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RESEARCH PRACTICES
SPECIALISATION

ARCHITECTURE OF LIVING SOIL

Abstract

Architecture has long been designated as a structure for humans, setting borders to nature. In other words, architecture tends to force nature to adapt to man-made infrastructure. The negative impact of the traditional building industry on the environment appears to create an ecological crisis. A possible alternative approach to architecture is to co-design with nature. Projects in co-designing with nature are often prototyped at the scale of the branch and tree. Co-designing at architectural scales is less convincing in the context of designing with the eco-system.

Co-designing with nature has been successfully prototyped at small scales. At a building scale, the incorporation of 'green' elements is not incorporating the eco-system in a meaningful sense. In this research study, I am exploring the integration of a forest eco-system with a tower typology as a provocation, questioning how co-design strategies might be applied on a more architectural scale.

Theoretical research regarding the relationship between nature and culture, together with studies of existing co-design projects, form the basis understanding of what co-design could be. The research is formed by series of drawings and prototyping which helps to explore the concept of co-design. They are the methodology of how I interpret the strategies of what co-design could be in a tower typology.

The result helps to address the question of how co-designing with nature could work on a large architectural scale. Living soil is one of the proposals that helps to introduce the eco-system. Building material and structural system could be integrated with the living soil which generate a continuous development of eco-system. Human interaction also plays a critical role in seeding the development.

Moreover, our perception of nature is important in exploring the conduct of co-designing with nature. It creates new understanding of nature and culture which also identifies the current ecological crisis. The proposed concept of co-designing with the eco-system reveals that architecture is the medium of culture to nature. The research then leads to a more in-depth understanding of ecology and of a system that works with it.

I hereby declare that,

I have consulted, and understand, the information provided in the University of Brighton's Plagiarism Awareness Pack and the information on academic standards and conventions for referencing given in the module directive.

I know that plagiarism means passing of someone else's writings or ideas as if they were my own, whether deliberately or inadvertently. I understand that doing so constitutes academic misconduct and may lead to exclusion from the University.

I have therefore taken every care in the work submitted here to accurately reference all writings and ideas that are not my own, whether from printed, online, or other sources.

Ming Hung Davis Mak
29th May, 2020

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Appendix A

Introduction

In my research, I am exploring the relationship between nature and culture through architecture. Our perception to nature is the key to the future development as it affects the way we think and design as an architect. The traditional building industry often sets a very clear border to the environment, for instance, between a street and a field could represent culture and nature respectively. How do we eliminate the boundary between culture and nature is the main question driving my research. We often isolate ourselves from the environment by designing what is the best for human sustainability with neglect of the environment.

Much contemporary architectural research in sustainability focuses on diminishing the negative environmental impact of the building industry, such as waste material and energy consumption. The conventional ways of adding greenery to buildings do not reflect the sense that we are incorporating architecture with nature. So, co-design with nature is the alternative paradigm which is the main investigation in my essay.

Co-design with nature is often prototyped at a small scale. It is uncertain how co-design could be incorporated in a large building typology. Discussing the possibility of introducing the strategies of co-designing in tower typology is a challenge that is worth researching. This is intended to be provocative, as the tower typology can be criticised¹ as an outdated design strategy due to its environmental impact.

I am using tower typology as a provocation to explore what and whether co-design could be achieved at a larger architectural scale. A series of 'descriptive' research studies in aspects of relationship between culture and nature has given a basis for understanding what co-design could be, providing a foundation for drafting the strategies of co-design in a large building scale. This 'descriptive' research is one of the three research stages mentioned in Tom Ainsworth's framework.² It is formed by series of drawings and prototyping. Talking to ecologist Tom Snow and architect Marie Davidova is one of the methods in conducting the research of co-designing with nature. My discussions with them regarding my research project has helped frame a better understanding of the eco-system.

The first part of the essay starts with examples of human perception of nature based on the ideas of cybernetician Gregory Bateson and urban ecologist Jon Goodbun. It sets different perspectives on how we see nature and the conception of humans being part of the ecosystem. The second part continues with a series of speculative, research-driven design prototypes of 'co-design' with nature on a small scale. Each project addresses a specific strategy for cohabitation with the environment. The third part of the essay introduces the concept of cohabitation in the tower scale abstracted from my thesis project. Three narratives are discussed within the aspects of environment, architecture, and human.



Fig 1. Division of a man-made infrastructure and the natural environment
(Photo credit: Marie Davidova 2018)

¹ Captured from the personal communication with Marie Davidova on 30th April, 2020.

² Session 4 Lecture from Research Practice Module, University of Brighton, 2019-2020



Part I Co-Evolve

Fig 2. Deforestation: Harvest for land use
(Photo credit: Roberto Schmidt)

Our Perception to Nature

This section begins by discussing how we see nature in a cultural aspect in relation to architecture and how they affect one another.

We often see nature as a resource that we can harvest. Our infrastructure is built upon the natural landscape that surrounds us. Deforestation and land reclamation are often used to provide land for 'human' sustainability. We often forget the fact that we have destroyed hundreds of thousands of natural habitats which helped maintain the balance of the eco-system. 'Over 80% of insects by biomass have disappeared in regions around central and western Europe since the end of the 1980s.'¹ The consequences of our actions as global warming and sea-level rise have been discussed over the decades. The main current architecture research in reducing the negative impact of the building industry has been working for years to reduce the waste and energy consumption of architecture itself, hoping to lower the impact on the environment and delay the consequences. In addition to this, can Architecture create a positive impact?

We reconstruct the environment into our comfort zone by destroying the habitats of other species, causing their extinction. According to the book, Steps to an ecology of mind, by Gregory Bateson, 'we often see nature as an antagonist than an ally, which leads to the destruction of the eco-system.'² We are extracting the resource and energy from the environment to develop our technology and civilization upon the ecological system. We often see ourselves as an individual unit of evolution. Bateson argued that the evolutionary unit should be organism plus environment, rather than organism itself. 'A dialectical approach forces us to recognize that organisms do not simply adapt to their environment; they also affect the environment in various ways by affecting change in it.'³ On the other hand, 'an organism is co-evolving with its environment, in which they are structurally coupled and inseparable.' One of the examples is us harvesting the forest. The soil we dug out is a rich carbon sink in which the tree root and microorganism help to store to lower the concentration of CO² from the atmosphere. Since we have destroyed the carbon sink and more greenhouse gases have been released to the atmosphere which causes global warming. The consequence of our action will eventually affect back on us with the loop of the ecology crisis.

¹ Marie Davidova, "Synergy in the systemic approach to architectural performance," FormAkademisk - forskningstidsskrift for design og designdidaktikk 13, no. 2 (2020): P.1, doi:10.7577/formakademisk.3387.

² Gregory Bateson, Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology (Chicago: University of Chicago Press, 2000), P495..

³ Nik Heynen, Maria Kaika, and Erik Swyngedouw, In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism (Oxfordshire: Taylor & Francis, 2006), P26.

The diagram (Fig 3.) shows the concept loop of an ecological crisis in which the elements of population, technology and 'hubris' are all connected and corresponded to the effect on each other based on Bateson's theory. They represent what Bateson argued to be the three root causes of all of many current threats to humanity's survival.⁴

- 1) Technology progress, leading to pollution
- 2) Population increase, leading to famine
- 3) Hubris, our confidence (arrogance), leading to war

Bateson states that one of the key concepts in the diagram is the term 'hubris'. It represents the self-confidence that we have which affects the way we see things and architecture is a point of intervention to our self-confidence. Since the increase of population and technology are inevitable in our society, hubris is a point of intervention among the three root causes. A traditional way of interpreting the sequence is that the increase of population will lead to the increase of a nation/country's self-confidence, which increases the chance of going to war with other nation.

The above expression is determined between nation to nation. What if we interpret the relationship in aspect of culture and nature? The increase of the population leads to the expansion of our infrastructure. The more city we build, the more confidence that we have in building upon the natural environment. In other way of seeing it, 'the more we believe in our "power" over an enemy environment, the more "power" we seem to have and the more spiteful the environment seems to be.'⁵

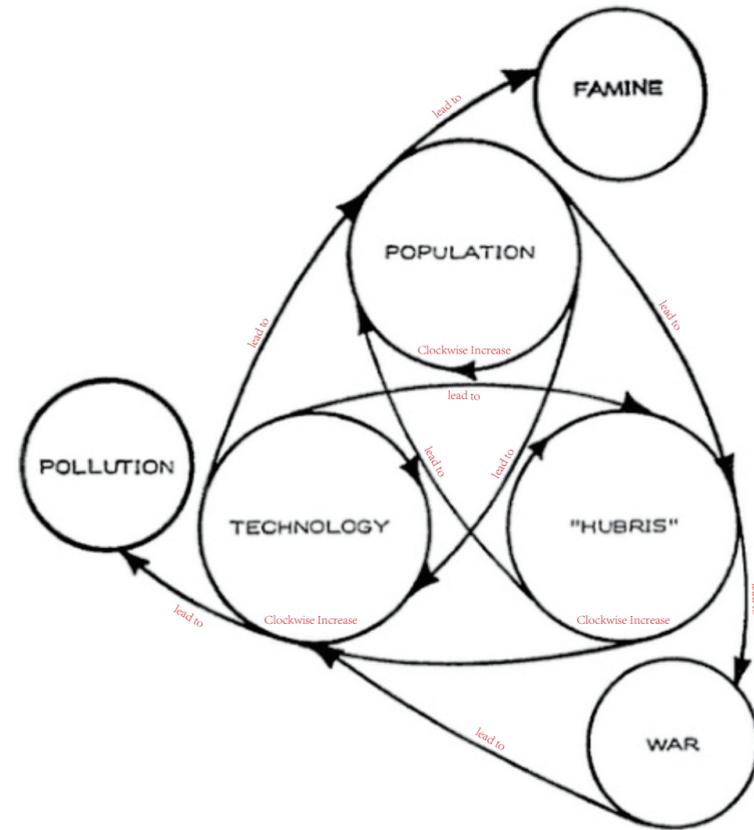


Fig 3. The Dynamics of Ecological Crisis. Captured from the book, Steps to Ecology to mind by Gregory Bateson.

