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Abs-TREPIA

Architecture in the Anthropocene – Beyond Sustainability Towards Regenerative and Positive Impact Architecture

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Partner Institutions
Universidade Federal do Rio Grande do Norte

Expected Future Partner Institutions
To be determined.

OBJECTIVES

Within the context of the actions needed to reach the UN Sustainable Development Goals and targets (UN SDGs), their implementation within the EU and within the established framework for regenerative design already presented, the objectives of this research project are:

- Pinpoint the possible procedural alterations to the triad business plan, programming, and viability study of a planned development (in Portugal) so that the final product can result in a positive impact development, with quantifiable metrics and defined relations within the UN SDGs.
- Create a roadmap of the eventual implementation of Cross Laminated Timber as an alternative to current construction methods for medium density housing (in Portugal) such that roadblocks are clearly identified, and the UN SDGs gains are quantified.
- Ascertain and quantify the impact of the incorporation of green and productive green facades in medium density housing (in Portugal and Brazil) as a contributing strategy for climate mitigation, food security, air quality and biodiversity within the context of the UN SDGs.
- Within the realm of tectonics, adapt and develop criteria and analysis tools that encompass and incorporate the dimensions of the UN SDGs as an integral part of the built environment such that design concepts can be prioritized and validated.

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ABSTRACT + IMAGES

Paul Crutzen (1933 – 2021), the Nobel laureate of 1995 for his work on the formation and decomposition of atmospheric ozone, popularized the term Anthropocene to describe a proposed new geologic era characterized by the drastic effect on earth by human actions. The International Commission on Stratigraphy (ICS) was to decide on the adoption of the proposed new era in 2018, yet no decision has been made to this day, as no precise date for its beginning has been agreed upon. Several events and dates have been proposed such as the manipulation of fire (Raupach & Canadell), the invention of agriculture - 5000/6000BC (Ruddiman), transatlantic commerce and settlements – 1610 (Lewis and Maslin), atomic isotopes in rock strata due to atomic testing – 1964 (Lewis and Maslin) and the industrial revolution and the steam engine – 1784 (Crutzen & Stoermer). Even though there seems to be evidence that the history of human development happened concomitantly with the anthropogenic impact on the environment, current consensus tends to point to the period between 1945 and 1950, the great acceleration. This period has been recently favored as it coincides with the tipping point of planetary equilibrium from the perspective of resource use and the earth's overall regenerative capacity to anthropogenic action.

Our success and history as a species have been supported by our progressive taming and controlling of nature. In this process we also have discovered ways to harness the resources and energy available in nature, mostly at a reduced economic cost. The access to cheap energy, be it in the form of human labor, animal labor, coal, oil or nuclear has made us immensely prosperous and wealthy. The availability of inexpensive energy has shaped not only our way of life but also our buildings throughout history, as Barnabas Calder has shown us in Architecture: From Prehistory to Climate Emergency. The real cost, however, became progressively known in the 20th century as the consequences and impacts of our actions where studied and quantified. The groundwork that perhaps made this possible was the human inquiry into nature as a system. Naturalists such as Alexander von Humbolt (1769 – 1859) reinvented nature from a modern Western scientific point of view. This scientific approach persisted and is perhaps better known to us through the work of Charles Darwin (1809 – 1882) through his masterpiece, On the Origin of Species. The continuous inquiry into nature and other earth sciences in the 20th century have given us the knowledge and the metrics to gauge human action within the systems that sustains life.

In the last 120 years a duality coexisted in the relationship of humans with the planet. On one side we have had the progressive clearing of land for agriculture, extensive geographic mining exploration, trawler fishing, etc. On the other hand, we have had the progressive creation of policies to establish limits to the extraction processes as the impacts of those actions became better understood. The 20th century was a moment when prosperity and knowledge became intertwined as a checkpoint to human activity. On November 5th, 1965, President Lyndon Johnson released for publication the Report of The Environmental Pollution Panel – President's Science Advisory Committee: Restoring the Quality of Our Environment. This report precedes the Brundtland report in 22 years and the first Intergovernmental Panel on Climate Change (IPCC) report in 34 years and at the time focused mainly on the impact of human activity and the need to curtail the impacts of our actions. It reads, in the words of President Lyndon Johnson: "Ours is a nation of affluence. But the technology that has permitted our affluence spews out vast quantities of wastes and spent products that pollute our air, poison our waters, and even impair our ability to feed ourselves. At the time, we have crowded together into dense metropolitan areas where concentration of wastes intensifies the problem…" The following years up to the end of the 20th century would evolve to encompass not only the need to stop polluting but also the realization of the impacts done to the several ecosystems and our frail position in that context.

