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The art of structural relation: Kazuo Shinohara's "strong structures" design thinking

Shuaizhong Wang ^a and Toni Kotnik ^b

^aDepartment of Architecture, ETH Zürich Zurich, Switzerland; ^bDepartment of Architecture, Aalto University, Helsinki, Finland

ABSTRACT

With increased interest in materials and construction in the architectural field, the use of building structure as the element of architectural expression has gained interest in recent years. In his analysis of contemporary Swiss architecture, Arthur Rüegg has coined the notion of "Strong Structures" for the tendency to activate a load-bearing structure for spatial and conceptual expression. The article applies this notion to the works of renowned Japanese architect Kazuo Shinohara, who has influenced many prominent Swiss figures in the debate over "Strong Structures." By conducting phenomenological research on his experimental practices in House in White, Tanikawa House, and House in Uehara, the article examines how Shinohara used the organisation of structural elements and relations to express the architectural and cultural context. Finally, by contrasting the structural design methods used in Switzerland and Japan, this article aims to introduce a relational structure design mindset in order to complement and extend the concept of "Strong Structures", which can enrich structural design by focusing on the art of structural relations.

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Kazuo Shinohara; strong structures; structural art; relationship; opposition

1. Introduction – Structure as architecture

Due to the recent advancements in digital computation and innovative construction techniques, the concept of "performative architecture" has gained popularity in the architectural field (Kolarevic and Malkawi 2005). Performative architecture is a term that refers to a quantity-based design strategy in which numerical parameters are used to evaluate or to predict the performative aspects of a design, such as its functionality, its economy, or its stability. As a result, the performative architecture enables greater control and freedom over the spatial and performative aspects of load-bearing structures (Picon 2010). With this, digital and parametric designs have rekindled interest not just in materiality but also renewed interest in the building structure (Araya 2011, 55).

Building structures, however, are not only working against gravity; they can also represent the artistic and poetic of the building (Frampton and Cava 1995). Like animal bones, structures impose shape, patterns, and order on the building (Garagam 2019), thus contributing to space-making.

This brings the concept of "Structure as Architecture" to the forefront (Charleson 2005).¹ This term refers to a design philosophy in which structures

are designed not only to provide the necessary stability, strength, and stiffness for architecture, but also to reinforce spatial and perceptual concepts and requirements. Apart from passive influence, as the most fundamental part of architecture, the structure has the potential to speak actively as an agent of architectural expression.

Such an understanding of structural design is not entirely novel but has been applied to architectural design on various occasions in the past.² This is particularly evident in the use of the column as a prototypical load-bearing element, like the sixteen arboreal iron columns exemplified in the reading room of the National Library of France (1868) designed by Pierre-François-Henri Labrouste. These columns are a clear expression of force transmission but behave both authentically and decoratively, powerfully and delicately. The slenderness of the columns created the illusion of towering ceilings that appeared higher than they actually were, enhancing the sense of the rooms' grandeur. The structural expression in the National Library of France is decorative in an honest way, and it transcends pure structural expression to achieve higher spatial quality.

CONTACT Shuaizhong Wang  shuaizhong.wang@arch.ethz.ch  Department of Architecture, ETH Zürich, Zürich, Switzerland

¹Besides the book *Structure as Architecture*, there are also many other research studies based on a similar idea, for example, Mostafavi, Mohsen. 2006. *Structure as space: engineering and architecture in the works of Jürg Conzett and his partners*. London: AA; and Sandaker, Bjørn Normann, Arne Petter Eggen, and Mark Cruveller. 2019. *The structural basis of architecture*. Abingdon, Oxon; New York, NY: Routledge.

²It has been used and named differently, including "organisational structures" or "spatial structures". For "organisational structures", see Kepes, Gyorgy. 1965. *Structure in art and in science*. New York: G. Braziller; For "spatial structures" see Heuvel, Wim J. van. 1992. *Structuralisme in de Nederlandse Architectuur*. Rotterdam: Uitgeverij 010. For more discussions, see the summary by (Rüegg 2009). "Starke Strukturen: Formen des Umgangs mit der Tragkonstruktion", *Werk, Bauen + Wohnen*, no. 5 (May): 4–11.

A similar example is Auguste & Gustave Perret's Church of Notre Dame du Raincy (1923) in Raincy. Due to the church's limited financial budget, Perret designed the church in reinforced concrete, a new material at the time that was used for the first time in church design (Santiago 2019). Four rows of tall, slim, and round columns supported the roof unadorned, and the joint between the column, beam, and roof shows visible evidence of the formwork used during construction. The reduction of the column, beam, and roof did not diminish the sense of space; instead, the authentic exposure of the concrete brought the entire church into a more powerful, holistic, and minimalist spatial atmosphere. Thus, the "Rationalism in the design of this building has replaced 'mysticism', and the whiff of Gothicism is subordinated to Perret's mastery of his material and its structural potential (Sharp 1972, 68)." The Church of Notre Dame du Raincy's emphasis on structural behaviour and construction is a manifestation of a structural design thinking that not only creatively liberated the wall but also successfully defined the church's character.

Ludwig Mies van der Rohe's design of the columns for the New National Gallery in Berlin (1968) also exemplifies the inherent tectonic connotation of such structural design. Mies' last work crystallises his lifelong pursuit of fluid and open spaces. To demonstrate the clear construction logic of the gallery, he deconstructed the entire structure into its roof, columns, and floor. Eight cross-shaped pillars positioned at quarters on each side of the eaves support a 1.8-meter-tall, 1,250-tonne roof. The distinct separation between the roof and the columns and the absence of columns at each corner of the roof give the building an air of light and elegance. The section shape of the flange near the end of the cross limb ensures that the stress distribution is as close to the outer edge as possible in the column design. The gradual increase in section size from top to bottom reflects the Doric column's classical structure rationality. The hinged point-joint between the column and the roof emphasised not only the tectonic distinction between the column and the roof but also the column's relevance to the classical capitals (Vandenberg 1998). The delicate relationship between the column and roof, and the weightlessness of the gentle touch, all contribute to the structural solution's significance. This creates the illusion of a structural design that is an honest load-bearing structure and an expression of his architectural philosophy.

The three examples of the National Library by Labrouste, the Church of Notre Dame du Raincy by Perret, and the National Gallery by Mies van der Rohe, are mere demonstrations of the idea of "Structure as Architecture". At the same time, they all demonstrate how advances in materials and construction techniques enable new forms of structural expression and illustrate Livio Vacchini's observation that "for

us [as architects] it is fortunate that with scientific progress construction methods and techniques are changing over the course of time. Due to this change of construction methods, the appearance of buildings is changing, too. That is the development of construction methods drives the evolution of architecture" (Blaser 1994).

2. Strong structures

According to the Swiss engineer Jürg Conzett, such development in construction methods is also one of the reasons for an increased interest in the use of supporting structures as a medium for architectural expression in contemporary Swiss architecture (Rüegg 2009). In his study of this tendency, the architect Arthur Rüegg proposed the term "Strong Structure" as a denomination for the design-oriented conflation of architecture and engineering. In his contribution to the Swiss magazine *Werk, Bauen + Wohnen* (The Editors 2009), Rüegg describes Strong Structures as "load-bearing structures that do not secretly fulfil their function by carrying loads to the ground as discretely as possible, but instead make architecture out of this existentialist theme, this drama". That is, the load-bearing structure defines the architectural identity of the building. Referring to Siegfried Giedeon's bon mot, Rüegg characterises Strong Structures as "structure becomes expression; structure becomes design". Comparable to the notion of Structure as Architecture, Strong Structures refer to a type of structural concept that emphasises not only on physical properties of a building structure but also its visual performance and spatial concepts. It embodies a structural thinking "that fundamentally shapes the character of a building, its spaces, and appearance". The concept of Strong Structures describes an "integral ordering structure" that involves both the interior and the exterior in equal measure (Schnetzler et al. 2012, 201).

