

The Ecological Turn

Design, Architecture and Aesthetics
beyond "Anthropocene"

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Doctoral Program
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The Ecological Turn

Designing and representing the Anthropocene:
a challenge for designers, planners and philosophers

Loreno Arboritanza, Anna Chiara Benedetti, Karilene Rochnik Costa, Simone Gheduzzi, Rosa Grasso, Ivano Gorzanelli, Simona Rinaldi, Ilaria Ruggeri, Laura Succini, Ilaria Zedda

October 2019: at the Mast (Bologna) is on display the exhibition *Anthropocene*, a multimedia experience, with the use of augmented reality, to represent “the incredible human footprint on earth” through the photographs of Edward Burtynsky and the films of Jennifer Baichwal and Nicholas de Pencier¹. From our visit, the construction of the *call* began with an interest in exploring the changes that this new geological era brings to our areas of research. On the one hand, the enormous impression made by the violence of human activity in Niger, Southeast Asia and Europe – quarries, mines, oil pipelines, enormous pumping stations – on the other hand, the impression made by the aestheticization of the ‘Anthropocene’ phenomenon, its translation into pleasant

¹ Sophie Hackett and Andrea Kunard, eds., *Anthropocene: Burtynsky, Baichwal, de Pencier* (Fredericton: Goose Lane Editions, 2018).

images. On the crest of this ambiguity and this challenge we wanted to build the call, orienting it in two directions with the intention of breaking with a certain tradition: on the one hand we asked philosophers, architects and professionals to rethink the forms of representation, aware that only by including the complexity of the living in our narrations is it possible to gain a non-anthropocentric vision, on the other hand we questioned designers and planners on the very foundations of planning, of designing, in search of a relationship between space, territory and time, an alternative to the dominant models.

Needed, in the construction of the *call*, to take note of how some tools of the designer have become obsolete: sustainability, the very idea of crisis, reversibility, the idea that nature returns where man has destroyed, preyed upon, suffocated. An attempt that doesn't stem from an environmental crisis, but from the awareness that our representation of the problem is distorted, anachronistic, still indebted to the idea of the map, to cartographic representations, incapable of adopting new models, scales, interconnections.

The rethinking takes place at several levels: in the very definition of Gaia, questioned by Bruno Latour², in the history of the relationship between humanity and the earth by Jean Baptiste Fressoz and Christophe Bonneuil³, in the discussion of representation from above by Sophie Hackett. We tried to discuss the Anthropocene at two levels: as an emergency in its actuality and as a threshold, a possibility to go "beyond the Anthropocene". What the conference hoped for, and what we believe happened in the great interest that the *call* aroused, consisted in a collective effort aimed not at sectorial competences, but above all at relationships. Relationships between new capacities to represent and think about limits, reciprocal dependencies beyond and within an idea of the world centered on the infinite availability of raw materials, on the extraction and continuous use of fossil fuels. Thinking

2 Bruno Latour, *La sfida di Gaia: il nuovo regime climatico*, trans. Donatella Caristina (Milano: Meltemi, 2020).

3 Jean Baptiste Fressoz and Christophe Bonneuil, *La terra, la storia e noi*, trans. Agnese Accattoli and Andrea Grechi (Roma: Treccani, 2019).

therefore about reproductive forces, permaculture, new materials, new ways of designing the territory, of seeing relationships that were previously hidden, of thinking through the multiple reasons for radical and innovative lifestyles, thinking about the same ontological status of things and the professions of designing.

The conference reflected this intention and broadened the horizon of the *call* by questioning the different parties that supported it. Today, more than a year later, the world has changed a lot due to the terrible Covid-19 pandemic, yet the issues and questions that the conference brought to attention have become no less topical, but more urgent.

The future ‘beyond *Anthropocene*’ is all to be imagined.

Selection process

The importance of sounding out the still little-explored lands “beyond the Anthropocene” with the multidisciplinary outlook that distinguishes our Department of Architecture – *Design, Architecture, Aesthetics* – was confirmed by the number of *abstracts* received – about a hundred – as well as by their diversification in terms of research fields and origins: approximately half of the abstracts received were in fact attended by foreign PhD students, architects, designers, philosophers, planners and researchers, mostly from the old continent, but also from more distant lands such as the Asian continent – Israel, United Arab Emirates, China – or the American continent. The variety of interdisciplinary sectors involved made it necessary to group them into macro-disciplines: Architecture, Design, Urbanism and Aesthetics. The main contribution came from the technical field of the disciplines of Design and Architecture, through concrete examples of experimental materials or new architectural paradigms, but there were also more theoretical contributions. The comparison between different disciplines produced a lively debate where new technological proposals for new forms of living – such as the “Microbial Dialogues” proposed by Armstrong and Hughes – alternated with theoretical reflections for new forms of existence – such as the “Geology

of Morals” proposed by Radman – with the common aim of providing alternatives for new forms of living with and for the environment.

The abstracts received were selected after undergoing the *double-blind peer review* procedure. However, given the positive opinion of the reviewers and the high scientific value, due to editorial and organizational limits, it was necessary to ask the selected authors to send the *full* paper, anticipating the delivery date before the Conference, differently from what was initially indicated in the *call*. Thus, also the *full* papers were submitted to the *double-blind peer review* procedure. Once examined the judgments of the reviewers, the Organizing Committee has dealt with the final choice of the papers presented in this publication with a selection method that would encourage as much as possible that multidisciplinary comparison pursued since the *call*.

Research addresses

Analyzing the full papers received, in order to create a structure that could better ensure the interdisciplinary comparison, we identified a series of thematic areas within which the different researches presented could converge. Each area was then associated with one or more keynotes to introduce the theme. Due to the timing of the conference, only some of the authors of the papers selected for each thematic area were invited to present the content of their research, while the publication provided more content to broaden the reflections on the different topics.