The idea of sustainability and green architecture during the 20th century existed but almost as a niche activity. A turning point resulted from the oil crisis of 1973 as the US Department of Commerce published (in 1976) the "Energy Conservation Through Effective Energy Utilization" report giving the idea of energy efficiency prominence and initiating the discourse of sustainability on a broader scale. Yet the concern of sustainability existed throughout the century within different moments shaped by different paradigms. These have shaped architecture and the built environment and have been influenced by the economic and ecological crisis associated with industrialization.

As Shady Attia has put it, six paradigms have evolved during the past 120 years, and we are now at the beginning of the seventh. The first paradigm is reflected in the ideas of Frank Lloyd Wright in 1906 on organic architecture (Uechi 2009), Le Corbusier and Marcel Breuer in 1906 on sun shading (Braham 2000), Fello Atkinson in 1906 on hygiene (Banham 1984), Hannes Meyer in 1926 on the biological model (Mertins 2007), Richard Neutra in 1929 on bioregionalism (Porteous 2013), Alvar Aalto in 1935 on health and the precautionary principle (Anderson 2010). The works of these architects presented a tendency towards rationalism and functionalism while denoting a fascination by the beauty of nature. This paradigm crystalized in the work of the Olgyay Brothers in 1949 and Olgyay (1953) in what we could call a bioclimatic stance. As the Olgyay brothers setup their first architectural lab in the 1950s, they were the pioneers that moved architecture into the scientific and empirical research world that is evidence based.

The second paradigm was dominated by the ideas of Ian McHarg in 1963 on design with nature (McHarg and Mumford 1969), Ezra Ehrenkrantz in 1963 on systems design (Ehrenkrantz 1989), Ernst Friedrich Schumacher in 1972 on appropriate technology (Stewart 1974) and Ronald Mace in 1972 on universal design (Thompson et al. 2002). The period is perhaps best reflected in the mid-1960s project Sea Ranch designed by landscape architect Lawrence Halprin and the architects Charles Moore, Joseph Esherick, William Turnbull Jr., Donlyn Lyndon, Richard Whitaker, where the concept was to "live lightly on the land" establishing a "territorial partnership" with any structure placed within it, not upon it. The work of those architects reflected an inclusiveness of environment and biology from the building interior to urban and planning scale. Schumacher's (an economist) writings, namely "Small Is Beautiful: A Study of Economics as If People Mattered", placed him as a central figure of the environmental movement as his work coincided with the birth of environmentalism and the growth of ecological concerns. This moment also encompasses a shift from empiricism in construction to a scientific approach where "to build is to solve a problem". Paramount contribution to this shift came from Gérard Blachère as he took charge of the Scientific and Technical Center for Building (CSTB) in France, which he directed from 1957 to 1974. During this time, he made CSTB a world-renowned research center, equipped with very modern test facilities and published his famous work "Savoir Bâtir" in 1966. His impact led to the "US / French Cooperative Program on Building Technology", promoted by the National Bureau of Standards. Given the fruitful collaboration, Blachère chaired the International Building Council (in the US) from 1967 to 1971, where he made a subject of reflection the approach by requirements and performance. The idea of measurable building performance within a regulatory framework gained roots.

The third paradigm was shaped by the first energy crisis and was dominated by the ideas of the American Institute of Architecture (AIA)in 1972 on energy conscious architecture (Villecco, 1977), the American Solar Energy Society (ASES) including the work of J. Douglas Balcomb in 1972 on passive and active solar architecture (Balcomb,1992), as well as the work of Edward Mazria on passive solar energy in 1979, the Passive and Low Energy Architecture (PLEA) society in 1980, and Thomas Herzog in 1980 (Herzog et al, 2001). Buildings with this framework showed a tendency of inclusiveness of solar and energy saving design strategies. The first ideas of energy neutral buildings and renewable energy integrated systems were introduced in several building prototypes and concepts during this period. The use of empirical simulation and measuring based technique to quantify building performance was based on energy codes and standards that were created in this phase. One of the pioneer codes was created in 1978 by the California Building Standards Commission, The California Energy Code – The Energy Efficiency Standards for Residential and Non-residential Buildings, as a natural sequence to the energy efficiency standards previously implemented in 1974 (today California has the lowest per capita energy consumption in the US).

The fourth paradigm reflected the ideas of Brundtland (1987), ranging from Laurie Baker on sustainable designs (Bhatia, 1991), Hassan Fathy's congruent with nature designs to build architecture from what is beneath our feet (Fathy,1973) to Samuel Mockbee and his Rural Studio and An Architecture of Decency (Dean, 2002). Along with many others, they expanded the scope and influence of sustainable design by embracing aesthetics and human experience in the context of environmental performance.