Such integral ordering by the building structure is not driven by mere rationality of engineering thinking. For Rüegg, Strong Structures are not "pure structure" like in the case of Gustave Eiffel's tower in Paris, the Sabolovska Tower by Vladimir Suchov in Moskau, or the pioneering concrete shells by the Swiss engineer Heinz Isler. Rather, the building structures are part of an "architectonic rhetoric" that at times even can obfuscate the load-bearing mode of action like in the design of the Olympic Stadium in Beijing by Herzog & de Meuron, the Swiss Re Building in Rüschlikon near Zurich by Meili and Peter, or the House Fosterstrasse in Zurich by Christian Kerez (Figure 1). These examples of Swiss architecture share a design thinking that aims at the "seduction of the senses and the intellect by means of craftiness of contemporary construction methods" (Rüegg 2009).

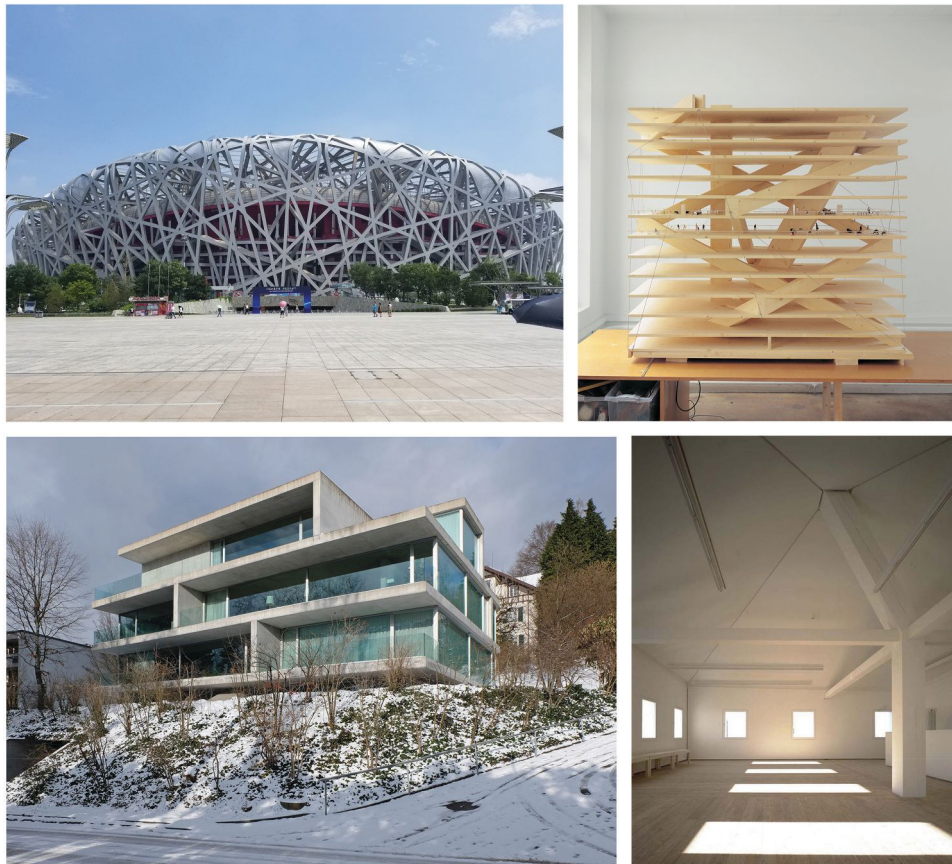


Figure 1. Top left: Herzog & de Meuron, Beijing National Stadium (2007). Source: Wikimedia Commons; Top right: Christian Kerez, Model photo of Swiss Re Next (2008). Source: Christian Kerez; Bottom left: Christian Kerez, Apartment building on Forsterstrasse, Zürich (2003). Source: <http://www.archipicture.eu/>; Bottom right: Valerio Olgiati, The Yellow House, Flims (2000). Source: <https://museen.gr.ch/>.

Developments in construction methods, however, are not the only reason for the appearance of Strong Structures in contemporary Swiss architecture. For the architecture historian Martin Steinmann the search for form has been an additional important driver in the architectural discourse in Switzerland for the past 30 years (Vuilleumier 2018). In his study “la forme forte”, he describes the exploration of the perception of primary forms within Swiss architecture of the 1990s and the impact of the minimal art of Carl Andre, Donald Judd and Richard Serra on a generation of young architects, especially in the German-speaking part of Switzerland (Steinmann 1991). As a result of these artistic references, the work of architects like Herzog & de Meuron, Christian Kerez or Valerio Olgiati is not only characterised by simple volumetry but also a focus on materiality and the precision and perfection of construction.

A characterisation that can also be attributed to the architecture of Kazuo Shinohara (Dehli and Grolimund 2019). It is this affinity to the work of the Japanese architect that has caused increased interest in Shinohara’s oeuvre within the Swiss context over the past decade and resulted in several publications (The Editors 2009; Compton et al. 2011; Dehli and

Grolimund 2019; Joanelly 2020) as well as an exhibition of Shinohara’s work at the Swiss Federal Institute of Technology (ETH) in Zurich in 2016. At this exhibition titled *On the Threshold of Space-Making*, the affinity was explored in an attempt to relate the work of Kerez and Olgiati to the architecture of Shinohara (ETH Höggerberg 2016). For Kumiko Ikada, curator at the Gallery Ma in Tokyo who specialises in architecture, such exploration of relationships is justified because “in some ways Swiss architecture is compatible with Japanese aesthetics. They use simple designs, but give great attention to detail and fine craftsmanship” (Narigon 2013).

In general, there is a high appreciation for contemporary Japanese architecture in Switzerland and architects like Kerez are “fascinated by the work of Japanese architects such as Kazuyo Sejima and Ryue Nishizawa of SANAA” (Narigon 2013), who both have been strongly influenced by Shinohara (Kuan 2019). At the same time, the work of Christian Kerez is a prototypical exemplification of the idea of Strong Structure (Rüegg 2009).

The affinity of the work of protagonists of contemporary Swiss architecture with the architecture of Kazuo Shinohara motivates the question of whether

Rüegg's notion of Strong Structure provides a suitable framework for understanding Shinohara's work and his high appreciation within the Swiss context. This research question obtains its relevance from the observation that most of the reception of the architecture of Shinohara has been highly entangled with Japanese culture. At the same time, Shinohara's writings are widely understood as an integral part of his design thinking, although often deemed abstruse and inaccessible even in their Japanese originals (Kuan and Kerez 2018). Therefore, the rising appreciation of Shinohara's work from abroad cannot be grounded in an introverted perspective that discusses his oeuvre from within the Japanese context and his impact on contemporary Japanese architecture.

Because of this, a phenomenological reading of Shinohara's work is used within this research, with the immediate, perceptive interaction with the building as starting point of engagement. This qualitative method of exploration does not only allow for guiding the consciousness towards the object itself without its entanglement into a multitude of cultural readings. But in addition, the phenomenological perspective relates directly to aspects of perception and, as such, to the "seduction of the senses and the intellect" that, according to Rüegg, is characteristic of Strong Structures. As Shinohara expresses his architectural intentions primarily through the publication of his carefully chosen photographic perspectives, this paper provides an in-depth analysis of his work by focusing on those photographs that best illustrate his design concepts. The focus of the analysis will be on Shinohara's experimental practices of House in White (1966), Shinohara (1974), and House in Uehara (1976). These three buildings are widely regarded as the quintessential expression of his design thinking (Taki, Warren, and Ferreras 1983), and in all of them, the archaic building element of a column is of central importance for the design. The analysis of the three small houses will allow a better understanding of the role of structure in the architecture of Kazuo Shinohara, and with this, an understanding of his work can be considered a Strong Structure that is an expression of an "existentialist theme" by means of structure.