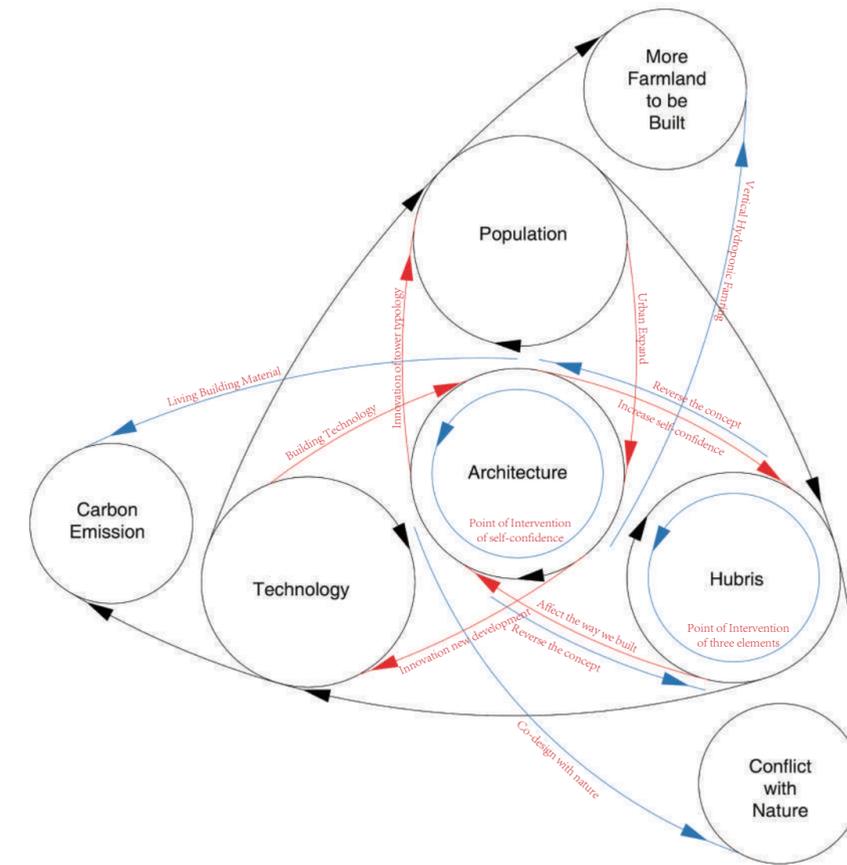


Fig 4. Defining the position of 'Architecture' within the context of Bateson's concept of ecological crisis

It then leads to the question of what position architecture is in, in relationship of those three elements in the diagram, population, technology, and hubris. Let us explore it step by step.

Urban architecture marks the increase of our population. The more infrastructure we build, the more confidence we have in building upon the natural habitats of other species. The more confidence we have, the more we neglect the consequences of our action. As they do not have an instant effect back to us. It takes time for the greenhouse effect to show its effect on the environment. So, we continue to build upon the natural environment in the same way until we see the actual effect that we are now having.

Nevertheless, the increase of our confidence also leads to the invention of our technology. Concrete structure in cities is one of our inventions in the progress of our technology. Concrete material is non-environmental sustainable but it is economically sustainable in building our infrastructure. Cheaper and faster we build could allow us to sustain rapid expansion of our population.

It seems that architecture is the medium which allows us to see the relationship between those three elements, population, technology, and hubris. In fact, architecture is a product of our culture which reflects our perception to nature. Thus, it also reveals the relationship in sustaining the increase of population and the integration with the advance technology invented.

4 Gregory Bateson, Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology (Chicago: University of Chicago Press, 2000), P498..

5 ibid

However, our current perception of nature is built by recreating the environment suitable only for human sustainability. The way we built is neglecting the sustainability of the eco-system. We are building and destroying the environment at the same time. The only difference is the way we perceived the term environment. In our logic, we tend to separate the environment into two types, for instance, urban to rural, town to countryside. Architecture is reinforcing this as a divide, in which it separates culture and nature. In fact, they are the same as natural environment is essential for our survival. An organism that destroys its environment destroys itself.⁶

Moreover, our relationship with nature could also be seen in other aspect. In Goodbun's article, Urban Political Ecology, he describes ecology as the economics of nature, based on the flow of matter and energy through organisms and networks of organisms.⁷ It is a transformation of energy throughout the ecosystem. It is similar to us harvesting the wood from the forest to use as building material or energy that we consumed. US economy used to base on sperm whaling for its oil from 16th to 19th centuries. The energy stored in whale oil transforms into light and heat provided the fuel for human civilization. Our action almost leads to the extinction of the sperm whale in the late 19th century.⁸ Later on, fossil fuel becomes one of the economic based energy which has been domain over the decades. In the meantime, burning of the fossil fuel also releases greenhouse gas which causes global warming and affects the whole eco-system.

Furthermore, the above examples have given an idea of how culture and nature are within one system and they are closely bonded. Bateson added in his book, Steps to an Ecology of Mind, that the cause of us destroying the environment is due to our mental perception of nature. In the chapter Pathologies of Epistemology, it states that if we mentally perceive the environment as part of our system, our consciousness tends to protect it rather than destroy it.⁹

If we consider nature as a partner, we will co-design with it rather than reconstruct the entire landscape to become a comfort zone for humans only. It would be contradicted if we consider the nature as part of our culture and damaging it at the same time. To reverse the damage that we have caused, first, we need to change our perception of nature as part of our system.

Our action is pushing the limit of nature and it will eventually correct itself with extreme methods unless we change. It states in Bateson's book that human civilization is currently in a precipice of evolving to a 'high' civilization.¹⁰ The only thing we are lacking is the wisdom to see our environment as our partner so as to change the way we live and build. In the architectural aspect, lower carbon emission design is just a cure for the symptoms, not the disease. A 'high' civilization would have the wisdom to co-design with the environment and preserve the nature, rather than to reconstruct the landscape to whatever we want it to be. A great technical advance is necessary for this connection. The present technology and knowledge of ecology have given us a solid foundation to co-design with nature. Some argued that it is impossible to change our way of living, designing, consuming, etc, overnight or even decades, neglect the political issue, official regulation, planner, society, etc. But do we have a choice under the circumstance in terms of survival? That is the reason why we would need to set ourselves with a flexible time and way of designing with the nature. It would allow us to have time to change and adapt. Flexibility is the term that Bateson uses in his book which he describes as the key to that shift, meaning that we could have room for tolerance to change and become diversity.¹¹ A diverse approach in designing our city means that we could have different ways of designing and building our infrastructure rather than just one. For instance, co-designing with the nature could be one of the design strategies in building our cities. Similar to eco-system, a bio-diversity eco-system is often considered to be a healthy one which has a bigger chance to survive and recover from the variety of disasters.¹²

6 Gregory Bateson, Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology (Chicago: University of Chicago Press, 2000), P500.
 7 Jon Goodbun, Gregory Bateson's Ecological Aesthetics - an addendum to Urban Political Ecology, field Journal, Vol. 4(i), ISSN: 1755-068
 8 "Sperm Whaling." Wikipedia, the Free Encyclopedia, last modified November 7, 2008, https://en.wikipedia.org/wiki/Sperm_whaling.
 9 Gregory Bateson, Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology (Chicago: University of Chicago Press, 2000), P487.

10 Gregory Bateson, Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology (Chicago: University of Chicago Press, 2000), P506.
 11 ibid
 12 Birut Zemits, "Biodiversity: Who Knows, Who Cares?," Australian Journal of Environmental Education 22, no. 2 (2006): xx, doi:10.1017/s0814062600001415.

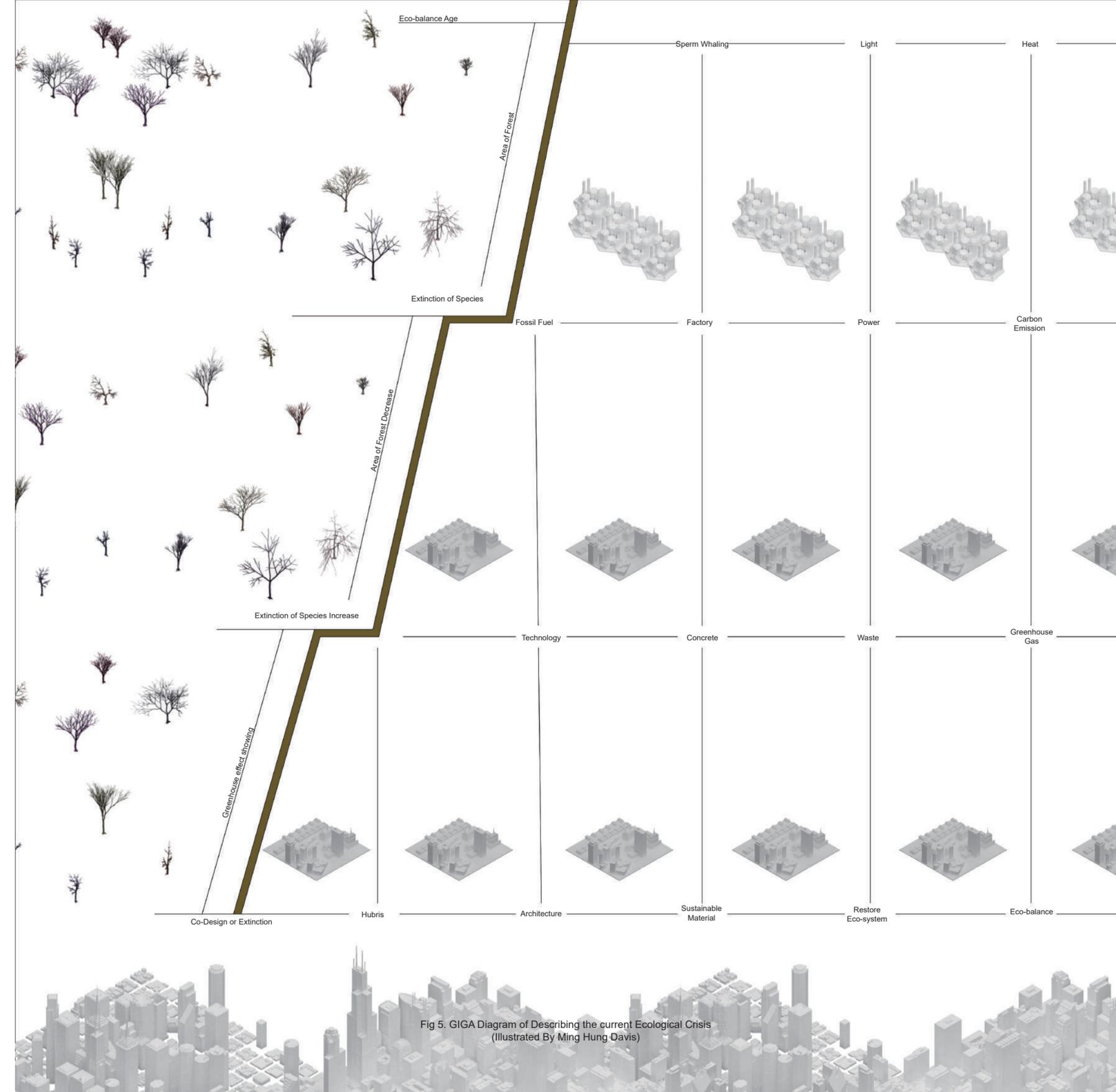


Fig 5. GIGA Diagram of Describing the current Ecological Crisis (Illustrated By Ming Hung Davis)



Fig 6. Treehugger CY, together with exhibited design gigamaps and GIS codes leading to the SAAP blog with a recipe for its creation and generating its iterations (Photo credit: Marie Davidova, 2018)

The Treehugger CY

Marie Davidova



Fig 7. 3D modeling of the Treehugger CY. (modelled by Ming Hung Davis Mak)

Designing with Nature

In this section, I am going to continue the discussion on the examples of research-driven design prototypes of 'co-design' with nature.

