuition and technical rigor, Zumthor reaffirms that architecture, when sensitive to detail, light and materiality, can transcend the pragmatic and reach the realm of spiritual experience.[7]

If, for Zumthor, the Atmosphere is the result of the tangible and emotional presence transmitted by an environment, this presence encompasses the careful choice and intense experimentation of materials, in addition to the care with details that transcend the merely visual aspect. In this sense, the Bruder Klaus Chapel is an emblematic example. The way in which the architect used compacted concrete, giving the exterior a monolithic and stratified appearance in colored layers, contrasts sharply with the organic interior, which evokes primitive memories of a charred cave or grotto, bathed in a velvety light. This interior also refers to the formation of amorphous and rough tunnels by igneous lava, while the presence of fire suggests a deliberate symbolic meaning (Figure 6).

[7] In this sense, Zumthor (2004, p. 11) states: "We must ask ourselves, incessantly, what a certain material can mean in a specific architectural context. Good answers to this question can shed new light on both the habitual use of this material and its sensory and meaning-generating properties."

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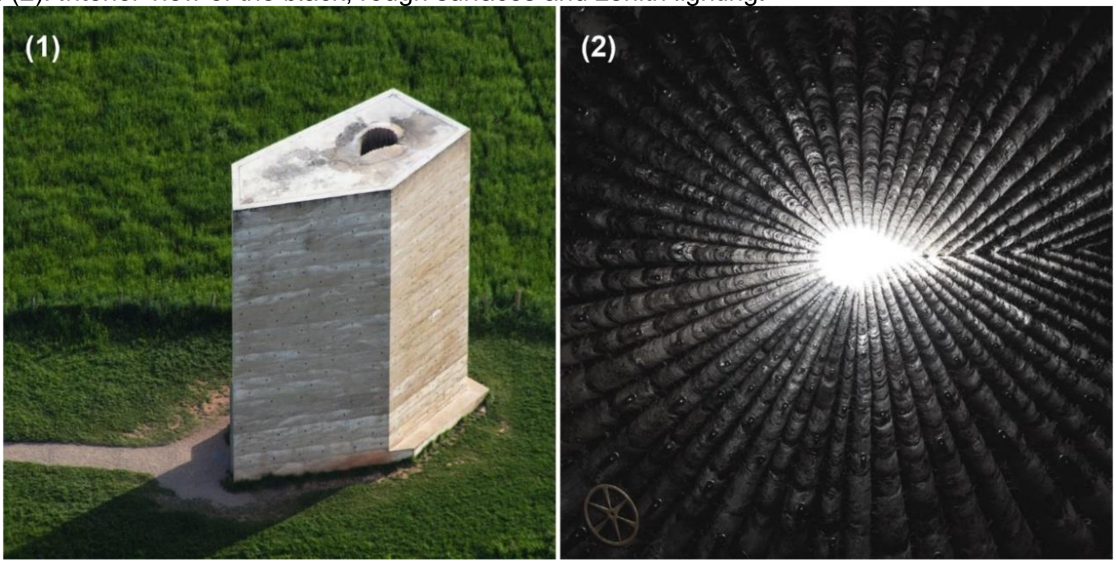
Figure 6 – Bruder Klaus Chapel. (1): External view of the layers of compacted concrete and the zenith lighting. (2): Interior view of the black, rough surfaces and zenith lighting.



Source: (1) Wolkenkratzer (2015). Available at: https://commons.wikimedia.org/wiki/File:Bruder-Klaus-Feldkapelle_(Wachendorf)_003x.jpg. Accessed on: 30 nov. 2024. / (2) Rasmus Hjortshøj - COAST (2017). Available at: https://divisare.com/projects/349303-peter-zumthor-rasmus-hjortshoj-bruder-klaus-feldkapelle?utm_campaign=journal&utm_content=image-project-id-349303&utm_medium=email&utm_source=journal-id-187. / Accessed on: 30 nov. 2024.

This treatment was essential to create a complex and meaning-rich atmosphere. Surfaces, weights, densities, sounds and the aromas of burnt wood dialogue directly with the senses, intensifying the experience. Exploring the tactile qualities of compacted concrete, Zumthor goes beyond its physical properties. The expressive materiality connects the building to the rural context, while the non-homogeneous layers of concrete preserve the marks of the construction process. These marks register the collective effort, transforming the construction into a shared memory, expanding its meaning of belonging and identity.

