

RESILIENCE AS AN INVESTIGATION OF THE RELATIONSHIP BETWEEN ARCHITECTURE AND NATURE

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Abstract

Recent architectural research concerning the theme of global warming seems to have brought attention to the natural phenomena that affect human life. It highlights a particular interest in the interpretation of the dynamic processes of the environment and all the natural entities, plants, and animals that inhabit it. The principle of resilience, which indicates the ability of physical entities to adapt to changes in the environment, represents the new paradigm of contemporary architectural design. However, the improper use of this term for communication purposes takes the attention away from projects that entwine a true relationship with the complex world of nature. This contribution aims to rediscover the new ways of relations towards the natural world beyond the interpretation that requires a technological replacement but through an organic sharing between human life and the environment. A series of case studies are divided into three different groups: architectural projects as an interpretation of natural phenomena, the construction of architectural experience as the integration of subnature in the project, and the role of the plants as natural things with a qualifying spatial entity. These different groups trace the conditions for a design that is truly compatible with the complex organic world, following the principles of resilience and changeability.

Keywords: nature, landscape, environment, resilience, subnature

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Introduction

This paper aims to explore spatial relations between human life and the natural environment. Global warming has imposed renewed attention to nature and the processes that govern it. The theme of resilience interpreted as the ability of an organism to adapt according to changes in the environmental context, acquires a central dimension in recent architectural conferences and exhibitions, directly or indirectly. It is no coincidence that, for example, the Italian Pavilion for the 2021 Venice Biennale, titled Resilient communities, placed the relationship between humans and nature about the changes generated by climate change at the centre of the debate, highlighting the key role of architecture in the creation of resilient communities which can react to the increasingly unstable contexts. (Melis et al., 2021). The term resilience has become the recurring leitmotiv, sometimes even in an unjustified way, of the texts accompanying the recent publications of the architectural projects presented in the most popular magazines. It sometimes leaves a communicative intent to shine through, rather than a concrete interest in exploring the complexity of the natural transformations within the project. The use of nature, if not concretely interrelated with biological processes, can lead to obvious contradictions which, beyond the simplified narratives, only highlight an iconic presence of the latter, distancing the project from the actual processes that truly make resilient biological organisms (Bellomo, 2019). The answer to environmental questions, in architectural terms, can only be obtained through a process consistent with the functioning of its entities. By interpreting natural phenomena as generational matrices of space and exploring the potential that the elements that compose it can provide.

Nature interpretation and representation in architecture

The iconic presence of trees, for example, can be seen incorporated in the crystal domes of the bridge that connects the new botanical tower by Stefano Boeri and Diller Scofidio + Renfro to Pirelli 39 (Giorgi, 2021). Here, ideally and spatially, the process of chlorophyll photosynthesis that exists through the relationship that the tree undertakes with carbon dioxide and metabolic water present in the atmosphere is denied. The location of the tree within a glass sphere prevents this relationship by delegating the management of this necessary interchange to the complex technological systems that are thirsty for resources. The buildings are built with multi-level trees, in which their relationship with the environment is structured according to the spatial logic of a condominium type of building. This contradicts the natural relationship that the tree supposedly undertakes with the underlying land and in particular, with the other trees. In this theme, for example, the botanist Stefano Mancuso discusses research about an ancient strain of *Agathis australis* discovered by Sebastian Leuzinger and Martin Bader, two researchers on an excursion in a New Zealand rainforest (Mancuso, 2020). The strain in question contained many living tissues despite the lack of leaves or other

organs capable of allowing chlorophyll photosynthesis or the absorption of soil water (see Figure 1).



