PAPER #5.08

VEGETATION AND THE CONSTRUCTION OF SPACE

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How to cite
De Marco, Paolo. "Vegetation and the construction of space." In *Proceedings of 3rd Valencia International Biennial of Research in Architecture. Changing priorities*. Valencia. 2022. https://doi.org/10.4995/VIBRArch2022.2022.15296

ABSTRACT

In the last century, the architectural renewal proposed by the functionalist ideal of the *living machine* placed the architectural object in a context, establishing perceptive relations with it but remaining substantially distinct. Although in some cases the vegetation was incorporated into the architecture for the definition of some internal open spaces, it is necessary to wait for a revision of these principles to find new research for a deep interaction between natural and artificial space (an ecosystem architecture-nature).
After these experiences, the focus on vegetation has decreased, returning to be a central theme of contemporary research, especially in response to the complex crisis and pandemic underway that has defined new qualitative and quantitative priorities for domestic space and cities.
The contemporary debate about the relationship between built space and vegetation has often been devoted to the urban scale and the external and public dimensions of buildings. At the scale of architecture, the presence of vegetation is often evaluated from the point of view of environmental comfort and for its use in energy strategies.
In response to the new needs of living and building (for a truly integrated and sustainable environment), the contribution aims to offer a reflection on vegetation as an architectural and spatial component (mainly in areas with medium-high population density) whose presence acts as an element of structuring and sorting the project. In the desirable change of priorities, the contribution aims to offer a reflection on the theme through a framework of the role of vegetation as a material of the project, making use of different experiences, reporting case studies, and analyzing the use of vegetation concerning the multiple issues of space. The contribution, therefore, elaborates good practices, in order to define ideas and rules for the role of vegetation in contemporary architectural space.

KEYWORDS

Architecture; design; nature; innovation; green.

1. INTRODUCTION

The question of *green* architecture and the presence of greenery in public and private spaces is today of such socio-cultural evidence that it seems necessary to return to reflect on the relationship between man and nature, the symbolic value as well as the spatial relationships that may exist between architecture and vegetation. The sanitary emergency and the conditions of isolation have led to reflections on the new needs of green for the domestic and for the collective space (De Marco and Margagliotta 2020), although the current resumption of interest in these issues, however, is often vitiated by some preconceptions (many times the

question is declined only to a technical-technological perspective) or inaccurate terminology. Therefore, there is a need to deepen some concepts from the point of view of the principles of architectural design and, moreover, to elaborate and update some of the notions underlying the relationship between architecture and nature, and more specifically the relationship between built space and vegetation.
In the required change of priorities, the contribution identifies and describes ancient ideas and principles useful to define a theoretical background to the contemporary architectural debate, as well as a reflection on the theme through a framing of the role of vegetation as a material of the project; moreover, different experiences are collected, reporting case studies and analyzing the use of vegetation in relation to different contexts and the multiple issues of space. The contribution therefore elaborates good practices, in order to define ideas and rules (environmental and aesthetic) for the role and presence of vegetation in contemporary architectural space.