3. Kazuo Shinohara's contextual structure

Kazuo Shinohara is widely regarded as one of the most influential Japanese architects and architectural theorists of the 20th century. The Japanese master architect himself classified his creative work into four styles.³ His design interests shifted from a conceptual understanding of Japanese architectural tradition to a confrontation with the chaotic metropolis of Tokyo. A particularly compelling aspect of Shinohara's oeuvre is his vision of a close connection between practice and theory, as well as his conscious positioning of his own work in a charged relationship with social and cultural issues (Dell'Antonio and Joanelly 2015). In 1967, Shinohara published an article titled "Theory of Residential Architecture" in which he discusses the role of technology in design and the necessity of a counterbalance to the purely rational. According to Shinohara, a "Twin Phenomenon" between humankind and technology was necessary to "offset the number of technical decisions in order to keep the two factors balanced" and to define the structure's "irrational" part in addition to its mechanical function (Shinohara 2011a). He asserted, "Thus, architects while opting for diverse technologies, must strive to achieve a whole greater than the sum of its parts. Technology is magnificent, but human life is still more so (Shinohara 2011a)." This could be viewed as a complement to his now-famous manifesto, "A house is a work of art" published five years earlier in which he began to believe that balancing the technical aspects of architecture is also critical when designing conceptual spaces (Shinohara 1962).

Shinohara's design concepts stem from his research on traditional housing and his search for the "art" of Japanese housing, in which he concluded that "Tradition is the starting point of creation, not the return point (Shinohara 1960a)." More importantly, the Japanese tradition he sought to explore is not simply an object displayed as a symbolic decoration but also how to express it within the contemporary context of Japan's spatial order and architectural configurations. This led him to choose the most ontological method that directly treats the elementary element of creating Japanese spaces: structure. According to the renowned Japanese structural engineer

³Shinohara's first style is derived from traditional Japanese architecture and delves into Japanese space's strong abstraction and symbolism, coining the concepts such as "frontality" and "division". Representative works include House in Kugayama (1954), Umbrella House (1961), and House in White (1966). The second style departs from tradition and focuses on investigating anti-spatial forms such as the "cube" and the "fissure space". Representative works include Uncompleted House (1970), Cubic Forest (1971), and Prism House (1974). In the third style, Shinohara became fascinated by the relationship between buildings and the urban environment and transformed these relationships into primitive, naked, and spatial confrontations in order to eliminate anything that obscures or confounds the fundamental ideas and shapes beneath. He considers people's bodies and movements as formal components that collectively define space in this style. Representative works include Tanikawa House (1974), House in Uehara (1976), and House on Curved Road (1978). In the fourth style, Shinohara began designing large-scale public projects, which resulted in some forward-thinking attitudes, such as "space machine" and "Modern Next," to infuse architecture with chaos and randomness to breathe new life into the city. Representative works include House in Yokohama (1985) and Centennial Hall at Tokyo Tech (1987). For details, see Massip-Bosch, Enric. 2015. "Emotion devices: The role of concrete frame structures in the architecture of Kazuo Shinohara." PhD diss. Universitat Politècnica de Catalunya-BarcelonaTECH, and Kuan 2019. *Kazuo Shinohara: Traversing the House and the City*. Zurich: Lars Müller Publishers; [Cambridge, Massachusetts]: Harvard University Graduate School of Design.



Figure 2. Shinohara Kazuo, House in White, Tokyo (1966). Photo by Murai Osamu. (Shinohara, 2011b, 74)

Yoshikatsu Tsuboi, “A structure’s beauty can be found near its rationality.” It is such transcendence of the pure rational that described the structural thinking of Shinohara and transformed his work into a “Traditional constitutive minimalism” through structural composition design (Shinohara 1960b).

3.1. The structural relations in House in White

Kazuo Shinohara designed the House in White two years after releasing the manifesto “A House is a work of art” (Figure 2). It is a representative case from his first style period and successfully represents contemporary Japanese culture.

The House in White (1966) was designed for a couple devoted to children’s literature and crafts, as well as for their three children. The house’s straightforward design featured a squared floor plan and a large pitched roof. People may be unaware of the building’s uniqueness until they step inside. The roof of the House in White was supported by a beautiful umbrella-like wooden structure in the centre of the building. However, Shinohara unexpectedly concealed a white ceiling beneath the roof structure, leaving only a round wooden column in the centre (Figure 3).⁴ The most common and efficient wall and ceiling arrangement logic in residential design is to follow the structure’s division logic. However, the wall in the House in White

has shifted slightly away from the centre column and placed in an un-centrally misaligned section (Figure 4). Due to this misalignment, the column’s position in the space creates a robust yet heterogeneous feeling. As a result, the composition relationships between the column, wall, and ceiling – which represent Japanese culture – resulted in the design concept of *frontality* and *No-depth feeling* (Shinohara 1996a; Beynon 2012).⁵

Frontality is a characteristically Japanese way of comprehending their tradition, which is also reflected in Japanese paintings, animation, and games. For instance, Ukiyo-e artists depict Japanese paintings by overlapping a series of flat planes with no discernible depth (Figure 5). Japanese animation employs a similar expression of motion, in which the people in front remain stationary while the background changes constantly. These all suggested an architectural trend toward emphasising width over depth, resulting in a more flat plane-like surface. Numerous architects have been profoundly influenced by this perspective known as “Superflat” and “2.5D” (Beynon 2012).

The House in White’s simple division by the wall also reflects the Japanese concept of space. As Shinohara once stated, “Japan has no space” (Shinohara 1996a), and the term “Ma (間)” is used to describe this Japanese’s distinctive understanding of space. The term “Ma” was frequently used in architectural discourse to refer to the in-between-space or the interval

⁴This column has both structural and cultural significance; it references the traditional Japanese *Daikoku-bashira*, which is frequently located in the centre of the home. The *Daikoku-bashira* is critical for the roof structure’s support; it is the largest column and one of the first to be constructed; it represents the household’s protector or primary supporter. This article will focus on the organisational aspects of this column rather than the symbolic one. More detail see Jacquet, Benoît. 2015. “On Things to Come: What contemporary Japanese architecture should be like”. Hosei University International Japanese Studies Institute. *Nihon ishiki no mirai: gurōbarizeshon to “Nihon ishiki The future of “Japanese Identity”: “Japanese identity” and globalisation*, pp.191-216.

⁵Shinohara discovered that the Japanese aesthetic has reduced architecture and art to a two-dimensional plane, and that the Japanese inertial aesthetic has a distinct aesthetic perspective known as *frontality*. When viewed from the front, such a design concept gives all buildings a sense of tension, but the tension weakens or disappears as the perspective shifts sideways. For more details, see (Shinohara 1960a). “Residential Theory”, *Shinkenichiku*, no. 4 (April).

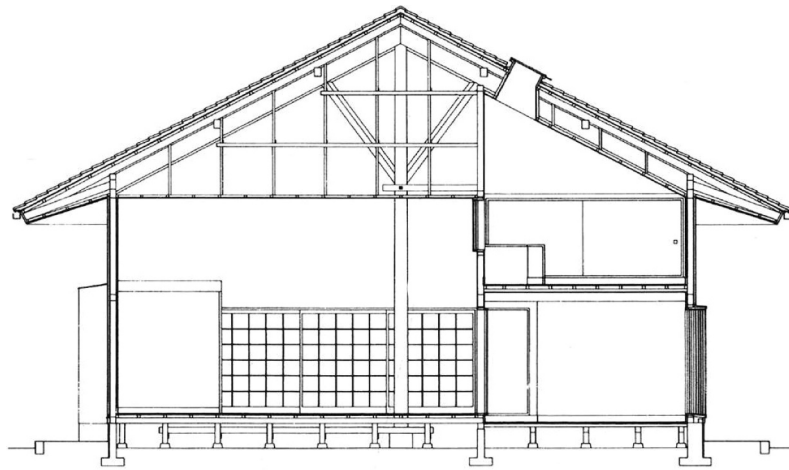


Figure 3. Section of House in White. (Editorial Board of Kazuo Shinohara's collection, 2013, p. 50).