Figure 1. The root system of a tree (Image by author)

The presence of living tissues, however, was allowed by the root grafting that other trees maintained with the stump, giving it the resources necessary to keep it alive through the passage of nutrients in the roots (Mancuso, 2020). Mancuso's example highlights how the concepts of sharing and cooperation are capable of guaranteeing the growth and survival of connected plant species. This paper explores how such a notion would apply to human life and its manifestations. Nevertheless, the recent architectural projects such as the forested skyscrapers already mentioned above generate a whole series of significant contradictions. The geographical location of the trees situated on the private balconies and terraces, precludes their use by the community, making nature elitist and not shareable. The lack of radical connection with the earth results in extremely complex tree maintenance that can only be implemented through expensive technological solutions. What nature, through an extremely efficient evolution, implements with minimum consumption of resources, becomes a wasteful process for condominium trees. In a logic of resilience that should lead to limiting the consumption of resources, to guarantee the permanence of the species, the action of replacing technological devices with natural mechanisms tested throughout natural history appears to be a lost battle. Yet, humans in the past have shown that they can give different interpretations of nature, which are not limited to a mechanistic replacement of the natural process, but which are based on the representation and reformulation of organisms about matter and space. Space is understood as an architectural essence that goes beyond any reasoning solely linked to the performance characteristics of the buildings, but which, from the relationship with nature, gives back meaningful forms and experiences. The following sections will explore more the connection between humans and nature and its relation with resilience through a series of case studies.

Biological sharing is fundamental in a design proposal that aims to be compatible with nature (Mancuso, 2017). Nature, in the search for an ecological approach, is not an element to be imitated or forced alongside the architectural or landscape project but represents a complex ecosystem

from which to draw the meanings of future design insights (McHarg, 1969). A significant element of McHarg's work (1969) is the representation of natural components that is achieved through mapping and data collection, a necessary process of knowledge that lays the foundations for possible design actions. Such representation of natural components can be seen in the most ancient archaic representations of the Lascaux Caves (Aujoulat, 2004). The set of signs and representations found in the Dordogne complex trace the graphic boundaries of nature permeated by a predicted spirituality and imbued with wishes and desires. Rock art was the work of the population on its existence in hunting which is organised based on its economic structure, social, and spiritual life. At the centre of the hunter's thought, there is the relationship of knowledge with the animal and the understanding of its essence which is summarised in the human-animal relationship as a process of growth and renewal of the human being (Bataille, 1955).

The first drawing analysed by this paper, representing the shape of the hand, is probably connected to the footprint left by the animals on the ground in their paths, the emulation of the trace left as an indication of a possible source of food. The concept of resilience is inherent in these pictorial representations, as a spiritual interpretation of the continuity of the animal species which, after being killed by humans, were fixed on the wall, in the hope that the heritage decimated by hunting could be rebuilt (Bataille, 1955). The painter's spiritual gesture invokes the permanence of the animal in the face of human actions, to ensure the mutual survival of the species, but not only that; the depiction act summarises the act of taming the prey. Imprisoning the animal in a representation meant reaffirming the control of humans over the animal and, consequently, over nature. Furthermore, the pictorial cycles, which correspond to a large number of species and specimens following one another through a spatial logic, are linked to time and seasonal rhythms, where horses, aurochs, deer, and cattle make up a real biological cycle (Aujoulat, 2004).

Lascaux's figures trace the relationship of humans intimately linked to natural phenomena, identifiable in the movement of animals and in their seasonal behaviours. Humans are capable of recognising the need to support processes and to respect their specific biological temporarily. Spiritual action strengthens this bond between humans and nature. The cosmological reading, which can be given with representations, is accompanied by a purely spatial one linked to the action of drawing as a minimal gesture of living (Laming, 1959). The arrangement of the paintings inside the cave defines areas that can be completely superimposed on the architectural action of spatial coding. The environment of the Lascaux Caves composed by Sala dei Tori, the axial diverticulum, the apse, and the feline diverticulum (Windels, 1948), is articulated in a succession of spaces defined by the relationship between sign and matter that ends in the search for a balance between nature and artifice (Figure 2). Such equilibrium also emerges in the contemporary project

when it explores natural phenomena, in a way that is not different from archaic and primitivistic interpretations. The case studies described above show how the role of knowledge mediated by representation constitutes a decisive element in the correct interpretation of natural phenomena.

