ON SUSTAINABLE
BUILT ENVIRONMENT
BETWEEN
CONNECTIONS AND GREENERY

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On the Book Cover: *Abstract tree of circuit printed board.*

Contents

DESIGN

ESSAYS & VIEWPOINT

RESEARCH & EXPERIMENTATION

CONSIDERATIONS AND RESEARCH ON SUSTAINABLE AND CONNECTED BUILT ENVIRONMENT

Volume no. 7 of the series Project contains essays and critical considerations, research and experiments, projects and actions addressing the subject 'connections' between people, between people and things/places and between things/places and 'greenery' in symbiosis with the built form, two topics of pressing relevance. Concerning the first subject, we can just remark a profound transformation, a pervasive widespread transition which combines dichotomies (analogue and digital), enhances oxymorons (artificial intelligence), overturns axioms (ubiquity), creates paradoxes (sharing economy) involving, without distinction, architecture, humanities and social science, anthropology, sociology, ecology, biology, physical-mathematical sciences and neuroscience whose impacts will become even more striking in the medium and long term. Although they are currently visible and accelerated in part by the global health emergency. A certainly 'digital' transformation, which scholars such as Floridi (2020), Galimberti (2020), Haraway (2018), Searle (2017) and Chomsky (2011) have placed above all on an ontological and epistemological level as it involves the essence of 'things', the way we define them, the world around us and in particular our relationship with the elements that constitute it. Therefore, the nature of things and the relationships that connect them are some of the great issues that digital transformation is 'imposing' today. They are also introducing innovative approaches and actions to solve both 'historical' and new problems (anticipating systems, possible futures, etc.) and new inconveniences (exclusion, digital divide, etc.), claiming the 'vitalism' by the current cultural, social and economic challenges that influence the contents of Agenda 2030 and the involved principles of sustainability, innovation and social justice issues. In fact, we are shifting from a reality made up of things to one characterized by relations – connections – moving in a daily reality made up of intangible 'objects'.

Physicality/materiality and history of forms also become virtual realities by mixing in the immaterial flow of networks and deterritorialised flows: the digital 'opens' by connecting (delocalizing) and 'confines', but above all, it 'induces' new spatial configurations in a constantly evolving relationship between genius loci and shape, function and flexibility of use, between the Vitruvian man, and his physical proportions, and the 'inforg' man who lives, works and relates to the contemporaneity of simultaneously physical, virtual and digital places. A space that,

as an ontological entity (natural, built, joint, open, secured, connected, residual, interstitial, on a macro or micro or nanoscale, no matter if we are talking about surfaces, volumes, thresholds, technical-construction/plant components and objects) in any form (from landscape to territory, from infrastructures to cities, from buildings to objects, up to systems, components and materials) expresses Connections: Physical, in the single material, analogical and tangible object; Virtual in configuring experiences of augmented and immersive reality, of wearable technologies; Digital in interacting and implementing new creative and communicative processes and, at the same time, technical, to control and monitor the project at various scales, conveying forms and images, functions and performances in a new dimension of digital sharing.

The relevance of the second subject is linked to deforestation and forest fires, urban sprawl, indiscriminate use of non-renewable raw materials and an increase in CO_2 emissions contribute to global warming and climate change, causing a devastating impact on our fragile ecosystem, society and the economy. Once it was established that we will not reach independence from fossil fuels (maybe) before 2050, we recall the role that nature and greenery in general can play in the short term to address the current challenge that threatens the whole planet. This was already highlighted by Beynus studies (2002). They are a knowledge heritage useful for the regeneration, with awareness and responsibility, of the built environment. Over the millennia, Nature has perfected strategies and solutions, processes and mechanisms to adapt to different climates and physical conditions through the rationalization of the use of matter and energy by optimizing material and immaterial metabolic exchanges. Even earlier Simon (1969) had understood the prospective of a 'new ecology' in which the animate and inanimate components of the built environment combine to characterize a 'unified' landscape.

While the Modern Movement has considered landscape, urbanism, architecture and design as separate disciplines, in the new millennium there is a 'scalar shift' in which they are considered as a part of a unified territorial system, in which we are called to design for humans and living beings, in a connection made of profound knowledge and understanding of the trajectories and coexisting needs of the many human and non-human inhabitants of the built environment. The relationship between the parts of the system takes on crucial importance when we adopt a broader and more systemic vision, supported by a holistic and participatory approach (Otto, 2008). Digital technologies can support this 'double convergence' in their shift towards a 'cybernetic ecology' allowing us to see the natural and artificial world as a unicum (Ratti and Belleri, 2020).

Once the classic artificial/natural dualism is overcome, new possible project scenarios emerge, made possible by the potential of computer sciences, bio-engineering, digital technologies, parametric design and 3D printing. They open up to new mediations and intelligence forms borrowed from a multiplicity of

living species which define and configure bio-design, bio-architecture, bio-infrastructure, and bio-city solutions. A new systemic, interdisciplinary and multiscalar logic begins to spread: from cyber-gardening to bio-technological remetabolization of whole neighbourhoods, to responsive envelope systems that integrate bio-materials and/or cultures of living microorganisms but also new opportunities for circular sustainability. Greenery and digital technology provide many benefits for environmental, social, economic, health, well-being and quality of life aspects: their 'creative and strategic' approach can be essential for sustainable and aware development.

