RUINS AND REGENERATION

Keywords
Cohabitation of humans and non-humans, regenerative architecture and design, socio-ecological networks, ecological and nature inclusive design

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Abstract:

The loss of global biodiversity poses a significant threat to ecosystems and human well-being. The growth of cities has played a substantial role in the 70% decline in global biodiversity since 1970. This decline can be attributed to the failure of cities to balance their rapid land take with the preservation or creation of urban vegetation. The loss and absence of green structures within cities has led to extreme temperatures, poor air quality, and inadequate animal habitats, which results in a negative impact on biodiversity, city resilience, and both human and non-human life. Addressing these challenges requires the integration of nature-inclusive design practices into urban planning, aiming to promote the coexistence of humans and non-humans. This paper explores the concept of regenerative design in architecture and its potential to increase urban biodiversity in Western European cities. The research was based on a comprehensive literature review and inspired by interviews with design practitioners to develop a framework that can transform cities into nature-inclusive habitats. The proposed framework incorporates design principles, including the design with the temporalities of nature and integrating existing, complex ecological networks into the design process. Furthermore, the framework's effectiveness was evaluated through a case study analysis. The paper emphasises the significance of humans coevolving with nature and adopting a holistic and systemic design approach. By understanding socio-ecological systems and promoting connections between humans and the environment, architects can contribute to regenerative interventions that promote urban biodiversity.

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Loss of Urban Biodiversity

Current research has shown the positive effects that living in proximity to nature can have on human well-being (Geneletti, 2022). However, when focusing on the growth of European cities, they are not able to balance their land take with urban vegetation. Urbanization and the areas, dominated by artificial land, have increased over the last twenty years in Europe. This process happened, without adequate transformation strategies to maintain green spaces or to compensate the loss of vegetation with new green structures. This development can lead to increased fragmentation of semi-natural patches in urban areas that has the loss of biodiversity and city resilience as a consequence (Biodiversity information system for Europe, 2023).

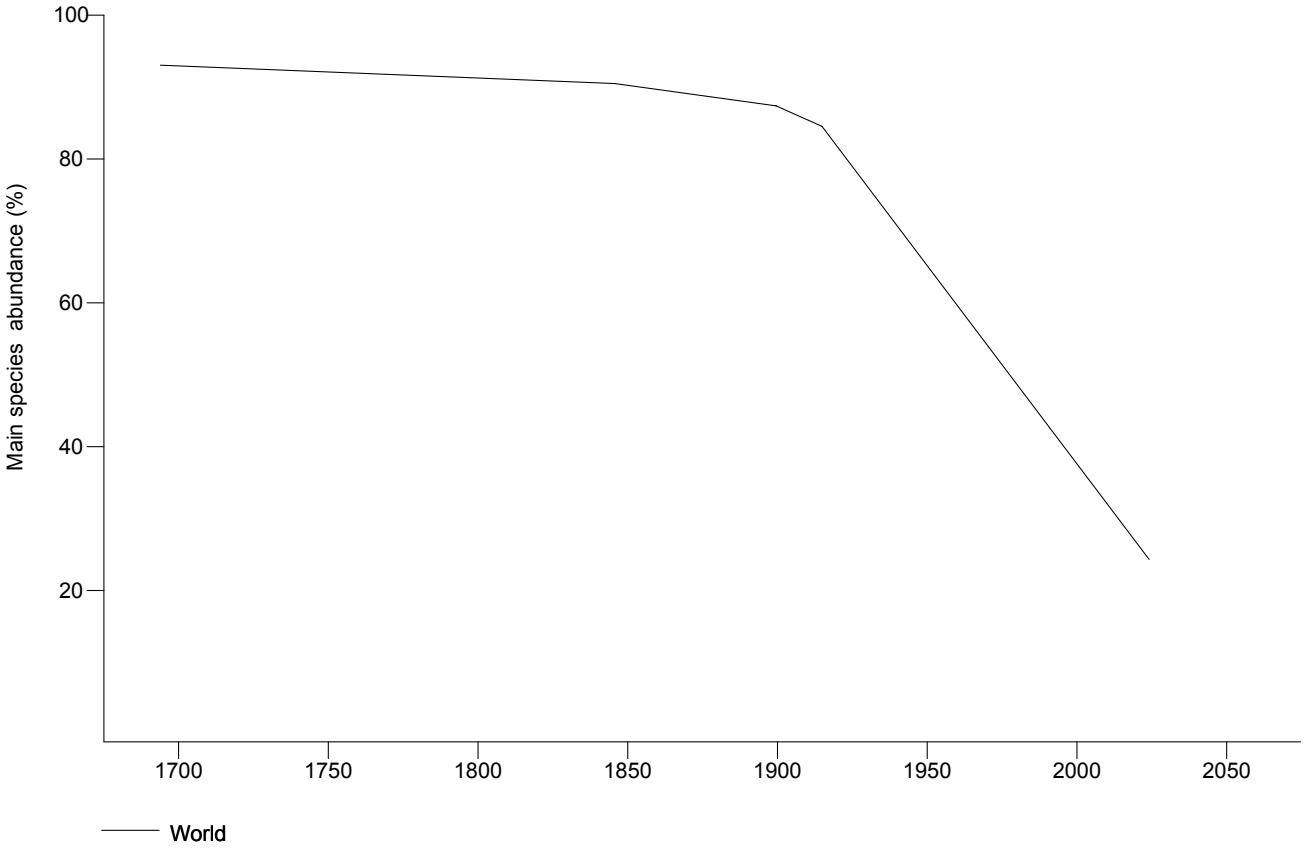
In addition to this, the current state of global biodiversity is alarming, with a 70% decline since 1970 (Hirsheimer, 2022). If the loss of species continues, as a part of the larger ecological crisis, the stability of ecosystems is at high risk which will have negative consequences for all forms of life, both human and non-human. The decrease in biodiversity has, also, given rise to further challenges within cities, including high temperatures, poor air quality, and inadequate conditions for animal habitats (van Siphout, 2019).

This highlights the important role of green structures and nature-inclusive habitats within cities. To increase urban biodiversity and enable the cohabitation with non-humans in our cities, tangible solutions are needed. However, the discipline of architecture, which plays an important role in shaping the structures and forms of cities, has so far paid little attention to the design for and with other species to increase biodiversity in our urban environments. Therefore, there is an urgency to incorporate more nature-inclusive design practices in urban planning to promote the coexistence of humans and non-humans within our cities.

Case Study: The City of Porto

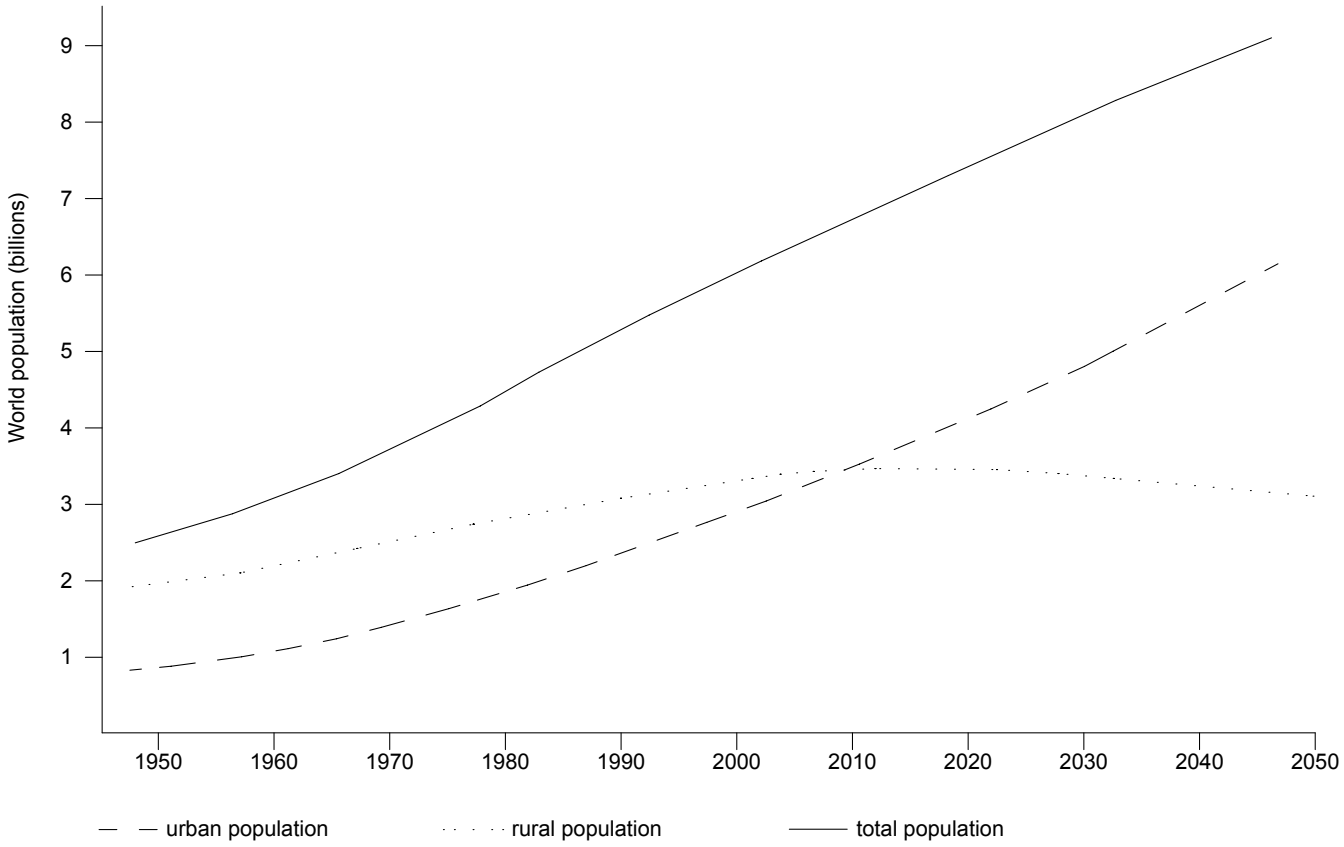
The problems described above also apply to the research and design area of our study, which is focused on the city of Porto, Portugal. Porto is as well facing a decreasing city climate. This can be attributed in part to the modernist urban planning of the last century which resulted in a limited urban green structure (Andresen et al., 2011). The remaining green spaces in Porto that support local biodiversity are mostly private green spaces within housing blocks that are separated from the public space (de Figueiredo, 2022). In our interview with Pedro Marques de Figueiredo, an architect, city guide and expert for the city history of Porto, he explained that these remaining urban green islands, and in particular one typology, overgrown industrial ruins, are currently at high risk of demolition due to the rapid city growth and real estate developments.

One concrete example of this is the current competition for the development for the industrial ruin ‘Palácio Ford’ in Heroísmo, Porto. The proposed plan involves demolishing all existing buildings and green structures, and displacing its current users and their culture and biodiversity, to make way for the construction of luxury hotels.



Global main species abundance

Source: Stiphout van, Maike. First Guide To Nature Inclusive Design. Amsterdam: nextcity.nl, 2019. p.20, p.18.