As mentioned in the previous section, co-design with nature could be a way to achieve the eco-balance in the future. The method of design could come in different aspects. There are some architectural prototypes on a small scale that are experimenting with the concept of co-living with nature.

The first example is the TreeHugger CY, developed in a workshop led by Marie Davidova. This co-design prototype is meant to test the generative and performative agenda in a real-life environment in reacts to the surrounding ecosystem. The prototype offers the opportunistic use of what Davidova calls "eco-systemic services".¹³ The responsive wood panel is co-performing with the relative humidity, algae moisture sorption, and temperature. The hygroscopicity of the wood screen controls the transformation of the form, it wraps when the weather is dry and hot which also allows airflow into it, it flattens when the weather is humid and cold.¹⁴ It also allows algae to grow on its surface and attract insects as a food source to larger birds and mammals. It is a successful prototype as it demonstrates the concept of co-design with the environment. The design could potentially allow the growth of a food web and eventually becomes an eco-system.

¹³ Marie Davidova, "Synergy in the systemic approach to architectural performance," *FormAkademisk - forskningstidsskrift for design og designdidaktikk* 13, no. 2 (2020): xx, doi:10.7577/formakademisk.3387.

¹⁴ *ibid*

Animal-Human Interaction : O.O.Z. Inc Bird Roof

Natalie Jeremijeno

The second example that I am introducing is the O.O.Z project led by Natalie Jeremijeno.

The prototype is built in a 1000 square foot roof garden for bird inhabitation. It includes the housing unit for birds, water system and other amenities which improve the quality of life for urban birds.¹⁵ Different devices are built and invented with recycling material interacting with the birds. This is a very good prototype to demonstrate the concept idea of designing a non-human habitat within a human one. Although, one may argue that the design is performing too much for human rather than birds, but it indeed opens up the concept of how we could co-design with the species when we have taken over their habitats.

Another project of Jeremijeno, the Tree X office installed around a tree in Hoxton Square in East London, aims to reinvent the way we see nature. Rather than seeing it as a passive resource to be exploited, the tree is acting as a landlord who owned and operated by itself.¹⁶ This is the prototype of human habitat installed in non-human ones. But it is less simple as the non-human habitats are also man-made, but of course, all nature is heavily conditioned by human activities.

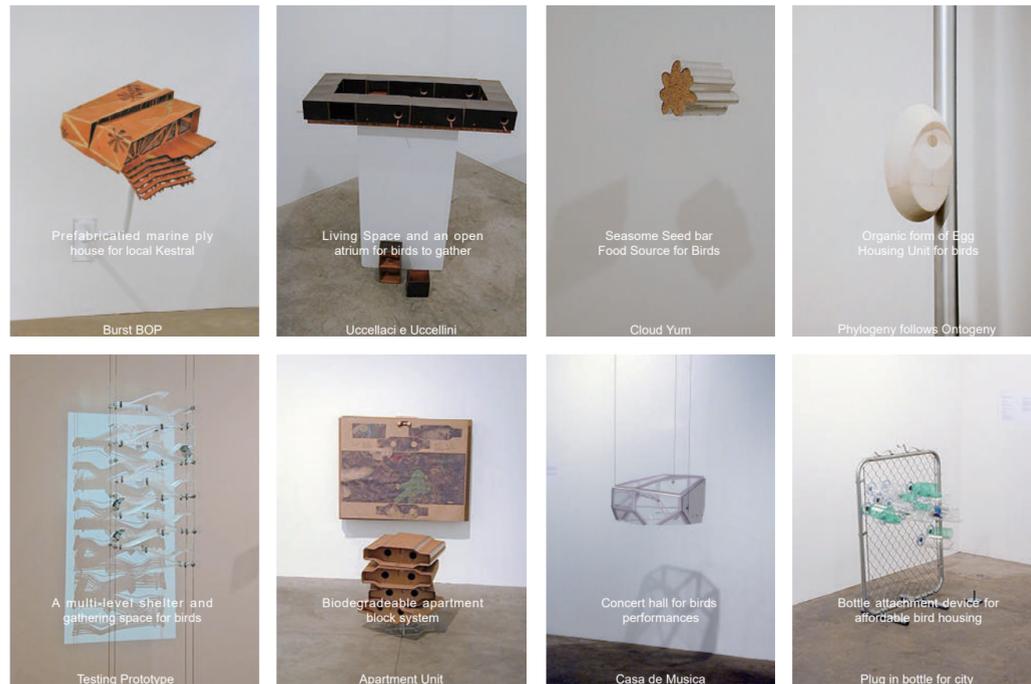


Fig 8. Devices that interact with bird designed by Natalie Jeremijeno. (Photo credit to Postmasters Gallery)

¹⁵ "OOZ, Inc. (...for the Birds)," We Make Money Not Art, last modified September 21, 2006, https://we-make-money-not-art.com/_my_pictures_fr/.

¹⁶ "TREExOFFICE — 21st Century Digital Art," 21st Century Digital Art, accessed May 25, 2020, <https://www.digiart21.org/art/treexoffice>.

Living Architecture System: Hylozoic Ground

Philip Beesley

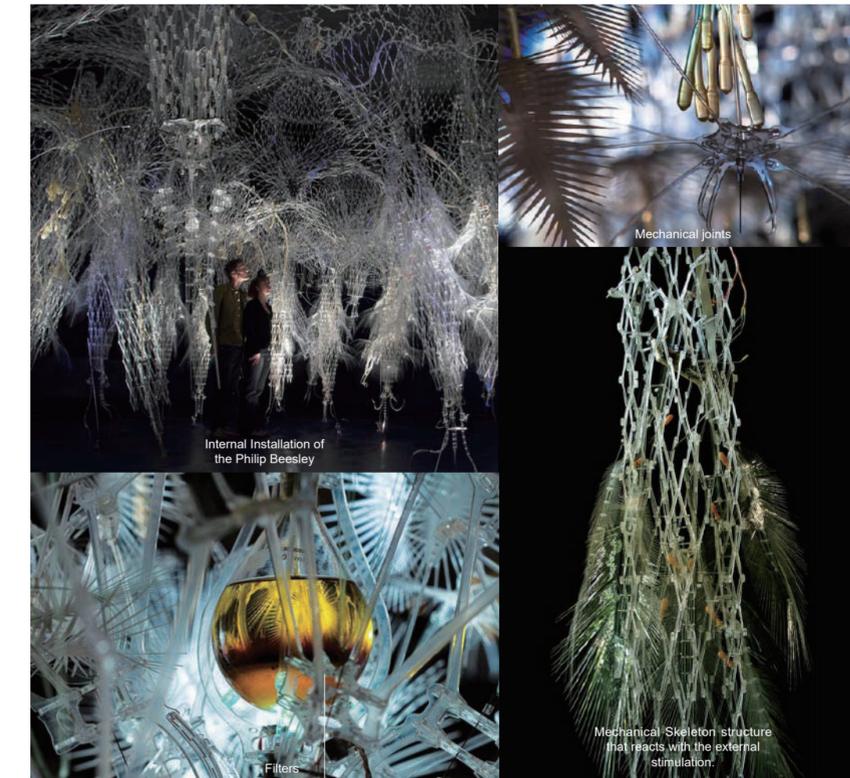


Fig 9. Installation designed by Philip Beesley. (Photo credit to Philipbeesleyarchitect)



Fig 10. Protocell developed by Rachel Armstrong (Photo credit to Philipbeesleyarchitect)

Another conceptual co-design installation developed by Philip Beesley is called hylozoic ground. The prototype is covered with sensors, microprocessors, mechanical joints and filters which allow the structure to move in response to its environment.¹⁷ It demonstrates the concept of Hylozoism in biological aspect which describes that matter has life in an ancient philosophical view. Beesley's installations perform and react to the external stimulation like an organism. He also proposes a future city which is a scaled-up version of the prototype that could operate as a living being.¹⁸ Although the material he used is not an organic matter, the concept of reacting with the external stimulation is a different approach in regard to co-designing with the environment in a biological aspect.

It is similar to the concept of the The OME, an experimental biological house developed by the experts from Newcastle and Northumbria Universities who are exploring living buildings that are responsive to the nature environment. Rachel Armstrong, who worked with Beesley on Hylozoic Ground, is one of the co-founders of the project who aims to create a new generation of 'Living Buildings' by designing bio-engineered living material that could process its own waste, reduce pollution, generate energy and supporting the biological environment that benefit health.¹⁹ It is a good approach in generating a sustainable material which allow the building to react with the environment. But one might criticize that the bio-engineering living material could bring a destructive impact to the eco-system as there are uncertainties to the biological reaction to the natural species when they are consuming or hybridizing the bio-engineering living matter that we created in a laboratory. Although there are ethical controversies to the area of bio-engineering, but the topic of living building material remains a good value of importance for more exploration in regard to our future building industry.

¹⁷ "Hylozoic Ground by Philip Beesley," Dezeen, last modified November 4, 2016, <https://www.dezeen.com/2010/08/27/hylozoic-ground-by-philip-beesley/>.

¹⁸ *ibid*

¹⁹ "Living Architecture," Australian Design Review, last modified December 12, 2016, <https://www.australiandesignreview.com/architecture/interview-rachel-armstrong/>.

Conventional 'Green' Building: Tower Flower

Edouard Francois

The above examples show a generative way of co-designing with nature in a small scale. In fact, lots of architects have been trying to scale up the concept of co-design with nature in a larger architectural scale. One of the project examples in Paris, the Tower Flower designated by Edouard Francois, is showing the difficulties in scaling up the concept of co-designing.

The design introduced 360 flower pots which line in the balconies on the three facades of the 10-storeys high apartment building, they are fed with an automatic water system to prevent the plant from dying in the height of summer.²⁰ Bamboo was chosen as it is a hardy and fast-growing plant, and it generates specific sound in the wind, which 'giving the impression to those inside that they are sleeping in a tree,' explained Edouard Francois.²¹ This design has demonstrated the conventional way of enclosing nature in culture. In this case, the nature, Bamboo, is implanted in the flower pots as the elements of nature which held by architecture.

Garden is one of the examples showing the relationship between the two in which culture is still in control over nature. Industrial agriculture is something similar as it implies nature as something within the human culture. The building has nothing to do with co-designing with nature. One might criticize the design by just being 'green' without any consideration of the eco-system. In fact, a lot of the modern developments are doing the same as the Tower flower which incorporates with the 'green' elements without considering the ecology proper. But the question is: does that approach really help with the current ecology crisis? If not, how do we co-design with the nature in a building scale?