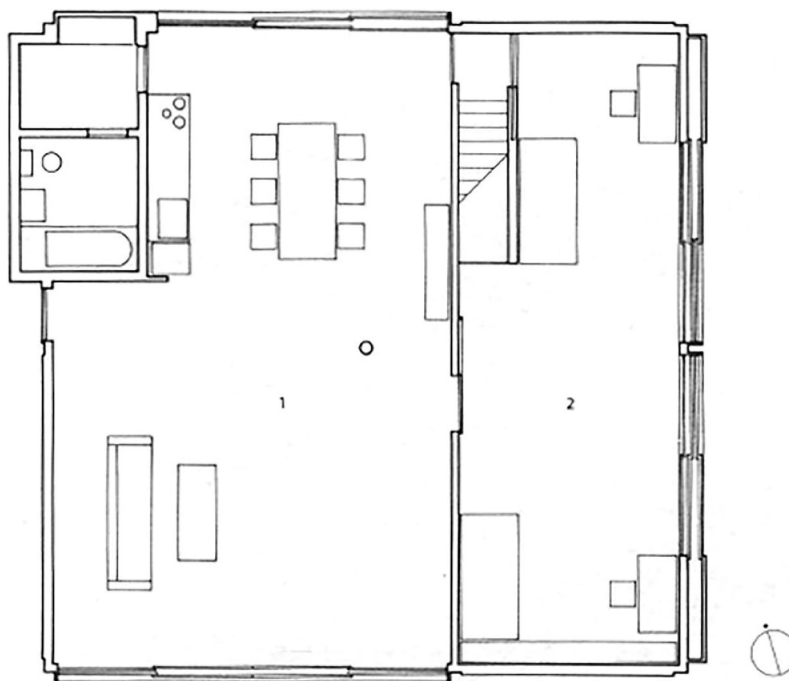


Figure 4. First floor plan of House in White. (Editorial Board of Kazuo Shinohara's collection, 2013, 51).

space between two objects (Isozaki 1979). The more abstract meaning of “Ma” is “separation,” which can be extended to encompass the meanings of the space-time blank (Pilgrim and Richard 1986). This concept is embodied in the East’s ancient thought and philosophical systems. In contrast to the emphasis on matter, Japanese aesthetics is more concerned with discovering deep meaning in “nothingness”, which is considered an empty space in Japanese housing and has the potential for human activity development. Nothingness, on the other hand, can never exist alone. The architectural structure and the void space are inextricably linked. As one of the most compelling arguments, Shinohara recognises that the Japanese “Ma” is formed through *division*, and that the space within the house subdivided by the column and wall is the fundamental feature of Japanese spatial identity.

Japanese space is defined ontologically by the homogeneous and ambiguous freedom that exists between the undefined interval areas between structural elements (Shinohara 1960b). Thus, through this subtle gap, the misalignment between the middle column and the wall activated the sense of Japanese space.

Through these Japanese-culture-oriented spatial organising logics, Shinohara was able to incorporate the Japanese identity and traditions into architecture through the use of everyday, elemental, and even universal structural elements – not the symbolic decoration, but the composition logic of the components. As a result, the structure takes on the role of a carrier of cultural values. Additionally, the composition logic’s misalignment method stripped away and metamorphosed the structure’s original and forceful attributes, transforming it into a non-structure, such as an exotic



Figure 5. “Actors Nakamura Fikusuke I as Kasugaya Tokijirō and Iwai Kumesaburō III as Yamanaya Urazato,” Utagawa Kunisada, 1857. © Museum of Fine Arts, Boston. (Source: <https://collections.mfa.org/objects/471798>) This painting looks like appears to be an overlapping of several flattened 2D images, without a strong perspective.

object. In other words, the meaning that people can perceive from space is derived not from the objects or elements themselves but the intangible organisational relationships between these objects. These relations evolve into a new kind of abstract ornamentation for the space that embodies Japanese traditions (Fujimoto 2008). On the other hand, this method of misalignment is also anticlimactic, as it dissociates the instantaneous climax that this beautiful structure may provide while retaining the heterogeneous feeling. Consequently, spatial perception becomes inextricably linked to time-liness, and time becomes a structural component (Ye and Qian 2017).⁶

The House in White’s structural logic is relatively straightforward. By distorting the relationships between various structural elements, Kazuo Shinohara elevated the House in White into a building capable of expressing the abstract context – Japanese culture and identity. Furthermore, they are expressed not through the superficial symbolic physical decoration but through the “structure” of the Japanese context as expressed

in the composition logic of the structural elements. Thus, the structure’s load-bearing performance is subordinate to the culture. In this sense, the column in Shinohara’s design for the House in White can be interpreted as a Strong Structures. The structural expression in the House in White oscillates between truth and concealment, making the building rational yet emotional, modern yet traditional, and ultimately transforming the cold structure system into an art of Japanese culture (Shirasawa 2008).

3.2. Structural oppositions in house in white

Japanese culture can be expressed through the design of relational Strong Structures in the House in White, which necessitates human experience and perception of space. Shinohara activates this human perception and experience of the space by working with architectural means opposition that re-contextualises structural elements like the column (Taki, Warren, and Ferreras 1983).

⁶Kazunari Sakamoto, a student of Kazuo Shinohara, explains why Shinohara decided to cover the wood trusses with a white ceiling: “When you enter the House in White, imagine that the white ceiling has been removed. When the very beautiful structure is exposed, you will find that it is two completely different expressions of space from the state that is covered. That is to say, its inclination is completely different. When this structure is exposed, it may become more powerful. But when this power appears, it rejects time, which is a kind of so-called pleasure that can only be obtained instantly (. . .) When the white ceiling completely imprisons the power of this powerful structure, you will suddenly find that this space directs to time. After the power is sealed, time can get the maximum expression, so what you can feel in the House in White is not so much space, but a kind of time, making time into a form, a form of dialogue with your body.” See more details from (Ye and Qian 2017). “Theory, Practice, and Education: A Ten-People Conversation of Archi-Neering Design”

In the case of the column in the House in White, Shinohara couples the single column with the wall through close vicinity, transforming the wall into a background for the column with the white and smooth background of the wall as opposed to the darkness and roughness of the column. The visual dematerialisation of the wall and ceiling creates the illusion of the column floating in space, liberated by and load to be carried. Weakening and blurring the column's load-bearing function and liberating it from the structural-technical reading (Semper 2004).⁷ Clearly, the central column alone cannot express the hidden cultural intentions behind the structural system. The opposition between the column and the presence of the surrounding elements emphasised the column's cultural significance. The offset of the central column in the space separation obscures the actual space symmetry in the design of House in White; the traditional pitched roof is visible from the outside, but the roof truss is wrapped up inside and can only be traced vaguely through the central column. These oppositions within the structural relations of the House in White can be interpreted in psychology and cognitive science as a "conceptual conflict" of perception.⁸ It can arouse people's curiosity, confusion, and even anxiety about space. In Shinohara's design, this opposition-induced spatial tension is a stimulant for human perception; it can be explained as the enactive process of perception under the arousal mechanism.⁹ As a result, it can actively attract people's attention, encouraging them to reveal a more nuanced and cultural reading of the structural elements beyond their load-bearing capacity.