The five papers in the volume investigating the 'connections between people, between people and things/places and between things/places', with the considerations made by the Authors do not cover all areas and fields of research. However, they delve into some connections in an exhaustive and interrogative way, sparking new interests and knowledge in the reader. Augmented Reality and Virtual Reality, modelling and handling, and digital design are only some of the tools useful to create a network of new connections. The interest in new connections can be found in the proposal of an Augmented Reality app for the Heritage and in the case study on the Basilica SS. Medici in Alberobello. It provides additional support for users in getting to know sacred spaces as they were conceived by their designer, but also through the specificity of Digital Design that, thanks to the ability to foresee future scenarios, helps to understand the possible answers that digitisation can give us on the apparent dichotomy with the sustainable dimension. SMAG and COLUX are the two mentioned case studies. The first one develops a system of products-services capable of monitoring the vital parameters of green spaces; the second designs an innovative platform to create virtual environments of products and housing spaces through Augmented Reality and Virtual Reality.

Some equally interesting pieces of research on the subject of connection were carried out to support the need of specific users living in unique environments, for example, patients and their rooms in a health and assistance centre. Concerning this connection, this volume presents three papers. In particular, one paper deals with the study of spatial/technological organisational models present in a hospital room, trying to combine space flexibility with organisational flexibility to optimise work fluxes in the healthcare processes for operators and the psycho-physical-social wellbeing of all users involved, from the patient to the health worker. The results of this study show that the physical environment can contribute also to the workers' productivity, to clinical, psychological and physical security (as for the prevention of medical errors or reduction of stress factors).

On the Health subject, there are two other papers. The first one is the result of a project developed by the cross-disciplinary group of the Polytechnic University of Milan focused on the subject of digital territorial networks for the valorisation of the territorial impact of the Health Homes in Emilia-Romagna (Italian Region),

aimed at defining 'design guidelines' useful to consider Health Homes again as resilience centres, after facing the tragic global experience of the pandemic. The second paper deals with a project focused on the transition towards an increasingly digital Healthcare, recognised by the European Union to improve the access to healthcare, and the quality of care and increase the efficiency of the healthcare system. It is shown that the use of BIM, IoT technologies and ICT applications in the Building Industry can provide important benefits to the implementation of effective design and management processes, revolutionising the design of buildings used to provide care and assistance services.

Although they both aim to search for sustainable, innovative and smart solutions, the two topics of this volume (connections and greenery) have to consider that the contemporary society – better called Sapiens society – is modifying its knowledge and habits because of changes, in which Sapiens is partially accomplice (Butera, 2021). The signs of the need to modify the growth parameters on which industrial societies are based continue to multiply. Over the last years, the debate – often heated between supporters of technological evolution that only aims at the economic well-being of a few people and those who promote happy degrowth – is increasingly compelling (Pallante, 2011). New social life models are growing in Sapiens society, imposed by external factors impossible to ignore: the migration of populations due to famine or poverty; the ever-present wars for control of depleting fossil fuels; the pandemic spread of viruses; climate changes and the resulting pollution and environmental disasters that have accelerated melting glaciers, increasing waste (Armiero, 2021), deforestation of millions of hectares of territory because of unpredictable climate factors, unique for their strength (42 million trees were destroyed in 2018 in the Alpine valleys of Lombardy, Trentino, Veneto, Friuli by 'Vaia storm') or caused by humans with arsons; unbridled urbanisation of coastlines and cities; the indiscriminate use of non-renewable raw materials generating the increase of CO_2. The list could continue, but this description provides a comprehensive overview of the main causes that contribute to making a devastating impact on our fragile ecosystem, society and economy.

The 'greenery' subject is the most extensive part of this volume, addressing with different papers the proposal of strategies for the regrowth and redevelopment of territories, environment, cities, and societies that live in it. These objectives are shared by scientists and scholars. Taking as starting points the European Green Deal and the recent European Taxonomy, the subject of sustainable development is dealt with also by listing guidelines to acquire a method useful to create and express opinions on the green redevelopment of places to be converted into public spaces, the greening of our cities to improve access equity, the distribution and better quality of green areas, the promotion of human well-being and social justice. A research hypothesis on environmental sustainability within building sectors proposes green solutions to make home and building spaces we live in re-

silient to hot temperatures thanks to the creation of interesting architectonic solutions. A possible solution is making trees part of the building, in particular for facades, improving the thermal comfort inside and around the building. The tree facades could become a new approach for designers of an aspect of architecture, both aesthetic and microclimatic, so far unexplored.