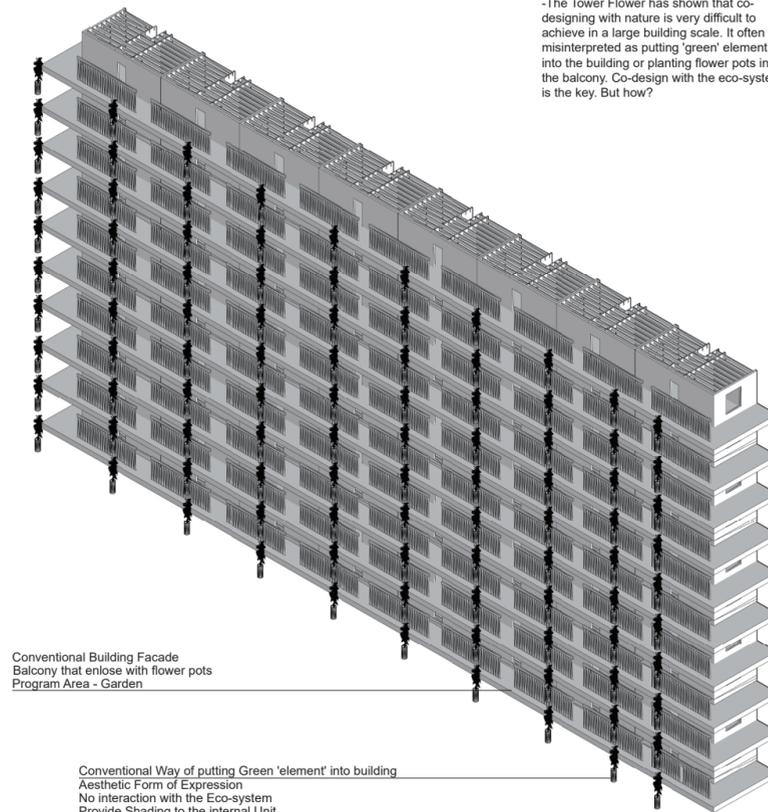


Fig 11. Nature Enclosing in Culture
Facade of the Tower Flower
(Modelled by Ming Hung Davis Mak)

-The Tower Flower has shown that co-designing with nature is very difficult to achieve in a large building scale. It often be misinterpreted as putting 'green' element into the building or planting flower pots in the balcony. Co-design with the eco-system is the key. But how?

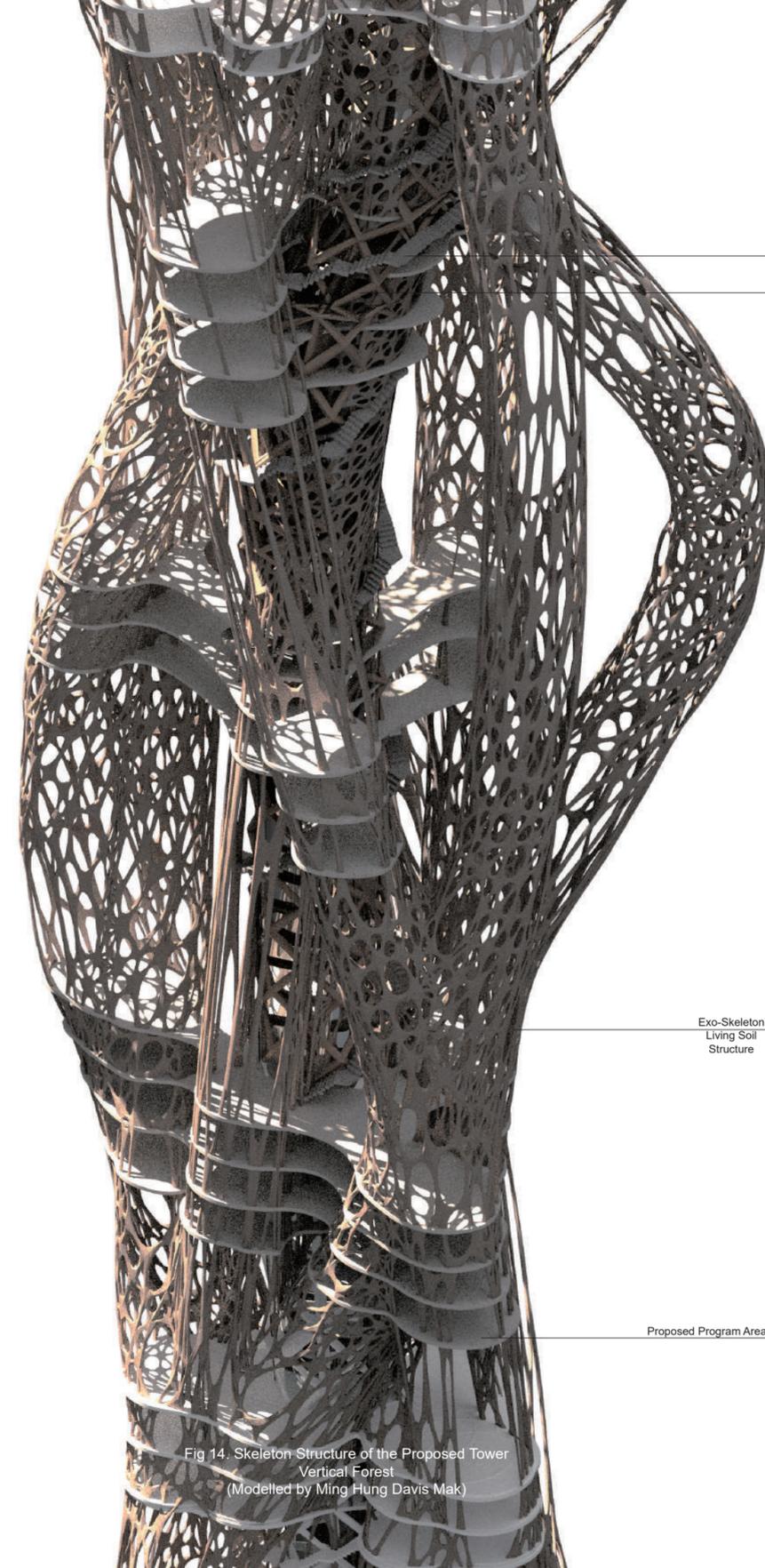


²⁰ "The Flower Tower of Paris," Amusing Planet, last modified October 15, 2017, <https://www.amusingplanet.com/2015/11/the-flower-tower-of-paris.html>.

²¹ ibid

Part III Co-Habitation

Fig 13. Vertical Forest
Top Deck View from the Proposed Design
(CGI Illustration by Ming Hung Davis Mak)



Staircase

Core Structure

Exo-Skeleton
Living Soil
Structure

Proposed Program Area

Fig 14. Skeleton Structure of the Proposed Tower
Vertical Forest
(Modelled by Ming Hung Davis Mak)

Thesis Project

In this section, I share some of the ideas of co-designing with nature in a building scale developed through my design thesis project. The research project is developed based on the concept of cohabitation between human and nature which includes the investigation of the fundamental elements that sustain the eco-system and how human interaction could help in building the system in the context of a tower as a provocation.

My proposed design tower is interpreted as a vertical forest extending from the existing landscape. The proposal is addressing the question mentioned in part 1 which architecture could, indeed, create positive impact to the environment. The idea of extending the forest ecosystem vertically is important in fighting the climate change and restoring the biodiversity in the proposed site area. There are three narratives articulated in this section within the aspects of environment, architecture and human.

Project Title: The Nest | Seed to City
Site: Ashdown Forest | Old Lodge Nature Reserve
MArch 2 Thesis Project | Studio 02 | University of Brighton

Environment

Living Soil Composition

In the research of my thesis project, the fundamental elements of a land-based eco-system begins with the "living soil". The definition of living soil, according to ecologist Tom Snow, is that it should contain 25% of air, 25% of water, 45% of soil and 5% of living organism.¹ The living organism in the soil is the key to make everything happen. Nutrients like nitrogen and phosphorus that are essential for the growth of plant are generated from the decomposition of the living organism, for instance, bacteria and fungi. The growth of the plant provides food and shelter for the insects which attracts higher predators. A food web is then created which is essential for the formation of the eco-system. Living soil then becomes the major environmental element that integrated into my design strategy as a material and structural investigations.

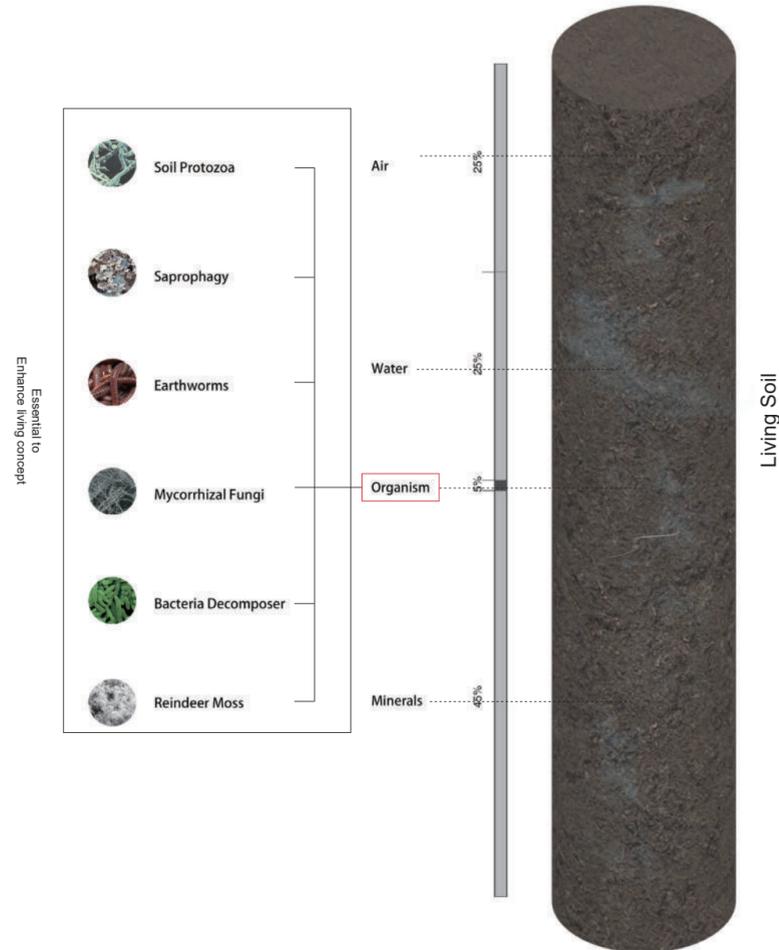


Fig 15. Composition of Living Soil (Modelled By Ming Hung Davis Mak) With Information Reference to Tom Snow