The Chapel is configured as a hermitage, a kind of medieval tower that, at first perception, provokes a deep estrangement. The rough texture of the walls and the reflection of light on the dark surfaces create a direct and almost primitive sensory interaction between the visitor and the place, evoking ancestral images. In a second moment, as the pupil adjusts to the inner luminosity, the emotional reaction intensifies. The contrast between the darkness and the soft light that penetrates through the zenithal opening, of organic shape, located twelve meters high, induces a state of recollection and reflection.

The manipulation of natural light and shadows plays an essential role in the construction of the Atmosphere, creating contrasts, accentuating volumes and intensifying

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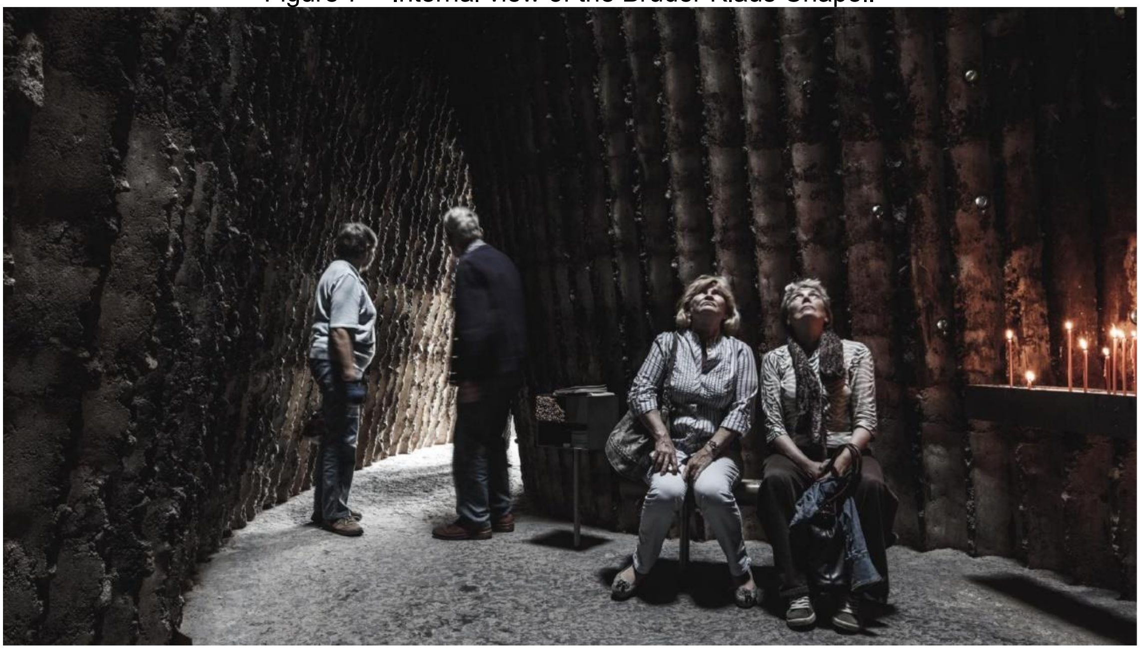
the perception of form, as a silent, human and timeless poetry. The entry of natural light from above goes beyond the architectural solution, working as a visual metaphor. By directing the visitor's gaze upwards, it promotes a transcendent experience, suggesting a symbolic path that connects the human to the divine (Figure 7).[8] The Atmosphere takes on even more unique connotations thanks to the brightness of the light that passes through the 350 small glass spheres inserted in the holes in the concrete, resulting from the locking of the internal and external formwork with rocking screws. These small spheres glow when sunlight passes through them, resembling stars that punctuate the darkness of the rugged walls, evoking the serenity of a starry night.

Figure 7 – Internal view of the Bruder Klaus Chapel.



Source: Rasmus Hjortshøj - COAST (2017). Available at: https://divisare.com/projects/349303-peter-zumthor-rasmus-hjortshoj-bruder-klaus-feldkapelle?utm_campaign=journal&utm_content=image-project-id-349303&utm_ medium=email&utm_source=journal-id-187. / Accessed on: 30 nov. 2024.