The structural opposition of the House in White enables the structure to be dualistic, both load-bearing and space-making. This is similar to Alvar Aalto's belief that architecture is composed of numerous opposite elements, and architecture's task is to use art to bring these opposing elements together to create a harmonious community (Aalto 1972). Similar ideas can also be found in Pérez-

Gómez, who demonstrates in detail how, rather than pleasing us, architecture functions as a "heteropoietic system" that challenges our perception in order to generate more imagination and meaning (Pérez-Gómez 2015). Although during the first style period, when the House in White was designed, Shinohara was primarily concerned with conveying the message that "A House is a work of art" by representing Japanese traditions and culture (Shinohara 1996a). Using House in White as a starting point, many of his subsequent works consider opposition as a more general way of thinking and designing, attempting to transcend matter through the opposition of the structure, ensuring that the structural relationship becomes the carrier of the design intention in a broader sense.

3.3. Oppositions in Tanikawa house and house in Uehara

Tanikawa House (1974) and House in Uehara (1976) are two additional examples of oppositional structural design. Unlike the first style, these two houses consider not only the expression of tradition or culture but also the representation of the urban and natural environment in a broader discourse.

Tanikawa House (Figure 6) was designed on a soil slope in the forest at the beginning of Shinohara's third style period. In Tanikawa House, he exposed all structural components without any concealment, including a large area of natural soil. Inside the house, it is evident how the earth supports the columns and then the roof; each element appears to be everyday-like, and they seem to function independently but also appear to be bonded together. These subtle relationships were generated by the composition-aroused contrast between everydayness and non-everydayness, which numerous oppositions could perceive within the house. The first opposition is between the roof and the earth. The earth is dark, organic, and rough compared to the white, man-made, and

⁷Gottfried Semper distinguished building structures between the structural-technical and structural-symbolic. The former depicts the ontological supporting structure, emphasising its artistic representation. This is similar to Shinohara's cultural reading of the column in House in White, behaving as a cultural representation instead of structural supporting elements. More details see (Semper 2004). *Style in the Technical and Tectonic Arts; or, Practical Aesthetics*. trans. Harry Francis Mallgrave and Michael Robinson, Los Angeles: Getty Research Institute.

⁸The "conceptual conflict" could be caused by doubt, perplexity, contradiction, incongruity, or irrelevance. This confliction is pivotal in eliciting curiosity, attractiveness, and emotional behaviour in human perception. For more expiations see: Berlyne, Daniel. 1960. *Conflict, Arousal, and Curiosity*. New York: McGraw-Hill; Schachter, Stanley, and Jerome Singer. 1962. "Cognitive, social, and physiological determinants of emotional state." *Psychological Review* 69: 379-399; Ramachandran, Vilayanur, and William Hirstein. 1999. "The science of art: A neurological theory of aesthetic experience." *Journal of Consciousness Studies* 6: 15-51; Colombetti, Giovanna. 2007. "Enactive appraisal." *Phenomenology and the Cognitive Sciences* 6: 527-546.

⁹The concept of arousal was defined as "a general pattern of excitation of the sympathetic nervous system." It is a pivotal factor in eliciting emotional behaviour. Without the opposition aroused conflictions as the attraction and vehicle for perception, people would not start the excitation of the sympathetic nervous system on reading the meaning behind the structures. For a detailed explanation, see Schachter, Stanley, and Jerome Singer. 1962. "Cognitive, social, and physiological determinants of emotional state." *Psychological Review* 69: 379-399; Varela, Francisco J., Evan Thompson, and Eleanor Rosch. 1991. *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge: The MIT Press; Thompson, Evan. 2007. *Mind in Life: Biology, Phenomenology, and the Sciences of Mind*. Cambridge: Harvard University Press. For more explanation about the spatial tension in the work of Shinohara, see (Shinohara 1971b). "Beyond symbol spaces", *The Japan Architect*, 04 (April). Arnheim, Rudolf. 1974. *Art and Visual Perception: A Psychology of the Creative Eye*. Berkeley: University of California Press; Sakamoto, Kazunari. 2009; "In search of a space of unparalleled tension [In Japanese. 比類なき緊張の空間を求め続けて]", *Shinkenchiku*, no. 1 (September): 22-24.



Figure 6. Kazuo Shinohara, Tanikawa House, Karuizawa (1974). Photo by Koji Taki. (Masip-Bosch 2011, 15)

geometrical roof. Each component's existence appears mundane, but when a slender column connects them, the opposing relationships between functional and non-functional, balanced and unbalanced, and artificial and natural are exaggerated and amplified. The second opposition is between the proportions of the non-functional space and to living space. To replicate the abstracted nature context within the house, two-thirds of the area in Tanikawa House is pure earth with no predetermined function,¹⁰ and the function was compressed into a relatively small area on one side. Additionally, the view from the living area is also shallow and narrow, which means that those standing inside the living room can not see the entire earth ground. Moreover, the space with earth and two over-scaled columns inside is quite open and tall; as a result, the proportion and meaning of the functional and un-functional areas are reversed, intensifying the perceptual opposition. In general, the opposing relations between man and nature, the natural and the

human-made, the open and the protected in the Tanikawa house, create a spatial tension that may induce nervousness.¹¹ Therefore, "people began to walk back and forth, trying to relieve their anxiety. There are many ways to interact, from which various meanings will be generated (Shinohara 1971a)." Through these oppositions and nervous stimulations, Shinohara extended and augmented the natural context of the site into the building, making it perceptible to the people. This contextual thinking was also demonstrated in the House in Uehara.

The House in Uehara (Figure 7) was designed in the third style period and featured two massive columns with trusses that penetrated the building's floor and occupied a large portion of the living area. This is because he believes housing is the concentrated expression of architecture, and architecture is not an autonomous entity but is inextricably linked to the urban environment (Shinohara 1996b). In 1964, through his observation of the giant, complex, and disordered urban condition, Shinohara indicated that "the beauty of contemporary settlements is not the beauty of unity but the beauty of chaos (Shinohara 1996b)." This is why House in Uehara incorporated and extended the "Beauty of Chaos" urban structure system in Tokyo into the interior building structure system. Although it is not a formal replica of the urban structure, the order perceived by the brutal-looking building structures is comparable (Shiozaki 2013). To create this chaotic order and trigger people to perceive meaning from it, apart from supporting it, the structure was designed to be so monolithic and massive that people could only see a portion of it regardless of whether they were in the living room or the underground portions. Thus, the structure becomes a mysterious allusion to the building's composition logic and configuration. Although all structural components function in their original state – what Martin Steinmann referred to as "forceful form" – the scale appears excessively exaggerated (Moravanszky 2007, 34). These methods, including the brutalism-like exposes of the structure, attempt to establish an opposition between material, scale, and position. The presence of the column and trusses in the House in Uehara, combined with their misaligned relationship to the floor slab, resulted in a reversal of the meaning of everydayness and non-everydayness (Taki, Warren, and Ferreras 1983). To be precise, the first floor, which lacks trusses, serves as storage and a parking lot, while the living room is

¹⁰Tanikawa House's spatial concepts for the earth area echo of traditional Japanese *doma* (土間), meaning dirt floor that connects the front door or kitchen. Apart from the concept of re-expressing nature, it is the presence of a "wasteful space (無駄な空間)" or "anti-space (反空間)" in Tanikawa House that Shinohara interprets as a critical non-functional and non-meaning space for the feeling of wholeness to generate meaning from individuals. For more details, see Shinohara, Kazuo. 1976, "When naked space is traversed [In Japanese. 裸形の空間を横断するとき]", *Shinkenchiku* (April); Jacquet, Benoît. 2015. "On Things to Come: What contemporary Japanese architecture should be like".

¹¹The same reason applies to the principles of perception stimulation discussed in notes 9 and 10.