Eco-Cycle

Connection between the Eco-system

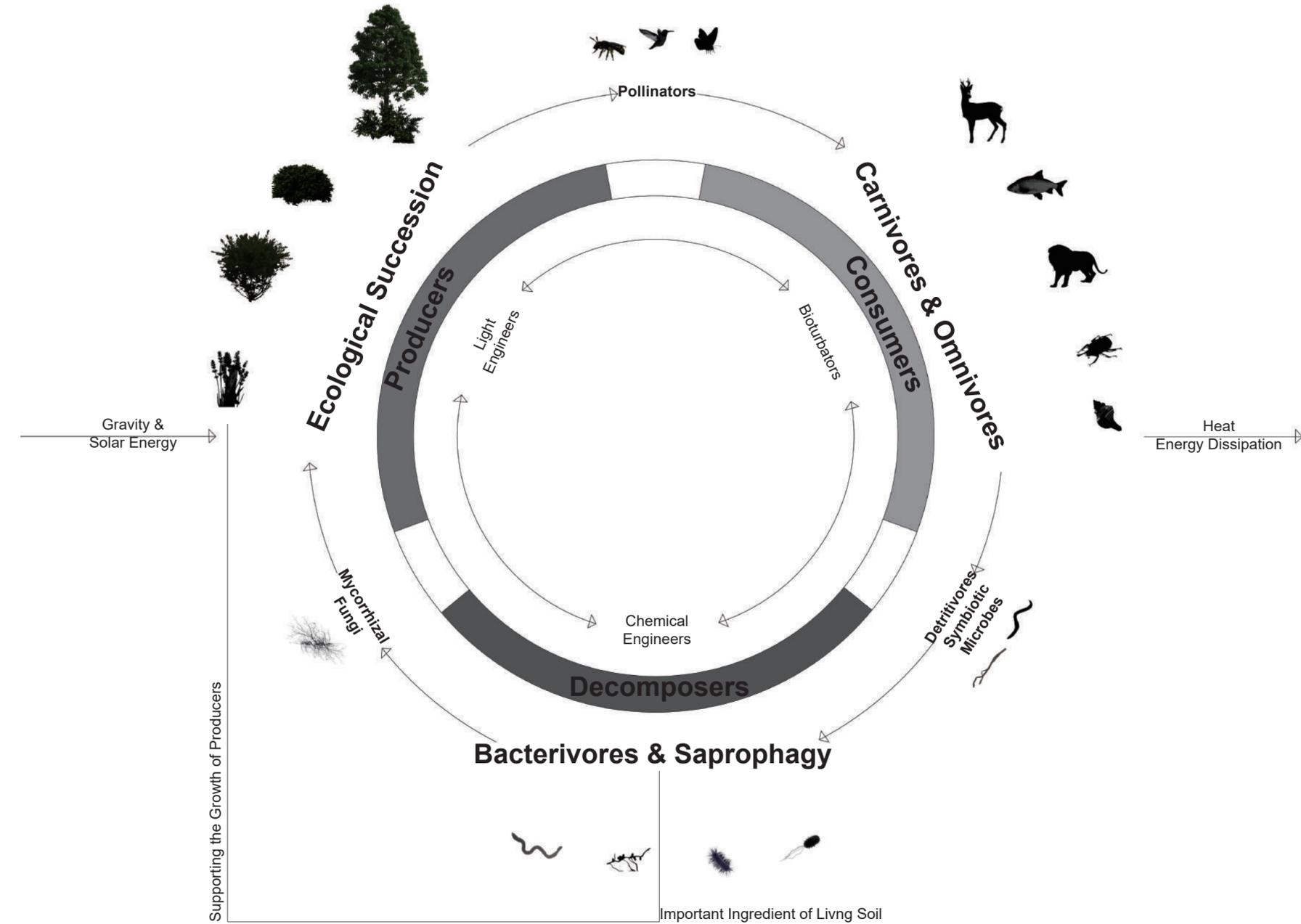


Fig 16. Eco-cycle (Illustrated By Ming Hung Davis Mak) With Reference to Tom Snow

¹ Personal Communication with Tom Snow dated 2nd April 2020.

Architecture

Conventional Rammed Earth Construction

In conventional building design, 'green' elements are often applied to the design strategies which architects are incorporating 'green' elements into the building to perform environmental sustainability which has been criticized in section 2 that the 'green' element does not necessary reflect the concept of co-designing with the nature. The nature is still enclosed within a culture context. Tower Flower is the example mentioned in part 2 that incorporated with the 'green' elements, but the design does not engage with the cycle of eco-system. Greenery is often reduced to an aesthetic form of expression in conventional building design.

In order to differentiate the concept of co-designing with nature from the aesthetic form of expression in traditional building design, I have developed the living soil as part of the building system rather than just incorporating the 'green' element into a specific area in the program of the design proposal. The building system is similar to conventional rammed earth construction system. But, the difference between two systems is the composition of the soil in regard to the construction method. The traditional rammed earth construction system is built by compressing a mixture of soil to form a solid block, which stabilizer like portland cement or other hydraulic binder is normally added.²² The mixture of the soil is then dried out and formed a load-bearing wall system which could be expressed in different forms of application in the building system like interior walls, built-in furniture and decorative elements. The rammed earth is considered as non-living as the fundamental elements that support life, air and water, have been extracted throughout the construction process. Living organism could not survive in the conventional rammed earth structure.



Fig 17. Rammed Earth wall Construction (Photo Credit to Rammed Earth Enterprises)

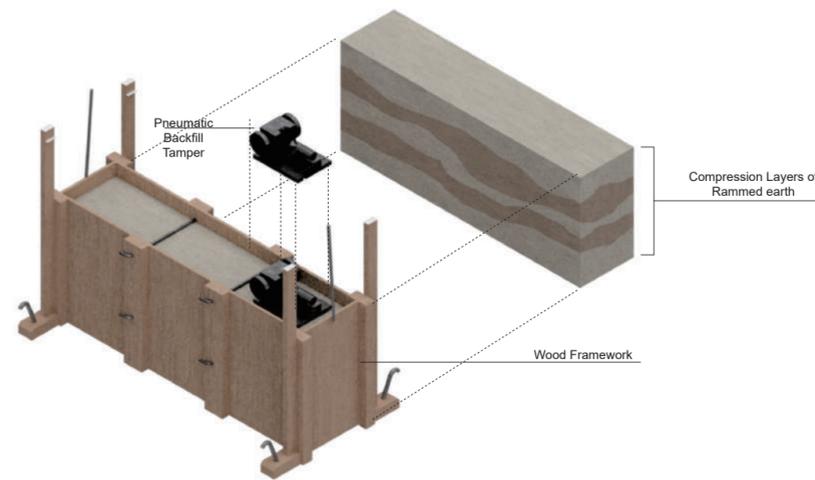


Fig 18. Construction Process of Rammed Earth Wall (Modelled By Ming Hung Davis Mak)

Integration of Living Soil Construction

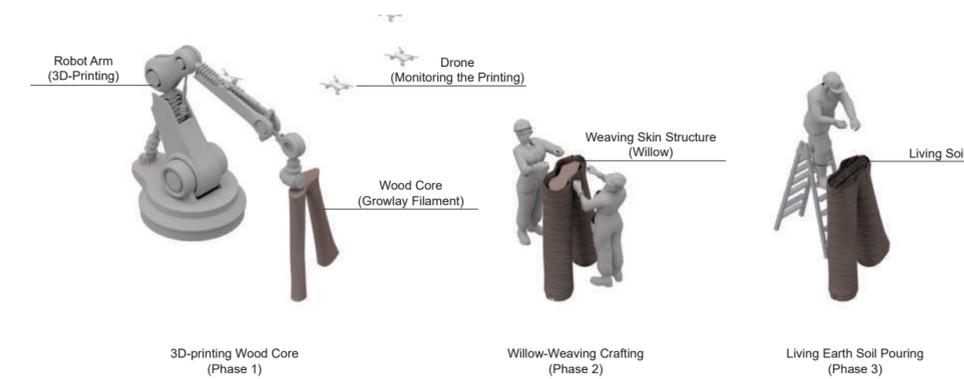


Fig 19. Construction Process of Living Soil (Proposed Design) (Modelled By Ming Hung Davis Mak)

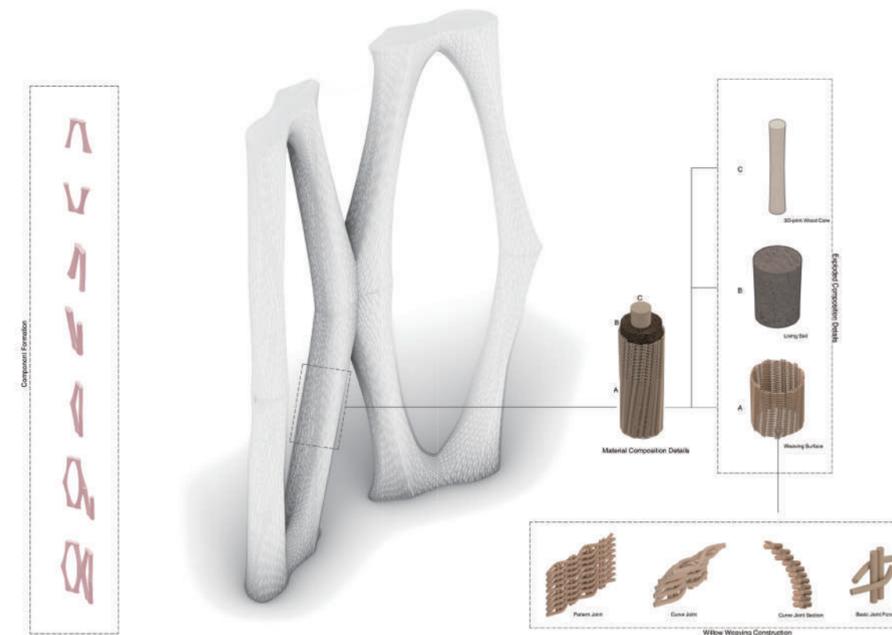


Fig 20. Proposed Design Structure Explanation (Modelled By Ming Hung Davis Mak)

My proposed building system are constructed in different way than the traditional rammed earth construction system. The structural system is formed by three layers. The core is a 3D printed wood structure which integrated with the material called the 'growlay' filament developed by Kai Parthy, a 3D printing expert and wood filament pioneer. The wood filament performs a high tensile strength in properties which make it suitable for developing as a structural building material. The filament is also biodegradable, which dissolves in water and provides nutrients for the growth of the moss and fungi. The decaying process of the filament could be described as like a fallen log in a forest where the log is decomposed by living organisms and provides nutrients to the surrounding soil for decades. Fig 18. is the conceptual description of the decomposition of a log that provides ingredients for supporting the growth of the eco-system.