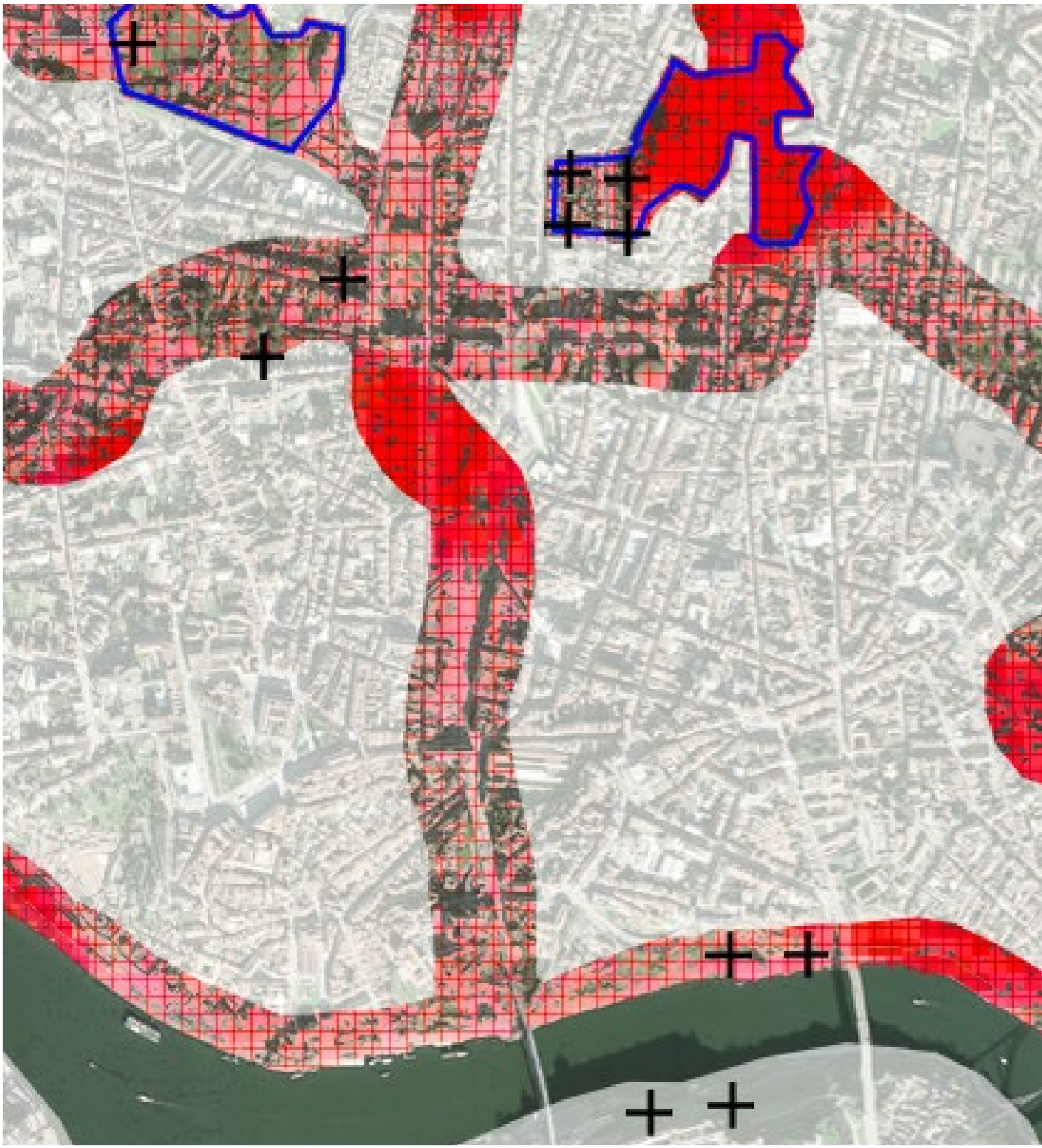
The growth of human population taking place in cities

02_Construction site in Porto

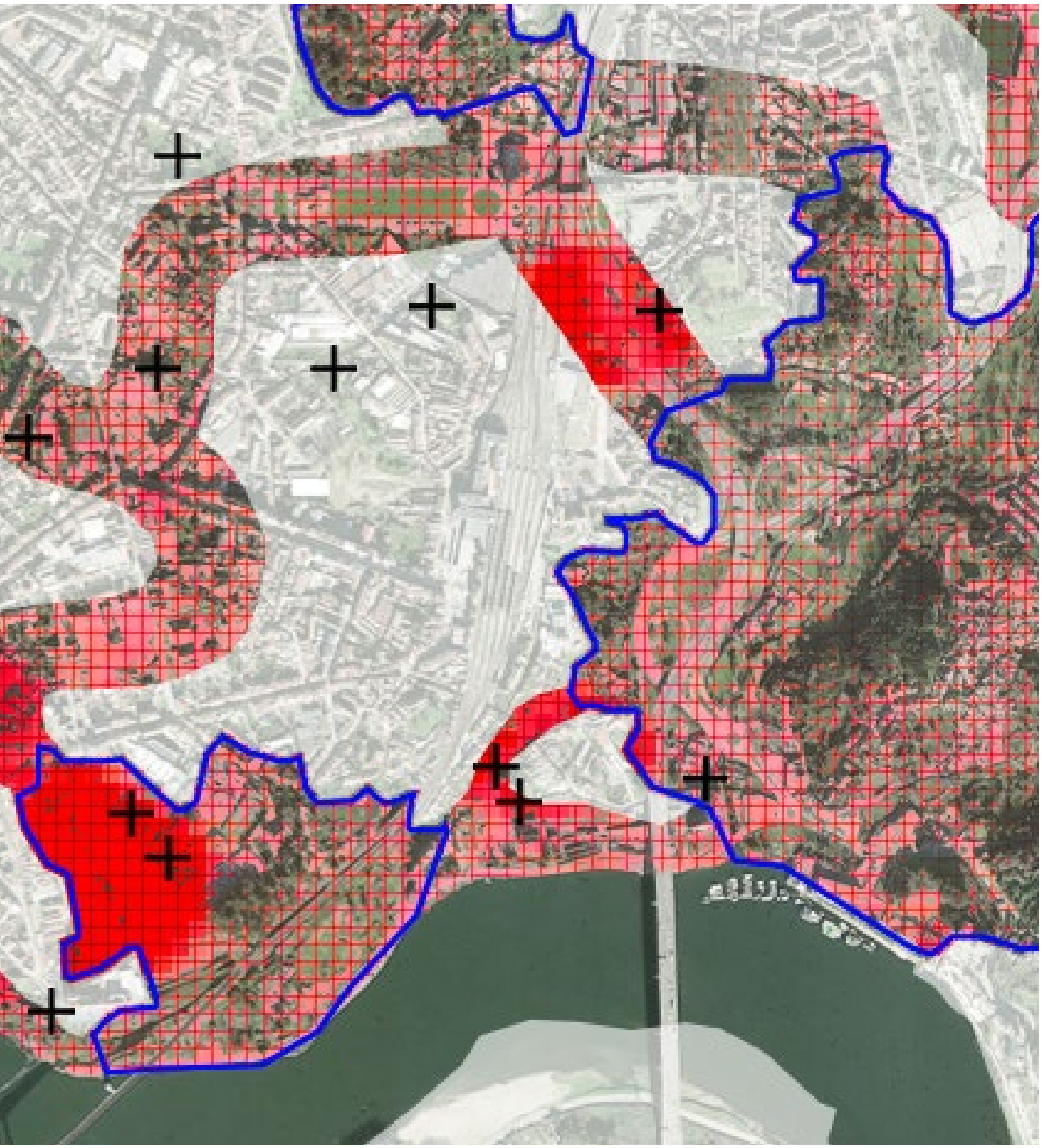
03_Map of the green spaces (green) and industrial ruins (black) in Porto

04_Map of the potential green connection (green) and industrial ruins (black) in Porto

Cohabitation



Source: CMP 2016; Grupo Clima e Ambiente Urbano, CEGOT, 2017.



05_Local Issue: Soil Pollution

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06_The industrial ruins in Porto


NOEDA
Mauser
Teatro De Ferro
Parque das Águas
Infraspeak
Oficina do Ferro

07_Palacio Ford, Porto

Methodology

The research started with establishing an overview of the theoretical discourse on regenerative design. This led to a deeper theoretical literature research into the paradigm of regeneration and its meaning in the field of architecture. Secondly, design principles for regenerative architecture were investigated. Informed by literature and nature-inclusive architecture practices, experimental drawings were made that sought to translate the conditions and needs of non-humans species and intangible elements such as time into design tools, using the case study site in Porto as an example.

To gather more data on the local issues of the study area, interviews with local practitioners, in and around the field of architecture, were conducted. These interviews included: Pedro Marques de Figueiredo, an architect, illustrator, city guide and expert for the city history of Porto, Prof. Nuno Brandão Costa, who is an architect and teaching professor at the Faculty of Architecture of the University of Porto (FAUP), Critical Concrete, a non-profit organisation for social and sustainable architecture and DostaTec, a firm for Environmentally-sensitive engineering services for building performance.

To achieve a holistic design approach, a design framework was established, consisting of methods to study the local context with the goal to form a multi-species community. During this process, experimental and exploratory drawings were used to illustrate the mapping of material flows, the perspective and needs from non-humans, networks and connections. The design is supported by prototypes and experiments at a 1:1 scale, with a focus on integrating non-human species into the built environment.

I.I The Paradigm of Regeneration

To establish cohabitation with other species within our cities, we have to react to the climate emergency and develop a way to live in balance with our planet and its other inhabitants. To accomplish this, the system we are currently living in needs to change considerably. This research aims to figure out how architectural designers can contribute to a positive change.

The prevalent idea over the last decades towards a more ecological way of living, which was followed by many different practices, was the paradigm of sustainability. Not only private people, consumers and companies tried to adapt their behaviour to be less environmentally harmful, also in the field of architecture and the built environment the goal was to reduce the impact that a building would have on the environment. Now this paradigm is getting increasingly criticised and the paradigm of regeneration is becoming more popular instead. But why does a paradigm matter when the intention of building or living ecological is the same?

The term '**paradigm**' refers to a widely spread idea, worldview or way of thinking and determines a lot of human behaviour (Ichioka & Pawlyn, 2021). Donella Meadows, who was an environmental scientist and pioneer systems thinker, explained in her book "Leverage points: Places to intervene in a system" (1999), that systems are highly complex and that it is therefore important to consider where and how to intervene within a system to achieve the desired impact. She argues that of the twelve most effective places to intervene, the two most powerful ones are the intervention on the level of "The mindset or paradigm out of which the system - its goals, structure, rules, delays, parameters - arises" and "The power to transcend paradigms". (Meadows, 1999, p 2-3) The former means to understand the idea, values or image that is the common base of a society. The latter means to understand what a paradigm is and to understand situations holistically (Meadows, 1999).

The paradigm of sustainability was introduced with good intentions, yet became meaningless due to overuse and frequent misuse (Ichioka & Pawlyn, 2021, Roggema, 2022). The term 'sustainability', arose in the 80's and was at first commonly understood as defined by the Brundtland Report's in 1987 as: "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p 41). Nevertheless what was introduced to bring a change, became transformed in its meaning as for example to describe maintaining profitability as 'economic sustainability' or simply misused for greenwashing (Ichioka & Pawlyn, 2021; Roggema, 2022).

In addition, the paradigm of sustainability aims at doing environmental harming things only less harmful, but in the end they are still negative for the environmen (Roggema, 2022; du Plessis, 2022). The Architect William McDonough observed that following the paradigm of sustainability is even in the best case only leading us to being less bad (McDonough, 2002). Instead we should reconsider the relation that we, as humans, have to the planet and its nature the same as the way we are living. The paradigm of regeneration follows the idea that the existence of humans should increase the wealth of the environment, instead (Roggema, 2022; du Plessis, 2022; Haggard, 2016; Whal, 2016). Therefore this paper works out what the meaning of the term "regeneration" in the field of architecture is, how

architectural designers can establish regenerative interventions and if they can contribute to a positive change as to the increase biodiversity and cohabitation. This should be achieved by answering the listed research questions.

Main Question:

How and to what extent can architectural interventions support regenerative developments and contribute to increasing biodiversity within western European cities?

Sub questions:

1. What does the term “regenerative” mean in the field of architecture and design within the built environment?

2. What is important to the design of regenerative architecture and are there principles for its practice?

3. How can architectural designers understand the many facets of their sites and their complex existing socio-ecological networks?