The man-made landscape is not just a manifestation of 'good' things that humans can produce: it is increasingly linked to physical and urban environmental deterioration and more, with settlements and communities experiencing social unease, pollution and inequality. It has been repeated several times in this presentation how the Anthropocene is leading to increasing use of resources, with profound and irreversible impacts on natural ecosystems. Health (also concerning Indoor Air Quality), security and sustainability are the paths that should guide social and technological development and innovation. Therefore, the potential of the combined use of 'grey' and 'green' solutions becomes important, to carbon capture and storage in the built heritage regeneration intervention, for the objective of halving carbon emissions by 2030 and being carbon-neutral by 2050, as established by European policies. This is the sense of the activities started by the working group at 'Sapienza', the University of Rome within the research PRIN 'Tech Strart' and the University research Climate-Pandemic-Proof Design. They were carried out through an application, on an experimental basis in a public housing estate in Rome, where 'green' (green infrastructures) and 'grey' solutions (materials with low embodied carbon and CO_2 absorption capacity) were developed synergically, systematically evaluating the impact in terms of reduction of climate-changing emissions compared to the current condition.

The subject of the ecological transition is also dealt with an environmental design that has taken a central role in political strategies and design considerations on urban regeneration and energetic and technological requalification. The improvement of environmental performances of the cities and the buildings aims for two important results: a better quality of life and places, following new socio-economic and aesthetic-cultural criteria, and a balanced relation between the built and natural environment, with their energetic and ecosystem advantages. Therefore, it is impossible not to consider the conditions of bioclimatic architecture, thanks to which technical solutions can be developed and adopted to rationalise the relationship between home and local climate, maximising favourable conditions, such as sunlight or ventilation, and minimising negative ones, such as humidity and frost. Considering that a sustainable approach to the architecture project cannot be separated from the consideration of the production sector present in the context of implementation, it is clear the importance of using wood species coming from a short supply chain. This necessarily entails many assessments on the feasibility of building solutions using wood as the most external layer in wall stratigraphy of ventilated perimeter walls. Italian forest areas, accounting for about 40% of the territo-

ry, are a source requiring sustainable management plans, aiming at the protection of biodiversity, with timber for the building industry sourced as much as possible from indigenous wood species, exploiting the opportunities offered by the forest bio-economy.

On the subjects revolving around the idea of landscape, the ecological transformation of urbanised water landscapes is quite important, starting from the idea that these places, in particular river deltas, are an insoluble twine of nature and culture, full of priceless biological and heritage assets. An analysis of these landscapes is reported by setting the interpretation of the methods through which the territory project deals with the environment through three categories having at their core the human material well-being, the untouched nature, and the search for a non-confrontational but mutually enhancing integration. The river landscape is constantly subjected to the growing instability of river ecosystems and the danger of flooding. These elements require risk management systems on a territorial scale, capable of handling territory protection, environmental improvement and biodiversity management, through models linked to the river ecosystem without imposing on it through rigid and constricting infrastructures. Taking the Po river basin as a reference and starting from the analysis of the potential of Ecological Landscape Design and Nature-based Solutions, we report some theoretical premises to create planning and design strategies on a large scale, without neglecting the ecological and ecosystem issues of river landscapes. Natural Parks too should be considered a precious resource for social and economic development, therefore, they need consideration, regeneration, and enhancement. These assumptions are the base of the proposition for experimentation in the Vulture Regional Natural Park (Basilicata, Italy). It aims to enhance the community identity and the territory's needs, keeping unaltered the aims of public administration together with the community. The project aims to be a pilot case, a 'rural workshop' that brings to life the inland economy, culture and innovation in a sustainable way.

Another improvement of the 'greenery' subject is provided by the Urban Environmental Design and, in particular, the study of connective paths, starting from Cadorna station to reach the Triennale in Milan. The study implements measures envisaged in the Master Plan destined for environmental, cultural and social regeneration of the Cadorna area, consistent with the European commitment to address climate and environmental issues concerning a competitive and resource-efficient economy. On the one hand, the urban systems play a role in the production of negative and climate-changing externalities, on the other, however, they are a privileged context for experimentation and innovation of virtuous practices of mitigation and adjustment of the impacts they generate. The urban environment is, then, a special scenario where we can analyse and observe the needs and desires of contemporary society. The implementation of 'nature-based' highly technological solutions provides for the investigation of technical aspects of plants as design

materials, in terms of performance, durability and maintainability, and gives the possibility of identifying the plant species that can best perform shading and evapotranspiration, according to the specific climatic characteristics of the planting site. Through an analysis of quantitative data, it could improve the environmental, economic, and social sustainability of any environmental regeneration project.

These are the subjects collected in this volume, essays and research that, although not exhaustive, can fuel the international debate and give researchers a way to tackle the contemporary climatic, environmental and health challenges by, on the one hand, implementing 'virtuous connections' among the different stakeholders of the building process and, on the other, identifying the innovation drivers useful to spread the culture of social, economic and environmental sustainability that could favour, through conscious products and processes, the much desired digital and ecological transitions.

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