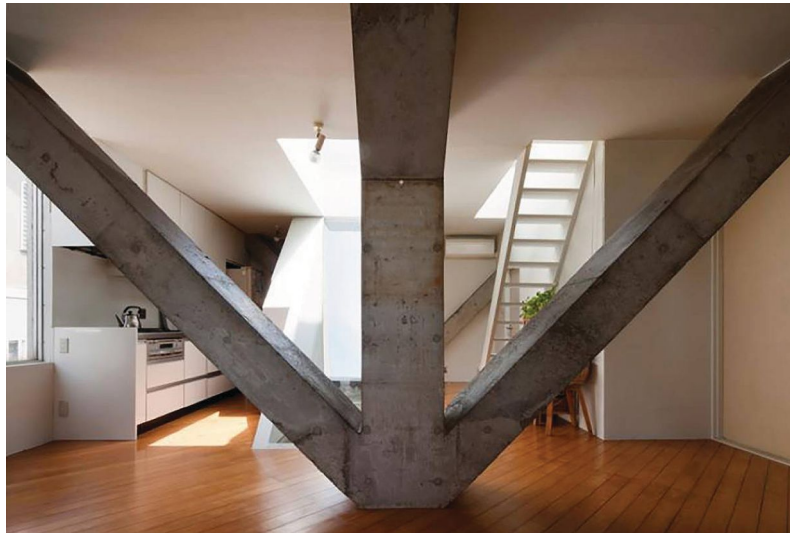


Figure 7. Kazuo Shinohara, House in Uehara, Tokyo (1976). Photo by Hiroshi Ueda. (Shinohara 2011c2013, 170-171)

unexpectedly arranged on the second floor, which features a massive dramatic truss in the centre. Typically, people believe that a living room with such a massive structure inside will influence the functions and behaviours of the room, which may be less than “functional”. However, this type of spatial confrontation can stimulate people’s subjective perceptions and behaviours, thereby increasing the likelihood of interaction with the structure. This increases the possibility of later developing meaning or empathy.¹² The owner of the House in Uehara has already incorporated these structures into their life; consequently, the structure becomes a perception-oriented extension of their body (Fujimoto 2008). As a result, House in Uehara could have been interpreted as a radical evolution and inversion of House in White – moving from delicate to brutal, from soft to hard material, and from concealing to exposing the structural system. Shinohara uses this form of expression to replicate the atmosphere of the urban context in the building.

3.4. Structural Relations as Context Expression

Kazuo Shinohara’s houses are aesthetic re-examinations of domesticity, an exploration of the role of the individual within a society in which “the house, the one space that comes in most direct contact with humanity, must face the uncertainty of both the interior and exterior worlds” (Shinohara 1971b, 83). For Shinohara, a house is a place of contextualisation, a place of artistic elaboration on the human condition

with “the house [...] to be separated from the territory of architecture: It has to be moved into the realm of art, where painting, sculpture, literature and others belong” (Shinohara 1962).

The critical design strategy in Shinohara’s artistic exploration was working with juxtaposition, which served as the primary method of structuring throughout his oeuvre (Taki, Warren, and Ferreras 1983). As illustrated above in the discussion of the House in White, the Tanikawa House and the House in Uehara, the structural elements of a column are critical in the transgression of the exterior world into the interior of the house.

In the House in White, the column contextualises the private house within Japanese history and elevates it beyond its convention. By substituting the post-and-beam construction used conventionally as a structural system for housing and replacing it with a central column, a structural system traditionally reserved for temples, Shinohara symbolically transforms the ordinary house into a work of art comparable to the Jōdō-dō at Ono (Stewart and David 2020).¹³

Over time, the static and symbolic use of building structures, characteristic of the House in White, evolves into a dynamic and experiential intrusion into the interior world. In the Tanikawa House, the open interior space is pierced by tree-like columns. Together with the slanted floor, the columns imbue the building with a dominant spatial sense of the surrounding forest, establishing a dynamic relationship between the user and the environment.

¹²The recent findings of the *embodied simulation* from neuroscience demonstrate that human perception and cognition are intrinsically dependent on the organisms’ interaction with their environment. Which meanings human perception derives from the active dynamic interaction and movement and thus derives its “meaning” from the evocation of similar bodily experiences. As a result, the opposition in House in Uehara may stimulate additional possibilities for the human meaning-making process. For more details, see Varela, Francisco J., Evan Thompson, and Eleanor Rosch. 1991. *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge: The MIT Press; Gallese, Vittorio. 2007. “Embodied simulation: from mirror neuron systems to interpersonal relations.” *Novartis Found Symp* 278: 3-221; Jelic, Andrea, Gaetano Tieri, Federico De Matteis, Fabio Babiloni, and Giovanni Vecchiato. 2016. “The Enactive Approach to Architectural Experience: A Neurophysiological Perspective on Embodiment, Motivation, and Affordances.” *Frontiers in Psychology* 7 (481).

¹³The Buddha hall (Jōdō-dō) at Ono has influenced the design of the House in White.

Such invasion of the surrounding into the building is accentuated even more in the House in Uehara by the columns' scale and materiality. The dimensions of the columns and beams are out of proportion, belonging more to the world of road infrastructure built in Tokyo from the mid-1960s onwards than to the domestic realm (Massip-Bosch 2015). Living in this house is compelled to revolve around the recurrent presence of the structure. The column obstructs and conditions life inside the house, calling for constant attention and creating an impression of urban density and chaos within the house's secured space.

The use of columns as a primary structural element in Shinohara's houses exemplifies Strong Structures, as defined by Arthur Rüegg, as existential drama articulated structurally. Shinohara's Strong Structures, however, is not grounded in technological rationality but opens up a poetic, experiential reading of structural logic. Shinohara enables perceptive experiences of the human position within a given cultural, natural, and urban context by means of the order of structural elements.

Often structural design is seen only as a technical topic. However, Shinohara demonstrates that the unavoidable presence of structure can be used as an architectural element that communicates by its appearance, position in space, and materiality. Shinohara's structure is a structure beyond the conventional rationality of structural performance. It acts as an activator of perception, as an element of pure tectonics. According to Eduard Sekler, "structure [is an] intangible concept, is realised through construction and given visual expression through tectonics". Tectonics is the expressive quality that cannot be described in terms of construction and structure alone in terms of the technical (Sekler 1965). In Shinohara's design, the structural elements of the column are not even articulating its particular construction and structural performance anymore. Shinohara's structure negates structure as structure; it is the structure as a sign.

4. Conclusion

The term "Strong Structures" refers to a structural design concept founded on structural rationality but transcending its physical expression. It naturally shares the long-running debate between technology and art in the history of architecture. This debate has to relate to two facets: on the one hand, it is composed of physical structures that must adhere to objective requirements; on the other hand, it has aesthetic significance that aims to elicit subjective emotions. The

duality of the architectural phenomenon distinguishes architecture from other arts (Nervi 1965).

After its initial publication in *werk, bauen + wohnen* in 2009, the notion of Strong Structures was expanded in the same journal in two subsequent issues, "Wide-spanning" in 2014 and "Bones architecture" in 2018.¹⁴ However, the discussions on these issues continue to focus primarily on the beauty expressed in structures based on construction techniques such as large-span structures. They are restricted to the debate about the realised forms in structural design due to material and technology innovations rather than their presence. These discussions omit the analysis of structural design's artistic side from the perspective of architectural space or human perception. In contrast to this purely technological approach to structural design, researchers such as Kenneth Frampton developed the "poetic of construction", which emphasises not only the technical aspects of construction but also the tectonic culture and aesthetics of the projects by Auguste Perret or Mies van der Rohe (Frampton and Cava 1995).¹⁵ But Frampton's understanding of structural expression as the art of joining differs from Kazuo Shinohara's methods of achieving an artistic expression through the articulation of structural elements.