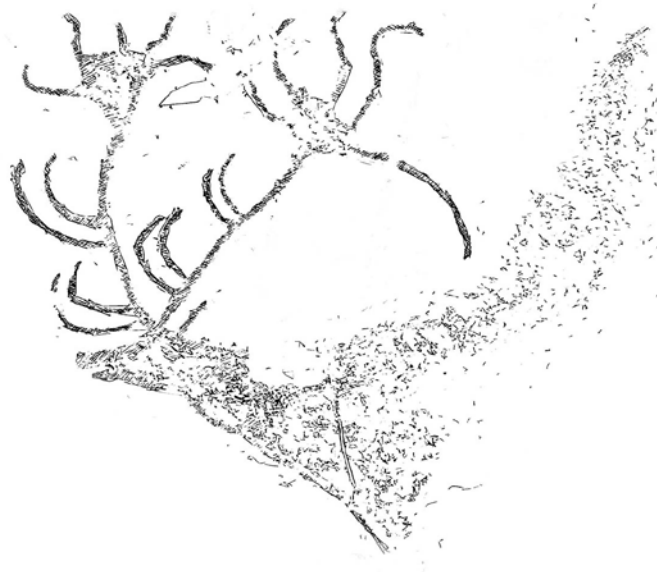


Figure 2. Deer, Lascaux cave, approximately 18.000–16.500 BC (Image by author)

Interpretation of natural processes and sustainability

The generation and transformations of extreme natural phenomena such as glaciers, volcanoes, permafrost, clouds, coral reefs, and algae have been discussed as the potential driver of an architectural project (Agrest & McPhee, 2018). In this case, nature is no longer simply a visual referent to be translated into architectural representation, but becomes, in its procedural condition, a phenomenon that generates the spatial complexity of the project (Agrest & McPhee, 2018). There is an architectural and material implication of such phenomenon as can be seen in the *Tippet Rise Art Centre* (Figure 3) in Montana. In such a project, the stone becomes a device for reading the processes of sedimentation, erosion, crystallisation, compaction, and metamorphism through an experimental and unpredictable construction (Abril & Mesa, 2016).



Figure 3. Anton-Garcia Abril, Tippet Rice Art Centre, 2016 (Image by author)

Within the natural complex, not far from Yellowstone Park, a series of structures are born, making up a set of sculptural

elements derived from the landscape and its processes. Their presence defines a geographical reference point, in comparison to the boundless landscape in which they arise. "Structure of landscape understands the project as a gesture of reflection that learns from natural processes and abstracts them into inventive processes, without architectural precedents, without an idea, without a relationship or circumstance to deny or stop the impulse to create a space within the limits of matter" (Abril & Mesa, 2016, p. 32). Representative logic, based on intuition, rejects any technological process as an abstraction of natural processes, thus relegating the creation of space to material experimentation. This is produced through alchemical models and methods that escape design control. The natural interpretation linked to this process of mimicry demonstrates more connection with the natural world.

The subsequent project of *Ca'n Terra*, created between 2018 and 2020 by Ensemble studio, demonstrate the material action of the Spanish collective is activated by emptying material that reinterprets the ancient function of the pre-existing Mallorca quarry in a residential space (Chiorino, 2020). The previous industrial use governs the project actions, characterised by minimal gestures such as cuts and subtractions, in an excavation area opposite Montana Park. If in the *Tippet Rise Art Centre* project the form is obtained through casts of natural forms, the focus in this project is on the search for space that is in a constant relationship between nature and artifice. Light becomes the material of the architecture that competes with the stone, three zenith holes are obtained through subtracting operations, to illuminate the darkest environments.

During the physical action of the excavation, an unexpected event occurs: a large boulder, falls to the floor below, drags an olive tree with it, clinging to the bare rock, and became the focal element of the interior space. Few other actions follow one another, contributing to the creation of space: a careful cleaning phase of the wall surfaces from mould and dirt accumulated over the years, the placement of translucent curtains fixed on light metal frames that separate the rooms through slender and reversible partitions, the installation of the technological elements necessary for energy and water needs of the house and the placement of the furnishings designed concerning the new spatial configuration produced by the excavation actions perpetrated over time.

Such subtraction process can also be seen in *Casa Trufa* project by Anton-Garcia Abril which represents the embryonic synthesis of the space discussed earlier. The photographic series of *Casa Trufa* construction phases describe a long temporal process linked to a tectonic action, contemplating the unpredictability that is determined in the relationship between terrestrial conformation, matter and action of human and animal (Abril, 2010). The project (Figure 4) is composed of a small refuge, a three-dimensional redesign of Le Corbusier's *Cabanon*, in which the envelope is replaced with a sculptural mass closely linked to the dynamic actions produced on it (Chiorino, 2010).