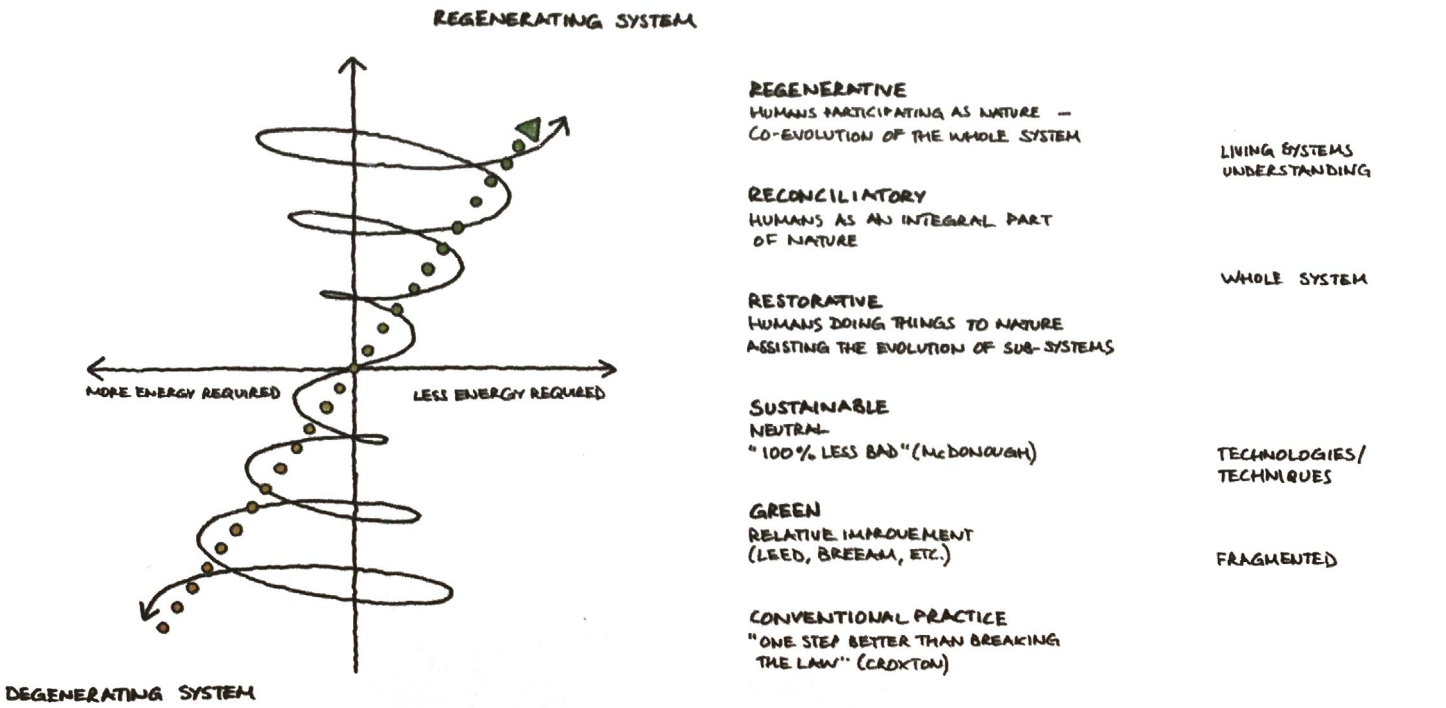
4. How can architectural designers intervene to reinforce a places qualities and promote their socio-ecological development?

I.II Regeneration in the Field of Architecture

This first chapter will discuss the meaning of the word regenerative in relation to architecture, design and the built environment, by elaborating on the term's origin and the different voices in the discourse about it. Special emphasis is put on the topic of co-evolving with nature, which often reoccurs in the discourse. Furthermore, it will be defined how this work is positioned within the existing context, to answer the first sub question.

In the following chapter the case study of the industrial ruins in the city of Porto will be presented. This case will work as an example to test potential design methods to include biodiversity and to catalyse regenerative processes.

The term regenerative comes from the Latin word "regeneratus" and means: "to bring forth again" (du Plessis, 2022, p 40). Over the last decades it was mostly used in the field of agriculture where it is used to describe forms of practice that are close to permaculture, agriculture that is based on the observation and imitation of ecosystems and their cycles. In recent years the term got adopted in other fields and applied to products, companies as well as to architecture. The term describes approaches that are net positive, hence giving back more to the environment than they are taking. This point in particular, is highlighted by several authors as it declares a very clear and measurable goal for a project. The scheme by Bill Reed makes visible what impact certain paradigms aim and that the paradigm of sustainability is insufficient (Reed, 2007; du Plessis, 2022). Various voices that argue for the paradigm of regeneration state that a sustainable approach often leads to the introduction of fragmented measures that only reduce a project's



The diagram of Bill Reed (Regenesis Group) illustrates the that we have to get above the line of neutrality to realize positve, regenerative approaches while it show the insufficiency of the conventional framing of sustainability. (Redrawn by Ichioka, Pawlyn 2021)

impact (Roggema, 2019; Wahl, 2016; Ichioka & Pawlyn, 2021). Instead projects would need to be developed with a systems perspective. Following Rob Roggema, Professor of Landscape Driven Design at the InHolland University of applied Sciences and publisher of the book: "Design for Regenerative Cities and Landscapes: Rebalancing Human Impact and Natural Environment", a shift from solving solutions by calculating and engineering towards understanding complexity and systemic change, is needed (Roggema, 2022).

I.III Co-evolving with Nature

The need of humans to co-evolve with nature is central to the paradigm of regeneration. Next to many others, this is argued by the members of the 'Regenesis Group' who already proposed the idea of regenerative design in 1995. The interdisciplinary group, including professionals from the fields of, architecture, landscape ecology, business, real estate development, regenerative agriculture, general systems theory, living systems theory, urban planning, and developmental psychology, believe that the current environmental problems, which were already present back in 1995, are the result of a "fractured relationship between people and nature" (Haggard & Mang, 2016, p 14).

On this, the voices in the discourse about regenerative design agree without an exception. Ben Haggard and Pamela Mang argue in their book "Regenerative Development and Design" (2016), that the core problem of how we design our build environment is a matter of our culture and not of technology. According to them, a shift in design practice rather depends on a psychological change than on technological innovation. Instead of seeing us humans separated from nature, we should become part of a co-evolving whole that thrives in symbioses with the environment that we inhabit. Doing this would give us the ability to co-evolve with other living beings and lead to a continuously complex and diverse planet (Reed, 2007).

This idea is shared by many other authors that write about regenerative design. So as well Chrisna du Plessis, the researcher with focus on "principles and guiding frameworks for the practices of sustainable construction and human settlement" states that establishing a new relationship between humans and other living beings is the key for the paradigm of regeneration (du Plessis, 2022). Rob Roggema, is making this argument even more clear, by saying that "man is part of nature" and the "city is part of the landscape" (Roggema, 2022, p 1). Also the book "Flourish: Design Paradigms for Our Planetary Emergency" written by Sarah Ichioka, a urbanist, curator, writer and Michael Pawlyn, an architect in regenerative design, and founding director of the London based office Exploration Architecture, argues that we have to acknowledge the reciprocal interdependence of human health and the health of the planet (Ichioka & Pawlyn, 2021).

Following the arguments of the named authors, this work is, when using the term '**Nature**' referring to the entire web of life that exists on earth, of which we as humans and our '**Culture**' need to become an integrated piece. Furthermore this work will refer to the definition that: "**regenerative design and development** is that which supports the flourishing of all life, for all time" (Ichioka & Pawlyn, 2021, p 14).

I.IV Practicing Regenerative Design

The literature discourse on regenerative design and architecture emphasises the importance of establishing a co-evolution with nature, yet, how regenerative design is implemented in practice is not as clear and remains a challenge. Unfortunately, there are not many comprehensive examples existing in contemporary architecture that show how holistic regenerative design is applied. One well-known example of regenerative design is the land restoration project of the Loess Plateau in China . The project turned a large deserted valley area back into a fertile ground, which had a positive impact on thousands of the area's inhabitants and helped many of them out of poverty (Ichioka & Pawlyn, 2021). However, just like this project, many of the examples for regenerative design are large scale interventions rooted in the disciplines of landscape architecture and urban planning. Large scale interventions like these in urban planning offer good opportunities for systemic change since they often allow redesign various different aspects of a place and its flows of resources. Yet, also smaller architectural projects can be of great importance since they come in direct contact with their users, inhabitants or clients and their behaviour. To establish these kinds of regenerative projects, it is important to find methods that can be used in their architectural design practice. Concerning the practice of regenerative design, various different approaches and theories are outlined in the literature.

An idea that recurs in many different sources, which challenges conventional architecture practice, is to follow a holistic or systemic design approach. Chrisna du Plessis presents in her text:" The City Sustainable, Resilient, Regenerative – A Rose by Any Other Name?" key-elements and goals for regenerative design. Her design ideas are based on the understanding of our built and natural environment as intangible social and ecological systems.

Following du Plessis, regenerative design is about the creation of connections, first of all between us humans and nature, but also between individuals and their communities, as well as communities with their natural system and place (du Plessis & Roggema, 2022). Furthermore, it is important to identify and empower 'soft' aspects, intangible aspects like motivation or a sense of belonging, to form social-ecological systems that respect and enrich the many relationships and flows of the environment they are embedded in (du Plessis, 2022). Understanding and working with socio-ecological systems, as du Plessis calls them, challenges architects and their methods since the work with ecological systems, social constructs and especially their interrelation has not played a significant role in architecture practice so far.

Another point of du Plessis for regenerative design is to create conditions that increase life. By setting up the right parameters, the emergence of new ecosystems is supported, and hence the biodiversity of a place can increase. Following du Plessis, this does not only mean to build up an ecological base but also to strengthen the complexity and diversity of cultural and social systems (du Plessis, 2022). This requires a different way of working from architects. The architect is not requested to design a, by building completion, finished product but instead to design an intervention that catalyses a dynamic process and is flexible to follow different trajectories.

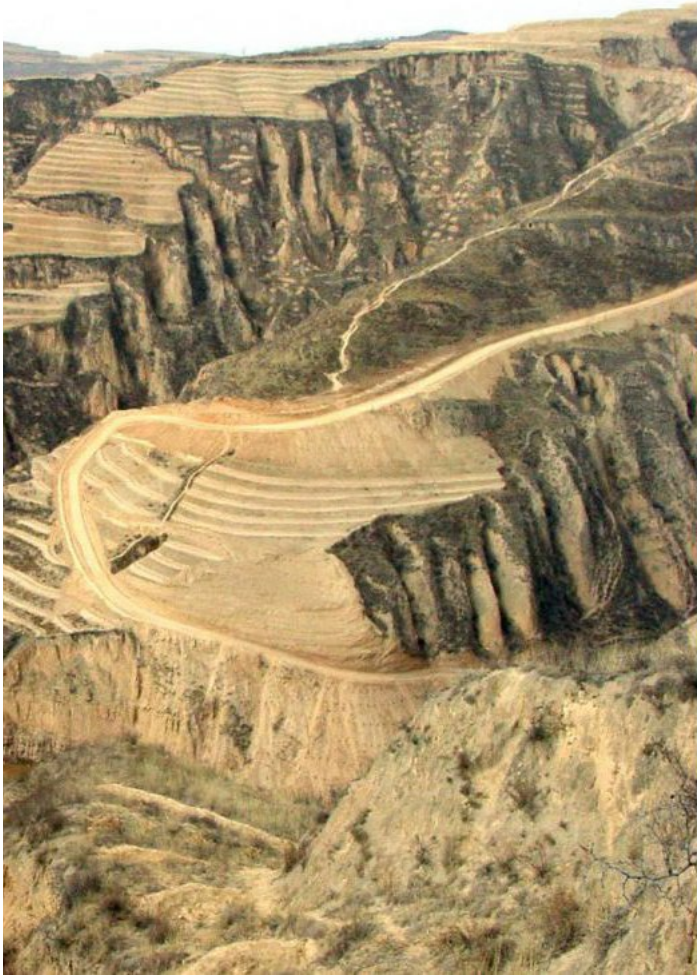
Rob Rogggema as well proposes to follow a form of system thinking in his text: "Designing for Regeneration". He states that 'Living Systems Theory' is essential in regenerative design to develop

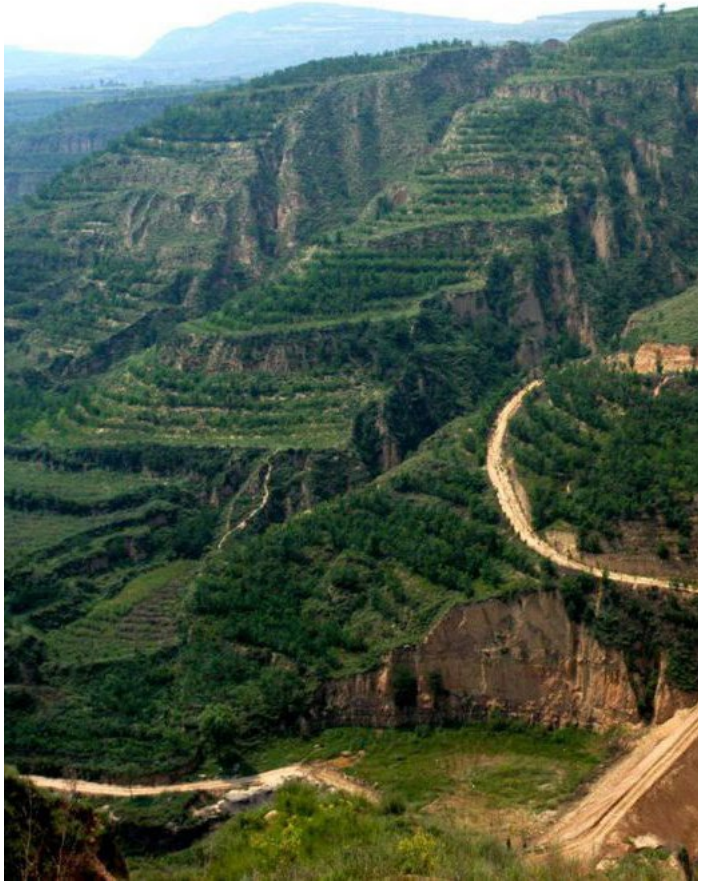
a holistic design approach that aligns with the development of ecosystems (Roggema, 2022). 'Living System Theory' is a framework-based approach that argues that already a cell or living beings but also organisations, communities or countries are all living systems, which are in continuous dynamical flux and in interaction with their environment. Pamela Mang and Ben Haggard agree in their book "Regenerative Design and Development" in this point and highlight, same as du Plessis, the important connection between social and ecological systems. Viewing the world as existing living systems which are interconnected should help us to reinvent our relation to nature as one of co-evolution and thriving in symbioses (Haggard & Mang, 2016).