2. NATURE AND ARCHITECTURE

In the contemporary condition, the *green* – present and persistent in different quantities and qualities – is the memory of a natural world to which man, in various ages and ways, has always been related. In primordial terms, in fact, depending on the cultures, nature has represented an unknown and indecipherable world (the fear of going into the woods), but also, at the same time, a harmonious system to which man himself aspired through behavior and forms. The history of civilization tells of numerous and different parks and gardens, real or ideal, both for their physical characteristics and for the symbolic values: the Garden of Eden, for example, it is the sacred and symbolic place that directly represents the Creation in which the human being lives and must take care of; inside, then, the trees offer fruits that can provide *knowledge* and *life*. And it is precisely the tree that is often used as a powerful archetype at the origin of the building (Kräftner 1981): the tree that unites heaven and earth, that brings together air, water and fire, becomes symbol – according to Jung (2012) – of many concepts such as the source of life, growth and development, the unfolding of form, rooting, shelter, but also death and rebirth. In the search for a relationship between nature and man – and consequently the relationship with architecture as a human activity of modification of places – essentially resides the sense of being on earth, or the central theme of philosophical thought that, according to different reflections and interpretations, each epoch has faced. In this regard, it is possible to macroscopically recognize two interpretative and operative positions – that of homological art and the one of analog art (Portoghesi 1999) – which are described below.
First of all, we must necessarily consider that, in an epistemological sense, architecture is a part of nature: it is as a whole of things and signs that man leaves during his passage, a testimony of our living on the planet. It is therefore a reflection *from the inside*, an analysis of a part in relation to the whole. The artifice, from this point of view, is a component of nature of which man himself is part: "The artist is man – writes Paul Klee –, he himself is nature, part of nature in the area of nature" (Klee, quoted by Hadot 2002, 185).
Architecture, therefore, as homology of nature and *second artificial nature* that modifies the primordial condition of *natura naturans* referring to the archetypes of dwelling, to the myth of the hut, to the construction as a combination of natural elements (Margagliotta 2020). Nature, then, as a model for every creator process and as ubiquitous physical reality, as well as a system of order (of the entire universe) that, in certain cases, feeds the project with figurative suggestions.

Thus, the column derives from the tree that, according to Vitruvius, with its foliage can inspire Callimaco to the creation of the Corinthian order; in the same way - writes Rykwert (1977) - from the '500 and for several centuries the architects

> […] managed to produce an Order of Architecture both elegant and rich […] but most limited their efforts to vary the Corinthian capital... and finally they forgot that, in order to compete with the Greeks, it was necessary, not already to follow them step by step, but to go back to the primitive theory, that is to say to the Nature itself (Ribart de Chamoust, quoted by Rykwert 1977, 6).

The relationship between nature and architecture can be interpreted, then, from a second position, diametrically opposed to the first for the results. Primitive nature is, in this case too, the precondition for any action, while architecture (and art in the general sense) – as the creation of the human spirit – arises by analogy from contemplation of nature, as an instrument of dialogue, of relationship, of comparison.
Architecture, therefore, not as a figurative imitation of nature but, rather, as a means and specific language of man (the only being on the planet that builds with aesthetic intentionality), albeit with an abstract and procedural aspiration to nature. It's the thought of man, inspired by nature, to create an artifact through the transformation of materials, to establish a system of order, controllable and persistent, with uses and functions, unlike the natural order as a field of changing relationships, 'rude' and 'negligent' – says Laugier (1987, 40) – to be remedied, in fact, with human ingenuity. The architectural principles are however studied and extracted from nature: think of the labyrinth, vegetal architecture probably derived from the geometrization of the forest and built exclusively with trees or hedges, made for playful purposes and delight but, at the same time, daedalic space of imprisonment; or even to the mountains, natural monuments from which to grasp generative rules since 'even the geological formations generate standards' and, to build well, 'man raises walls in the image of the rocky faces' (Le Corbusier 1941, 47).
In the same way, from the analysis of the laws that structure the natural elements we can get to build the rules that support the architectural composition; as Le Corbusier states:

> Nature is mathematical, the masterpieces of art are in harmony with nature; they express the laws of nature and make use of them (Le Corbusier 1955, 29).

In the wake of this research, in the last century the architectural renewal proposed by the functionalist ideal of the *living machine* placed the architectural object in a context (urban or natural) establishing perceptive relations with it but remaining substantially distinct from it. Although some parallel experiences have investigated the hypothesis of an organic architecture, arising from a processual and generative inspiration of nature (St. John Wilson 2007), the *mechanistic* position undoubtedly had greater diffusion; to exemplify this approach, we can remember some of the architecture-manifesto of the International Style, the Villa Savoye by Le Corbusier and the Farnsworth house by Mies van der Rohe, extremely different in formal and spatial research but united by a similar relationship with the surrounding nature – to which architecture looks while remaining at a reasonable distance – and with the soil:

> The grass is a beautiful thing, the forest too. The house will land on the grass like an object, without disturbing anything (Le Corbusier 1964, 24).