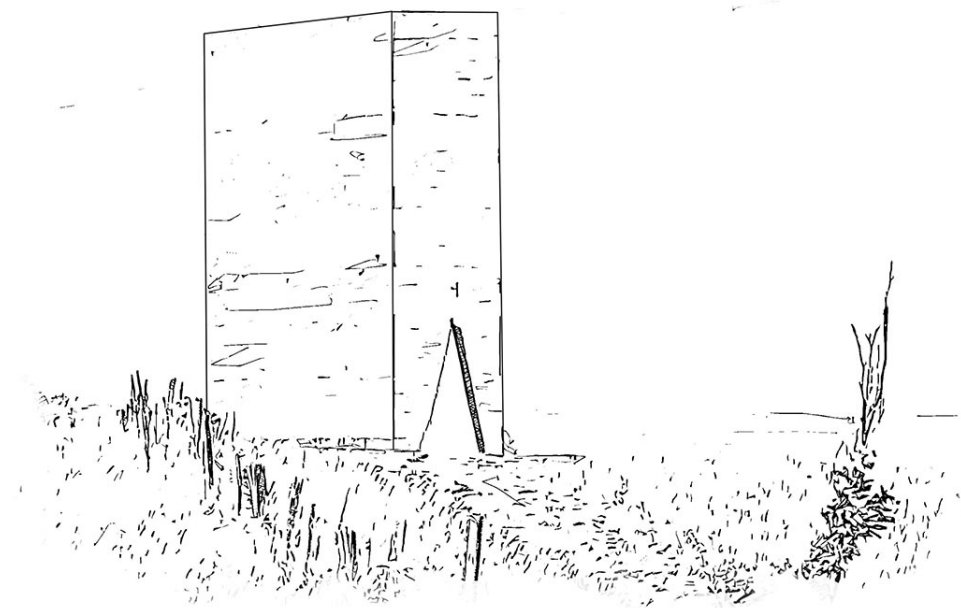
Figure 4. Anton-Garcia
Abril, *La Trufa*, 2007
(Image by author)

The formal creation process of the project involves specific material operations that interact with the environmental context, starting with the excavation work that defines the external appearance of the building. This was followed by placing the bales of hay in overlapping casts, in which the excavation represents the external configuration, while the hay represents the internal one, to be filled by pouring concrete. Subsequently, the architectural object is closed by filling it with excavated material. Once the setting and hardening phases have been completed, we witness a discovery, in a slow subtraction process of the architecture, where the hay is then slowly consumed by a calf that reveals the interior space over a year (Chiorino, 2010).

The temporal logic of the contemporary construction site is here abandoned to reproduce the temporal systems linked to the natural processes that leave physical marks on the material. Concrete, a material with relatively recent technology, was placed in contact with the living earth to reconstruct its shape, evoking the mineral masses or the iconic shape of the truffle full of rounded protuberances (Tonon, 2010). The interior space evokes the absence of hay bales through the mould of the pre-existing volumes and the texture of the organic material eaten by the animal, which then mixes with the concrete. The image of the primitive refuge of the Lascaux cave is here recalled differently, no longer through the representation of animals, but through the action of the animal itself, which the architect physically implements through a process of subtraction of matter in creating the space.

Subnatural dimension as a design reference

The hypogeal configuration of *Abril's La Trufa* project evokes a further understanding of the subnatural dimension of the environment, which includes the muddy and dusty matter (Gissen, 2009). In a different interpretation of natural processes, environmental forces such as dust, mud, gas, smoke, debris, weeds, and insects are configured as elements introduced as an experiential component in the more experimental areas of architecture (Gissen, 2009). Such experience can be seen in the *Bruder Klaus Chapel* project by Peter Zumthor (Figure 5). The project is located on the Eifel hills in Germany in 2007, where the primitive spatial configuration of the hut merges with the sensory experiences of smell and sight which are obtained through the combustion process of wood (Baglione, 2006).