Therefore, if initially the *call* divided the analysis of the ecological turn linked to the Anthropocene into two parts, namely the representation of the phenomenon within the cultures of the project and the changes produced in their processes, in analyzing the material received we have mainly identified four areas in which the research is moving. The selected papers have in fact opened a comparison from an aesthetic point of view, especially related to the analysis of political ecology and its repercussions on the design developments within society, as well as on the necessary overcoming of

the dualism man - nature, to open the design culture also to non-human relationships. A large number of papers then focused on material experimentation, both in terms of innovation of production processes, as well as the production of new materials and their sustainability. Finally, another group of researches is focused on the new forms of the urban, from the change in the reading and design of the city, to the overcoming of boundaries linked to a trans / post - urban logic.

The publication is structured following these four multidisciplinary areas, each introduced by the keynote text and followed by the authors of the selected papers.

Subtitle 1: Eco-political narrative diversification

Within the aesthetic research there were four keynotes to discuss the topic, also through the round table Anthropocene and Care, followed by the presentation of their individual researches. According to **Stefania Barca** there is a need to identify counter-hegemonic narratives of the Anthropocene that oppose the hegemonic end-of-history narrative, echoing Mark Fisher's concept of "capitalist realism" and extending it to the current phase of neoliberal environmental governance. **Laura Centemeri** offered an introduction to the practice of caring for the earth and the relationships between living beings called Permaculture, underlining the difference between "permanent" ecosystems and the design of spaces where to "reinhabit", through repairing social and ecological relationships. **Emanuele Leonardi** is in charge of politicizing the concept of the Anthropocene in order to remove the illusion that all of humanity in its breadth and generality is guilty of the climate changes we experience. Through the contribution of Jason W. Moore, Leonardi hypothesizes that the correct definition of the Anthropocene is Capitalocene, that is, the specific relationship between the form of production and land consumption of capitalism and the epoch known as the Anthropocene. Finally, **Miriam Tola**, always in a critical perspective towards capitalism, focused on the terrestrial and extraterrestrial Elon Musk's ambitions and on

the will to save a portion of humanity from environmental disaster by implementing man's colonizing will.

The ability to propose different narrative models is a fundamental theme for the debate on the Anthropocene. **Stefano Ascari** has therefore tried to shift the focus from the unrealistic questions on how to defuse or reverse the transformations produced by man to learning new models of life adapted to the new context. He critically discusses the models of representation of the Anthropocene through a debate on different theoretical and aesthetic proposals, proposing new models of narration. New narratives are thus proposed and, at the same time, consolidated narratives are questioned. This is what **Elena Brea**, **Pablo Ferreira Navone**, **María Buey González**, and **Gabriel Alonso** do in their contribution, which moves from questioning the still current, consolidated concepts of hygiene and health in the domestic environment as the result of a necessary exclusion of any microorganism – regardless of whether pathogenic or non-pathogenic. On the contrary, the authors prompt for a post-anthropocenic design approach to the domestic environment, which does not ignore or exclude microorganisms, yet includes them instead. Thereby, the house ceases to be a fortress for mankind and becomes a place where different lives can coexist in symbiosis, mutually benefiting. A further point of view is proposed by **Yael Eylat Van-Essen**, who suggests rethinking the role of architecture in the Anthropocene era through the new set of “ontopolitical” assumptions that shape contemporary socio-political thought. The paper explores how the principles of mapping, sensing and hacking, discussed by Chandler in the context of Governance, can be applied to the architectural domain thereby stimulating new processes for architectural interventions. Finally, **Andrej Radman** placed an “ecological work of art”, the *Habitan Esas Laderas* (2019), by Argentinian artist Flora Reznik, as the object of his analysis, analyzing it as a starting point to discuss not so much the conditions of possibility of knowledge, but rather the “real conditions” in which things and life germinate.

The full paper by Stefania Barca, for editorial reasons, is not included in the publication.

Subtitle 2: Beyond the dualism of man - nature

If on the one hand there is a change in a political and social vision, this also has repercussions on the relationship between man and nature, overcoming dualism to seek new forms of design and coexistence. **Kjetil Fallan's** presentation Deep Ecology as Deep Design introduced the reflection by presenting the concept of "deep ecology" in relation to design, highlighting how the Deep ecology movement can be used to explore the connections between eco-philosophy and Eco design.

Next, **Gionata Gatto** and **Alessia Cadamuro** defined design as a tool to overcome the hierarchical systems between humans and non-humans by fostering the development of multi-species connections and collaborations. Field experimentation, multi-disciplinary collaboration, and more-than-human ontology lead through design to highlight how the participatory dynamics enacted by plants can activate more inclusive participatory practices between humans and non-humans.

From this new relationship it follows that the concept of User itself, as **Tuğba Deringöl** and **Sema Serim** have explained, suffers in the development of its definition the transformation's effects of the human being within this new era.

At the same time, the effects of the Anthropocene epoch, with developments that are often linked to catastrophic phenomena, leads to the need to establish new figures for the relationship between human and non-human. **Alberto Petracchin** introduces the figure of the Ark as a reference architecture for the coexistence and re-foundation of a new post-catastrophe world.

The relationship between human and non-human is also key in **Craig Jeffcott's** contribution, which seeks to define new strategies for speculative design practice to achieve a biodiverse future, i.e. a future in which we take care of the ecosystem and commit ourselves to repair, maintain and protect it. Moving from an ontological reflection and from a critique of speculative design practices with no impact, nor care to biodiversity, Jeffcott calls for new strategies for the discipline

– strategies that are ecological and attentive to queerness and at the same time capable of overcoming diversity and allowing, by means of play, storytelling, and speculation, the questioning of the established past and the imagination of a better, inclusive future.