Although in some cases the vegetation was accepted in the architecture for the definition of some internal open spaces (roof-gardens,

patios), it is necessary to wait for a new phase of research, with the revision of these principles and subsequent experiments to find the attempt of a deep interaction between natural and artificial space. Particularly significant is the experience of Atelier 5, also because it develops deliberately starting from the lecorbuserian legacy, but reversing the results: the Halen residential unit (1960) rises from the study of the Unitè d'Habitation but extends horizontally grafting on a hill, in a refined interpenetration between architecture and nature with numerous private vegetated spaces (gardens, patios, grassy terraces) that replace the idea of collective greenery (Atelier 5 1995). The utopian and ecological researches of Paolo Soleri, instead, move from a critique to the indefinite expansion of the Wright's Broadacre city. The concept of arcology, defined by the same architect as a portmanteau between architecture and ecology, is substantiated in the unfinished experimental city of Arcosanti (Arizona, 1970), which proposes alternative models of housing, design and construction: limit the expansion of the city by designing the population density (miniaturization), build a community, use prefabrication to reduce consumption and costs:

> Nature shows that for all organisms or society of organisms with any increment of complexity, there corresponds a spatiodurational contraction of its functions (Soleri 2019, 128).

The concept of an architecture-nature ecosystem is common in the architectural research of the 60s and 70s of the last century. It dates back to the last CIAM, celebrated in 1959 in Otterlo, the dissemination of some theoretical ideas on megastructures (architectural and urban units) inspired by the mechanistic vision but also by theories on biological growth. On that occasion, Kenzo Tange anticipates the establishment of the *Metabolist* movement (Koolhaas and Ulrich Obrist 2011), made up of Japanese architects who, starting from a critical analysis of their metropolis, propose new principles and suggestions for the future environment:

> The reason why we use the biological word metabolism is that we believe design and technology should denote human vitality. We do not believe that metabolism indicates only acceptance of a natural, historical process, but we are trying to encourage the active metabolic development of our society through our proposals (Kurokawa 1977, 27).

These utopian visions, despite some built projects, did not have a real practical response. Probably, the search for a new combination between artifice and nature in the last century finds its maximum expression in the proposal of Moshe Safdie for Habitat '67 in Montreal.[1] The multifunctional complex (residences, commercial and services spaces) offers an experimental solution for dense living, with modules entirely prefabricated in concrete, superimposed in different configurations to include vegetation, create paths and open spaces at high altitude, green terraces, small gardens. The 354 modules are divided into three pyramidal mounds, almost artificial and habitable hills, which also suggest an allusion to a primordial and natural system of aggregation of elements (Fig. 1).

Figure 1. Moshe Safdie, Habitat '67 in Montreal. Source: (Safdie Architects)

After these experiences, the focus on vegetation has gone into the background of other issues to return to be a central theme of contemporary research, also in response to the complex crisis and pandemic underway. The period of isolation has called into question our living spaces (especially for city dwellers): the house has become the threshold that, while on the one hand it has imposed a boundary to collective life, on the other it has returned to be a refuge. This has made clear the new priorities of living with open air spaces and a renewed union with nature that guides architecture since its founding principles. Despite this, the renewed and dutiful interest in the role of vegetation in architectural design risks, in some cases, becoming a mere formal theme.

3. ARCHITECTURE IN NATURE

Outside the urban condition, in those places that can still be considered phenomenologically *natural* (Norberg-Schulz 1992), the presence of vegetation in architecture appears, in some ways, obvious. However, we can recognize among the recent experiences, specific cases in which the nature and the arboreal pre-existences become together essential components of space and form, in which a condition of mutual improvement is built, an internal tension that enriches the meaning of the tree and the architecture (Kräftner 1981, 25) Consider, for example, the Nordic Pavilion by Sverre Fehn at the Gardens of the Venice Biennale (1962), in its construction as an assembly of simple elements (walls, beams, a roof of *lamellae*) around of Mediterranean hackberry trees (*Celtis australis*); the extreme order of the monomaterial space is enhanced by elaborating its exceptions to leave intact the trees, become the fulcrum of the space and, for this reason, exalted in their symbolic value. Eloquently, the corner solution sees the bifurcation of a large beam to dodge (and at the same time include) another large tree (Norberg-Schulz and Postiglione 1997).[2]

The same approach is employed by Giuseppe Samoná already in 1947-50, when he built the house "la quercia" (the oak) in the wood of Gibilmanna, in Sicily; in the context of almost untouched nature, the boulders emerging from the ground and the presence of large trees determine the settlement aspects of the project, until the oak trees penetrate the interior space and pierce some roofs (Purini 1990).