From the outside, the project consists of a 12-metre monolithic block with a pentagonal base, similar to a mass of concrete extruding upwards and only torn by a triangular-shaped entrance. The facade is designed using the formwork used for the casting, through a plot marked by the connection holes and a succession of horizontal appeals that declare the temporality of the construction site. Each horizontal mark represents the limit of the casting reached during the working day, engraving an ideal time scheduled in the facade texture (Durish, 2014). However, the internal space is linked to fire and smoke is concretised as a permanent result of the architectural gesture. Hundreds of tree trunks with various diameters as part of the client's forest are arranged as internal formwork, creating an organic morphology in open contradiction to the abstract geometry of the external volume. After the casting and its hardening phase, the trunks inside are set on fire for three weeks before being removed. The space resulting from this operation was shaped by the smoke produced by combustion as the foundational element

Figure 5. Peter Zumthor, *Bruder Klaus Chapel*, 2010 (Image by author)

of the chapel space. The dark-coloured surfaces show traces of carbonisation, bending the layout chosen by the architect during the design phase. An oculus placed at the top of the ascending rhythm imposed by the surfaces illuminates the interior space and refracts along the walls marked by the fire. The olfactory perception of burning becomes the most evident testimony of the construction process, configuring a sensory experience of the space. Such experience is also emphasised by the existence of water, which by tapping on the lead surface also concretises the auditory stimulations induced by this architecture.

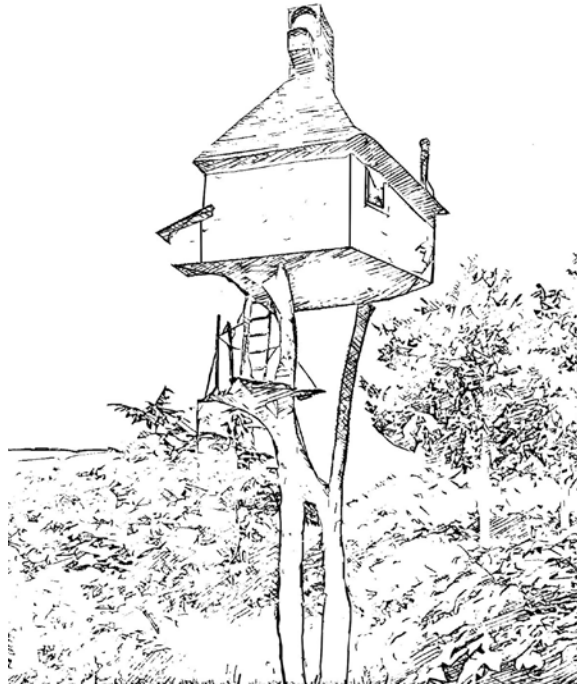
Wood carbonisation as a theme is also frequently part of the works of the Japanese architect Terunobu Fujimori. In this case, a rediscovery of traditional Japanese construction techniques confers the resilient properties of materials. In the Roof house project completed by the architect in 2009, a series of elements emerged from the process of reading and rediscovering the archaic actions of the building (Liotta, 2010). The volumetric definition which conforms to a geometric reading of the surrounding landscape produces a multitude of steeply sloping roofs, which reproduce the roughness of the nearby mountains and define space through its matter. The plant is arranged around a courtyard containing a large central garden, mediated by a portico which is entrusted with the function of external-internal buffer space in a reinterpretation of the spatiality deriving from traditional architecture. Tree trunks, preserved in their original form, alternate with glass panels in performing the filter function. Subnatural entities that give an experimental nature to the project exist in a form of mud and fire. In the first case, a muddy stucco becomes the material capable of connecting the partitions of the building in close connection with the earth. In the second case, through a treatment of the facades with carbonised cedarwood, recovery of an ancient oriental construction technique improves durability. These design actions represent the synthesis of an observation path that Fujimori undertook several years earlier with the ROJO collective (Fujimori, 2008). The group bases its activity on the observation and research of significant events in the urban environment. Through a series of photographic campaigns and annotations, the group collect the set of shapes traced by humans and the signs left by natural phenomena. The collected material is summarised in possible design actions. Knowledge of these elements offers new exploratory potentials of architectural space capable of redefining the concept of resilience in a more sustainable and inclusive dimension. Many of the components belonging to the subnature that are often excluded from the architectural project can now acquire a new role in the construction of the space.

