Weaving artificiality and nature. Architecture, context and techniques as interacting agents

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Abstract. At the start of this century, a discussion took place with regard to humankind as an Earth-shaping force and the beginning of a new geological epoch, the Anthropocene. This paper investigates how this condition, where nature and artificiality are considered mutually influencing agents, could concern the field of architecture. It sums up the interdisciplinary background behind the main threads on the topic, and discusses the main implications for architectural design, a discipline traditionally concerned with the relationship between the artificial human habitat and the surrounding nature.Several case studies back up these speculations and show different design concepts that try to work on a fluid relationship between artificial and natural elements.

Keywords: Urban regeneration; Architectural design; Rehabilitation of existing buildings; Design for sustainability; Technological design culture.

Introduction

Currently, settlements, buildings, infrastructures and agriculture spread over 75% of land free of ice (Sanderson *et al.,* 2002). The resulting global artificial layer and the ensuing human ecosystem brought Earth scientists to speculate about a new geological epoch, the Anthropocene, in which humankind became an earth-shaping force, as strong as other natural forces (Crutzen and Stoermer, 2000). Human scientists drew on the concept to investigate the evolution in the relationship between culture and nature.

Under this point of view, the debate on Anthropocene is also an opportunity to reframe the discourse about sustainability, which until recently largely focused on the reduction of human impact on the environment. Thus, the role of architecture shifted from sheltering people from natural agents to protecting nature against human actions (Raman, 2007) by means of techniques, typologies, and components aimed at reducing energy and materials depletion.

This approach, however, leaves several open questions. The increasing demand in resources required by the growing world population and their need for a higher and equal quality of life (Sachs, 2015) requires a rather drastic reduction of impact. Moreover, minimising impact is not a radical cultural change, since it basically confirms a dualistic separation between culture and nature, the first still exploiting the latter, just more respectfully.

The Anthropocene helps to build a consistent frame around these two topics, since it acknowledges the increasing role of human-induced transformations and takes the separation between nature and culture as an epistemological assumption and not a given fact (Latour, 2015), thus paving the way to reconsider common views on sustainability issues.

The discussion about Anthropocene is gaining foothold in the architectural discourse, where authors highlight its importance in reconsidering the relationship between culture and nature (Turpin, 2014), breaking the disciplinary boundaries (Neveu, 2017), or reframing the discourse about sustainability (Spanedda, 2018). However, Earth sciences and humanities went further in investigating the relationship between societal organisation, space production, technology deployment, and natural environment. At present, analytical disciplines dominate the discussion, but they appear to lack the tools to envision possible positive futures, something that is at the core of architectural design and its related disciplines. Architects could, therefore, step into the debate by contributing with their knowledge about physical transformations, and at the same time by critically reviewing several basic concepts in their disciplines, with a view to findings in the discussion on Anthropocene.

Three takes on anthropocene

There are several discussion threads about Anthropocene, each with a different focus.

The first strand opened the debate, as Crutzen and Stoermer (2000) raised the hypothesis that human activity began at some point to significantly alter the planet's surface, thus initiating a new geological era. This led to a flourishing branch of studies describing how artificial and natural processes pervasively concur in developing complex ecosystems. A second strand in human sciences criticises the modernist way of relating nature and society, taking the opportunity to part from the Cartesian dualism between nature and culture and to, instead, connect them in a fluid relationship (Latour, 2015).

The third strand refuses to consider Anthropocene the product of humanity as a whole, but a consequence of the exploitation of natural resources by a culture centred on the production and marketing of commodities (Moore, 2018).

All these strands contribute to the general debate, and offer critical vantage points on the transformation of the physical environment. The following paragraphs will then summarise each of them and focus on their possible meaning for architectural design.

Earth as artefact

The first thread focuses on the relevance of human-induced changes on Earth's surface. By analysing the stratigraphic layers and the extension of land under human control, it emphasises the pervasive, long-lasting impact of human activities in geology and ecology (Rockström *et al.,* 2009), which eventually blur the boundaries between natural and artificial. In 2005 the USDA survey team classified the soil profile for Freshkills Landfill, which is largely made out of trash, coming to the conclusion that it has much in common with the soil from the slopes of North Carolina's Appalachian Mountains (Denizen, 2014). Through humanity, technology has irreversibly become a part of nature with no chance of radical mitigation or restoration to a previous condition (Grosz, 2014).