Another viable strategy is the one related to *big data*, as reported by **Luca Barbieri**, **Alberto Calleo**, **Giorgio Dall’Osso** and **Ludovica Rosato**. The authors explore in the context of the data age, the possible use of *big data* and artificial intelligence as tools for the transition from a utilitarian and anthropocentric dimension towards an anthropocentric design culture, analyzing how such tools can be used as amplifiers of the weak signals of climatic, social and cultural change to create readings, interpretations and narratives of the complex systems we live in. Finally, **Oscar Buson** questions the culture of energy and the closely related concept of petrolscape, and focuses instead on the alternative culture of entropy, which necessarily affects architecture. New types of infrastructures and architectures based on renewable sources and on the concept circular economy are thus envisioned, where production and living return to establish a reciprocal dialogue and that permit rethinking the relationship between energy production and space creation, as well as between individuals and their community. Just as the culture of energy resulted from human creation and has in turn shaped our ways of living, so it is expected to happen in a more conscious culture of entropy.

Fallan’s full paper, due to editorial issues, is not included in the publication.

Subtitle 3 : the turning point of materials

Within the Anthropocene era, the focus on anthropogenic material consumption is primary, being the main feature linked to the geological definition of Anthropocene itself. At the opening of the debate, **Formafantasma** keynotes present the *Cambio* research, commissioned by the Serpentine Gallery and related to the production and consumption developments of the wood supply chain. Dissecting the

ecological and political responsibilities of the design discipline, through a holistic approach, they started from the material's history, passing through the steps of the production process, finally examining the future of the material in relation to human consumption.

Attention to material development also means developing new materials that reflect the principles of ecological development. **Eugenia Morpurgo** investigates how and if it is possible to plan, through the disciplines of design, regenerative production processes to create new bio-based materials starting from poly-cultural and non-extractive cultivation systems. His proposal is Syntropic material Library – a digital archive of bio-based materials, which allows on the one hand to subdivide materials according to their origin and on the other hand the user to have a vision of the materials according to the link with the coexistence of the species, activating new processes for regenerative ecosystems. **Franziska Pilling** and **Paul Coulton** consider a *More-than-Human-Centered* material design approach that presents artificial intelligence (AI) and data as design materials using the non-anthropocentric *Object-Oriented Ontology* (OOO) philosophy and related alien phenomenology thesis, proposing an investigation into methods of making AI operations, functions and impacts legible through the speculative design practice of *Design Fiction*. Also in the debate of experimental research on new materials are **Rachael Armstrong** and **Rolf Hughes**, who invert the paradigm of microbes as negative agents for our survival into ecosystems capable of improving our lifestyle and ecosystem, providing us with concrete examples such as the European Project *ALICE* and opening the door to a new “life-promoting era of microbial design”.

Equally important is the research on the use of existing materials and their necessary change within a development process oriented to an ecological material consumption. On the one hand, the importance of the role of the practitioner, in addition to the material, is of fundamental importance – as explained by **Elisa Zatta** – who made a clear and complete presentation of on-going reuse strategies applied to the built environment in the European context, and enlighten as

the role of practitioners is fundamental to foster a cultural and architectural change. Between material development and strategic use of artificial intelligence, **Cecilia Mazzoli, Marta Bonci** and **Davide Prati** proposed a “green” alternative to design through a parametric approach to prefabrication that makes use of “another plastic”: 100% recyclable elements made of bio-based polymers such as Green *HDPE*, obtained from sugar cane. As a result we’ll have cheap, flexible and reversible temporary structures, designed for new and above all sustainable urban spaces. Finally **Ilaria Vanni, Alessandra Vaccari, Paolo Franzo**, and explored the unique combinations and interdependencies emerging in contemporary Italian *fashion design*, focusing on the encounter between technology and biology to experiment with fabrics and materials for the fashion industry.

Subtitle 4: shifting urban visions

The great changes in vision, as also described above, clearly affect what is our vision of the city. The territorial planning that refers primarily to the urban and determines a strong division between center and periphery is transformed into a broader vision of territory, going to define new urban paradigms. **Maurizio Carta**, keynote of this last part, rethinks in fact radically the model of development of the city, now generator of a sustainable future, in which humanity takes charge of adopting new behaviors to implement an urban revolution of the transition to a generative and responsible Neanthropocene.

The new technologies influence the change and expansion of the new urban vision, as **Federico Diodato** explained later, proposing an alternative use, not aimed at the production of economic value, typical of the smart city narrative, but as a tool to facilitate social relations and to establish an ethical relationship between territory and community. **Saverio Massaro** analyzed how the vision of the city itself must be translated into a circular vision, illustrating strategies and actions to promote a cultural shift for raising the awareness of waste management systems working in European cities

according to the circularity principle. At the same time, as **Matteo Vianello** points out, the need to expand the boundaries of the urban vision leads to repeat western paradigms in non-urbanized environments: through the analysis of *Oceanix*, the author problematizes the replication of terrestrial urbanization in water space. Even within the urban environment it is necessary to reconsider the relationship between man and nature: **Elena Ferrari** illustrates the history of three abandoned burial areas in Berlin and investigates the role of these biodiversity-rich gardens within urban transformations according to ecological social and political aspects. If, on the other hand, we consider the question of visions and narratives, **Elena Vai** proposed an analysis of the change in the relationship between man and territory, leading us to see how advanced design and speculative design can activate a conscious design community to overcome the current crisis and imagine “probable, plausible, possible and preferable futures”. Finally, **Dario Scodeller**, **Eleonora Trivellin**, **Davide Turrini** and **Marco Manfra** explored the context of the inner Italian suburbs with the aim of drawing attention to strategic scenarios, theoretical guidelines and examples of good design practices linked to the promotion of eco-literacy, community and *on-demand* social-health services, the promotion of local food systems, the preservation of know-how and craftsmanship, highlighting the contribution that an articulated and multi-scalar design can provide in transforming territorial fragility into social and economic opportunities.

Conference days and results

The richness of the contributions brought to the conference and especially the interdisciplinary way in which the theme of *Ecological Turn* was treated are difficult to exhaust and summarize in a conclusion. During the two days of talks, it became clear how ecological thinking and sensitivity to the environmental transformations that we are experiencing, deeply affects the practice, even daily, of architects, designers, planners and researchers.