Following the approach of the Living Systems Theory and the idea that our build environment is a socio-ecological network gives us a starting point for a regenerative design practice. Yet, the named ideas, which are described in the literature, like the work with Living Systems Theory, socio ecological systems or the creation of conditions are still quite abstract. These ideas need to be translated into tangible and practical methods to implement them in the architecture practice. Furthermore, as regenerative design deals with social and ecological aspects, the tools of conventional architecture practice need to be rethought and methods from other fields tested that could enrich the practice of architects. Therefore, the following chapters elaborate on principles to practise regenerative design within the field of architecture.

Cohabitation

Source: VSM, Restoring China's Loess Plateau,
https://vegansustainability.com/restoring-chinas-loess-plateau/,Retrieved 27.06.23.





08_Regeneration of the “Loess Plateau” in the north of China

II.I The Idea of Role

As previously stated, following the approach of the living system theory and the idea that architects should support socio-ecological networks with their projects, constitutes a challenge in the practice of architecture.

Pamela Mang and Ben Haggard propose the 'idea of role' as a base for regenerative design practice. The idea of role is different from the, in architecture practice, more conventional concept of function. While a function describes what a certain entity does, a role describes what its needs to be to help, for example to support certain aspects which are important to the life of a system. Therefore its function is flexible, not fixed and changes according to what is needed. A vivid system is an assemble from entities with distinctive roles that complement each other. To define a role of an entity or possible intervention, it is needed to be understood within its local context and in a system of reciprocal elements that work together towards a common purpose. "The continuing health of living systems depends on each member living out its distinctive role" (Haggard & Mang 2016, p 138).

Normally designers initiate their project by defining a spatial program, consisting of different functions, if this is not already given by the client. For example a community centre provides spaces to meet or gather and a housing project provides shelter. If we think of the same projects in regards to their roles within a system, the community centre could play the role of bringing people together, being an inter-cultural connector, or of being a mediator between different people or species. The housing project could take over the role of bringing safety and comfort. Like this the project is shaped and adjusted to fulfil its role, and able to adjust its function to fulfil its role in different scenarios. Like this regenerative design interventions are not about the actual build construct but about the value that they have as members of a community (du Plessis, 2022).

Actor Network Theory in Regenerative Design

The 'idea of role' shows many parallels with the '**Actor Network Theory' (ANT)** which is a theory from the field of social studies that describes the reciprocal interconnection of everything material and non-material that exists in our social and natural world and argues that not only subjects but also objects are Actors, as they play active roles (Yaneva, 2022). The Actor Network Theory, from now on referred to as ANT, arose in the 1980th, in the context of science and technology studies and was developed by several protagonists, most famously, Bruno Latour, John Law, Michel Callon and Madeleine Akrich (Belliger & Krieger 2016).

ANT helps to describe the relations between the physical, as well as the non physical, such as ideas, beliefs or concepts and is referred to as an approach for 'material-semiotic'. (Belliger & Krieger, 2016) Furthermore the theory describes in a 'symmetrical', non hierarchical perspective how humans and non-humans are acting reciprocally in ever shifting networks and relationships and therefore allows to bridge the gap in the thinking between nature, society and technology. (Belliger & Krieger, 2016; Latour , 2008; Callon, 2006)

In relation to the literature on regenerative design, ANT describes more precisely how to set different actors, entities and their roles into relation. These ideas go in line with the 'idea of role' by Mang and Haggard, same as the 'living systems theory' and should help in the context of regen-

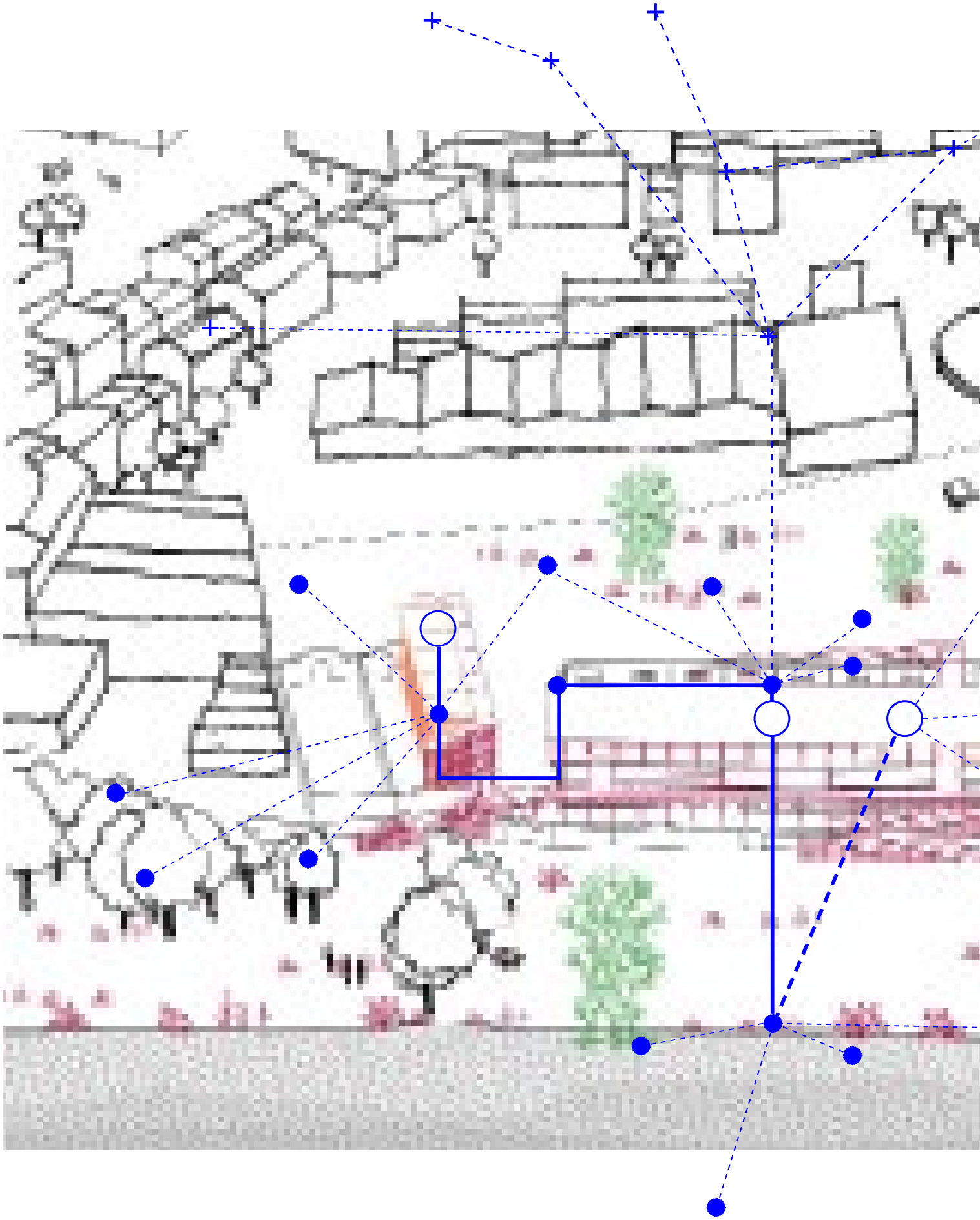
erative architecture to better understand the reciprocity of social and ecological systems and how to integrate these in the design practice.

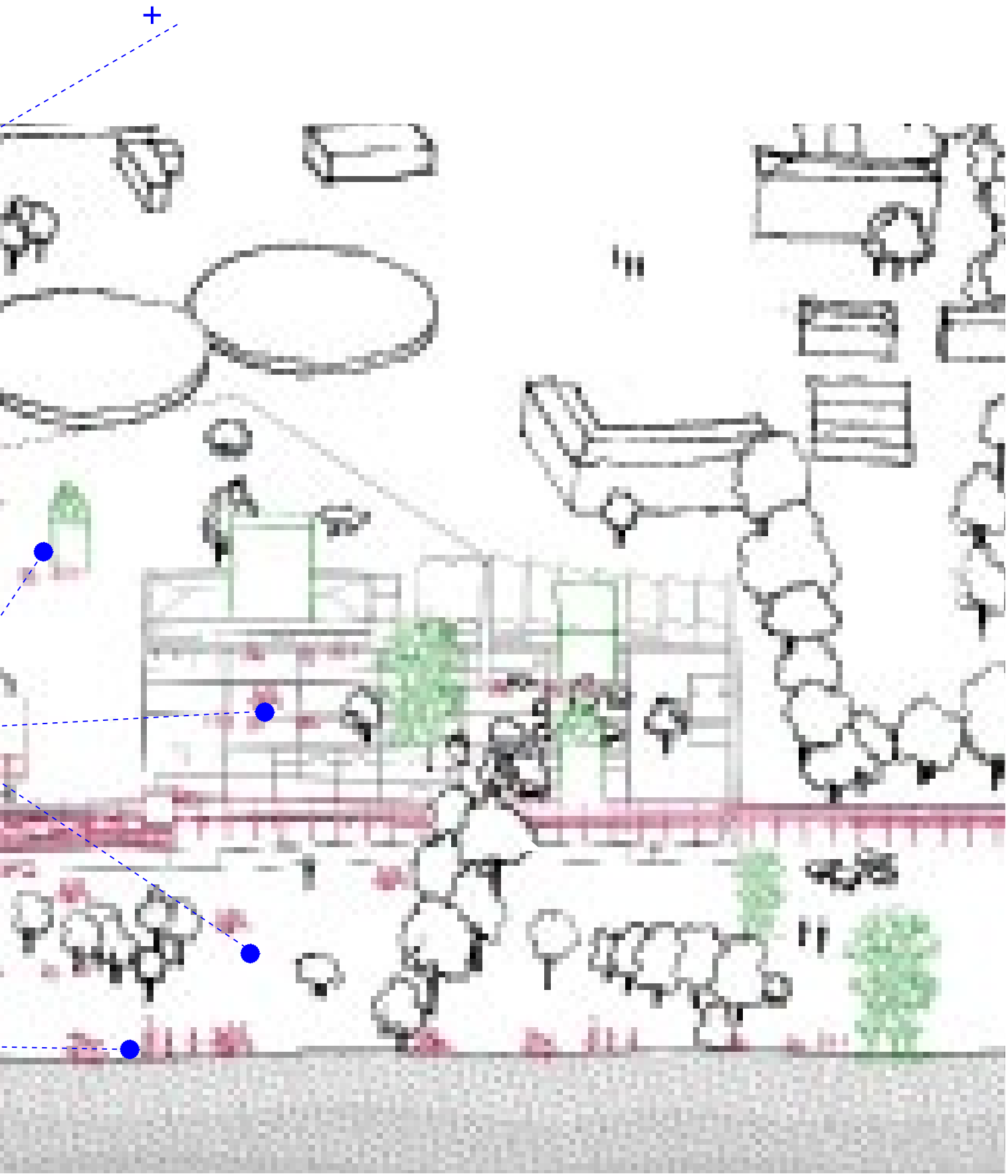
One of the most progressive ideas of the ANT is to neglect the differentiation between subject and object. It points out that not only people, but also 'things', as natural objects can actively carry out actions. These objects are, same as subjects, declared to be 'actors'. According to Madeleine Akrich's definition 'actors' are everything that can perform actions, while an action is defined as the performance in facing specific challenges or tests. From these performances, a series of competences can be derived with which the actor is equipped (Akrich, 2006).