Load-bearing elements like the column define the architectural identity in all of the examined projects of Shinohara. The structure fundamentally shapes the character of the building, its spaces, and its appearance. In this sense, Shinohara's designs can be viewed as Strong Structures according to the characterisation of Rüegg. But Shinohara does not obfuscate the load-bearing mode of action as Rüegg has observed in contemporary Swiss architecture. Instead, the opposite is true. Human experience and perception of the structure are critical components of Shinohara's architectural practice. His approach is not driven by technological development alone but rather by a re-reading and artistic representation of cultural history. Compared to the pursuit of material and mechanical efficiency in structural design, or extreme balance, lightness, and slenderness, Shinohara takes a nearly reversed track, placing a premium on the structure's expression through the lens of human perception – a stronger presence than mechanical efficiency. Instead of obfuscating the structural behaviour, Shinohara emphasises it. This accentuation transforms the structural element into a sign beyond its functional necessity. A structure informed by culture, urbanism, and nature.

From a methodological standpoint, Shinohara's structural expressions are derived primarily from his

¹⁴For details, see articles in Wide-spanning, *Werk, Bauen + Wohnen*, November 2014; and Bones architecture, *Werk, Bauen + Wohnen*, March 2018.

¹⁵There are also many similar studies related to Kenneth Frampton and the debate between technology and art, like Dean Hawkes' *The Environmental Imagination* or Luis Fernández-Galiano's *Fire and Memory*. They all try to link technical and poetic dimensions together.

refined and restructured compositional relations of various contexts, which are represented by the oppositional relationship of everyday structural components. And his method of composition for Strong Structures is distinct from that of the Swiss architects he influenced. This is evident in examples like the house in Fosterstrasse by Kerez. The structure of the building is defined by the interplay of walls and plates aiming at moving the inner forces around in space. This game-like design approach results in spatial variation and a building “without a façade”. Despite this visual openness, there is no relation to the surrounding, and the structure is an introverted configuration of space-making within the limits of the building. The structure is “strong” in its physical presence but not so much in its contextual relationships. Compared with this, Shinohara’s buildings are more extroverted despite being closed boxes. Shinohara’s consideration of the structure’s contextual relationship departs from cultural dimensions but focuses on human perception rather than the formal symbols of culture. This enables him to connect the building to its surroundings from inside to outside through the structural organisation, thus surpassing the culture in order to merge or connect with specific contexts such as nature or urbanity. This difference in design thinking between Kerez and Shinohara mirrors the conceptual differences between European and Asian cities that Shinohara once pointed out in his letter to Herzog & de Meuron.¹⁶ Intriguingly, even though this paper does not analyse Shinohara’s architecture in detail from a broader Japanese cultural perspective, but rather from a more phenomenological and relational perspective, it reaches similar conclusions to many of the studies of Shinohara by Japanese scholars that appear in the text from a cultural perspective.¹⁷ This also supports the article’s thesis about the artistic potential of structural relations.

Rather than calculation or analysis, Shinohara’s method of relational structure is based on his primary static sense of structure. Therefore, his experimental practises with “Strong Structures” exceed the understanding of “Performative architecture” by transforming it from a *Technological Performance* into a *Cultural Performance* (Araya 2011, 50–57). In contrast to the purely performance-oriented technological or cultural aspect of structure, his houses truly embody “A House is a work of art”, a purely artistic expression. His works exemplify that dramatic structural presence can also be accomplished via the design of human perception. With the current advancement of technology, his “Strong Structures” way of thinking elevates structure above the threshold of a cold machine. His work also reminds us of the significance of developing both

structural engineers’ and architects’ technical and artistic intuition in their education. With these intuitive qualities as a foundation, architects and structural engineers can better embrace emerging technologies and ideas (such as virtual reality and agent-based modelling, which combine technical and artistic exploration) and integrate them into the building and structural design process.

“The matrix of art is the chaos floating in the human body. For a clear mood and emotion, art is unnecessary. Chaos stirs people up and tries to generate uneasiness. Currently, people rely on art to eradicate this uneasiness. Once the energy stored in chaos materialises, that is the moment of art (Shinohara 1964).” Shinohara’s lifelong pursuit of the permanence of art and order coincides with the inherent timelessness of building structure. Perhaps the relational art of structure is the ultimate direction he indicated to us.

When the *structure* becomes present, and the *relation* emerges, *art* appears.

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No potential conflict of interest was reported by the author(s).

Notes on contributors

Shuaizhong Wang is a Ph.D. candidate and research assistant at the Chair of Structural Design, Department of Architecture, ETH Zurich. He received his Master of Architecture with Distinction from Aalto University (Finland). He was an exchange student in Yoshiharu Tsukamoto laboratory (Atelier Bow-Wow) at the Tokyo Institute of Technology (Japan). He has worked for B&M and JKMM Architects in Finland. His work has been published internationally, and he is the winner of many architectural competitions. He is also a guest editor for the Journal of Architecture and The Architect. His research focuses on architectural and structural design theory, structural art, neuroscientific perception and embodiment, and graphic statics.

Toni Kotnik is Professor of Design of Structures at Aalto University in Helsinki. He studied architecture and mathematics and his research is focused on integrative design methods at the intersection of architecture and engineering. Prior to joining Aalto University, Toni Kotnik was teaching and conducting research at the Architectural Association (AA) in London, the Swiss Federal Institute of Technology (ETH) Zurich, the Institute for Experimental Architecture at the University of Innsbruck and the Singapore University of Technology and Design. He has been lecturing worldwide at leading universities as well as museums like the Guggenheim Museum Bilbao and MoMA New York. His practice and research work has been published and exhibited internationally, including the Venice Biennale, and is centered on the integration of knowledge from science and engineering into architectural thinking and the design process.

¹⁶Shinohara’s detailed understanding of the distinction between European and Asian cities can be found in his letter to Herzog & de Meuron. See Mueller, Mathias, and Daniel Niggli. 2015. “beauty of chaos: Plea for a city of tolerant coexistence”, *Werk, Bauen + Wohnen*, no. 5. online at <<https://www.wbw.ch/de/heft/artikel/leseprobe/2015-12-schoenheit-des-chaos.html>>.

¹⁷For example, see the research of Japanese scholars such as Seng Kuan and Koji Taki, who are mentioned in the article.

ORCID

Shuaizhong Wang  <http://orcid.org/0000-0002-0157-7587>
 Toni Kotnik  <http://orcid.org/0000-0001-7640-0009>

