The city nature network

Rethinking urban structures and approaches towards climate and biodiverse design

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Preface

In the modern day more than half the world population is living in cities, making the urban environment essential for the upcoming dynamic redesign towards a viable future (Department of Economic and Social Affairs, 2019). Our cities on the other hand are existing creatures, shaped over decades to the certain rigid morphology that we see today. Where these structures contain outdated buildings and spaces, these structures house the changing systems of the city. Although these outdated structures are not ideal, these buildings distinguish places, conveying (in)tangible values for the environment they are in (Tarrafa Silva, A., & Pereira Roders, A., 2012). The buildings come together in streets, flowing in quarters, together forming the urban fabric of the city.

With this vast framework of morphological structures connected to their past and environment through values, the urban fabric presents itself as a rigid being. The users of this fabric, the people who live/work/visit it are rather dynamic. They form together with disposable objects within the dynamic systems. In contrary to this dynamic human systems there are the natural ones. With the expansion of the city these systems suffered from a backlash since their territory was disturbed, and the biodiversity in these areas dropped (WEF, 2020). However, natural systems are still present in our cities. If the natural systems would disappear cities would collapse.

In the cities affected by the New Silk Road their structures are under pressure. Looking for example at Trieste, we find a city with a rigid morphological base that is outdated and unfit for modern day dynamic systems. Next to that new portal-developments projecting growth of the free port and a shrinking population propose an additional set of problems to the city.

In order to keep both these dynamics vivid in our urban environments it is important to rearrange our main foci from our human and technical systems alone to a combined vision where the natural systems are valued equally to the human and technical ones. This new approach to the urban fabric along with the value of the current urban fabric brings an opportunity to see the current existing urban structures as a base for our upcoming assignment as society. This paper positions the role of existing urban structures as base for a dynamic sustainable redesign. At first the theoretical framework is set to guide the discussion, with different terms to define ecological structures. Afterwards three case studies are reviewed, each with a different scale and approach towards tackling the issues at stake. To at last conclude with the findings, notations and limitations.

Theoretical framework

In order to guide the discussion of redesigning the historic urban structures a framework for this discussion is needed.[1] When looking at the existing historic urban structures in the Western world they all suffer from a number of factors: UHI-effect, loss of biodiversity, lack of green spaces, extensive rains, environmental pollution and monopoly of the motorized vehicles. Also, seen the developments of climate change, there is a need to cut human-related emissions of greenhouse gasses to zero. The urban structures play as mentioned before a viable role in the solution of all the problems that are mentioned before. These problems can be addressed in multiple ways, later explained in methods. First a more closer look to the problems and themes we are looking at.

Problems

WATER AND URBAN HEAT

The dense and closed surface of the densified city is problematic for the more natural systems to work. Soil interacts with its environment, where concrete does not. This given is the base for the problems of flood rains and the UHI-effect.[2] By closing off our surfaces, water is not able to go into

[1] historic urban structures, as ment in UNESCO (2011)

[2] UHI-effect stands for Urban Heat Island-effect (Kleerekoper, Van Esch & Salcedo, 2012).

the soil, let plants grow (which use the water) and cool down their environment. This difference is seen best in big cities like Barcelona where the temperature downtown can be up to 9 degrees Celsius hotter than outside the city (Mueller et al., 2020).

In the same densified cities extreme weather conditions -due to climate change- cause flooding showers.[3] However, this problem is not only a climate change problem. Over the past centuries paved cities suffered more from extensive showers and took measures to drain the water as soon as possible. Although cities close to sea level or down the valley do not always have this option. Here it is important to let the water infiltrate and store it before going into the sewage system, this way preventing it from crashing.

BIODIVERSITY

As result of the ongoing urbanization of our world we see changes in biodiversity.[4] Biodiversity loss caused by urbanization is dependent on the level of urbanization. Urban tissue usually replaces a natural system/area. This way dividing its population, with the urban area as border between them. This disconnection creates a more vulnerable nature (IPO, 2018), since the populations of animals can not migrate to other areas to feed themselves when food-stock is low in the area and the genetic pool will be tied down to the species living in this closed of area.

Where a mediocre level of urban tissue causes a smaller loss, a dense city causes a great loss of biodiversity and causes therefore a great loss of natural systems (Apfelbeck et al., 2020). This loss has also consequences for the humans living within these cities, since these systems are viable for the livability in our cities. A complete distinction would mean that our cities would become desolate beings, not suited for humans to live (Apfelbeck et al., 2020). On the other hand it is important to notice that current day cities are able to house threatened species (Ives et al., 2015), without a change in our built environment these species would distinct eventually also.