This idea refines the idea of Haggard and Mang that architectural structures are fulfilling a role. According to ANT a building can perform within a certain climate and host or enable specific actions of its users and other actors. Like this, the architectural object can be read within a network of different actors and relations. Following this, the ANT can help in the stage of the design to define a role or relations, according to which a building has to be planned. Especially for the design of regenerative architecture and the aim of cohabitation within the build environment, neglecting the differentiation between subject and object is interesting. In the time of the '**anthropocene'**, a time in which we humans are in the centre of our world-view and the subject to our actions, the ANT can shift the view on our acting and help to design for the coexistence of humans and non-humans, such as animals, plant, other organisms and materials.

Another aspect that is interesting about the ANT is the handling of different scales. Entities and structures of different scales are considered symmetrically: according to ANT thinking, large and global actors, such as states and big organisations, are no more complicated or abstract than small, local, actors. At the same time, the local is neither more concrete nor truer than the global (Callon, 2006). This perspective allows to put actors and matters from different scales into relation and better understand their influences on each other on a local level. In the practice of regenerative architecture this thinking could be used to map out important heterogeneous aspects like climate conditions, animals, humans, buildings, processes and organisations to show their reciprocity in plans or diagrams, and result in a more holistic design.

Cohabitation





09_The site and the roles added through the intervention

II.II The Idea of Place and the Assemblage Theory

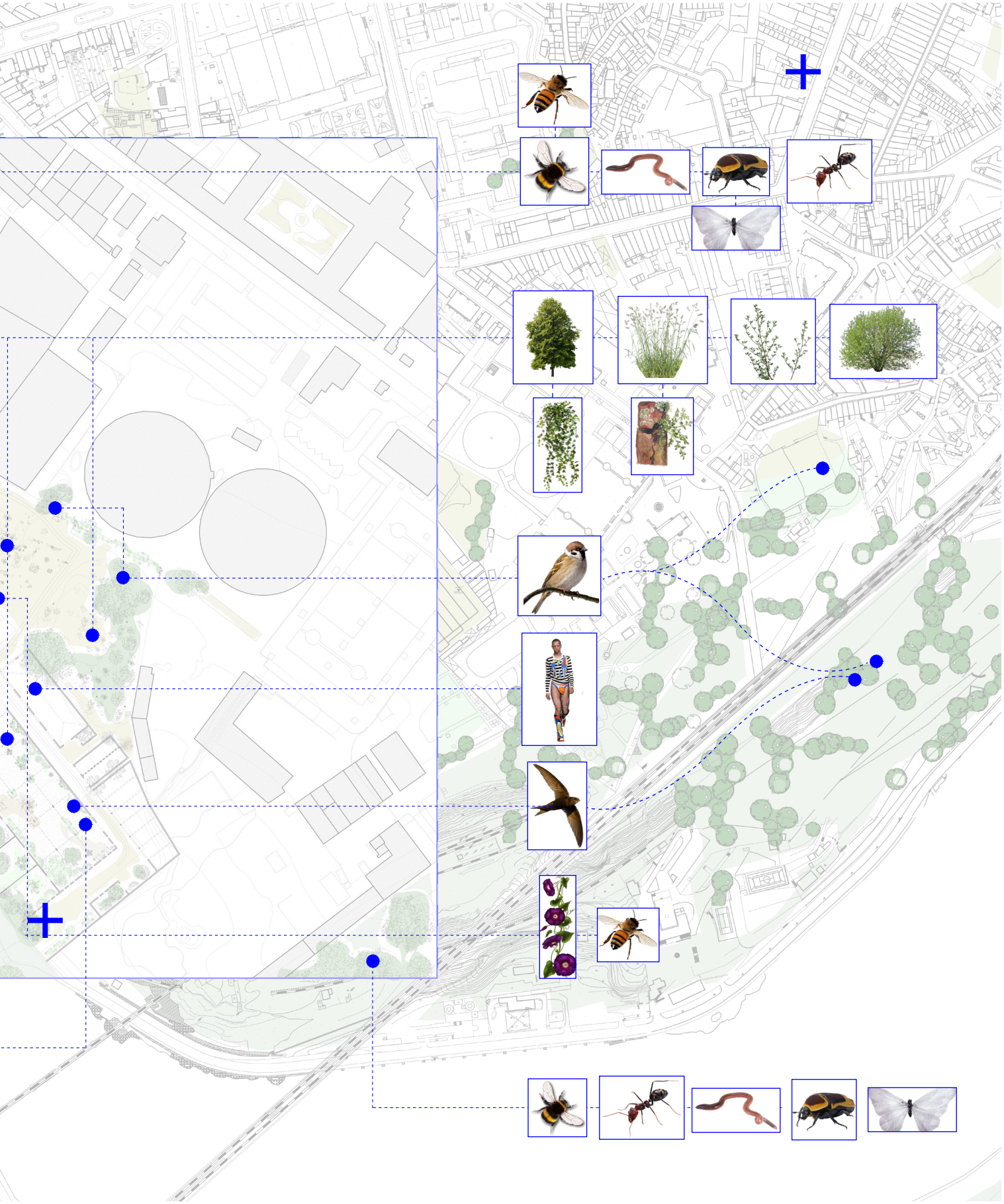
A further theory that helps to translate the explained ideas of the ANT into the field of urban planning, is the 'Assemblage Theory'. The '**Assemblage Theory'** describes the relation and reciprocity that different places can have on each other and therefore helps to bring principles of ANT into spatial dimension (Farías, 2010).

Following the theorist Ignacio Farías the: "city is made of multiple partially localized assemblages built of heterogeneous networks, spaces and practices" (Farías, 2010, p 2). He continues that to understand the complexity of cities and the: "multiple and overlapping enactments that constitute urban life require a commensurate method of analysis that encompasses the human and non-human aspects of cities – from nature to socio-technical networks, to hybrid collectivities, physical artefacts and historical legacies, and the virtual or imagined city." (Farías, 2010, p 2). According to Farías, ANT significantly changes the way cities are viewed by including heterogeneous, non-human and human actors without restriction in urban contexts, thus providing a way to capture their particular complexity and openness.

Assemblage theory shows the city as an assemblage of many heterogeneous factors and their relations. Important to mention is that this theory, the same as the ANT, does not interpret these relations as static but dynamically shifting (Farías, 2010). The Assemblage theory adds a spatial dimension to ANT and helps to perceive the environment of a potential site on different levels that are strongly interrelated with each other. These could be built mass, green structures, biodiversity, social and economical aspects which are spread over a place and in addition to this in constant development.
As stated before, an as holistic understanding of place and the interrelations with the living system an intervention is embedded in, is essential to regenerative design. According to Reed, the design process needs to begin by attempting to understand how the systems of life work in each unique place (Reed, 2007). Therefore the assemblage theory could help in regenerative design to show the relations of an intervention within the local complexity and to understand a site as entangled with its souring on a bigger scale, for example the city it is built in.

Cohabitation

● Actors + Organisations



10_ Local Network

II.III The Idea of time

The Idea of time that is taken for granted in western culture became prevalent during industrialisation. The concept of living by the hours that divide a day was spread to structure the day and increase the productivity of labour that worked in the factories. Ever since this concept is ruling the western world and has a short term thinking as a result (Ichioka & Pawlyn, 2021). Earlier in western culture, and still today in some indigenous cultures, this concept did not exist. Instead people oriented themselves at cycles of nature as the rhythm of the moon, the seasons or the growth of plants. Therefore the perception of time was manifested in the cycles and acts of nature which defined a thinking in longer time spans. This idea of time is as well important to regenerative design. If designers want to plan with nature they also have to think in its temporalities and time of development (Ichioka & Pawlyn, 2021). Designers need to take into account the time that processes, like the build up and decomposition of natural materials, the seasons or the behaviour of animals and other natural acts need.

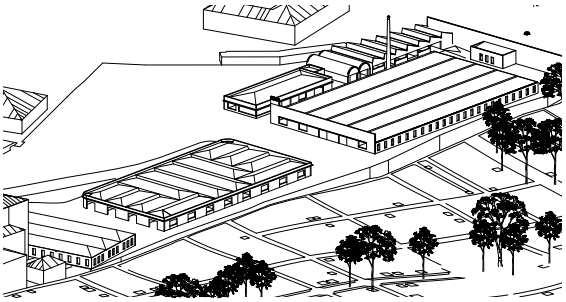
An example of constructions that deal with these themes are the living root bridges in north east India. In the remote forests of the province of Meghalaya the indigenous tribe Khasi builds bridges from the aerial roots of rubber trees (ficus elastica) to overcome rivers and gorges (Ludwig et al., 2022). These bridges can span over distances up to 20 metres and are realised over the life span of several generations. The construction of the bridge gets initiated with the planting of two trees facing each other on both sides of the river. When the trees grow big enough their aerial roots get directed to the opposing shore to be connected with each other. Until these grow together and are stable enough to be used it might take up to several decades. This needs collaboration over generations and means that probably only the grandchildren of the initiators will benefit from this bridge. (Ludwig et al., 2022)

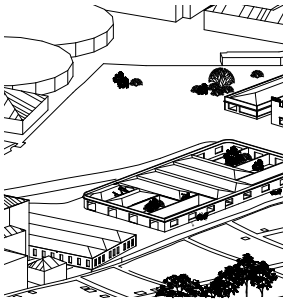
This kind of thinking needs to be rooted in the world-view of a culture to be successful. James Ogude states that after the South African principle of ‘ubuntu’, people foster them selves in relation to other people, further actors from their environment such as plants and even to their ancestors that have preceded them, which contributes to a long-time perspective (Ogude, 2019). The identification with the past but also with the future generations can in this way lead to a higher connectivity and care for a place and its development over time (Ogude, 2019). This identification, would probably, with the caring for the development of a place, as well change the awareness for the health of our environment, since it is the basis for the life of the future generation.

The important role of our cultural development for the development of the environment, as well gets highlighted by Roman Krznaric in the podcast ‘Flourish’. He states that for the human future not just the biosphere, the air we breath, but also the ‘ethnosphere’, the ‘cultural air’ we are surrounded by, is fundamental. The ‘**ethnosphere**’ is a metaphor for our cultural development which will, according to Krznaric, possibly define our biosphere (Krznaric, 2020). Therefore changing our perception of time and achieving this awareness for the wealth of our environment constitutes an important part of regenerative design.