The external skin structure of the proposed building system is a willow-weaving structure which holds the soil in between the core and the skin. In this case, the soil acts as a supportive structure to the core which is held by the weaving structure. So, the soil does not necessary require compression force to become a solid block to perform load-bearing structure. In addition, the use of weaving-skin structure provides gaps which allows the in-flow of air and moisture to the internal soil. Life-supporting elements, air and water, are integrated into the soil and nutrients from the decay of the wood core create a perfect condition for the soil to become a breeding ground for the eco-system.

²² J. Sanz, "Repair of rammed earth walls in the walled enclosure of Daroca (Zaragoza, Spain)," *Rammed Earth Conservation*, 2012, xx, doi:10.1201/b15164-120.

The integration of the living soil to the building system performs similarly to the prototypes that built by Marie Davidova and Richael Armstrong mentioned in section two. They are corresponding to the concept of co-design with the nature by introducing unique building system that fabricates the eco-system. But one would criticise that Marie Davidova's device does not build to support a bio-diverse environment in regard to a successful eco-system. The algae grow on the wood panel is insufficient to form the base of the eco-system. The fundamental ingredient of supporting the growth of eco-system is missing out in the device, but the concept of designing the habitats for insect is still interesting.

The proposed building system is performing similarly to the bio-engineered building material that Richael Armstrong proposed. The living organism in the living soil is absorbing the carbon and decomposing the waste of the eco-system to provide nutrients for the growth of the organism. The exo-skeleton of the design then becomes the living 'forest' with the growth of the eco-system. This application could also be applied to the internal wall structure similar to the conventional rammed earth construction. The application could potentially cover the whole building surface. Maintaining water cycle is an essential design aspect to achieve the continuity of the eco-system. The architecture is integrated with the life supporting elements rather than the aesthetic of the architecture.

The proposed design encourages the development of the ecology rather than just putting 'green' element to the tower. This demonstrates the idea of designing for nature is responding to the hubris idea mentioned in the first part of the essay. The integration of the living soil in the building system reflects our standpoint in seeing the relationship of nature and culture. As mentioned in the previous section, architecture is a point of intervention to our self-confidence. Co-designing with nature does not necessary mean that we are reducing our 'hubris', in fact, it reveals that we are strengthening our belief in working with nature that perhaps could benefit our civilization to certain extent. 'Hubris' for Bateson is our tendency to see ourselves as masters over nature which integrates with the advance progress of technology development.

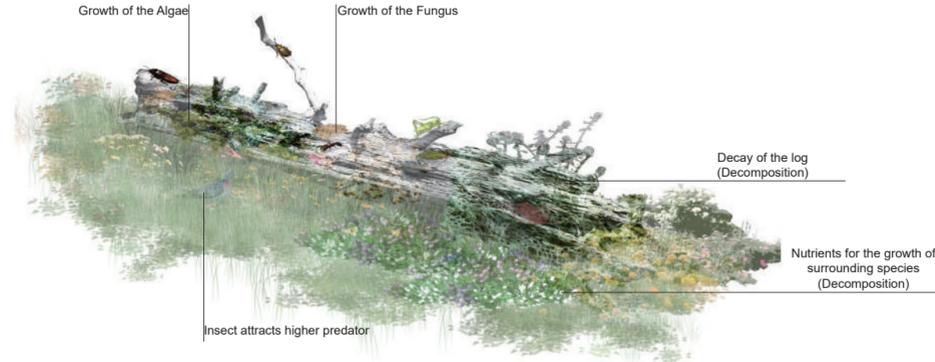


Fig 21. Decay of the Log in Nature (Modelled By Ming Hung Davis Mak)



Fig 22. Proposed Design Section of Decay (Modelled By Ming Hung Davis Mak)

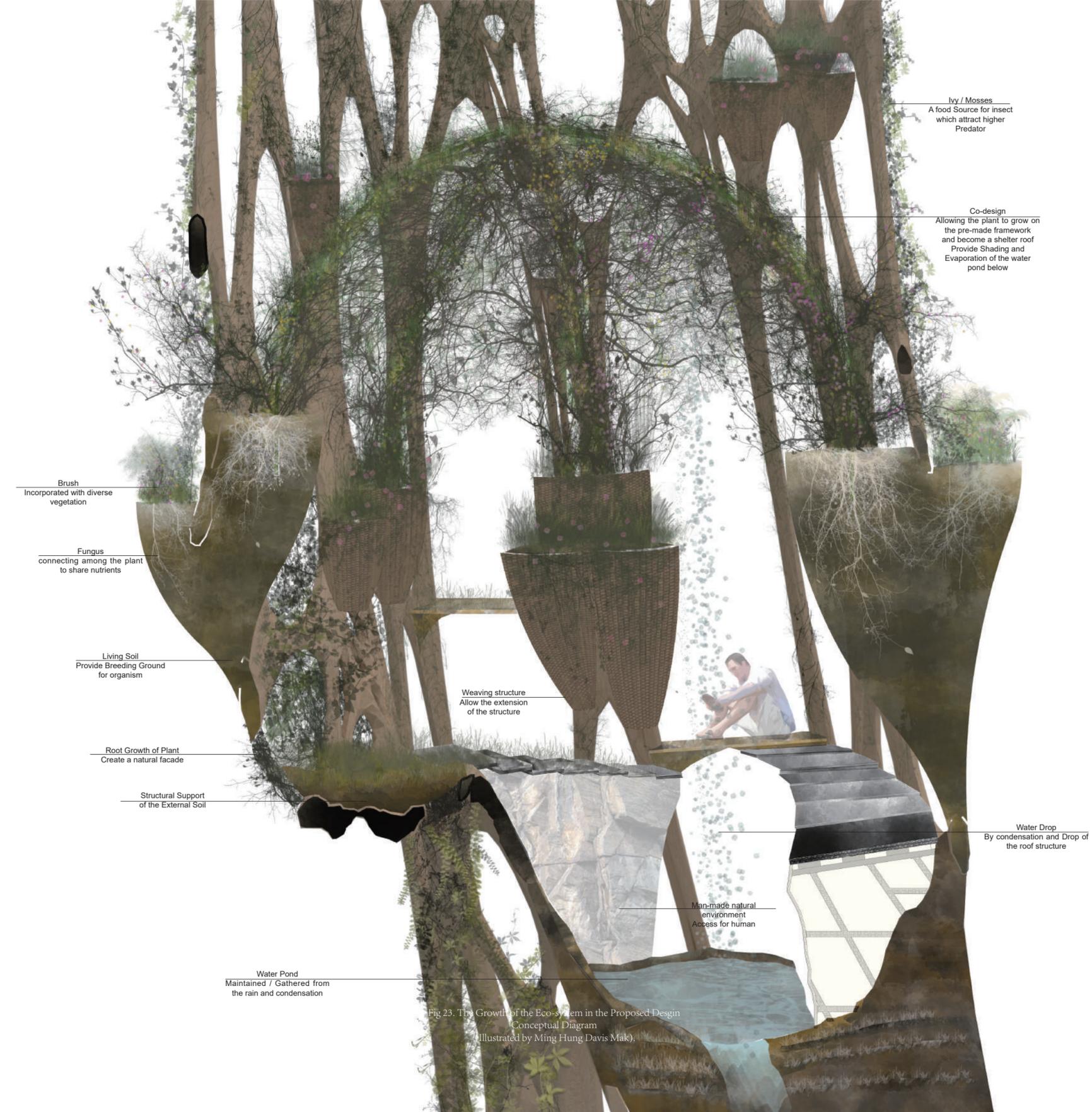


Fig 23. The Growth of the Eco-system in the Proposed Design Conceptual Diagram (Illustrated by Ming Hung Davis Mak)

Human

Moreover, in terms of the relationship of human and nature, the construction process of the above structure could be seen as us 'seeding' the building. The process of 'seeding' does not end when the construction is completed. Part of the design concept in my research is the annual celebration of the harvest festival. Wicker structure is one of the elements that is built to celebrate the festival. Within the building context, more structures of the exo-skeleton are built as part of the celebration of the festival. This proposes two concepts of the design strategy. The first marks the continuity of the annual celebration of the festival where the human participants 're-seed' the building. The celebration is important in the context of the tower typology as it could grow higher without interfering in the existing landscape. The second reflects the importance of human interaction as being part of the eco-system. Human interaction is valuable in creating more breeding ground for the growth of the eco-system through the celebration.

The celebration of the festival also re-defines the term 'hubris' in our relationship to nature. It reveals the fact that we are not only co-designing with nature, we are also co-working with nature. Our celebration to the festival no longer limited to culture, in this case, nature is also included as being part of the celebration. The designated structural system encourages the in-built eco-system within the human habitat. The proposed architectural design eliminates the boundary between nature and culture. It also changes the way we perceive nature in architecture. The nature no longer encloses within the context of culture as conventional way of integrating the 'green' element, they are embedded into the building itself and co-evolved together.

In conventional architectural design, 'green' elements are often perceived as trees and plants located in specifically programmed areas of the building. Gardening is an example of how traditional architecture has built in the 'green' element. Nature then becomes part of the spatial program that architects needs to deal with. One well-known example which goes against the conventional way of building design is the Hundertwasserhaus, built in 1985 in Vienna, Austria, designed by Hundertwasser. The green elements of this project do not present only as tree/plant nor a specific greenery like garden. The 'green' element is built into the space which is 'nature-friendly', for instance, the bottom 'window' opening of the wall provides entrances for the insect. Transparent glass bottles are casted into the wall which aims to create a natural diffusion of light to enhance the sense of nature. Undulating floors are also part of the features that allow the merging of nature and human. The example has shown the concept of designing as nature-friendly but it is missing the way of maintaining the eco-system which the living soil is offering. In my proposed design, the living soil is integrated into the building system which indicates the true combination of nature and culture.