In fact, the conference explored in a highly multifaceted way social, biological, political, geographical and purely architectural themes, at different scales, from the molecular one, of environmental beings, to the global one, which concerns flows and metropolises, with the intention of responding to a problem of degeneration of our relationship with the planet.

The contributions reiterate, some more explicitly, some less so, the need to trigger a new era of ecological anthropocentrism in which humanity, instead of being the problem, designs and implements the transition to ecological development, interpreting this change not only as a reconciliation with nature, but as a total paradigm shift and narrative of non-anthropocentric human/urban development.

CALL

The Ecological Turn

Permaculture; Environmentalism; Eco-design; Care; Einhabiting.

How does the ecological thinking affect architects, designers and the design culture itself? The Anthropocene is a geological event, but also a political one that lies in overcoming the idea of crisis. Acknowledging this change means rethinking the very ecology of the project in environmental and atmospheric terms.

The changes we face don't depend on missing balances, but on compromises reached between conservation and exploitation. The Anthropocene is in our suggested reading the time of the end of our representations and the time of the beginning of other narratives that belong to a non-linear dimension.

The ecological mindset understood here will not be a generic reconciliation with nature, but a political project, a clash between narratives, a challenge to designers and architects, their materials and their design practices to rethink the way

in which human beings define themselves, their images and relationships within the world in which they live. In other words, a renewal of conflicts: between classes, between nations and production models, between technological choices.

Anthropocene is a category which has the merit of challenging our conventions in an oblique manner by reconnecting the history of mankind with the history of the Earth. In this respect, design visions can be the tool for activating new relations.

Within this process of change, how do the figures of architects and designers rethink their role, their knowledge, experimenting with new design approaches?

The conference wants to explore these issues from different points of view, in particular the “socio-bio-geosphere in its uncertain becoming by making the disciplines of the project communicate and by varying the scale of analysis, from the molecular scale of the environmental effects on our heritage, to that of the world’s flow of goods and capital organized by the World Trade Organization, passing through the local scenarios of industrial sites or socio-environmental mobilizations” as Jean Baptiste Fressoz and Christophe Bonneuil wrote.

The questions that guide this talk are on two levels of reading:

- 1 - How to represent, imagine, visualize the Anthropocene through the design cultures?
- 2 - How can this political event change the design and production processes?

Track 1

Understanding Complexity: narratives, representations, images

As Franco Farinelli argues, until 1969 the territorial government was adapted to the methodological limits of the geographical map, that is to the rules of the Euclidean metric and to its three fundamental characteristics: continuity, homogeneity and isotropism. Through these three properties the intellectual appropriation of the world of western culture took place, which was so rendered interpretable and therefore governable.

The Anthropocene is the scenario in which the designer is called to overcome the notion of nature as an object, something that can be controlled and disposed of, to explore the possibilities arising from new ways of interpreting, feeling and perceiving relationship between human beings and the territory.

Are non-anthropogenic visualizations possible?

Which visual culture, which narratives, which forms and images can respond to the need to represent the flows, data and relationships
of the earth system?

Possible arguments, suggestions are:

- representation models that go beyond the cartographic conception of territory towards narratives and images of non-anthropocentric urban metabolism;
- informative-narrative proposals of complex phenomena through new design approaches.

Track 2

Thinking and designing ecological

Resolutionist and heroic narratives are no longer sufficient to hide behind noble intentions such as “sustainability”, “environment”, “ethics” or “awareness”, design approaches that in reality still pursue selfish paths of destruction, consumption, extraction functional to the dynamics of a growth linked only to logistics capitalism.

Starting from the current demands of our time such as emergencies, climate change and local conflicts, the need for designers to rethink the very meaning of living and to renew the relationships between the shape of an object, the material that constitutes it and the context in which it is located spreads. Designing in the Anthropocene does not mean solving but gaining points of view where different disciplines contaminate and collaborate towards an anthropo-decentralized approach, from design to biology, from architecture to economics, from technology to humanistic knowledge.

Possible areas of reflection:

Time. If until today the contemporary project has responded to the needs of producing and consuming more and more resources, what materials, technologies, production models and processes open up to ecological living? How to rethink the project according to its own reversibility?

Territory. How to rethink the very meaning of living in an era where it is increasingly difficult to rely on consolidated categories and dichotomies, such as subject-object, natural-artificial?

How will the intangible resources of a territory, the identities and relationships between communities be used to make project processes more responsible? In a system of interconnections and interdependencies, how can we imagine urban and rural areas and the relationships between public and private? How can design culture activate ecological design forms and new behaviors?

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S.03

THE TURNING
POINT OF
MATERIALS

Cambio

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Design as an act can be defined as the innate propensity of humans to conceive and perform desired changes to their habitat, but design as a discipline is a historical phenomenon formed in relation to the Industrial Revolution and its paradoxical ideology. This manifestation of design introduced the notion of the universal human and the satisfaction of their needs through the visionary institutions of mechanisation, logistics, and mass media. In particular, the borderless reach of capitalist production seemed to offer a benevolent future of democratised middle-class affluence, the antidote to the atrocities of national and religious strife in modern warfare. But this vision was premised on the accelerating and infinite extraction of resources and their conversion into financial wealth, the externalisation of waste and environmental damage from the richest nations to the poorest, as well as the reinvention of the human as an assimilated consumer-labourer, as standardised and replaceable as the products they made and purchased. Design has been both the greatest emancipator and implicitly supported the exploitation of communities around the world, at times improving the lives of citizens and at times subjecting them to the interests of the dominant economic and political forces.

The tension between the transformative power of design and its participation in consumption is in fact not a new debate; the confluence of artists, scientists and philosophers brought together by Tomas Maldonado at the College of Ulm, Germany, in the 1960s, was created with the aim of establishing a multidisciplinary debate on the social function of design. If on one side the programme was supporting the reconstruction of West Germany after the war, on the other, it was also busy escaping the product-centred conception of design as a fundamental tool for the expansion of mass consumption. These early reflections are as relevant as ever today, when the idea of democratic design has been abused for decades to serve economic interests, and at a moment when planned obsolescence is so shamelessly assimilated with design culture.