11_Example of Ecological Sucession Palacio Ford

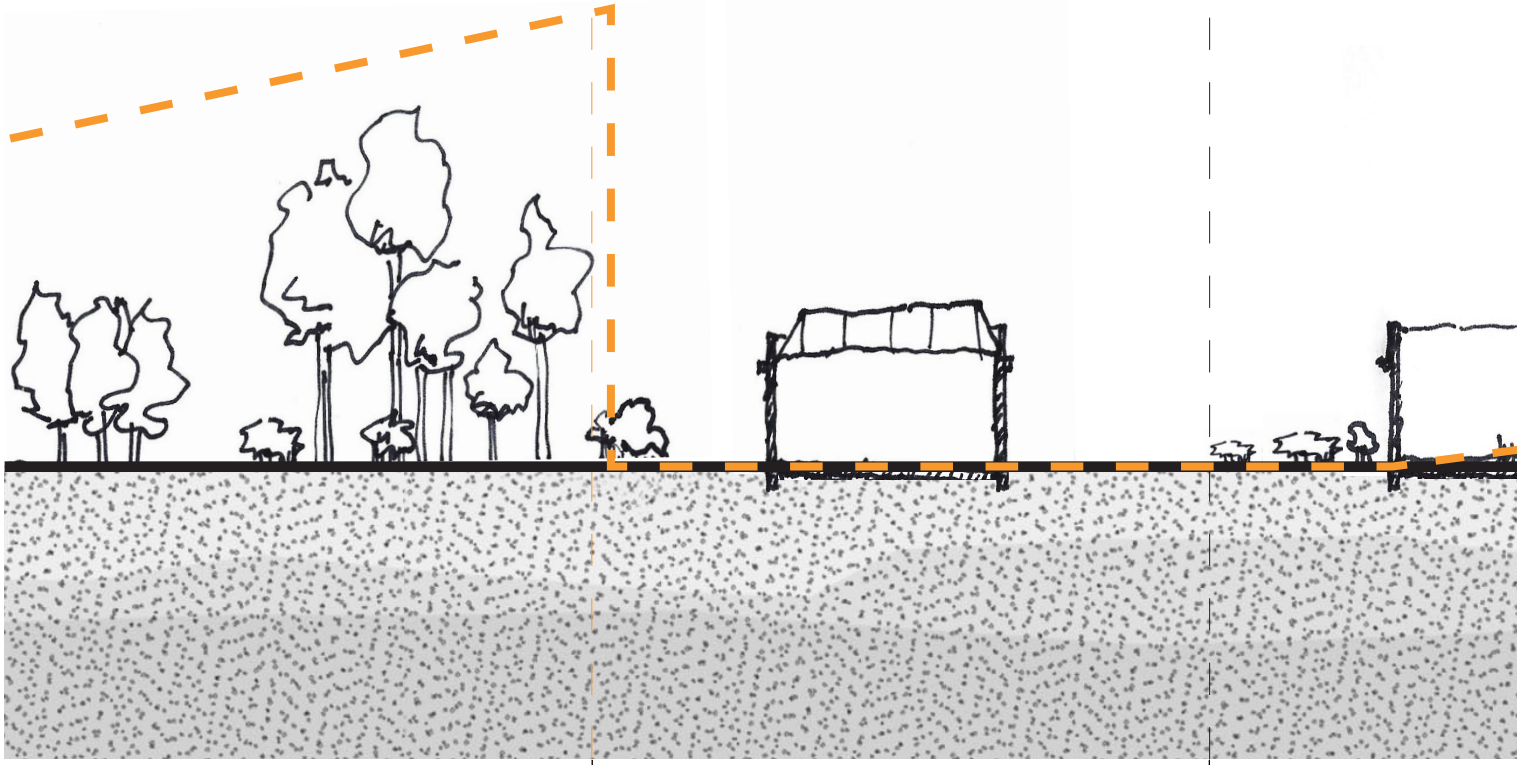
Cohabitation





Point of disruption

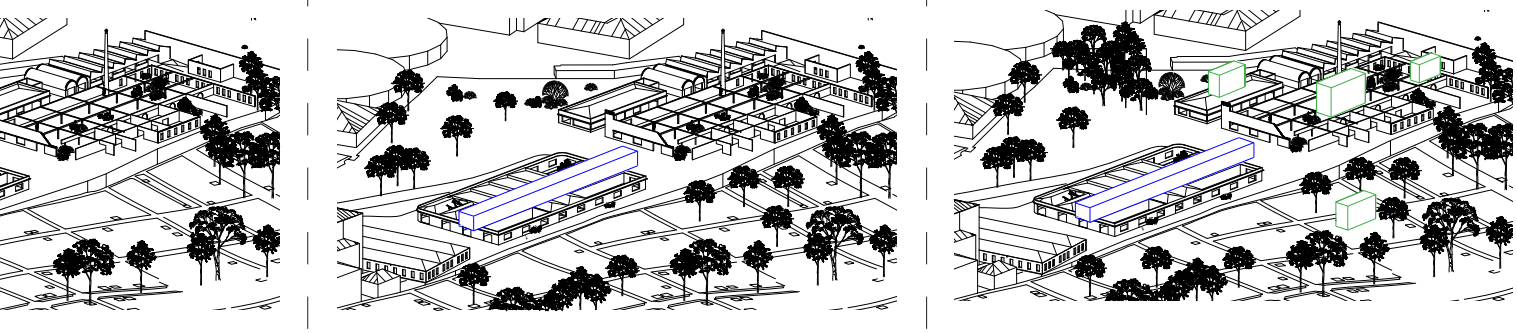
Pioneer



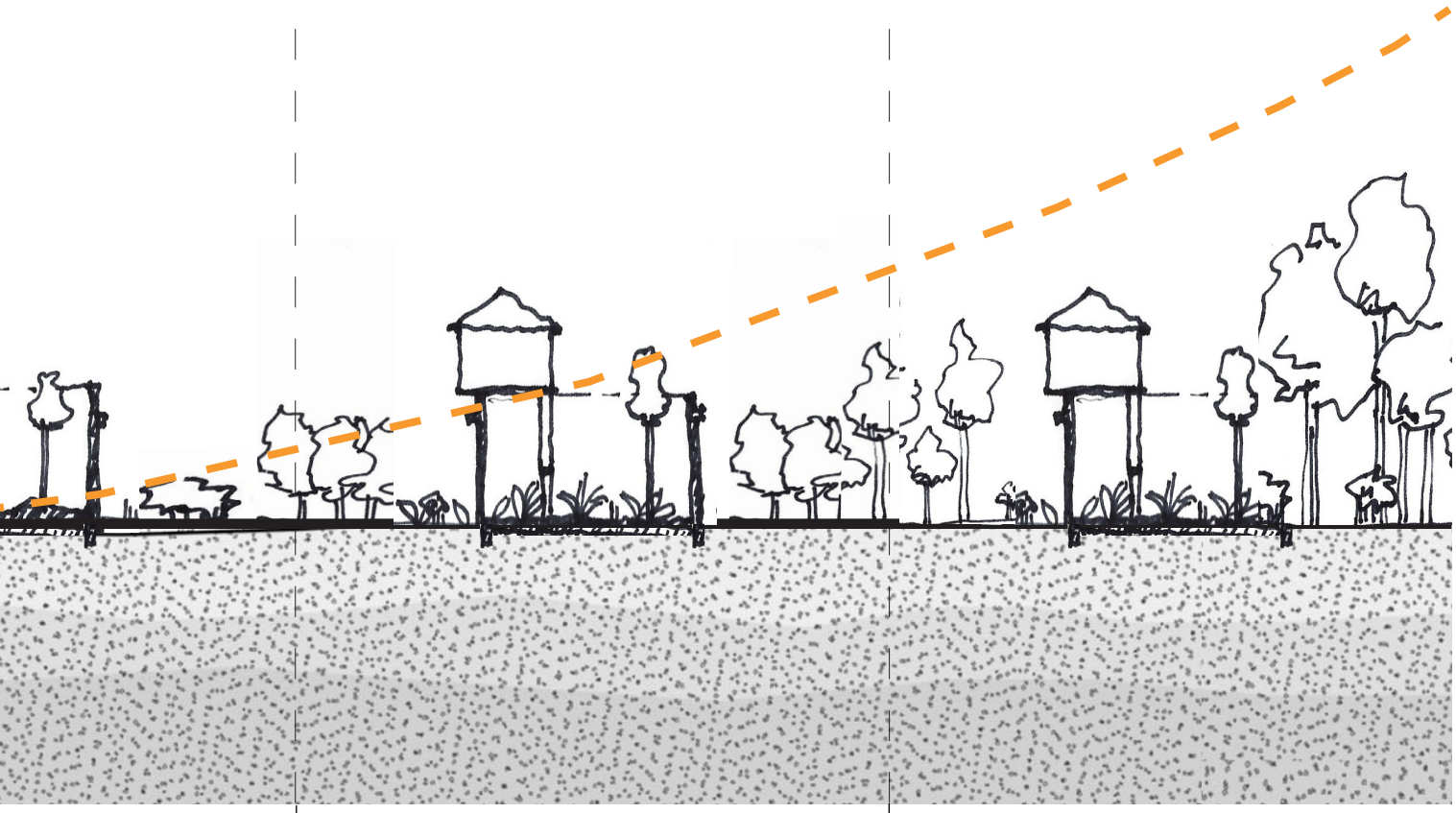
Forest

1934 Ford Production

1960 “Abanc



species → Intermediate community → Climax community



12_Concept of Ecological Sucession Palacio Ford

lonment” | 2023 Regeneration | 2035+ Urban Forest

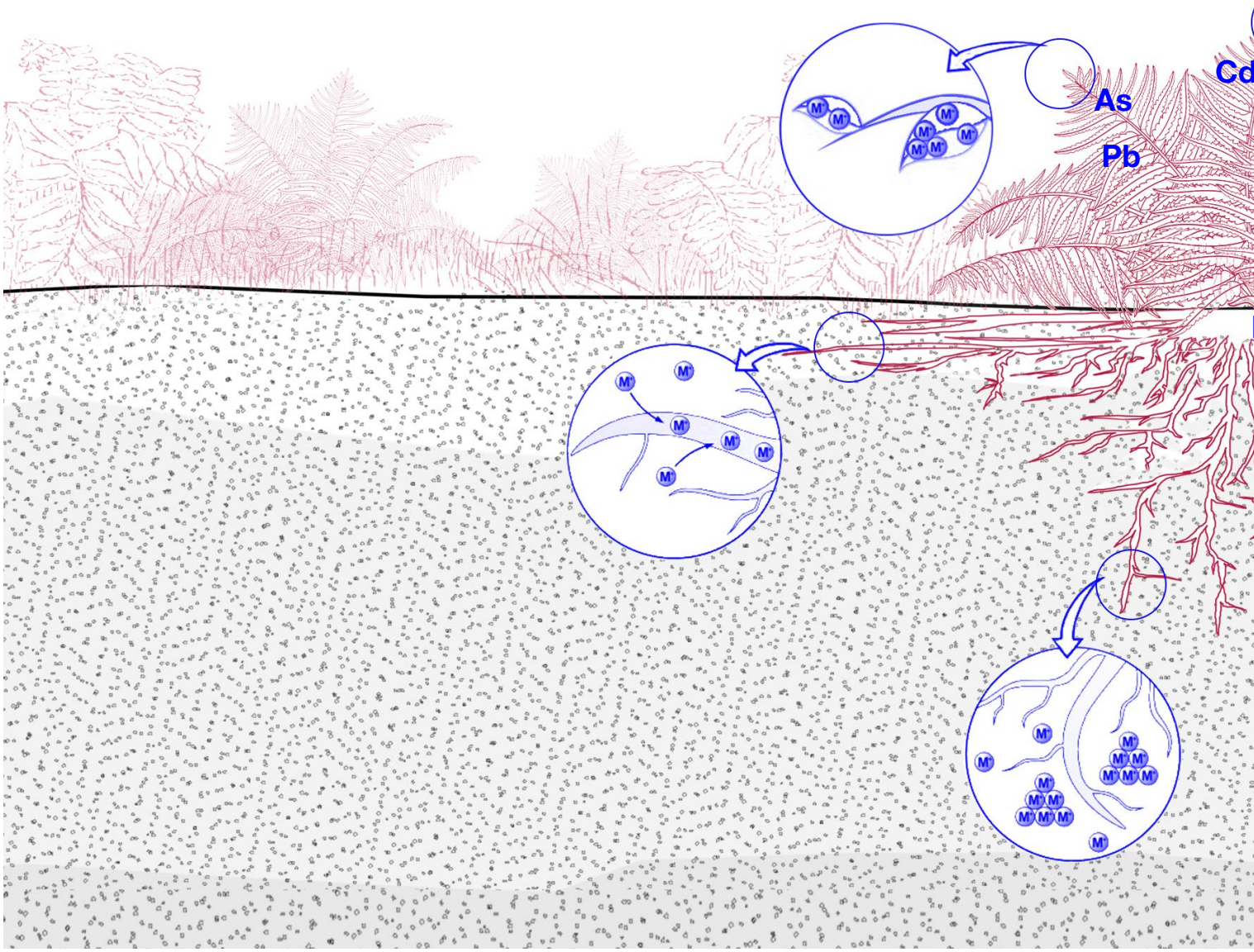
II.IV Building upon Potentials

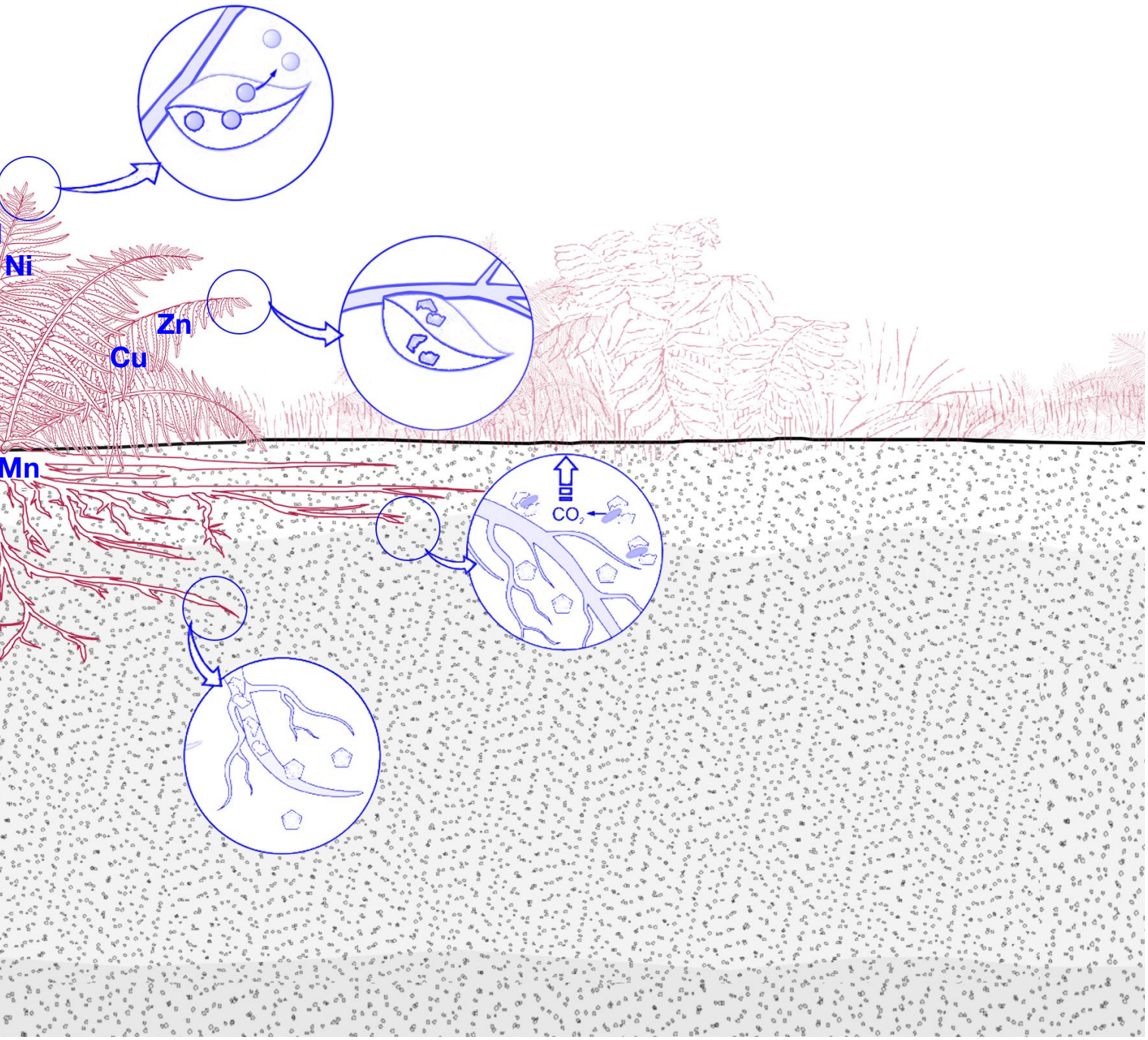
Another principle of regenerative architecture is to start designing with the aim to embrace the existing potentials of a place (Roggema, 2022; du Plessis, 2022).

After analysing what places characteristics for its human and non-human actors and the properties of its ecological system are, it is important to discover the values of the different roles that are existing in a system. These could be the activity of certain actors, the skills of its actors, a social structure, the local climate or other specific conditions. After mapping these out, the idea is to empower the actors of the place in their doing by improving their needed conditions. In this process the quality of the new designed intervention and its role is closely related to the potential that was earlier grasped and traced by the designers from the system as a base for the design (Haggard & Mang 2016). Therefore a complex understanding of the place is important to regenerative design.