References

- Aalto, A. 1972. "'Art and Technology', Translated by Juhani Pallasmaa." In *Alvar Alto Luonnoksia*, edited by Schildt, G, 87–88. Helsinki: Otava Publisher.
- Araya, S. 2011. "Performative Architecture." PhD diss. Massachusetts Institute of Technology.
- Beynon, D. 2012. "Superflat Architecture: Culture and Dimensionality." In *Interspaces: Art + Architectural Exchanges from East to West*, edited by White A, Marcello F, 1–9. Melbourne, Vic.: University of Melbourne, School of Culture and Communication.
- Blaser, W. 1994. *Transformations – Livio Vacchini*. Basel: Birkhäuser.
- Charleson, A. 2005. *Structure as Architecture: A Source Book for Architects and Structural Engineers*. Oxford; Burlington, MA: Elsevier/Architectural Press.
- Compton, A., L. Marion, M. Suhrer, M. Vibberts, and M. Breitschmid, Hrsg. 2011. *Kazuo Shinohara. Architecture History Case Studies Series*. Zurich: Band 8. Corporis Publisher for Architecture, Art, and Photography.
- Dehli, C., and A. Grolmund. 2019. *Kazuo Shinohara: 3 Houses*. Luzern: Quart Verlag für Architektur.
- Dell'Antonio, A., and T. Joanelly. 2015. "Tradition – Cube – Machine – Chaos: Productive Contradictions in the Working Methods of Kazuo Shinohara." *werk, bauen + wohnen* 12 (December): 10–19.
- Editors, T., 2009. "Editorial." *Werk, Bauen + Wohnen* 5(May): 2.
- Frampton, K., and J. Cava. 1995. *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*. Cambridge, Massachusetts: MIT Press.
- Fujimoto, S. 2008. "The Link between the Eternal and the Everyday - New white/new Abstraction [In Japanese. 永遠と日常を繋ぐもの—新しい白/新しい抽象]." *Shinkenichiku* (6): 111–124.
- Garagam, S. 2019. "The Bones of Architecture." In *exhibition*. Lisbon: CCB.
- Hönggerberg, E. T. H. 2016. *On the Thresholds of Space-Making: Kazuo Shinohara*. 21 September 2016 to 21 October 2016. Zürich: gta Exhibitions.
- Isozaki, A. 1979. *Ma: Space-Time in Japan*. New York, NY: Cooper-Hewitt Museum.
- Joanelly, T. 2020. *Shinoharistics: An Essay about a House*. Zürich: Kommode Verlag.
- Kolarevic, B., and A. Malkawi, eds. 2005. *Performative Architecture: Beyond Instrumentality*. London: Taylor & Francis.
- Kuan, S. 2019. "The House Is a Work of Art: Kazuyo Sejima on Her Fascination with 'Shinohara's Way.'" <<https://www.gsd.harvard.edu/2019/09/the-house-is-art-kazuyo-sejima-on-her-fascination-with-shinoharas-way/>> [accessed 14 February 2021]
- Kuan, S., and C. Kerez, eds. 2018. *Kazuo Shinohara: On the Threshold of Space-Making*. Baden: Lars Müller Publishing.
- Massip-Bosch, E. 2011. "Kazuo Shinohara: Beyond Styles, Beyond Domesticity." *2G-Revista Internacional de Arquitectura-International Architecture Review* 58: 4.
- Massip-Bosch, E. 2015. "Emotion Devices: The Role of Concrete Frame Structures in the Architecture of Kazuo Shinohara." PhD diss. Universitat Politècnica de Catalunya-BarcelonaTECH.
- Moravanszky, A. 2007. "Concrete Constructs: The Limits of Rationalism in Swiss Architecture." *Architectural Design* 77 (5): 30–35. doi:10.1002/ad.512.
- Narigon, N. 2013. "An Interview with Christian Kerez", *Tokyo Art Beat*. <https://www.tokyoartbeat.com/en/articles/-/an-interview-with-christian-kerez> [accessed 14 February 2021]
- Nervi, P. L. 1965. *Architecture, Aesthetics and Technology in Building*. Cambridge, Mass.: Harvard University Press.
- Pérez-Gómez, A. 2015. "Mood and Meaning in Architecture." In *Mind in Architecture: Neuroscience, Embodiment, and the Future of Design*, edited by S. Robinson and J. Pallasmaa, 219–235. Cambridge, Massachusetts; London, England: MIT Press.
- Picon, A. 2010. *Digital Culture in Architecture: An Introduction for the Design Professions*. Basel: Birkhäuser.
- Pilgrim, B., and Richard. 1986. "Intervals ('ma') in Space and Time: Foundations for a Religion-Aesthetic Paradigm in Japan." *History of Religions* 25 (3): 255–277. doi:10.1086/463043.
- Rüegg, A. 2009. "Starke Strukturen: Formen des Umgangs mit der Tragkonstruktion." *Werk, Bauen + Wohnen* 96 (5): 4–11.
- Santiago, E. 2019. "Notre-Dame du Raincy and the Great War." *Journal of the Society of Architectural Historians* 78 (4): 454–471. doi:10.1525/jsah.2019.78.4.454.
- Schnetzler, H., A. Muttoni, J. Schwartz, and A. Flury. 2012. "Strong Structures." In *Cooperation: The Engineer and the Architect*, edited by A. Flury, 193–206. Basel: Birkhäuser.
- Sekler, E. 1965. "Structure, Construction, Tectonics." In *Structure in Art and Science*, edited by G. Kepes, 89–95. New York: Braziller.
- Semper, G. 2004. *Style in the Technical and Tectonic Arts; Or, Practical Aesthetics*, trans H. F. Mallgrave and M. Robinson. Los Angeles: Getty Research Institute.
- Sharp, D. 1972. *Twentieth Century Architecture: A Visual History*. London: Heinemann: Secker and Warburg.
- Shinohara, K. 1960a. "Residential Theory." *Shinkenichiku* 35 (4 91–106).
- Shinohara, K. 1960b. "Plane Composition Viewed from Space Division, the Methods of Japanese Architecture (8)", *Papers for the Architectural Institute of Japan*, No. 66.
- Shinohara, K., and Editorial Board of Kazuo Shinohara's collection. 2013. *Architecture: Kazuo Shinohara*. Nanjing: Southeast University Press.
- Shinohara, K. 1962. "A House Is A Work of Art." *Shinkenichiku* 37 (5): 77–78.
- Shinohara, K. 1964. *Residential Architecture*. Tokyo: Kinokuniya Shoten.
- Shinohara, K. 1971a. "Tanikawa House." In *Kazuo Shinohara's 16 Architectures and Architectural Theories*. Tokyo: Bijutsu Shuppan-sha.
- Shinohara, K. 1971b. "Beyond Symbol Spaces." *Shinkenichiku* 46 (1): 249–256.
- Shinohara, K. 1996a. "First Style". In *Kazuo Shinohara*, 60–71. Tokyo: TOTO Shuppan.
- Shinohara, K. 1996b. "The Third Style". In *Kazuo Shinohara*, 202–211. Tokyo: TOTO Shuppan.
- Shinohara, K. 2011a. "Theory of Residential Architecture." In *2G 58/59 Kazuo Shinohara: Casas Houses*, edited by A. Puyuelo, 246–259. Barcelona: Gustavo Gili.
- Shinohara, K. 2011b. "House in White Puyuelo, A 2G 58/59 Kazuo Shinohara." In *Casas Houses*. Vols. 74–87. Barcelona: Gustavo Gili.
- Shinohara, K. 2011c. "House in Uehara." In *2G 58/59 Kazuo Shinohara: Casas Houses*, edited by Puyuelo A., 162–175. Barcelona: Gustavo Gili.

- Shiozaki, T. 2013. "Beauty of Chaos, Assemblage of Places: House in Uehara by Kazuo Shinohara" [In Chinese. 混乱之美与复数场所的集结]." *South Architecture* 157 (5): 23–24.
- Shirasawa, H. 2008. "The Reconstruction of 'House in White' [In Japanese. 「白の家・移築」という再築]." *Shinkenchiku* (6): 113.
- Steinmann, M. 1991. "La forme forte. En deça des signes." *Faces* 19: 4–13.
- Stewart, B., and David. 2020. "Fashioning Change: Three Iconic Japanese Houses." In *Kazuo Shinohara: 3 Houses*, edited by C. Dehli and A. Grolimund, 169–179, Lucerne, Switzerland: Quart Verlag.
- Taki, K., N. Warren, and J. M. E. Ferreras. 1983. "Oppositions: The Intrinsic Structure of Kazuo Shinohara's Work." *Perspecta: The Yale Architectural Journal* 20: 43–60. doi:10.2307/1567065.
- Vandenberg, M. 1998. *New National Gallery*. Berlin. London: Phaidon Press .
- Vuilleumier, L. 2018. "Die Suche nach Form." *Bund Schweizer Architektinnen und Architekten*. Accessed March 1, 2023. <https://www.bsa-fas.ch/en/a/429-die-suche-nach-der-form/>
- Ye, J., and C. Qian. 2017. "Theory, Practice, and Education: A Ten-People Conversation of Archi-Neering Design" [In Chinese. 理论·实践·教育:结构建筑学十人谈]." *Architectural Journal* 583 (4): 1–11.