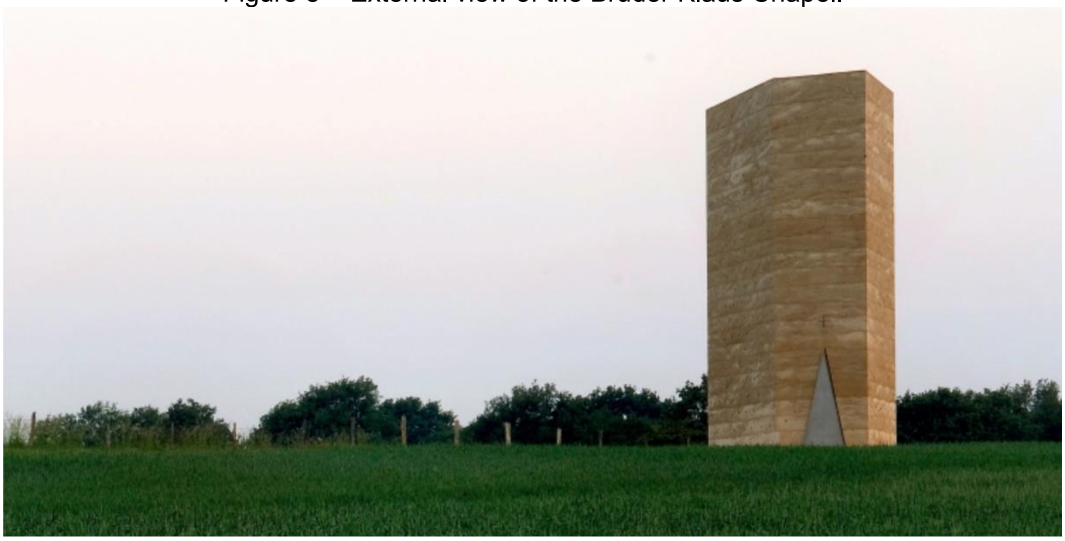
Silence, in this case, is dense and has its own sound volume, treated by Zumthor as an essential condition for experiencing spatiality, allowing introspection and contemplation. In a quiet environment, the senses are sharpened. The absence of noise can be perceived almost as a sound, while small whispers or footsteps of another person gain greater clarity. This introspection can lead the person to disconnect from the outside world and connect with themselves, allowing thoughts, feelings, and memories to surface.

[8] According to Zumthor (2014, p. 121): "Over time, the project became clear and elementary: light and shadow, water and fire, materiality and transcendence, the earth below and the open sky above. And then, suddenly, the small devotional space became mysterious. A stroke of luck."

As the Chapel has no electrical installations inside and the zenith lighting is open, without a fence, the rain or snow that falls from the top form a small puddle on the floor. This model, with a thickness of only 2 cm, is composed of an alloy of tin and lead melted on a concrete subfloor, obtained from the slow casting of four tons of recycled cans (Zumthor, 2008).

The transition between the external and the interior space was masterfully carried out. First, you have to take a walk of about one kilometer, between Wachendorf and the Chapel, gently climbing through an open field. This route, described as a pilgrimage, prepares the visitor for the experience to come (Potworowski, 2024). The route not only connects the building to the territory, but also intensifies the perception of the Chapel as a spiritual refuge, marked by simplicity and the force of nature. From this perspective, the walk to Bruder Klaus becomes an essential part of the architectural experience. The crossing of the heavy triangular steel door, 15 cm thick and 3.5 m high, completes the rite of passage, marking a symbolic threshold between the outside world and the environment of introspection and sacredness (Figure 8).

Figure 8 – External view of the Bruder Klaus Chapel.



Source: SAVORELLI, Pietro. *Capilla Bruder Klaus, Wachendorf*. Arquitectura Viva, Madrid, n. 120, p. 66-69, 2008. Available at: https://arquitecturaviva.com/obras/capilla-bruder-klaus-wachendorf. Accessed on: 30 nov. 2024.

The design process of the Chapel was long,[9] at the same time experimental and intuitive, marked by the intense use of sketches and large-scale models, modeled with

[9] In June 1997, Peter Zumthor won the competition for the construction of the Kolumba Museum in Cologne, Germany. The following year, the architect received a letter from the couple Hermann-Josef and Trudel Scheidtweiler, farmers from Wachendorf, 50 kilometers south of Cologne. In 1999, probably during a visit

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materials that reproduced the materiality of the project to the maximum.[10] This approach allowed sensitivity and perception to anticipate how spaces would be experienced. As the Atmosphere is intrinsically linked to memory and imagination, the use of the models helped Zumthor and his team in the refinement of their choices, enhancing the spatial configuration, which, by evoking personal and collective associations of the entire rural community involved in the project, became deeply significant.