Engaging with the existing, human and non human, community in the place and the team and stakeholders of a project can also lead to a co-evolutionary and co-creative development. By pursuing participation in the design or build process and by planning adaptable structures the different involved parties can contribute to the place and "bring new value into the world" (Haggard & Mang 2016, p 140). Like this the actors can live up to their distinctive roles.

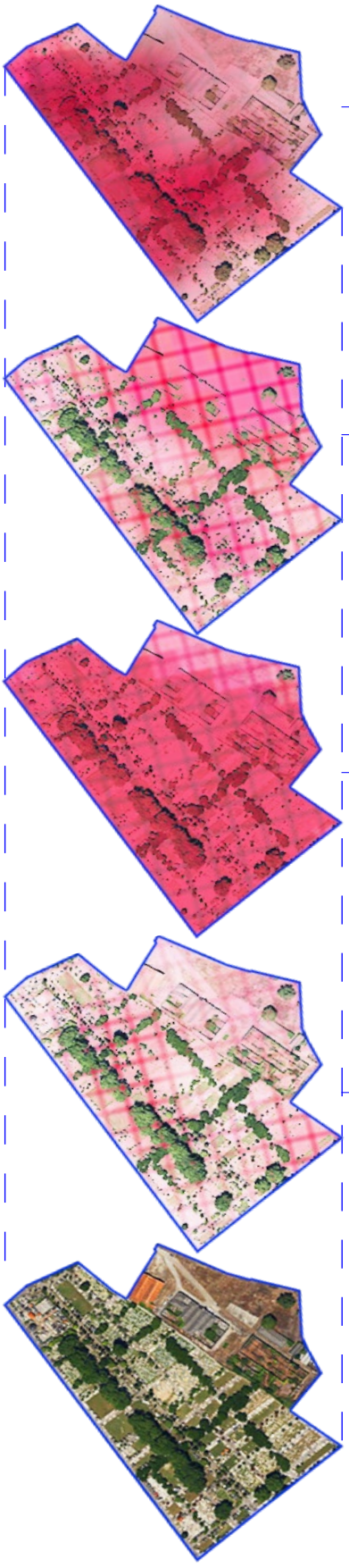
Furthermore the involvement of actors into the formation of the place, as well often leads to a project that is natural to the place and establishes due to identification a relation of care between the users and the place (Roggema, 2022). By respecting other actors and giving them the opportunity to play their distinctive role within a project, the community and team becomes relevant and the place is charged with meaning. This can foster the group spirit and creativity, and lead to the maintenance of a place and its development which ensures the project to be successful (Haggard & Mang, 2016).


As
Pb
Cd



13_De-pollution: Uptake of Heavy Metals by Phytoextraction

Cohabitation

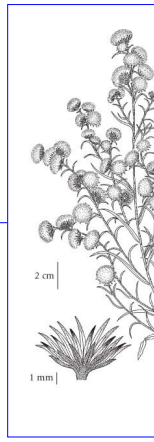


Lead

Populus tr
Po

Zinc

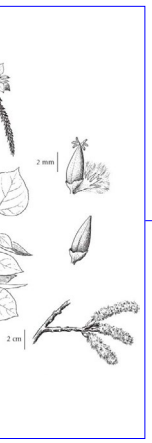
Arsenic



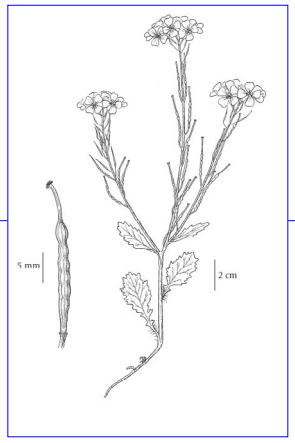
Mimosa
Mir

Copper

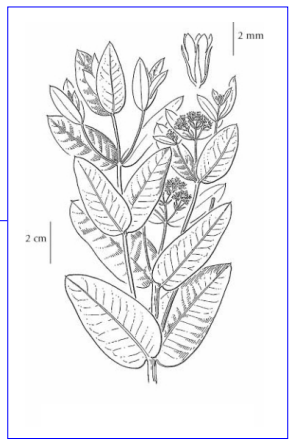
Source: CMP 2016; Grupo Clima e Ambiente Urbano, CEGOT, 2017.