Another relevant case study is the house that Kazuo Shinohara realizes for the poet Shuntaro Tanikawa in the forest of Karuizawa (1974); the architect acts on the space of the *do-ma* (dirty floor) which in tradition is a surface of unpaved land, storage area but also threshold-space between inside and outside.

Shinohara preserves the natural soil even in its inclination and on it erects a wooden pillar that alludes to the presence of a tree that supports the roof. With this sophisticated symbolic action, the expressive emphasis of architecture turns to the service room, which becomes the main space of the house, between nature and artificial construction. The expressive force of the natural component is also present in the Plywood house by Herzog & de Meuron (Bottmingen, 1984-85): the small wooden pavilion is an expansion of the main building that stretches to almost touch the majestic Paulownia tree in the garden. In this case, the placement of the artifact seems to attempt contact between vegetation, which, however, produces a volumetric deformation such as to characterize the shape and the internal space.

To preserve the soil in its natural course and the shrubs, Lacaton & Vassal decide to detach from the ground the house in Cap Ferret (1988), located on the west coast of France, in the Arcachon Bay (*El Croquis*

2015). The lifting expedient is also useful to gain a better view of the surrounding horizon, while the tall pines are literally incorporated into the architecture, which can be crossed vertically through a special supports adapted to their waving, their growth and maintenance in a good state of health; *natural columns* (even if not structurally bearing) between the artificial pillars, which determine the articulation of the plant and the section (Fig. 2). An effective structural tree-house union is realized in the small refuge of the Tree hotel in the north of Sweden (2008-10) by the studio Tham & Videgård: the tree is the real structure on which hangs, suspended in the woods, a high-tech cube with side 4 meters, consisting of a lightweight aluminum frame, covered externally with mirroring glass, creating an effective camouflage.
And again, in Mêda, Portugal, a large chestnut tree protects and shelters under its canopy the refuge designed by João Mendes Ribeiro (2018-20). Starting from a parallelepiped shape, the wooden structure undergoes deformations and inclinations that determine an internal-external, geometric and organic spatial continuity, an extreme and indissoluble mixture of architecture in nature (Mendes Ribeiro 2021).

Figure 2. Lacaton & Vassal, House in Cap Ferret. Source: (Lacaton & Vassal)

4. VEGETATION IN DENSE LIVING

The archetype of the city establishes a precise separation between the natural and the urban environment that, through a fence, delimits the living space with respect to the surrounding territory.[3] Although in the contemporary metropolis the spatial expansion has inevitably dissolved this fundamental rule, the city, in its principle, excludes and separates; and even when nature has been included within the urban structure, it has been as a *fragment* (Espuelas 2004, 50). And if in the past the image of the city was consolidated on the precise idea of the clearing – *empty* space geometrically defined and subtracted from the vegetation – the distorting *natural* metaphor of the current urban condition is the forest (as in fairy tales, place of bewilderment). Overcome the literary similarities, the contemporary city expresses the inattention of man towards nature that is manifested in a tendential action of concealment, so that it remains invisible to the senses with a perception inversely proportional to the urban dimension (Rifkin 1989). At the critical state to which the environmental (and cultural) condition of the urban landscape and the society has reached, the reflection on city and nature calls into question those archetypal conditions that now seem irrecoverable. It appears necessary to make a change of priorities to define new cultural horizons, to orient space research, to address the environmental and climatic needs of contemporary territories (Donadieu 2006).
The contemporary attempt to rebuild a careful dialogue between nature and building in areas with mediumhigh population density, the vegetation becomes an extraordinary element that is usually introduced by the same project as a determining element and principle and as part of the spatial system (Hunt 1993).[4]
Representative examples of this approach are found – also for reasons of different tradition, architectural culture and attention to nature – especially in the eastern metropolises. A