Architectural and urban design should then deal with this new kind of context, working on the combination of natural and human processes, instead of drawing boundaries between the two spheres.

As an example, "Urban Metabolism", a IABR–2014– Project Atelier by Field Operations and FABRICAtions, investigates the substance flows within the city of Rotterdam: goods, people, waste, plants and animals, energy, food, fresh, water, sand and clay, and air (Fig. 1).

The work envisions flow optimisation by transitioning to a circular economy enabled by four spatial design strategies.

ISSN online: 2239-0243 | © 2021 Firenze University Press | http://www.fupress.com/techne
DOI: 10.13128/techne-10689

The first, "Collecting Resources", examines options for recovering raw materials from waste, which result in redesigning households (to collect waste), marketplaces (to gather reusable commodities), and infrastructures (to distribute phosphates or host urban farming).
"Creating Biotopes", considers steering the natural process of silting to form a new dyke, build new biotopes around unused docks, and increase the surface for land farming. The high voltage lines are reworked as ecological corridors, linking new and existing biotas. Rainwater storage sites provide freshwater throughout the year, preventing ground salinisation and configuring new public spaces.
"Channelling (Energy) Waste" mostly focuses on geothermal heat and CO_2 treatment at a regional and city level.
Finally, "Catalyzing Re-Industrialisation" envisions new forms of manufacturing and crafts settling within the gaps in the urban fabric left by retail, along with mobility optimisation. Working places could thus be located where people live, instead of forcing employers to commute.
By shifting the focus from objects to flows, this proposal entwines natural and artificial processes through different scales. Although it lacks detailed quantitative information, the study offers a positive view of Anthropocene thanks to an interdisciplinary inquiry. It visualises a physical environment, which is hard to divide into artefacts and natural elements, in an attempt to build a better living environment for humankind and all the other species.

Environment as diffuse agency The second trend on Anthropocene offers a more philosophical stance on the blurring of artificial and natural.
The planetary ecological crisis reveals that nature is not just a static background for human actions, a passive provider of energy and resources. Instead, the environment reacts showing humans that their agency is shared with other agents in a mutual limitation of each other's autonomy (Latour, 2014).
As nature becomes a tangle of agents responding to human behaviour, it ceases to be a predictable subject to immutable laws, therefore disrupting any technological determinism and dissolving the old Cartesian dualism between artificial and natural.
These circumstances shed a different light on the idea of context, a fundamental notion in architectural design.
Context is often seen as a background provided by a specific site, carrying information about types, functions, evolutive rules, materials, and social behaviour. Designers actively react to it, choosing to take this information into account in terms of continuity or opposition.
However, the figure/background opposition might evolve into a broader, dynamic interpretation of context as an interactive set of agents working at different scales.
To explain such an extensive vision, Moe (2007) visualises the role of contextual agents in the design process by borrowing the concept of "epigenetic landscape" from developmental biology. An epigenetic landscape is a virtual topography in an abstract, multidimensional space, whose shape influences the developmental pathways along which a physical entity evolves. All contextual agents (political, economic, historical, technical, ecological, social, cultural, material) dynamically deform this virtual topography, producing minor or major inflections at different times through mutual influences, even if the inflecting force is the same. Designers should strategically lead the formation of the abstract epigenetic landscape in order to steer the design process and thus the formation of the spatial organism.
An example of such a strategic lead can be found in Elemental's plan for the reconstruction of the coastal town of Constitución, close to the Maule estuary in Chile (Fig. 2). In 2010, the site was hit by a tsunami. Elemental was tasked with the master plan to rebuild the town, including the infrastructure for tsunami mitigation. The participatory phase of planning revealed both a historical lack of public space within the town, and the need to keep a direct access to the river, which led to three solutions.
The first was leaving a fallow strip along the coast, with the risk of prospective illegal occupancy.
The second was building a protective wall, massive and tall enough to withstand the impact of tsunami waves, and then houses behind the wall. Local building firms backed up this proposal.
The third was planting a forest along the estuary to dissipate the impact of future tsunamis. This also provided a public space between the town and the river, and direct access to the latter. Instead of deploying "hard" techniques against a natural threat, the forest embodies resilience, a concept which is gaining foothold in the current debate about sustainability (Cumming and Collier, 2005).
Citizens opted for the forest.
The different contextual natural, social, and economic issues (one of the town's main employers is a forestry company) are clearly similar to the drivers tugging Moe's epigenetic landscape. The designers' ability in assessing, questioning, and combining social and natural issues, the integration of natural and artificial elements in the final design, and their refusal to jump straight into a predefined outcome allowed them to effectively steer the design process, even in a complex task like rebuilding a town under emergency conditions.