The fifth paradigm was dominated by the ideas of the US Green Building Council in 1993 on green and smart design, Sim Van der Ryn and Peter Calthorpe in 1995 on ecological community design (Van der Ryn et al. 1991), ARUP in 1996 on integrated design (Uihlein 2014) and Wolfgang Feist and Bo Adamson in 1996 on Passive Haus Concept (Feist et al. 1999). With the emergence of this paradigm architecture and its discourse proliferated globally with more complex and broader environmental considerations (Deviren and Tabb 2014).

The sixth paradigm was shaped by the ideas of the Kyoto Protocol in 1997 on carbon neutrality (Protocol, 1997) and the UN IPCC Assessment report in 1990 on climate change, and the subsequent reports in 1995, 2001, 2007, 2014 and 2022. Equally important have been the IPCC Special Reports focusing on Emission Scenarios (2000), Renewable Energy Sources (2012), Extreme Events and Disasters (2012), Global Warming of 1,5ºC (2018), Climate Change and Land (2019) and Ocean and Cryosphere (2019). The work of Bill Dunster on Zero Energy Development and Edward Mazria on the 2030 Challenge had a strong impact on architectural research and practice in this period. Energy neutral architecture became a reality embracing resilience, dynamism, and integration with the 2013 publication of the EU 2020 nearly zero energy targets for its member states.

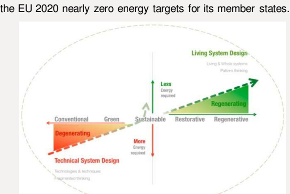

Figure 1 - From green to regenerative (adapted from Regenesis)

We are now at the threshold of another paradigm shift. This moment comes as a natural continuum and builds upon the ideas of regenerative design, cradle to cradle design and biomimicry. This paradigm has been strongly shaped upon work and ideas developed by landscape architect John Tillman Lyle in 1996, particularly with his publication of "Regenerative Design for Sustainable Development" on the idea of regenerative design; further work developed in the Center for Regenerative Studies at the California State University, Pomona, sedimented the concept. The work of Michael Braungart and Donald McDonough, particularly their publication of "Cradle to Cradle: Remaking the Way We Make Things" in 2002, has been fundamental on the idea of cradle-to-cradle design; work later supplemented with the 2013 publication of "The Upcycle: Beyond Sustainability – Designing for Abundance", moving thus into regeneration. Janine M. Benyus' book "Biomimicry – innovation Inspired by Nature" published in 1997 is center piece to the concept of Biomimicry, having since given proof of its applicability. The paradigm shift where we find ourselves in today operates then through environmentally effective sustainable buildings to create a positive impact or, better, regenerative design.

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Abs-TREPIA

CiAUD Centro de Investigação em Arquitetura, Urbanismo e Design

FCT Fundação para a Ciência e a Tecnologia

SCIENTIFIC RELEVANCE FOR THE DISCIPLINE

Human influence on the planet is such that even the geological scale has been impacted. The side effects of human action globally have revealed themselves in climate change (or crisis), loss of biodiversity, food insecurity, soil degradation, frequent occurrence of extreme events, to name a few. Several UN committees have developed their studies and reports leading to the consolidation of a response, a synthesis that corresponds to the roadmap of actions to take and that are published as the United Nations Sustainable Development Goals. The European Union and all member states individually have taken a pledge to implement these goals as a collective effort to mend past actions. These implementations are regularly assessed so that individual countries and zones can measure their progress. Much has been done already but much more is yet to be done.

The research here proposed focuses on some of the UN goals and their targets and aims at improving our capacity to respond to the crucial steps to be taken collectively. In some of the stated objectives not only do we try to respond directly to some of the targets but also try to see the possibility of compounding action through responding to one target while creating added value to other targets of different goals through proxy. The proposed research is a contribution to put architecture on course to be part o a global solution to the immense problem currently on the table.

EXPECTED ECONOMIC AND SOCIAL IMPACT

Should the research be as fruitful as one expects and as ambition allows, the results will have a direct economic and social impact in society. To be more specific and focusing on each objective individually: if programming methodology can be improved such that the final object provides a positive impact not only will the methodology be transmissible but also the final product (building) created will have a proven added value; Should CLT prove to be a viable construction alternative, the identification of the specific roadblocks to its implementation can create the possibility for its implementation with a national player; if the green and productive green façade proves to be a viable and positive impact solution with quantifiable benefits on the environmental, social and economic dimension it could lead to policy that benefits both the city as well as those that inhabit it; the incorporation of SDGs into the tectonic framework of architectural evaluation could provide a valuable tool to disseminate current knowledge in the field and create the possibility of new perspectives, essentially becoming a powerful pedagogical tool.