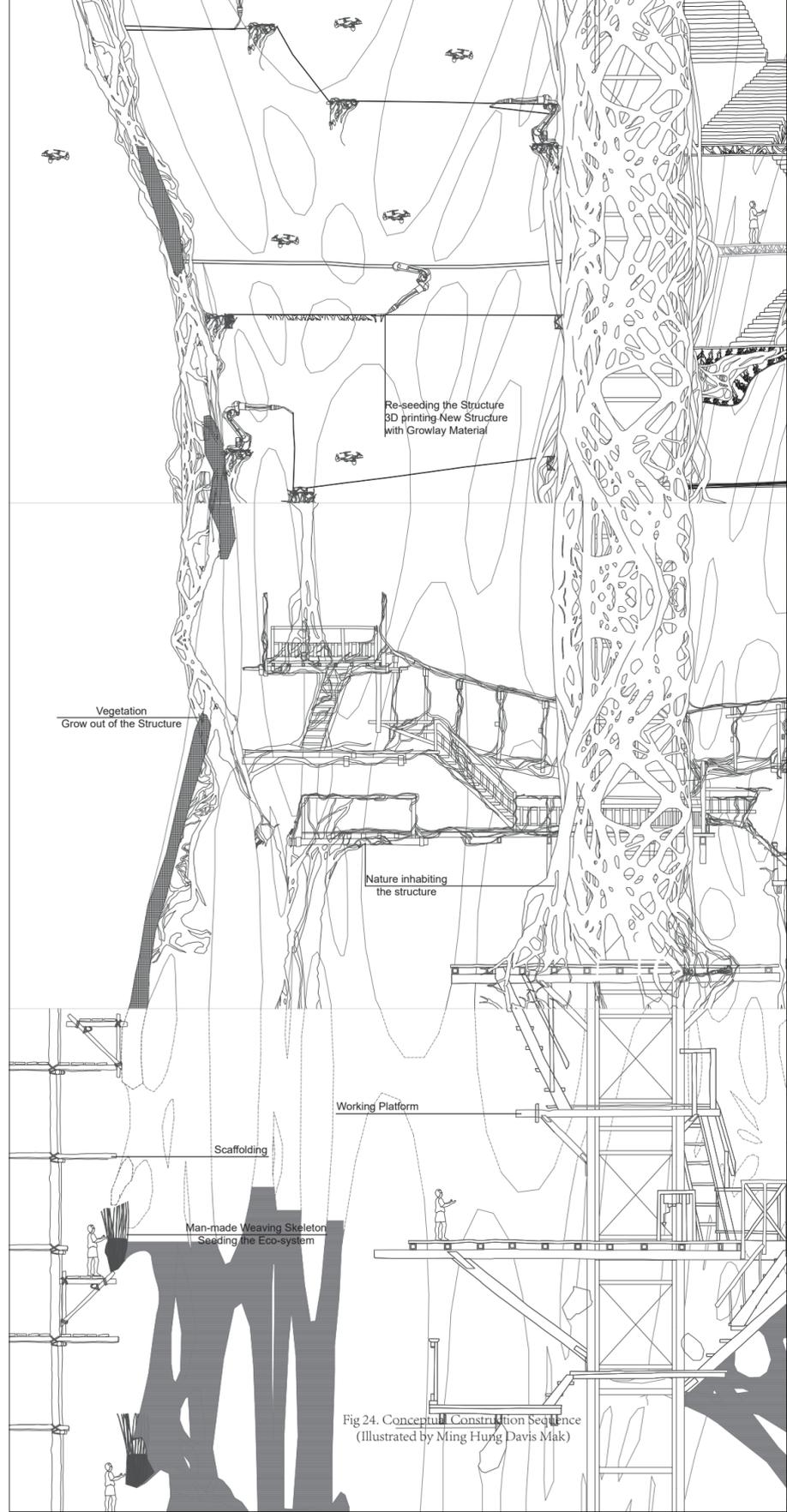


Fig 24. Conceptual Construction Sequence (Illustrated by Ming Hung Davis Mak)



Fig 25. Caprice of Harvest Festival (Illustrated by Ming Hung Davis Mak)

Conclulsion

Co-designing with nature is achievable in a large architectural scale and it is important to our future development. Our perception of nature defines our way of designing as an architect.

In conventional building design, co-designing with nature is often misinterpreted as putting 'green' elements into the design that do not integrate with the eco-system in a meaningful sense. It is mainly caused by our hubris which oversees nature as something within the human world. The garden is one of the examples where we tend to enclose nature within the context of culture.

The research of living building material suggests an alternative paradigm in exploring the concept of co-design. The example of integrating the living soil into the structural system is a way to achieve the concept of co-design in a large architectural scale. And it goes beyond typical tree and branch scaled co-design interventions. Thus, the progress of the technology also implements the feasibility of the proposed system. 3D-printing technology provides us the opportunity to explore the structural and material system in an unconventional way.

Human interaction with nature is indispensable as they are integrated as part of the eco-system. The celebration of the festival in the proposed design also reinforces the importance of partnership between culture and nature. Therefore, the living soil serves as the medium between culture and nature in which it is supporting the growth of the eco-system and is also performing as part of the structural system in architecture. Living soil could be the key to the future development which help with the current ecological crisis that we are looking for.



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Appendix A

Reading list

Marie Davidova, Synergy in the systemic approach to architectural performance - The intergral multi- and cros-layered agencies in eco-systemic generative design of the post-anthropocene, vol 13, 2020

Michael Weinstock, Emergence Morphogenetic Design Strategies - Fit Fabric: Versatility through redundancy and differentiation, 26 May, 2004

Reading Review:

Marie Davidova, Synergy in the systemic approach to architectural performance - The intergral multi- and cros-layered agencies in eco-systemic generative design of the post-anthropocene, vol 13, 2020

The article started with introducing the problem that large number of species has been extinct with the environmentally destructive of human activities. More than 80% of the insects by biomass have disappeared in central and western Europe since 1980s. It states the human activities are reconstructing the nature environment into our own comfortable zone which destroy thousands of natural species. In the future, shall we turn into an architectural form of building that could co-exist with the nature? For now, in architectural point of view that we are creating borders to each other as countries and nature. Our infrastructure has setting a clear boundary to the nature (natural environment), which can only be suitable for human race to live in but not nature. And it brings out a very interesting sentence that the idea of the co-activation of a shift from the Anthropocene towards support for bio-diversity and adaptation to climate change in the co-generation of natural, cultural and technological fabric by humans and non humans. Later on, in the article, it started to bring with the method of engaging with the latest technology to resolve the problem, bringing in AI, prototyping in full scale to investigate the possibility of co-performance and co-habitation of the nature and humanity. Creating a biosphere within the eco-system. The design will base on study of the pattern of interaction and relations at vast field which then it generates a generative design in relation to that aspect. Those co-design methods are normally framed as real life co-design laboratories that directly confront and interact with real life on site. The prototype would be acting on the feedback loops and refining on the feedback and create its own progression.

And then it comes with a few examples of the real life prototyping to demonstrate the idea of the time-based co-design of interacting these layers and feedback with looping stages and path over time. These reactions would involve several processes of machine learning. Input the environmental change factor into it and it turns into the outcome of it. Very good sentence 'Such observations show that climatic, political, cultural, technological and natural systems are time-based and in need for continuous cross-referenced co-adaptation, though many of those systems operate in very different time frames.' As this is a very good point to the adapting the nature with the generative design. Natural selection is also one of the adapting systems of the species or nature to the environment? could be?

Reading Review:

Michael Weinstock, Emergence Morphogenetic Design Strategies - Fit Fabric: Versatility through redundancy and differentiation, 26 May, 2004

The essay starts with some very interesting examples on the vertical urbanism which focus on the material and structural system design of high-rise buildings. They were proposing a new type of structural system taking from the natural structure seeking for flexibility and stiffness that provide models for geometry, pattern, form and behaviour. Their high-rise structures in which a helical structural system and an intelligent skin are integrated into a versatile material system. The proposed structure is basically engaged with the idea of woven structure as a concept, in a way to provide strength with meeting in regular interaction points. It engaged with the optimization of the material to form a strong and stable structure, same as honeycomb structure in Dubai Investment Council Headquarters. Their study was found that helix form is being selected for this specific experiment of generic pattern in natural systems. It doesn't surprise me as it even human DNA is formed with a spiral helices form of structure. Xylem vessels in plants are the slender tubes that transport water and solutes up from the roots into the stem and leaves. That gives a big support in investigating the spiral helix structure which can be observed and obtained from nature. The study wasn't stopped in here, the most interesting part of this essay is the cellular automata which is a mathematical set of rules that governs the cell replication and destruction. Used to model complex systems composed of simple units such as living things. "Organism area bundles of relationships that maintain themselves by adjusting their own behaviour on anticipation of changes to the patterns of activity all around them." This is a very good explanation of the essay to what

they are expressing that, the form of replication of individual unit in nature is the strongest and most interesting form that we are looking for. For the past decades, centuries, we are trying to learn about the law of nature, gravity, velocity, weight, mass, etc, which could only help us understand the very basic knowledge of nature, and we are trying our way to build our own interpretation of the form somehow, could be, against nature. (Climate change / global warming be part of the evidence?) (One said, the strongest force is the force of nature. We are trying so hard to build the most terrifying bomb in the history of mankind, but one supernova explosion could erase the entire solar system.) The essay has suggested that the ecology system is the basic cell unit system or might be the smallest which we have no idea in the past century, but now, we have the technology to engage, to study, to learn the evolution of the nature structure and how it adapts to the change of the environment which might be the key that we want to build with in the future?

Reading List

Mary Caterine Baterson, Steps to an Ecology of mind, Chapter: Pathologies of Epistempology, Chicago Press, Edition 2000

Mary Caterine Baterson, Steps to an Ecology of mind, Chapter: The root of ecology crisis, Chicago Press, Edition 2000

Mary Caterine Baterson, Steps to an Ecology of mind, Chapter: Ecology and Flexibility in Urban Civilization, Chicago Press, Edition 2000

Flexibility and ecological Planning Gregory Bateson on Urbanism, Jon Goodbun

Reading Review:

Chapter: Pathologies of Epistempology

The chapter has first introduce the concept of perception that people would do, he engage with the 'seeing me' theory which people are not actually seeing him, but the we are seeing a bunch pieces of information about me. A concept of introduction of what we see and what it actually is, they are both somehow different. The use of difference interpretation in meaning of pleroma and creatura - worlds of explanation and worlds of understanding. Pleroma is representing hard science (force and impact). Creatura is about organization and communication (difference). It then listed a few things which should be considered as mind thinking. An interesting example a thinking process should have included trial and error within it. Self correctiveness is a key to the 'thinking' process. Variable should be in within the process. If the computer can be in control with the its internal temperature which means that it could also be thinking as well. 'An organism destory its environment destory itself' Unit of evolutionary survival is same as unit of mind-concept. Now it switch from individual survival (single term of species, family, into a bigger of units, meaning the ecosystem. Concept shift in here, from single species survival becoming the interaction/relationship between different species which mean eco-system. I think this passage is more into what a thinking mind would be in relation to identify the problem, issue by changing the perception or perspective. We will see the whole thing rather than a piece of information. I would use peeling off of an apple to describe the concept. We see thing as its facade, the external skin of the fruit. We have to peel the skin off in order to see the whole thing.