Entropy reversal The third thread refers to the current exploitation of natural resources as the mark of a consumerist society, and not of humanity as a whole.
According to Moore (2018) the origins of Anthropocene trace back to the conquest of the Americas, the first great expansion of European logistic chains. Stigler (2017), drawing from Lévi-Strauss and Georgescu-Roegen, argues that, in order to optimise the transformation of resources in commodities, Western civilisation promoted

01 | Urban Metabolism, Rotterdam (2003), FABRICations, James Corner Field Operations, Environmental Assessment Agency, Havenbedrijf Rotterdam. Scheme of the ecological corridors along the high-voltage lines. A) Avifauna corridor, B) High voltage line, C) Agricultural land, D) Urban area, E) Terrestrial fauna, F) Water storage. Drawing by the author

02 | PRES – Sustainable Post- Tsunami Reconstruction Plan (2010-2016), Elemental and Arup, Constitución, Chile. A) New forest, B) Waterfront housing on pilotis, C) Emergency housing. Drawing by the author

03 | Zollverein School of Management and Design (2006), SANAA, SANAA, Heinrich Böll, Transolar, Bollinger + Grohmann, Horstmann + Berger, Essen. A) Emscher river, B) Pumping station, C) Passive insulation (red dotted lines, only partially drawn), D) Dismissed mine shaft. Drawing by the author

a specialised but very fragmented knowledge, mirrored by a landscape scattered with mono-functional buildings and infrastructures. He states that, in the Anthropocene, industrialisation reorganises the world into closed, entropic systems. Thus, a response to Anthropocene requires some negentropic work to instate a new order among the dispersed knowledge and the material remains of commodification.

Although Stigler's concept of negentropic work could seem rather vague and undefined, the principle of working by establishing relationships, both in space and among disciplines, is a specific, essential quality of architectural design. Since the late '70s, some authors focused on collecting "the scattered fragments of the essence of our present and awkwardly re-build with them our new churches" Gregotti (1987) and on dealing with the "density of history and nature" (Maciocco 2011). Promoting architecture as a way to re-organise systems of relationship through physical actions, they paved the way to work on the entropic landscape of Anthropocene, articulating space to synthesise contradictions, make order and unfold relationships.

Therefore, architectural design may become Stigler's negentropic work.

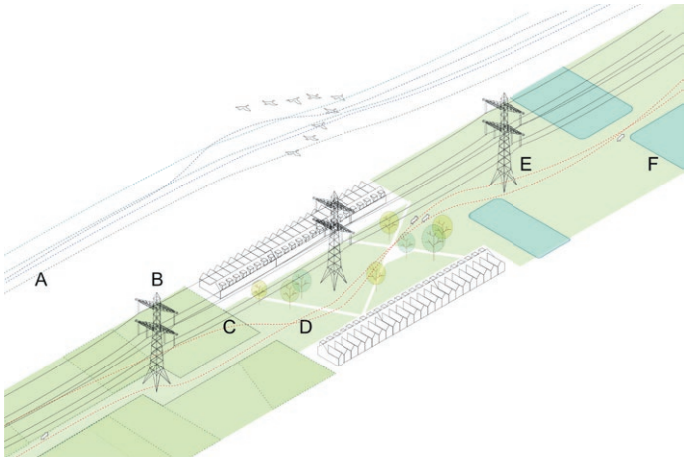
On the physical plane, it recombines in a new order obsolescent buildings, settlements, infrastructures, fragments of nature, and the broken loops of materials and energy. This post-production process (Bourriaud, 2002) still needs to find its own aesthetics, but is required to give sense to the intricate legacy of fossil capitalism.

On the plane of knowledge, design has the opportunity to gather the sparse knowledge of different specialists, prompting collaborations around specific issues. A process of problematisation that should allow every single specialist, and better than abstract specialities, to contribute to a much needed "politics of hyper-complexity" (Turpin, 2014), overcoming the blurred boundaries between natural and artificial, waste and resource.

An example for this is the Zollverein Essen Design School by SANAA, part of the reclamation of a former industrial site in Germany (Fig. 3).