RESEARCH PLAN AND TASKS

Regenerative architectural design is a process-oriented whole systems approach to design. In the act of design, the process is structured within a "systems thinking" structure which, in itself, is an interdisciplinary study of systems, complex systems. In the field of architecture, as one considers the multitude of variables and possible outcomes, the process is often times a complex system. The process of a large project is innately a complex system. The process of a small project can also become a complex system as more variables and stakeholders are introduced. The regenerative approach, as it focuses beyond the built object itself, naturally increases the variables to be considered moving the process into the realm of complex systems.

This reality of complexity in planning and architectural design had been captured by Horst Rittel in the 1960s, in what he referred to as a "wicked problem". In his paper of 1973, *Dilemmas in a General Theory of Planning* he presented that current (at the time) science was prepared to deal with "tame" problems and not complex ones, or "wicked problems" as he labelled them. An entire methodology was then developed to cope with the complexity of information exchange, storage, and retrieval in order to adequately inform the decision process.

Some of the current methodologies to regenerative design, even though no reference is made to Rittel, seem to share some of the same core principles. Today the most visible framework and methodology proposed for a regenerative approach to design is that presented by Pamela Mang and Bill Reed, of the Regenesis Group. Their proposal is based upon a much wider scope of the field of study or the variables at play in the solution (or resolution) to a problem. Construction can be seen as a factor, or eventual catalyst, to generate positive change within an enlarged reality. This increase in the number of variables results from the introduction of nature as part of the problem; nature systems almost become another stakeholder with a voice in the process.

It is within this framework that the work will be developed. The research methodology will be, for the most part, common to the four proposed objectives. Since each will be developed concurrently, individually by a team member, there will be no sequencing or a cadence amongst the objectives. For each development phase or step, regular progress meetings will facilitate the exchange of information among colleagues. The communication will focus on the level of applicability of a method to find correlations within the expected complexity of each different study ground to attain a common goal which is the introduction of a regenerative character to the act of developing, building, living, and perceiving.

As such the development plan is based on five steps:

1. State of the art: Literature review, scoping and systematic review and synthesis of the state of the art (this step is presently concluded for the four objectives).

2. Precedent and case studies: identification of cases that inform the process from historical, contextual, and factual point of view.

3. Analysis: analysis of surveyed information (raw data), development of a correlational matrix that relates the UN SDGs goals and targets, the identified regenerative goals and the characteristics of each study case (within the realm of each objective). Quantification of the cost/benefit of each pursuable correlation.

4. Validation of applicability and conclusions.

5. Synthesis and dissemination.

Based on a common development structure each objective will have its own manifestation that reflects the study area. So, the first objective within points 1, 2 and 3 of the structure we could expect the assessment of current practice in such items as environmental impact reports, subdivision green corridors, school and park taxes. Then, the correlational matrix would help us identify other possible solutions or measures with higher impact.

In objective two, we could expect to identify why, historically, other wood construction systems have had no acceptance, what the current impediments are and ultimately identify the possible regenerative gains in its adoption, both in urban form and in the forest.

Regarding objective three, we could expect to characterize the impact of the introduction of green facades in the dimension of thermal comfort, food security, air quality and biodiversity with a corresponding grading of its regenerative effectiveness.

In the fourth objective we could expect to gain insight as to how the field of tectonics could encompass the place and a nature system as part of the expression of the built environment and in this manner provide us with an architectural regenerative planning and evaluation tool.

EXPECTED SCIENTIFIC RESULTS

The expected scientific results are as follows according to the research objectives:

- Development and refinement of a business plan/programming methodology resulting in a development has a quantifiable regenerative effect on the built environment according to UN SDGs targets.
- Assessment of the quantifiable regenerative impact of the implementation of CLT as a construction system, and identification of the eventual strains in the supply chain, economic and legislative stage and acceptance by stakeholders.
- Quantification of the added value of the incorporation of green facades within medium density housing allowing for the development of an applicability matrix eventually leading to policy implementation.
- Development of a methodology and method of analyses of the regenerative project within the realm and perspective of architecture through tectonics with a potentially pedagogical dimension.

BUDGET: € 7.500,00

The proposed budget reflects the expected expenses that will be needed to carry out the proposed research and that essentially fall upon the purchase of simulation and programming software and with far less expression fieldwork expenses and dissemination of results. Additional specific information about software modules desired can be given upon request.