precursor project can be the house in a plum grove designed by Kazuyo Sejima (Tokyo, 2001-03), which builds its theme from the conservation of trees; the white volume, pure and simple, with openings arranged irregularly in the thin walls (in 5 cm thick metal panels) is equipped with a private terrace with vegetable soil. White and light volumes are those of the Moriyama house (2011) by Ryue Nishizawa, where the compact solid and the continuous envelope are avoided in favor of a complex and articulated configuration; the domestic space is decomposed into separate and independent bodies which are accessed from the garden that becomes an open-air inhabited space. Nishizawa himself experimented with this principle according to the vertical development in the Garden & House (Tokyo, 2012): in a small rectangular lot (4 x 8 m) overlap 4 concrete floors, apparently without facade envelope; the vegetation, present in all floors in large pots, to separate the interior of the residence from the street, colonizing and animating all the space. And again, in House N in Oita (2008) Sou Fujimoto proposes a gradual transition from the public road to the private space through three layers (three shells) consisting of perforated surfaces: the first space is the garden intended as a true mediation area, with permeable soil and vegetation; the second shell encloses the space of the tatami and the bed, while in the inner core there is the dining area. Ultimately, however, the unusual distribution of the spaces generates a real internal-external interpenetration, in which home and garden do not have a precise distinction.

The same Fujimoto has recently completed the residential tower *Arbre blanc* (white tree) in Montpellier (2019) drawing some of these concepts in the Mediterranean and with a high-density building. The first two levels of the tower are intended for commerce with public access, while on the roof there is a bar, a hall and a terrace for all residents; the remaining 15 levels develop 113 apartments, each of which has a private open space endowment thanks to the large projecting floors, populated by plants and small trees in pots and flower beds. The size and proportion of these protuberances (it would be mistaken to call them balconies) builds a real space of admixture with nature and vegetation, also acting as a shading system.

It is difficult to understand if the analogy with the structure of a tree (the trunk and the branches that protrude towards the light) is a primordial suggestion of the project or the outcome of a precise research.

The result, however, is a coherent and credible project, which brings about real innovation in the endowment of vegetation and private open space in urban residential models (Fig. 3).

Remaining in the European context, but in a peri-urban context, the project by BIG and JDS architects for the Mountain Dwellings in Copenhagen (2008) – perhaps mindful of Habitat '67 – is based on the spatial distribution of housing towards the best solar orientation. To achieve this, the plans for the car park also follow this configuration and constitute a kind of base for the levels of the residences. It's a variation of the housing typology, so the apartments – which have relatively small areas – are arranged as vegetated terraces, scaled gardens, significantly increasing the spatial endowment of each of them (Fig. 4).

Finally, it is also interesting to analyze the project for 57 university residences in the campus of the

Technical School of Architecture in Sant Cugat del Vallès, realized by H Arquitectes (2010-11), a firm that for years has distinguished itself for the search for economic and sustainable solutions. In this case, vegetation is used as an element of integration in the landscape, for the creation of community spaces and small private areas, responding overall to a strategy of summer shading. The patio building, on two levels, faces consistently towards its

interior, where vegetation composes shady places and meeting spaces. The project also develops the theme of industrialized modular construction that allows the reduction of emissions and production residues and – once its useful life is over – the reuse of modules and its component systems in other configurations. In this sense, the project also responds to an organic logic of architecture, which does not produce residues but resources for new uses.