After close inspection of the site, the designers opted to provide the building with an active insulation layer made by warm water circulating through pipes cast inside the concrete shell. Although this solution seems detrimental in terms of energy efficiency, the reason for this peculiarity lies in the abundant waste warm water coming from an unused flooded mine. In fact, a pumping station extracts water from the nearby mine shafts with a temperature of approximately 28°C, and discharges it into the River Emscher. The water goes through a heat exchanger, heats the building just at the cost of the pump consumption, and chills before returning back to the riverbed, thus decreasing pollution. The system provides a CO_2-free energy consuming 75% less energy than a reference building (Moe, 2010).

| 01



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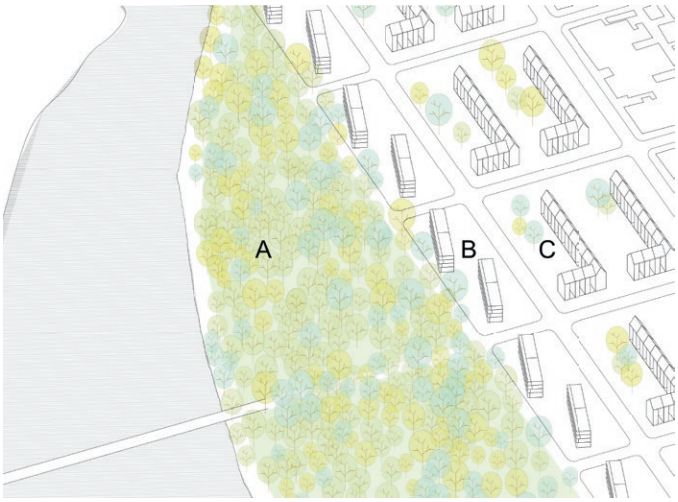

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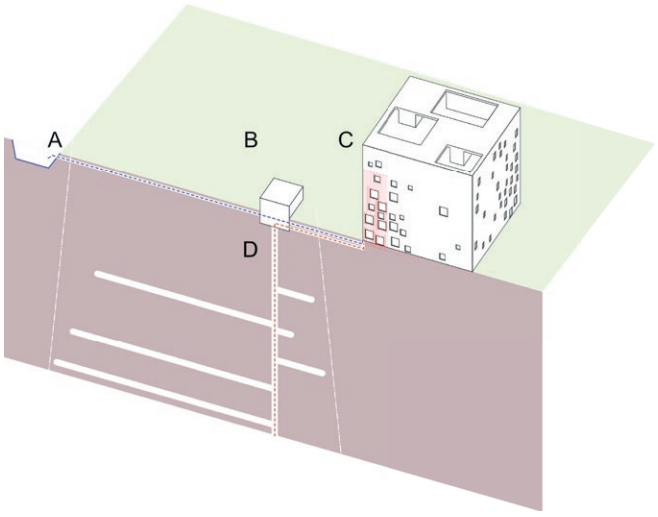

The designers reframed the thermal performance issues by considering the context as a part of the building's energy system. The different remnants of industrial activity are recombined in a new entity, blurring the boundaries between artificiality and nature, since the wastewater is used just like a "natural" geothermal source.
This context-aware technological solution deliberately disrupts the usual concept of optimisation, like the well known "Passivhaus" model that reduces the energy exchange with the environment through sealed envelopes and closed energy flows. Instead, the building becomes permeable to energy flows from the outside, closing the loops at a bigger scale, an unintentional proof of Stigler's concepts.

Conclusions

This paper argues that the fundamental issues raised by the current debate on Anthropocene directly concern architectural design disciplines. The relationship between culture and nature, the physical transformations of the planet's surface, and the ability to intervene in existing systems of relationships, traditionally fall into the disciplinary fields of architecture. In spite of their potentially relevant contributions, architects are mostly absent from the debate. But, in order to effectively tackle these issues, design disciplines should expand their scope, developing, along the design of objects, ways to design processes and enable complex systems of relationship between natural and artificial, existing and new, waste and resource. This implies reconsidering the way we look at techniques, examine context, choose whether to building anew or to renovate and, last but not least, a steady process of interdisciplinary problematisation to challenge obsolete assumptions.
Although it might seem a steep and winding path, it could be a challenging way to bring architecture back to its role, which Price (2003) described so concisely, of "a socially beneficial distortion of the environment".
This work was supported by "Fondo di Ateneo per la ricerca 2019", University of Sassari.

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