The architect, who did not charge for the project, only requested silence in relation to the techniques used and the construction processes (Trias de Bes, 2013). In this way, he contributes to the creation of a myth. Without detailed documentation, when all those involved are no longer present, the constructive secret will remain veiled. The process is partially elucidated by some photos and a brief text of his authorship. With this, he achieves maximum abstraction, transforming the chapel into a mythical object, as well as the saint himself that it honors.

CONCLUSION

The analysis of the Bruder Klaus Chapel from the perspective of tectonics revealed how Peter Zumthor resignified the constructive practice of compacted concrete, transcending its functional use to reach a poetic and phenomenological dimension. The architect not only rescued a centuries-old technique, but also reinterpreted it in an innovative way, integrating technical and sensory aspects in the creation of a significant work. The construction process, marked by its singular materiality and sensory interaction with the environment, reaffirms the potential of a part of contemporary architecture that dialogues with phenomenology, to provide transcendent experiences.

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related to the progress of the Kolumba Museum project, Zumthor met the couple and visited the place where the chapel would be designed, returning only in 2001 for a new visit (Trias de Bes, 2013). According to Netz (2007), Zumthor stated: "After I won the competition for the Diocesan Museum of Kolumba in Cologne, the Scheidtweilers read about it in the newspaper and thought: Swiss architect, Catholic, this would be incredible! Because they wanted to build a field chapel and dedicate it to Brother Klaus, who was also Swiss." The architect also revealed a personal reason for accepting the project, stating: "Bruder Klaus is a kind of family saint to me: he was important to my mother, who said that he often helped her in difficult situations." About the long time of conception of the project, Zumthor commented: "It took me years to find the right interior for the small country chapel" (Zumthor, 2014, p. 121). After this period of maturation, the work began in 2005 and was completed in 2007.

[10] Zumthor produced 1:10 scale models using bamboo sticks and white clay to study the effects of light on the sloping walls of the chapel. Subsequently, he built a full-scale model (1:1), simulating the logs with black sanitary pipes, which allowed for the necessary adjustments to define the final drawings of the project (Potworowski, 2024).

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In this context, the results highlight Zumthor's unique ability to articulate the mastery of the physical properties of compacted concrete with existential questions (Zumthor, 2014), promoting experiences that engage the senses, stimulate deep reflections and create an atmosphere of intense connection between the human being and the architectural space. The Bruder Klaus Chapel stands out as an example of the articulation between technical excellence and phenomenology, configuring itself as a spiritual refuge whose essentiality and depth evoke, in the words of Pérez Oyarzun (2002, p. 35), the "[...] possibilities of narrative argumentation that the constructive process contains".

The relevance of this study lies in its ability to foster discussion about tectonics, highlighting its importance for both the practice and the theory of contemporary design. In addition, the interdisciplinary approach adopted, anchored in complexity, offers a significant contribution by broadening the understanding of the limits and reaches of architecture as a cultural and artistic practice, integrating constructive technique, poetic expression and phenomenology.

In addition, this study suggests that the valorization of the artisanal process, by combining experimentation and technical rigor, can point directions for architectural practice, promoting a return to the elementary qualities of construction and the conscious use of materials. In this sense, The Bruder Klaus Chapel dialogues with the thought of Fernández-Galiano (2013, p. 3), when he states that the "[...] matter is the most spiritual thing today", clarifying that, in a "[...] a world saturated with digital images, the return to the physical and tactile humility of primitive materials has the character of a pilgrimage to the essential sources of construction [...]."

However, it is necessary to recognize the limitations of this work, especially with regard to the analysis of the compacted concrete technique in other architectural and cultural contexts. Future studies could investigate how the methodology developed by Zumthor at the Bruder Klaus Chapel can be applied in projects at different scales and programs.

Finally, the Bruder Klaus Chapel not only reinforces the importance of tectonics as an element capable of articulating technique and expression, but also inspires a perception of architecture as a practice deeply rooted in the human condition. By valuing materiality, manual making and experience, Zumthor's architecture allows the construction of a

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discourse that goes beyond the local and dialogues with time and memory, achieving a universal meaning.[11]

[11] In this sense, we conclude the text in tune, once again, with the thought of Fernández-Galiano, who states: "Symmetrically, the local is also the most universal. As the writer and philosopher Miguel de Unamuno warned a century ago, it is only possible to achieve a universal dimension by delving into the roots of what is proper (2013, p. 3).

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