The role of the tree as a spatial focus

Fujimori's work looks at the theme of the tree and its behaviour carefully as a living natural entity that weaves with space. Telling his projects through this aspect allows us to reconnect with the theme of the tree as a spatial entity that

performs as the protagonist of architecture. In this sense, the numerous tree houses that he built during his design activity, subsequently presented at the 2008 Venice Architecture Biennale, are significant. Fujimori's tea houses (Figure 6) reveal a playful aspect linked to the primitiveness of living, in which the tree is the foundation and the structural element of the entire project (Pierconti, 2019).

Figure 6. Terunobu Fujimori, Teahouse, 2008 (Image by author)



In the confectionery store complex La Collina—translated as "The Hill"—, located in the territory of Shiga, Fujimori discusses the use of the material in contemporary architecture which integrates vegetation and architecture, developed from the detail to the landscape scale (Pierconti, 2019). As part of the La Collina complex, there is a shop called Kurihyappon, which reproduces the forest on an architectural scale (Pierconti, 2019). Fujimori alongside the president of the company who commissioned the project, selected the chestnut trees to be used as the crucial element in the construction of the space, intermingling with the furnishings and acting as a structural element. Inside the building, the trees are thought of as physical entities, competing in the construction of the architecture while maintaining their natural conformation. However, their constructive nature is not denied, openly declaring the task of supporting the building, at the intersection with floors and roofs. The nature of the internal and external space thus clearly declares their identities, highlighting the design logic based on an experiential interchange between construction and environment.

If Fujimori's work declares its belonging to the organic world through the fusion of nature with an experimental reinterpretation of traditional Japanese models, on the other hand, the research of Vo Trong Nghia and his studio VTN

Architects tries to make the tree coexist with the residential space. The tree is the architectural protagonist until it becomes a real inhabitant of the house, like every living element that populates the interior space. The experience obtained, for those who will inhabit the architecture of Vo Trong Nghia, will be that of feeling inside a forest. As an example, *Villa Ha Long* is composed in the plan as a pentagon, where the sides of which draw a promenade are grafted between green volumes, creating open, semi-open and closed spaces. The vertical development happened in layers, and the external space is divided by a transition of semi-external spaces up to the internal ones in which the tree regulates the transitions. Inside the path, large vases dug into the attics house the trees, which characterise the interior of the house that is also perceptible from the outside. On the sides, the rectangular openings allow access to a large amount of air and natural light and leave space for the botanical species that, with their thick foliage, emerge from the excavations in the facade (Benetti, 2019). The semi-external space connects the interior and the terrace part of the garden and is a place to promote various domestic activities. It is a multipurpose space that acts as a link between each environment, as a place for gardening, visiting, sitting, and walking. At the same time, the double-skin reduces the external climate impact, mitigating tropical heat and noise. The large foliage, together with the gaps in the facade, determine large shadows that help to characterise the appearance of the building. The monolithic concrete skin is carved out of large openings and gives space to nature as the last insistent way to appropriate the space and characterise its shape in an open coexistence with the human being who will inhabit it.

The Stepping Park House (Figure 7) continues the issues addressed by VTN architects through the adoption of the tree within the domestic dimension. The project is a new residential area in Ho Chi Min, located near a park. The house exists as an extension of the park, where plants, light, natural air, and sun are all elements that contribute to domestic well-being, reconstructing the appropriate climatic conditions for the life of humans and plants in it. The space is articulated through a series of internal terraces that make up a diagonal void in section, through a subtraction of volumes staggered on three levels. This separates the common space of the house from the private space (Benetti, 2020).