emuloides /
plar

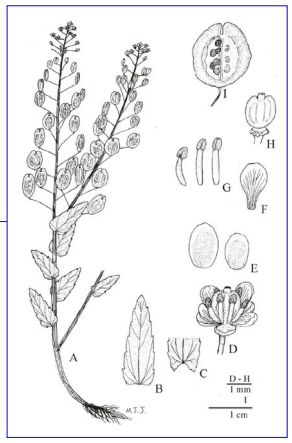


Brassica juncea /
brown mustard



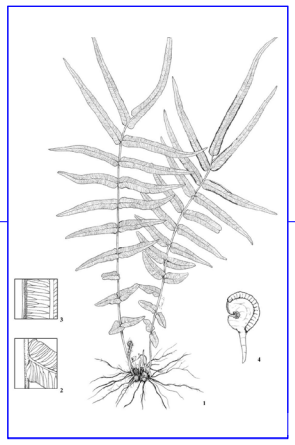
Apocynum cannabinum /
hemp dogbane

Noccaea caerulescens /
Penny-cress

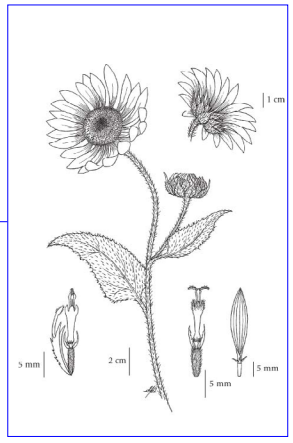


Thalaspi arvense /
Field penny-ycress

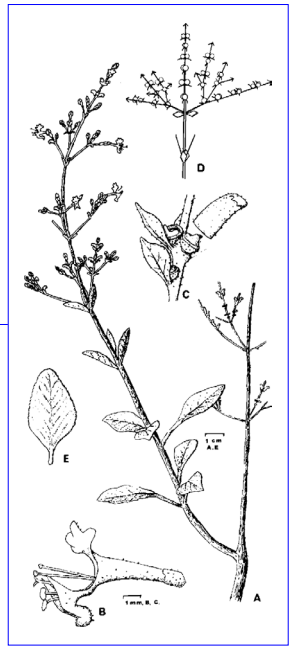
pudica /
mosa



Pteris Vittata /
Chinese brake

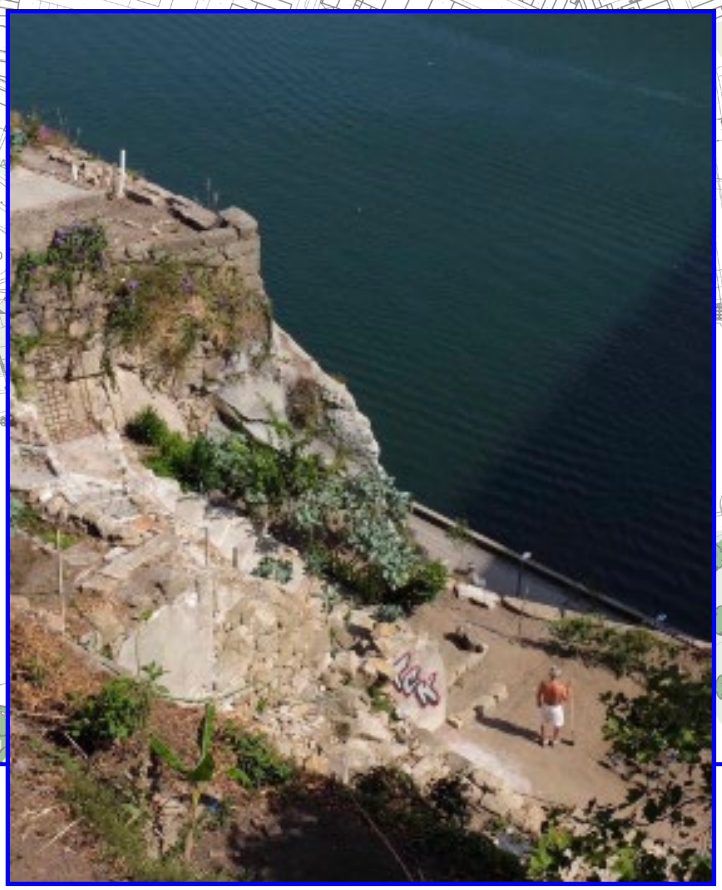


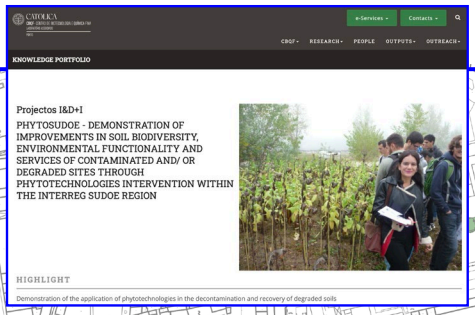
Helianthus annus /
Common Sunflower



Aeollanthus biformifolius /
Rocksage

Cohabitation

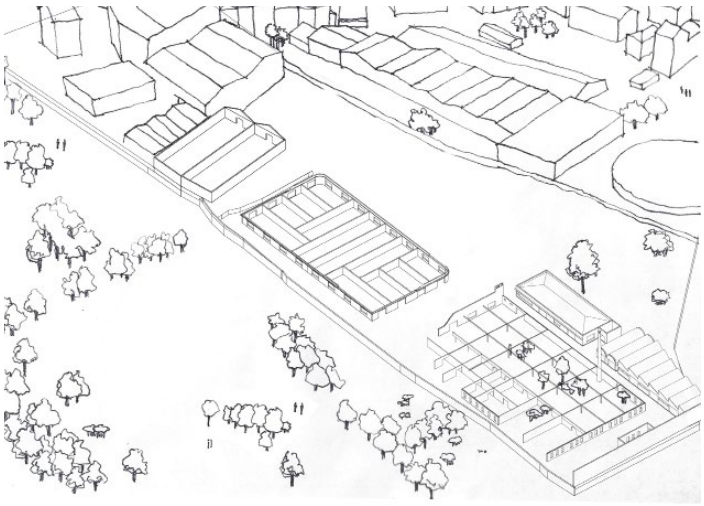




15_Organisation: Involving gardening associations from Local network

16_Site model 1:1000

Cohabitation



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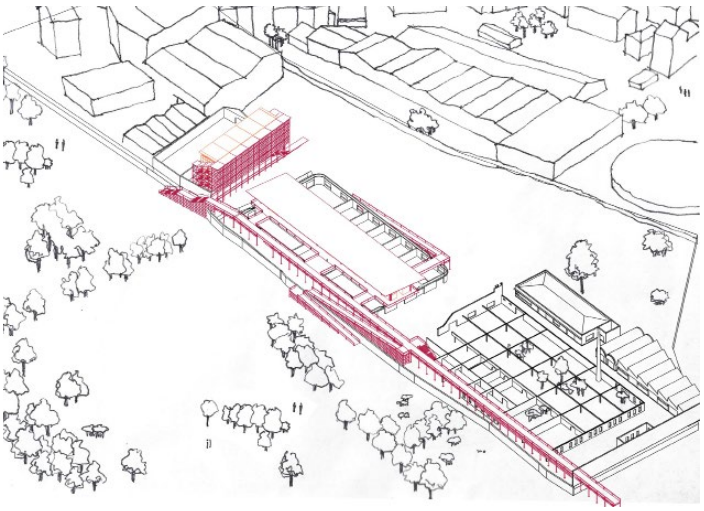

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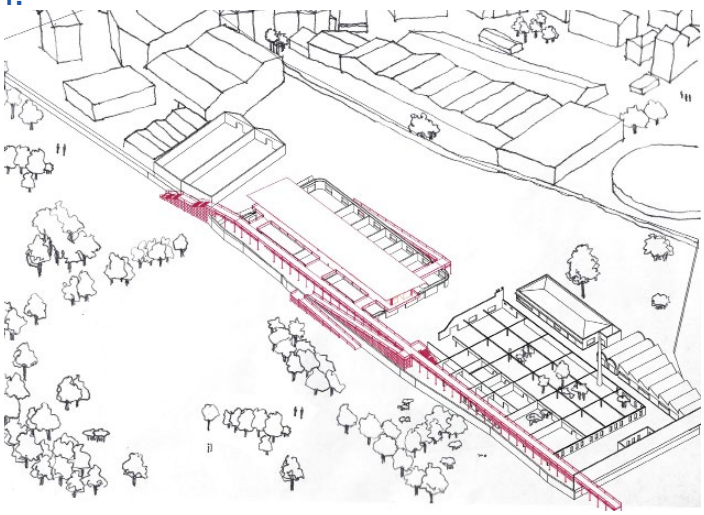

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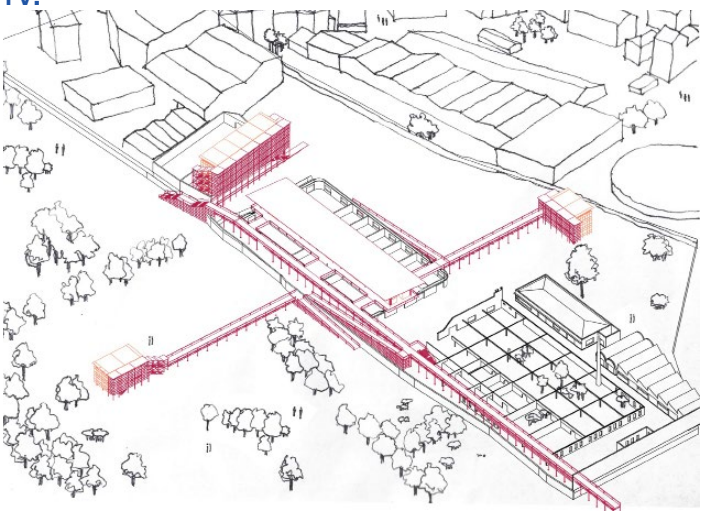
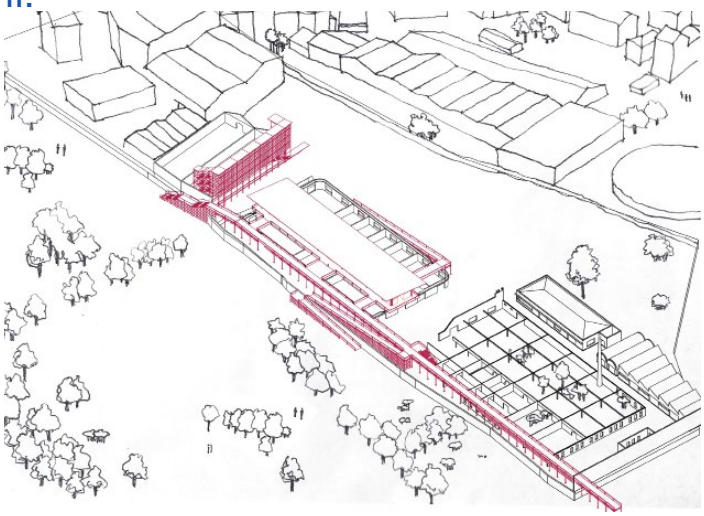
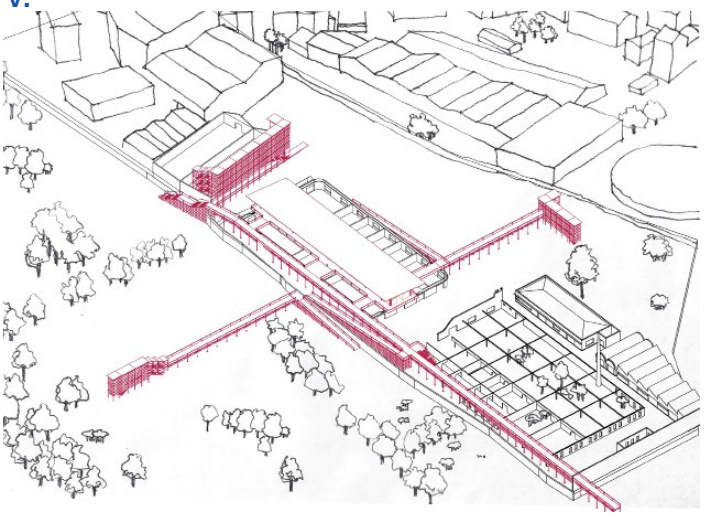


V.



III.



VI.

Discussion

The aim of this study was to investigate how and to what extent architectural interventions can support regenerative developments and contribute to increasing biodiversity within western European cities. The first part of the research focused on establishing an overview of the theoretical discourse on regenerative design. The literature review defined principles and guidelines for regenerative architecture. While some literature leaves a lot of space for interpretation, sources that provided explicit explanations and examples of regenerative design proved particularly helpful. Working with examples and case studies is crucial as regenerative design must be closely linked to specific places.

Secondly, to define a systemic approach that architects can follow, this paper has proposed several principles for regenerative design. The principles presented in this paper serve as a valuable starting point for regenerative design, but their success depends on their application, testing, and retroactive, refinement in the realisation of projects.

1.The Idea of Role

This principle emphasises the importance of understanding the role of entities within a system, rather than focusing solely on their functions. The concept of 'role' aligns with the Actor Network Theory (ANT) in emphasising the reciprocal interconnection of entities and actors, which not only include humans but also animals, plants and objects. In order to apply regenerative design in practice, it is fundamental to understand our environment and potential sites as living systems that are part of dynamic social and ecological networks. To deal with those, Actor Network Theory extends the idea of regenerative design by placing interventions as new roles into an existing system.

2. The Idea of Place

This idea highlights the significance of considering the relations and reciprocity between different places. The Assemblage Theory helps in understanding cities as composed of multiple interconnected places, built from various networks, spaces, and practices. It adds a spatial dimension to the 'Idea of Role' and enables a complex analysis and understanding of the many different facets and existing relations in a place.

3. The Idea of Time

This principle suggests that designers should consider the temporalities of natural processes, such as the growth of ecosystems, the decomposition of materials or the behaviour of animals. By designing in consideration of time and natural development architects can catalyse processes that evolve with their environment and support their network in different scenarios.

4. Building upon Potentials

The last principle for regenerative design is to embrace the existing potentials of a place. Designers need to analyse the characteristics of a place, its actors to identify their roles, and improve the conditions necessary for their activities. Engaging with the local community and stakeholders can lead to projects that are natural to the place to foster identification and establish a relationship of mutual care with its users.

To evaluate the effectiveness of these principles, they were applied and tested in the case study

of Porto, to retroactively refine this systematic approach. The application of the principles led to a more comprehensive analysis of the site, offering new perspectives and insights. However, it is important to acknowledge the challenges of obtaining and interpreting knowledge from other disciplines, such as landscape architecture and ecology, which are crucial for successful regenerative design implementation.

While regenerative design holds promise in ecological architecture that can help to facilitate cohabitation of humans and non-humans within our cities, there are some challenges. To start with, its implementation poses significant challenges to the practice of architecture since it requires methods and knowledge from other disciplines such as landscape architecture, ecology and social science. These are fundamental for an extensive analysis, as a basis for a design project. This interdisciplinary collaboration enables a holistic approach to regenerative projects. In addition, another challenge is to translate aspects such as social bonds, ecological conditions or time into architectural plans in order to design with these. Therefore, interdisciplinary collaborations with experts from other fields are needed to design holistic regenerative projects. Moreover, establishing regenerative projects depends on cultural shifts and alternative approaches to city development, rather than relying solely on technological innovations.

Conclusion

Loss of urban biodiversity is a critical issue in European cities, where urbanisation has led to the loss of green spaces and fragmentation of natural habitats. This decline in biodiversity has negative consequences for both human and non-human life, including increased temperatures, poor air quality, and loss of animal habitats. To address this challenge, regenerative design offers a promising approach to promote cohabitation between humans and non-humans in urban environments.

The discipline of architecture has traditionally paid little attention to designing for biodiversity. Therefore, incorporating nature-inclusive design practice in urban planning is essential to establish new habitats and to increase urban biodiversity. Regenerative design principles, that enable the understanding of a place and its existing ecosystem, considering the relationships of its actors, and promote its thriving over a long time, provide a valuable framework for architects.

Implementing regenerative design requires interdisciplinary collaborations. It involves integrating knowledge from ecology, landscape architecture, social science, and long-term thinking into architecture. By embracing regenerative design, architects can create more holistic interventions that support socio-ecological networks, regenerate urban environments, and enhance coexistence between humans and non-humans.To achieve the full potential of regenerative design, ongoing refinement and evaluation through realised projects are crucial.

Urgent action is needed to address the loss of urban biodiversity and to promote nature-inclusive design practices as integral parts of urban planning. Through collaborative efforts, we can transform our cities into thriving habitats that benefit both humans and non-humans, creating a harmonious and long lasting coexistence.

Paradigm	Refers to a widely spread idea, worldview or way of thinking and determines a lot of human behaviour.
Anthropocene	The human world-view in which we humans are the centre and the subject to our actions.
Nature / Culture	The entire web of life that exists on earth, of which we as humans and our culture need to become an integrated piece.
Regenerative Design and Development	That which supports the flourishing of all life, for all time.
Living Systems Theory	A framework-based approach that argues that already a cell or living beings but also organisations, communities or countries are all living systems, which are in continuous dynamical flux and in interaction with their environment.
Actor Network Theory (ANT)	A theory from the field of social studies that describes the reciprocal interconnection of everything material and non-material that exists in our social and natural world and argues that not only subjects but also objects are Actors, as they play active roles.
Assemblage Theory	Describes the relation and reciprocity that different places can have on each other and therefore helps to bring principles of ANT into spatial dimension.
Biosphere / Enthosphere	The “ethnosphere”, the “cultural air” we are surrounded by, is a metaphor for our cultural development which will, possibly, define our biosphere, the air we breath.

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Images

All unreferenced images and diagrams were made by the author.


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Keywords
Cohabitation of humans and non-humans, regenerative architecture and design, actor-network theory, ecological and nature inclusive design

Research
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Author: Konrad Schlüter