The exhibition, and by extension also this catalogue, acknowledge the legacy of industrial production as the fundamental source for the expertise and agency of the designer in contemporary society, as well as addressing the historic contribution of the designer's role to environmental and social instability and its incompatibility with models of sustainable or even survivable futures. The exhibition does so by taking as a subject of research and reflection the timber industry, a hyperobject that because of the scale of its evolution over time and space, is difficult to describe, understand or even regulate. The industry's tentacular supply chain has grown out of the bioprospecting that took place throughout colonial territories during the nineteenth century and has become one of the largest in the world, both in terms of the corporate revenues involved, and in terms of its impact on the biosphere. Clothing, furniture, paper, fuels, fertilisers, are just a few of the thousands of products sourced from trees, many of which have been felled in some of the most biodiverse and fragile ecosystems in the world.

The title of the exhibition, *Cambio*, references the membrane that runs around the trunk of trees, the function of which is to produce wood (xylem) on the inside and bark (phloem) on the outside. The vascular cambium also plays a fundamental role in helping plants and trees to adapt to climate instabilities and thus to transform themselves. When a tree is felled for the production of timber, the branches and roots are cut and the bark removed. This is the moment in which a living species becomes a product. But the word 'cambio' in Italian also means 'change', and the show is named after it precisely because of the polysemic nature of this. We hope in fact that the exhibition could participate in shifting the common perception of design as a tool for styling to an approach that can effect real transformation in a time of climate and social instabilities.

While taking such a diverse and expansive subject risks generalisation, we firmly believe in the necessity to read and understand

design within its larger context, one that includes extraction, refinement, production, distribution and afterlife of things and materials. For too long, design has based its development on essentially one big narrative; the idea of human wellbeing and its function as a solution to human desire. This indulgence of human aspirations has debased design and narrowed down its scope of intervention, and where it has looked beyond the production of objects, it engages only with the transformation of half-finished materials into desirable products more than questioning the infrastructure that facilitates this process.

The development of a holistic and inclusive perspective is, we believe, the only way to take the design discipline forward to more responsible and critical levels of engagement. In Cambio, the inclusion of the works and voices of practitioners never, or rarely, considered as part of the design conversation, is a way to recognise design and production as part of a complex ecosystem not separate from the 'natural' ecosystem, both of which can be transformed for the better only with the convergence of different knowledges and approaches. It is a method of simultaneously enriching design culture and making the discipline more inclusive of narratives that have been too often overlooked.

Our aim is in the first place to better understand the level of complexity we are all working and living in, while at the same time offering clear reflections and design questions: How can the practices of observation and care toward plants — tuning into their lives, features, behaviours and necessities — shed light on our ecological and entangled lives? What can we learn about climate change by analysing the anatomical features of trees? How would wood production change if we took into consideration their ability to sequester CO₂ from the atmosphere? How can we as designers make more informed choices when deciding to select a wood-based material over another, beyond its aesthetic and functional properties? And perhaps most importantly, how can the imagination and 'elastic' approach of design be helpful

in translating today's emerging environmental awareness and scientific knowledge into informed, collaborative responses?

This trans-disciplinary approach is not only a way to increase the scale and depth of research, but is also an ethical position that respects the expertise, skills and lived experience of individuals and institutions in other fields and other cultures. These interrelations ask designers to address responsibility, politics and other issues arising from design's complicity across multiple industries, communication networks, and aesthetics.

While this catalogue has been conceived in relation to the show and many of the contributors are also part of it, we see this as an opportunity to further elaborate on some of the ideas of *Cambio* while introducing new reflections and practitioners that could not be part of the show because of the limitations of the medium of the exhibition. The book alternates more extensive texts that touch upon some of the issues addressed by the show with a selection of interviews we conducted over the last year and a half. The interviewees include members of the scientific community, activists and scholars preoccupied with the survival and the conservation of arboreal resources on the planet.

Over the years, the interview has become our favourite way to engage with the work of highly-specialised individuals or institutions, because it allows both the interviewer and the interviewee to freely elaborate on their ideas, and to create links and analyses that might be edited out of a written text. This is particularly true with academicians and scientists, who are rarely asked to speculate about the implications of their practices. Nevertheless, it is exactly when attempting to understand and appreciate a discipline or area of knowledge in terms of its relation to others that a more cohesive, effective and expansive narrative can be established. This catalogue and the exhibition have, among others, the function of creating a conceptual umbrella under which a diversity of ideas and expertise can be collected. This will, we hope, contribute in the development of

a more responsible understanding of the complex relationship between materials sourcing, design, production and the larger implications that these actions have on planet earth.

Last but not least we see *Cambio*, the exhibition and its diverse outcomes not as the outcome and end of a period of research, but rather as the beginning of an ongoing investigation. We will extend the approach and principles of *Cambio* into the GEO-DESIGN Masters course that we are going to lead at the Design Academy in Eindhoven, the Netherlands, and which will commence in September 2020. The Masters programme, just like the exhibition, aims to develop research and communication tools to facilitate a deeper understanding of today's reality and to make transformative interventions through design and its material, technical, social, and discursive possibilities. We believe that the designer can be a critical agent in global systems, but their skillset and perspective must expand rapidly beyond isolated, self-referential processes of artistic making and subjective intuition. Design must be radically rooted in an expansive understanding of reality — but a reality that acknowledges how 'real world' problems are easily reduced to briefs for well-funded design solutions with negligible benefit to their intended users. Education, in this sense, is probably one of the few contexts where this more radical approach to design can be investigated, and where fragile but crucially important new narratives can be fostered.

Bio-based Polymers for the Design of Temporary Structures through an Eco-Sustainable Construction Process

Ecological Parametric Design Approach; Interaction Design; Bio-Based Polymers; Reversibility And Recyclability; Temporary Architectures.