On the ground floor, the void serves as a living room which opens onto the park; while on the top floor, the family room is covered in greenery. The facade surrounding the void is covered with ivy plants, with the loopholes providing shade on the top floor. The void incorporates both circulation elements and natural elements such as plants and trees, providing private rooms with additional natural light. In contrast to the communal spaces, private rooms such as bedrooms are placed in solid volumes. Planting trees in the opening of these volumes of direct sunlight cools the wind and illuminates the interior space with greenery. Inside, the trees populate a small domestic forest, enlivened

by the ventilation allowed by the facade, open and filtered only by the thin bamboo trunks placed on the surface. As you walk around the house, you will feel the wind blow from the living room to the top floor of the house. The house for trees (Figure 8), built-in 2014, is conceived as a large pot that contains the trees on the roof. The pot is arranged in the plan as squares in rotation, which exist as a container for human beings but at the same time also accommodate the Vietnamese tropical plants.



Figure 7. Vo Tron Ghia, Stepping Park house, 2014 (Image by author)

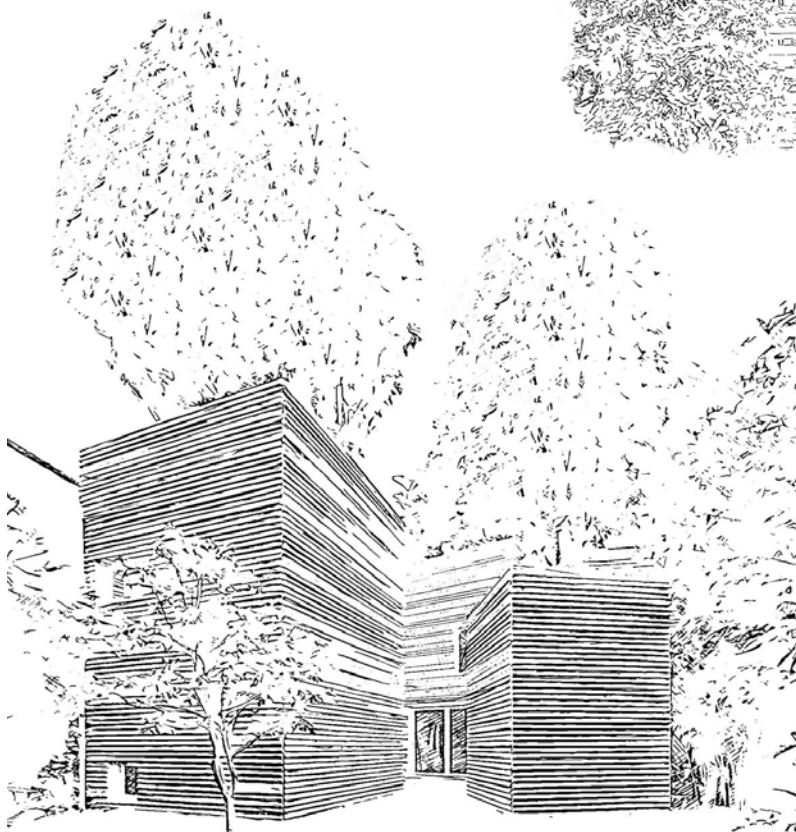


Figure 8. Vo Tron Ghia, House for the tree, 2014 (Image by author)

Conclusion

The aim of this paper intends to identify new design paths by the concept of resilience. The case studies presented describe how a natural interpretation in architecture is possible that rejects the technological intention of replacing organic processes and their components. Instead, these projects demonstrate natural interpretation which recognises the material peculiarities for the construction of space, through logic compatibility with the natural process. Starting from the natural process of mineral concretions, passing through the subnatural dimension of muddy and gaseous particles produced by combustion, up to the tree as natural entities that construct the architectural space, these organic elements are all contemplated as a nature-driven constructive tool of architecture. They are in an active role, capable of strengthening the relationship between the life of humans and that of the natural elements that surround us.

The numerous examples previously addressed demonstrate how a consistent approach to nature is possible, but an abandonment of the emulative logic that the constant hyper-technology of architecture intends to pursue is required. Architecture, in a new organic reading of nature, which derives directly from the interpretation of its entities and not from its simple formal emulation, can become a concretely efficient organism compatible with the complex mechanisms that govern the natural transformations of the earth. In this sense, the notion of resilience will be able to take on a new and more relevant role to the natural phenomena from which the term itself derives, becoming a design requirement necessary to relate, not only spatially, but constitutively, with the complexity of the changing contemporary world.

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