Figure 3. Sou Fujimoto, Type plan of Arbre blanc residential tower in Montpellier. Source: (Sou Fujimoto Architects)

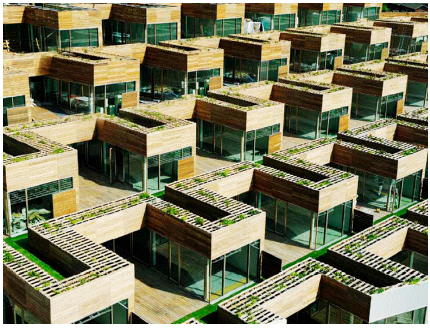

Figure 4. BIG, Mountain dwellings in Copenhagen. Source: (BIG Architects)

5. CONCLUSION. SPACE, NOT JUST SURFACE

The contemporary debate about the relationship between built space and vegetation has often been devoted to the urban scale (the presence of parks, gardens, avenues) and the external and public dimension of buildings. If, as is desirable, studies and theories for the protection and implementation of *urban forests* will lead to improving the endowment and quality of collective greenery on the ground (FAO 2016), to the scale of architecture, however, and especially with regard to the home, the presence of vegetation is often evaluated from the point of view of environmental comfort and its use in energy strategies.

The recent pandemic emergency and the global ecology crisis has exacerbated some issues relating to the domestic space, so much so as to make clear the need to equip our homes with *spaces of nature*. These should therefore be living and customizable vegetal spaces – not only *green* surfaces but places where you can *stay in* and can really be experienced – that also allow the enjoyment of the air and the sun and, why not, also a desirable reconciliation of individuals and society with nature.

However, the presence of vegetation and the adjective *green* is not a sufficient condition to define a horizon of sustainability to the architectural project. The risk, in fact, is that the green tendency reduces the vegetation to a limited epidermal value to the external surfaces or, even worse, that it is reduced to an ornamental device without acting on the actual spatial characters and the quality of living (Pallasmaa 2010). Nor is it possible to reduce the themes of sustainability and vegetation to just a quantitative economic parameter, since it also concerns qualitative, complex and multi-scale issues (architecture, city, landscape, geography) (Bassanelli 2020).

On the basis of these principles, therefore, it is necessary to look for solutions that are easily applicable and implementable, that have fair maintenance costs, that can constitute models that can be effectively extended on a large scale. The contemporary experiences presented here describe a serious and profound architectural research for the introduction of vegetation in the residential architecture project. In the natural context, we can note an interesting relationship of respect for the soil; the trees become priceless spatial devices to be preserved and brought inside the domestic space.

Also, in the urban context, good practices demonstrate a new organic approach, the possibility of spatial coherence and architectural-nature interdependence necessary for the construction of a real and innovative ecosystem: the decomposition and perforation of the *architectural box* to allow an interpenetration with vegetation and increase the open air spaces; the experimentation of new residential typologies less compact and which, however, project the living spaces outwards, with small private spaces

of nature, useful and enjoyable. These spatial innovations have the potential to define a new hybrid landscape of the integration of architecture and nature. Although the presence of vegetation in the city and in buildings still appears today a condition of exception that is artificially introduced, it can actually represent a new architectural paradigm, an ordered and rational system that, finally, it faces a truly sustainable horizon.

NOTES

[1] In the same years there were numerous experiments on the topic of prefabrication of housing modules and highdensity aggregation systems. For example, the Nakagin Capsule Tower in Tokyo by Kisho Kurokawa (1972) or Kafka's Castle by Ricardo Bofill in Sant Pere de Ribes (1968). Bofill himself theorized these concepts of spatial development (Hacia una formalización de la ciudad en el espacio, 1968) put into practice with the projects for Walden 7 and Xanadú. With a fundamental focus on the issue of vegetation, the project of the Espai vert in Benimaclet, Valencia, built by architect Antonio Cortés Ferrando (1990) is relevant.

[2] The recent removal of the tree, in fact, enhances the close dependence that the project has built with vegetation.

[3] The ancient cities in the desert areas included within the walls the oasis (source of life). In this sense, the fence was the separation between two different natural environments.

[4] Starting from the thought of Cicero, in the '500 humanist Jacopo Bonifadio introduces the concept of terza natura (third nature), or a "nature improved by art"; to this category belong the gardens – portions of nature reproduced for playful purposes – which are distinguished from the cultivated nature, that is the second nature of the agricultural systems that man creates for productive purposes; the first nature is instead the uncontaminated and wild, also called wilderness.

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