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Environmental sustainability is the primary common goal of any resource processing intervention. It finds a legitimate collaborator in construction technology and innovation, whether consciously adopted to improve eco-friendly energy savings or used passively to reduce the effect of works on the global ecosystem. Research and technical implementation are essential components of the project, often not very tangible but useful in achieving economic results and, above all, higher quality in the relationship with the end user. Biopolymers represent an area with significant development potential because they combine high technical potential with the sustainability factor. Green polyethylene (PE) maintains the same properties, performance, and versatility of application as fossil-based PE, which facilitates its immediate use in the plastics production chain and its recyclability within the same recycling process of traditional PE. Creating temporary modular structures

that optimise production times and costs with technologies that exploit environmental sustainability principles represents a valid alternative to usual, expensive and complicated construction systems. By adopting a parametric approach to the prefabrication of components, designers could obtain a more economical, easily customisable, modular, flexible, reversible, adaptable, and demountable solution.

Introduction

The role of industrial design has always been to create interactions between man and the environment. “Research and technological application [...] are essential contents of the project, often not very visible but effective for obtaining economic results but above all of higher quality in the relationship with the end user”.¹ By definition, interactive art cannot ignore the public’s participation in the functioning of the work. The attempt is to overcome the artist-spectator duo’s intellectual or contemplative relationship, activating emotional stimuli that involve the public in a path of participatory experience. When extended to the relationship with urban space, the concept of interaction between man and urban-scale construction is nowadays, more than ever before, a topic of great importance. The environmental impacts of the life cycle (manufacturing, installation, service life) of temporary pavilions built with “new materials” and reused materials is a recent research trend.²

This paper aims to demonstrate, through eco-friendly design, how it is possible to obtain a temporary spatial structure that respects the environment without sacrificing the aesthetic aspects. It consists of adopting a new perspective oriented towards the recent architectural postulates and the eco-compatibility criteria of the life cycle, design time, and zero km materials. Finally, the goal is to suggest potential applications of “second-hand” materials, components, and design connection systems.

1 Alessandro Trivelli, (Maggioli Editore, 2011).

2 Catarina Thormark, (Doctoral Thesis, Lund Institute of Technology, 2001).

For example, a study on the “Reuse of materials and components to build a temporary eco-structure”³ explored how recycling and reusing materials at the end of their life cycle can attain practical and not only theoretical benefits. In other words, it is possible to develop concrete strategies that are feasible, with genuine green accounting advantages through the avoided impact. The case study shows that locally recovered and reused materials have a high potential that extends beyond this particular project. There is a significant amount of available waste and secondary products that would otherwise become waste.

The Delft University of Technology developed a research project that promotes reclaimed plastic material to fabricate temporary structures.⁴ The project is supported by using digital techniques and reversing design processes rather than new resources. Therefore, temporary structures appear to be the most suitable buildings for developing and prototyping innovative construction systems based on materials and components still unexplored.

Reversible urban space: temporary structures made with bio-based materials

The effects of the global crisis on the city are manifold, both socio-economic and solo environmental. Still, they can be synthetically traced back to an increased demand for quality, services and functions that are not adequately addressed. By its very nature, the city is a dynamic organism, taking shape in step with human life evolution. Therefore, its continuous variation is a prerequisite for the coexistence of the built form of the environment and collective living structure.⁵

3 Carol Monticelli et al., 2013.

4 Ginevra Nazzari, (Master's degree thesis, The Netherlands, Delft University of Technology, Faculty of Architecture and the Built Environment, 2019).

5 Emanuela Belfiore, (Gangemi, 2001).



A change in the system of values has been brought about by the need to meet increasingly complex and mixed needs originated by new individual and collective behaviours.⁶ In the transition towards a renewed urban comfort, urban planning must be synchronised over time. It has to propose solutions that consider both the needs of the city and people trying to reconnect the social and spatial fragmentation, according to an inescapable ecological key in relation also to climate change.⁷ [Fig. 1]

In recent years, the temporary use of urban public space is consolidating as a system of being together in the open air. Today, living in a small area of urban outdoor is an international trend.

Fig. 1

Woman in a white and blue floral shirt with a clear plastic bag on her face. Photo by Daniel Chekalov on Unsplash.

6 Laura Ricci, 2014.

7 Francesca Acicca and Manuel Torresan, 2017.

In the space between the sidewalk and the street, custom-made products can be installed to perform a noble practice for man: the meeting and sharing of a place. In the United States, this kind of architecture has become a usual practice for recovering non-places in the community in the last decade.

The goal is to “steal” as much as possible portions of road and space dedicated to vehicles and give it to people, giving shape to small areas for stopping, sitting, and resting. New social needs dictate the decision to adopt this type of design to slow down the increasingly frenetic pace of living in a large metropolis. San Francisco was the first city to experience this new way of stopping along the city streets.⁸

Since 2012 the city has been filled with temporary installations. They contribute to welcoming people and enhancing the landscape while sharing a social and ecological responsibility, becoming a resting place surrounded by vegetation and often used to display art, to create pleasant and comfortable spaces in portions of the city that were previously anonymous and without identity. These temporary installations establish themselves as sustainable small-scale interconnected products to activate new social practices, share readings and information, and strengthen the civic fabric. Structures “scattered” in urban spaces to bring people together and reactivate the economy and vitality of areas that had died out over time.