Reading Review:

Chapter: The root of ecology crisis

This is a very short, effective Chapter, introduce with the conflict among society with the change correspond to every aspect with whole philosophy of government, education and technplogy. And then, it introduce the DDT - insecticides, which people used in 50s to increase the agricultural product for the population explosion of human. And it brought out the idea of imbalance of the system, which the DDT has caused the extinct of certain species of insect in order to provide sufficient among of food for us which it also caused the extinction of the species who feeding on the the insect which got destoryed by the DDT. More and more consequence which the DDT has been spread all over the world, highly possible contain inside the body of fish, tree, grazing. We, human, are the consumer standing on the top of the food chain. After it has introduced the imbalance and consequences behind the concept. And the diagram of the dynamics of ecological Crisis brings out the cycle of how the current situation of mankind is sitting in the loop of ecological crisis. Which the increase of the population, increase the demand of food, increase of the technology development, increase the pollution, increase our arrogance, which brough us to war, and the war brought us to more advance development of technology. A loop. As refer to the previous passage, we are indefinitely desorying our environment which will eventually destory us. Change of our perception towards environment seems to be a way out to our current situtaion. Consider our environment to be a partner rather than competitor. Work with it rather than against it. If we change our concept towards environment, it would be different in all aspect which government would not be able to handle.

Reading Review:

Chapter: Ecology and Flexibility in Urban Civilization

In this chapter, he continues with the idea of changing conceptual shift to achieve a sustainable and healthy ecology. The idea to achieve a high civiliaztion is ' A single system of environment combined with high human civilization in which the flexibility of the civilization shall match that of the environment to create an ongoing complex system, open-ended for slow change of even basic hard-programmed characteristic.' We are currently in a low civilization which we knew the fact that we are destorying the environment and the nature will correct itself with extreme method. And all we are doing is delaying the consequences of our action (pollution, climtate change). The only way to turn us to become a high civilization is to change our preception towards us and environment. Using the technology that we have developed and work with the enivornment but not against it. Flexibility is then becoming the key to that shift, meaning that we could have a room for tolerance to change or become diversity to certain aspect. A very good point towards the regulation of the planners. If we do have a room for tolerance in the regulation, thinking more on the ecological aspect more than profit for individual interest and that return to the theory of we are winning/conquering the nature, but at the same time, we are destorying ourself. We won and we lose. We are in a situation that we have no choice but to change in order to survive. Different exmples in the article have given the idea of Flexibility to change. Concept of environment to us, technology aspect (technology used for only human benefit or with environment), energy sources, (pollution or clean energy to work with environment), Flexibility to planner (from human aspect only to ecological aspect).

Reading Review:

Flexibility and ecological Planning Gregory Bateson on Urbanism, Jon Goodbun

In this article, it continues the concept of Flexibility of Bateson in the context of the one single system of environment which it requires a new way fo seeing how the cities behave towards the term of 'ecological aesthetic'. He uses the examples of conferences, Bateson's principle, Bateson's work film project to a sense that ecological is part of our system, not separated. And he quoted that, 'an ideal relationship between human civilisation and the rest of the planet as 'a single system of environment combined with high human civilisation in which the Flexibility of the civilisation shall match that of the environment to create an ongoing complex system, open-ended for slow change of even basic (hard-programmed) characteristics'. And it also mentioned the complexity of the networks relationship with the exmaple of cities and organism whcih they can be evolve and develop, but they need to have systemic room for manoeuvre. And bringing that into our modern urban development, we might want to emerge as a mean to develop empathy and understanding or the often non-intuitive behaviour of both human and non-human system. It appears to be we tend to separate ourselves from the ecology which we took control of the planning, building, leaving very few Flexibility for non-human species to live onto. Our planning strategy need to include ecology within it rather than a separate section of a regulation. Flexibility allows rooms for the stress in parts of the system and ecology, which my undertanding is that it allows the room for adaptation, for example, human body is adapting the temperature(summer and winter) by unconsciously shifting our body fat from under the organs to under the skin. But the question would be, what is the control?

Reading List

Irénée Scalbert, The perfect worlds of ecology - Field Journal, 12, July, 2010

Jon Goodbun, Gregory Bateson's Ecological Aesthetics - an addendum to Urban Political Ecology,

Reading Review:

Irénée Scalbert, The perfect worlds of ecology

This article starts with introducing the the concept formation of ecology world which it can be seen as lots of different small world/eco-systems, Pond is an example that she used, describing the relationship between different standpoint of the species, plant - fish, producers - consumers, they are decomposed by bacteria and become substances for other plant to feed on to. A cycle is then created. A very interesting pond eco-system diagram "A typical pond ecosystem, The Joy of Knowledge Encyclopaedia," 1976, drawing by Brian Hawkes.

Second part of the article referring to the consciousness of us being separated or problem of nature appears to be man. To my point of view, mankind has been existed as part of the nature which nature has been giving Flexibility to balance the damages that caused by human, as nature considers human as part of its system, the environment/nature/system has shifted/change so much to incorporate with human activities - city infrastructure, Concrete roll, harvesting nature resources in a way that damages to environment. The nature system has such a Flexibility that it can withstand such a big change and allowing the different parts to incorporate with us. It is us, human, that often not recognize ourself as part of the nature, precepting that nature is more a competitor than a partner. The third part of this article is about how we architect could help change the environment as buildings are responsible for 40% of all CO2 emission, and we are playing an important role in the politics of ecology which we are the combination of knowledge, imagination and practice, we as in architect would be the best placed to envision viable compacts between humans and nature.

Reading Review:

Jon Goodbun, Gregory Bateson's Ecological Aesthetics - an addendum to Urban Political Ecology (1)

In this article, Jon started with the introduction of relationship of ecology and economy based on the Bateson's theory and work. It set out the relationship between organism and environment which they are inseparable. They are interconnected and organism is evolving with the environment which they are structually coupled/co-evolving. The article states that organism and environment relation is based on three elements, social - cultural - economic. Ecology is equal to the economy of nature. Cultural is part of the nature like Urban political ecology (UPE). A very good quote from the article, 'The organism in general do not simply adapt to their environment, they also affect that environment in various ways by affecting change in it. Basic definition of ecology in aspect of human term area, human - architecture - urbanism.

The second part of the article is using the example of first scientists to be employed in an ecological capacity were those of the Dutch and English India companies from the late eighteenth century to bring out the connection between ecology and economy on managing the both local landscapes and global material flows. The idea of matter and energy Flow captured through eco-system in nature is a sense of representing a transformation of the the economy as it represent the concept of economy. Basically, in my understanding, the article uses a lot of example to identify the connection between nature and organisms, and they are both connected, and the economy definition is a bit different as he describe it in aspect of ecology which matter and energy Flow within the eco-system/community. It is similar to the aspect of human to resources that we harvest from the environment,

Reading Review:

Jon Goodbun, Gregory Bateson's Ecological Aesthetics - an addendum to Urban Political Ecology (2)

for example (typical), gold and silver mine, but not accurate at this point, the whale oil from 16 to 19 century which determining the economy based on the hunting of the whale (environment).

Theory of Bateson towards the scientific researchers overemphasising the energy and matter Flow in the ecological system rather than being mentally incorporated with the fact that we are part of the system being observed and interacted with. In fact, Bateson was more focus on the mentally conception of how human consciousness is being isolated as conceiving human is separated from the rest of the world. But in fact, we should extend our mind to be an individual mind of a larger mind which we are a part of the subsystem. An example of the Lake Erie is perfectly fit to demonstrating the mental conception shift that Bateson has mentioned. In my point of view, it states the psychological aspect that people normally won't hurt/damage himself/body part that he mentally perceived that is part of his own system. Likewise, we tend to protect and preserve our property than destroy it. Same to the situation to the Lake Erie, if we consider the Lake Erie is part of our home/system, we will then tend to protect than pollute it. That's referring to the Bateson' concept theory of our relation to nature.

In the conclusion, I think the article is using some of the real life examples to bring out the theory of how we are engaging with the shift of perception of nature. Through urban and architecture, human civilizatio has been transforming throughout thousands of years, we have quipped with knowledge

Reading Review:

Jon Goodbun, Gregory Bateson's Ecological Aesthetics - an addendum to Urban Political Ecology (3)

from understanding the nature/environment, the technology that we developed can be used as a tool to help us build upon the infrastructure that we have. The problem isn't our technology, it is our preception to the nature.

Watching list

Michael Hensei - RSD6 - Keynote.

Donna Harraway - Companion Species

Michael Hensei - RSD6 - Keynote.

What could be learn from the the nature to architecture, growing excess and use?

Start with the political issues, boarder, refugee. drawing the line, architecture and city takes up ground. city are developing in different form from different times. Human dominated against the natural environment. Mediated interaction of the physical and biological environment.

Stand your ground. removing the green part of the city, protest came in (in turkey) Environmental aspect to greenery, benefit for highway, road connection, vs habitation of bird and trees. Olympic game, political issues. Dangerous of the the protest when political aspect kicks in. Culture as well.Place managment VS well design space.

Outdoor Recreation Act Protect to outdoor activity, right to spend time in the outdoor. Sense of wellbeing. Land use right.

The right of ground natural landscape that prevent flooding has been destory, and erase by human activities. Ecology didnt though of with the development of human. River in New Zealand has been legally protected. Hard to enforce the law.

Not efficient. Insufficient oversite.

Whose ground anyway Stakeholders is non-human species. (monkey ? Insect?) Right for the animal to live in. Polar Bear starving because of the human. Urban wildlife to the accident in the urban area. Fail to design to co-habitation of the species. Wildlife entering home. Planed Biodiversity - Assoicated Biodiversiyt- Locally specisl freely Evolcing Biodiversity. Nature should have their right to be restored. Rlght of the nature.

Making ground. Undisturbed ground for the natural landscape. Live above ground, preserved the gound. netting to define the space boarder of home and species. Pigeons tower. Hollow way for pigeons. Man-made space for animals. Could be design for the nature, well considered to the nature. Not fit to the nature (not enough) Architecture could formed and designated to form factor of disturbution with the nature, Nour's Project. Fire escape example to the design to nature. GIGAMAPPING. The human made environemt not entirely contradict to the nature, but can co-habitated with the nature.

Watching Review:

Donna Harraway - Companion Species

academic analysis natural environment, relationship between species. Methodology, Wolf and Jackson can be friends. genetic research of dogs. Pack of wolf joining together. Wolf Raised by the scientist.

Animal raised by the scientist. biological genetic paricular dog and human. biological determination Human is also part of the nature, if the question is human raised animal, could that become a peaceful part of the cohabitation of the eco-system. We training the species to become Like education in human. If no education would become the the war zone. Partly engaged with the concept.

Central concern. Making traces to the animal response to the rasing to the nature passionate concern. The nature could be shaped. Species world. Adapting. Didn't speak any of the animals. bacterial, small mammals,

colonical all my cell, sym biogenrtiste. Check DNA, irresistable, gene is more alike. Similarity of every species.

Animal geology. Gesture. Social suibject. Co-present. Species Boundary. We required them, they require us. Bio-culture. Genetic. Capital. Bacteria know it first, since the birth of the live. Bacteria do it first. Master and servant relationship. Human intention of intentionerity. Austrition,, Dogs and cow relationship. Importation of sheep. History, Aus and UK dogs, and become ecology. Work of dogs, engages with the different species. Training of the wildlife? through genetic correction and education.