Whether a project commissioned by public bodies or an initiative coming from a private client, temporary installations represent the interconnections and interdependencies that arise between society and territory. They enhance the respect for the space in which we live and, consequently, the behaviours we assume. Places that are morphologically similar are different in atmosphere, care, vitality, and the number of people involved. As stated by Mariateresa Aprile, of the Sapienza University of

8 Francesco Armato, 2018.



Rome: “Why are some spaces preferred to others? First of all, it should be considered an aesthetic question, but the morphology is not a consciously considered element in the choice of places, and it is not enough to explain how space becomes a place. Instead, the functional aspect has a greater incidence. Vital spaces, crowded with people on the move and intent on doing many different activities and preferred by citizens, are those that are most able to adapt to many activities that take place there even simultaneously; they are flexible spaces for different uses.”⁹

The world is seeing an increase in architectural experiences based on the design of interventions aimed at fulfilling new and growing needs for populations - in more or less critical situations - which not only respect the environment but place it at the centre of the project through the adoption of sustainable criteria, constructive systems and materials. Even in Africa, where it might seem that these factors do not represent the prerogatives of architectural projects, the search for spaces adaptable to the ever-increasing need for drinking water has led a team of architects to rethink space to make it useful to the Ethiopian population. Warka Water is a project in which an integrated village designed to accommodate 100 people - local ethnic groups in Cameroon who need to live with dignity - will also become a cultural centre with quality spaces for social gatherings. An example of collaboration with rural communities is construction

Fig. 2

On the left, the original Warka Tower; on the right, the Warka Tower project by Arturo Vittori (Warkawater.org). Image elaboration by authors.

9 Mariateresa Aprile, (CNAPPC, 2017).

with indigenous techniques and local natural materials that respect the place's cultural identity - an example of how to live in harmony with nature [Fig. 2].

The Warka Tower installed in the village collects water from the atmosphere (rain, fog, dew), providing an alternative water source for rural people who face challenges in accessing drinking water.¹⁰ A passive structure, it works only with natural phenomena such as gravity, condensation and evaporation. Easy to maintain, it is independently managed by the villagers. The project depends on local weather conditions, the geomorphological characteristics of the site, and local culture. With research into innovative materials, the design can undoubtedly contribute to realising new behaviours and man-space relationships.

Another example of how temporary structures can prove to be intelligent design solutions in support of populations in need is offered by architect Shigeru Ban, well known for his use of paper tubes in various applications. After the Hanshin-Awaji earthquake in 1995, Ban used paper tubes for the walls' main structural elements to build temporary shelters and a church for disaster victims. The project was further adapted and used in 2001 for relief homes in Ahmedabad, India, and in 2010 for post-earthquake shelters in Haiti. While suitable for permanent applications, paper tubes have become popular for temporary structures, especially for their potential inventiveness and minimal environmental impact.¹¹

The 21st century between environmental pollution and new lifestyles

While rethinking urban space as a place where different cultures, ethnicities and attitudes meet, creating relationships and new scenarios, the design of versatile, safe and dynamic

10 Arturo Vittori and Andreas Volger, (blog), 2015.

11 Steven J. Preston and Lawrence C. Bank, 2012.

structures finds its expression in a construction process for temporary structures made of ecological material.

Most of the factors leading to environmental pollution are plastic waste, photochemical smog, traffic, global warming, climate change, the disposal of chemical and toxic substances, pesticides and soil contamination, and widespread telecommunication systems. As stated in the document published by the European Environment Agency, entitled *Urban Environment*, in the last five years many administrations have promoted a sustainable development method within the framework of local Agenda 21 policies, including reducing the consumption of water, energy and raw materials.¹² Besides, green areas can improve the urban climate by absorbing air pollutants and providing physical and recreational spaces.¹³ Another worrying factor that contributes to environmental pollution is waste, with its production and disposal. It is known that most of it is plastic waste, and the use we make of it today is now disproportionate due to its availability. Leading industrial and materials scientists and chemists say it is not necessary, even impossible, to imagine a world without plastic. Quite the opposite: it is possible and necessary to think “with another plastic”. The principles outlined by ICLEI in the *Cities for Climate Protection* campaign to reduce CO₂ emissions highlight the importance of renewable energy sources, the recovery of energy, cogeneration, promotion of public transport, and planting.¹⁴ Simultaneously, the essential role that the use of ecological and sustainable materials can play is not a small one: some materials derived from renewable sources, and therefore always available, can capture CO₂. The range of innovative bio-based and biodegradable materials is vast, as is the choice of associated production methods to create ecological and sustainable products and services.

12 European Environment Agency, (Denmark: European Environment Information and Observation Network, 2008).

13 E. Gregory McPherson et al., 1997.

14 Heather Zeppel, (Palgrave Macmillan UK, 2013).

Biopolymers represent the turning point for solving problems related to the recovery of waste and the increase in petroleum product prices. There are three ways in which biomass can be processed, and they give rise to polymers such as PLA, PE, or PHA.¹⁵ The advantage is that biopolymers can replace traditional analogous materials already on the market. Biodegradable products derived from biological sources, used in packaging and food, have a very short life cycle, whereas non-biodegradable polymers derived from natural sources are recyclable and durable over time. They are used in the automotive, appliance, footwear, and construction sectors. In the field of highly performing temporary structures inserted in urban and architectural contexts, the material used is derived from a renewable source with a low environmental impact (therefore biodegradable).

“C’era una volta” temporary structure

The material selected for this project is *I’m green*™ PE¹⁶, a plastic produced from sugarcane. This renewable raw material captures CO₂ from the atmosphere during its production, contributing to reducing greenhouse gas emissions, which is a strategic objective in the long term. The innovative aspect is that Green PE maintains the same properties, performance, and versatility of application as polyethylene of fossil origin and can be recycled within the same recycling chain as traditional polyethylene. Therefore, rethinking the meaning of living and experiencing ecologically new connections and relationships with others is possible. As some cities grapple with economic decline and depopulating neighbourhoods, several academics and professionals have focused their attention on the causes, conditions, and patterns of the resultant vacant land.

15 Braskem, 2019.

16 <http://plasticoverde.braskem.com.br/site.aspx/I'm-greenTM-Polyethylene>

In contrast, others lay out broad programmatic, institutional, fiscal and design responses to address vacancy on-site or on citywide scales. Are “permanent” solutions appropriate? Tactical urbanism, for example, follows a path for temporary, incremental, flexible and experimental responses to vacant urban land.¹⁷ Engineering and sustainable features of temporary structures need to be considered an integral part of the design process, beginning at the conceptual phase. The safety of structures cannot be checked only at the end of the design process but must be fully integrated throughout to be most effective.¹⁸ This reversible parametric construction system is designed to tackle the themes of recyclability, sustainability, modularity, and form-function relationship. The design process of assembly systems with low environmental impact must include the study of safety, waterproofing, and the production processes associated with biopolymeric materials.¹⁹

One of the priority requirements of the assembly system consists of the parametric design of the prefabricated modules. So it is possible to obtain flexibility and versatility, in terms of different solutions and, therefore, different liveable experiences, based on the needs of the users and the social purposes for which the temporary structure must be built. The dry assembly of elements makes it possible to join different components with mechanical joining technologies that become so integral through a precise constructive logic that does not require the use of connection materials intended to consolidate after installation, such as adhesives and sealants. The aim is to create a modular and versatile complex, which may be a valid alternative to traditional construction systems, often complex and expensive (in terms of money and time), used today to create temporary structures. The parametric design gives the structure the

17 Jeremy Németh and Joern Langhorst, 2014.

18 Preston and Bank, “Portals to an Architecture”.

19 Marta Bonci, (Master’s degree thesis, Bologna, Alma Mater Studiorum – Università di Bologna, Scuola di Ingegneria e Architettura, 2019).

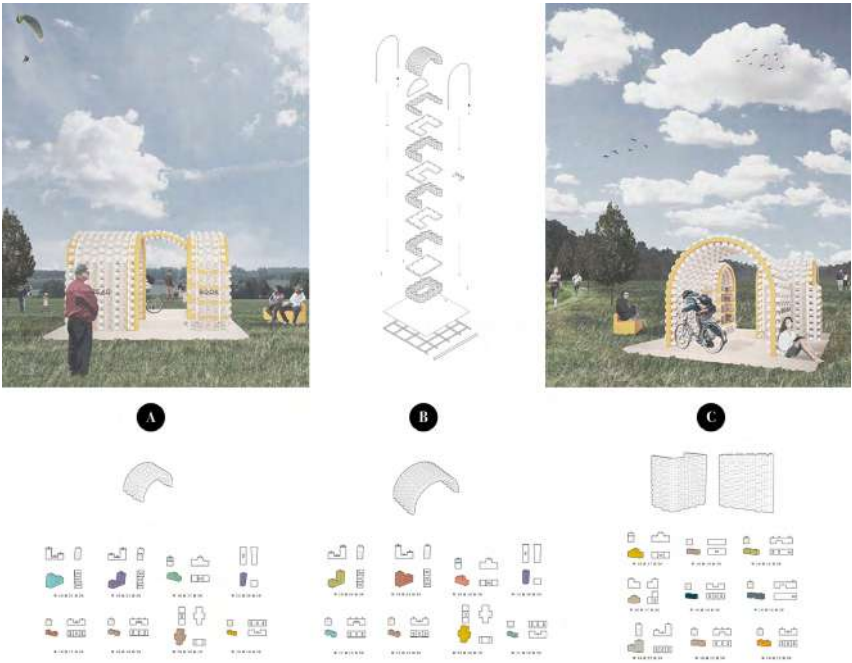


Fig. 3

Parametric process
for temporary bio-
based structures.
Image by Marta
Bonci©.

following characteristics: prefabrication, modularity, flexibility, reversibility, adaptability, customisation, disassembly, and sustainability. The peculiarity of the proposed construction system is the self-locking function. The modules are generated starting from the segmentation and assembly of modular elements, similar or identical. Depending on their configuration, they constitute a compact and unitary system, without the aid of additional connection elements, exploiting the intrinsic topological properties of assembled solids. With these TIM systems (Topologically Interlocking Materials), each segment transfers its weight to the blocks immediately below, on which it rests. Construction proceeds with successive rows, from bottom to top, as in any gravity system, and with consecutive arches. The structure construction is self-supporting, with excellent stability and resistance thanks

to every segment's weight and the self-locking system, which gives integrity and solidity to the whole.²⁰ [Fig. 3]

The system's building blocks are made of bio-based and 100% recyclable HDPE with gas-assisted injection moulding, starting from ethanol obtained from the alcoholic fermentation of sugar cane. By dehydration, ethanol is transformed into ethylene and then into polyethylene through standard catalysed polymerisation (by addition). The material is completely waterproof and suitable for outdoor applications thanks to its polyolefin nature. It is ductile, therefore it has no brittle fracture behaviour or particular deterioration of its properties over time. Thus, there is a considerable saving of material while obtaining extreme lightness of each piece, reducing cycle times with a 20-30% energy consumption saving at each cycle and eliminating any suction.

Conclusions

The project seeks to promote recycled materials to realise temporary structures for different aims to rethink and renovate the urban spaces that today are unused or degraded. The construction of these *pavilions* is considered an essential test bench to experiment, validate and disseminate innovative solutions based on recycled and reused materials, forming modules to be dry assembled with parametrically designed flexible configurations, according to a circular approach. The importance of reusing materials for the construction of eco-structures could reduce the environmental impact by up to 40% in specific building categories, showing how vital it is to distinguish the different phases of a building's life cycle. In temporary structures, architecture, lightness and reversibility are a priority because the most significant environmental impact is during the production phase. During the in-use phase, the impact is nearly zero, mainly due to the frequent absence of thermal plants or air conditioning systems.

20 Cecilia Mazzoli, (Doctoral thesis, Bologna, Alma Mater Studiorum – Università di Bologna, 2015).



In line with the research paradigms, the parametric approach - which lies at the basis of the design process for developing the proposed construction system - guarantees compliance with sustainability principles. These are intended as modularity and prefabrication, speed of production and on-site assembly, reversibility and customisation, recovery, and recycling materials. Future development of the research project could lead to the generation of unlimited geometric configurations of the blocks and the final assembled solutions, depending on the requirements to be fulfilled and the optimisation and circularity level to be reached.

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