AIR AND NOISE POLLUTION

Furthermore the urbanization, together with other human-caused trends is responsible for the environmental pollution, causing many issues like bad air quality as well as noise pollution (Ukaogoo, Ewuzie & Onwuka, 2020). Both factors are even more strengthened by the motorized vehicles that are so common in these area's, polluting even more. These factors lead to a higher death number among inhabitants (Mueller et al., 2020). The need for change and a more wildlife-inclusive form of designing and planning is clear.

Approaches towards identifying solutions

In order to achieve a better way of urban planning, one should recognize the problems as stated before. Afterwards the starting points and means are identified. Constructing a sustainable building has to become a standard way of construction.[5] Designing cities with gray and green infrastructure and monitoring the qualities of life, quantities of motorized traffic and the number of species.

ENGLAND: GREEN INFRASTRUCTURE

Key notion within this new form of urban planning is to identify the existing green infrastructure. Green infrastructure is defined by Natural England as "*A strategically planned and delivered network of high quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality of life benefits for local communities"* (National England, 2009).[6] This Green Infrastructure (GI from now)

[3] State of Climate in 2021 (WMO, 2021)

[4] Biodiversity. According to PBL (2021) is best described as variability within and among the sum of all ecosystems, species and genetic material.

[5] Dutil, Rousse & Quesada (2011).

[6] Natural England is the public body responsible protecting and improving England's natural environment.

provides a network for natural systems to use. However the GI-elements itself could also be conceived as a system itself, it provides a base for a growing number of species to reenter the urban area and settle again in the city. This way gaining biodiversity in stead of losing it. Green infrastructure in combination with a reduction of the problems mentioned before is our way to more breathable, vibrant, social cities.

THE NETHERLANDS: NATIONAL ECOLOGICAL NETWORK

Adapted by the Dutch government as a nature policy in 1990, the ecological main grid (in 2014 renamed the national ecological network) was meant to connect the different habitats that were there to stimulate natural processes and migration of animals between those area's. The intention of this policy was to stop the decline of biodiversity and at least be in line with the European standstill-principle.

This way of approaching nature as being technocrat was new, but was also expensive and in the economic recession later that decade the policy was dressed down extensively.[7] After the recession the policy was adapted to make it fit to let the more local governments be the executers of this nature policy. Private stakeholders have the possibility to enter with their private plot as part of the network, they can receive a subsidy for their effort.

Also agricultural parties are invited to cooperate in areas that are destined to house biodiverse agriculture. This private-public cooperation through subsidies creates a new (cheaper) way of creating the network. However, where this network of subsidies and nature parks is existent in the rural areas, the urban areas are yet to be defined.

NATURA 2000

The notion of creating places to stay and places fit for migration is not a new concept. The high quality natural parcs are a backbone of the European nature-policy. In the Natura 2000 guidelines for birds this notion was introduced dividing area's in residential and migration area's both with different demands. This way helping the bird migrations.

These networks do not form networks do not form a physically closed network but rather they form a network of spaces that are communicating with other spaces that are in reach for the species of concern. This way smaller animals do need a more dense sequence of spaces where birds are able to cover greater distances between their resting spots.

Case studies

In this chapter three examples are reviewed, using three different strategies, scales and their approach towards the existing structures. At first the plan of the Superblock of Barcelona is reviewed, secondly the plan of Victoria business district, at last the subsidy plan of multiple Belgian and Dutch municipalities.

1. Central executed masterplan: Superblock plan (Barcelona, Spain)

Due to the industrial revolution all over Europe the population rose firmly, these people would go to the city to find work. This process was also happening in Barcelona in the 19th century. This urban growth was facilitated by the expansion plan of Cerda. This progressive plan was designed around a block structure with wide streets with lots of space for the greenery (natural systems), human space and space for public transport (Mueller, Rojas-Rueda, Khreis et al., 2020).

[7] The purchases of farmland made this policy which intended of creating a physical connections between existing nature and creating new on weak spots in the system (Joop en Bal, 2016).

Over time the scale of the city outgrew the existing structure and the technical system of the car took all the free space intended to house all the previous mentioned systems. Nowadays this city suffers from the severe consequences of the UHI-effect (Moreno-Garcia, 1994), air and noise pollution (Mueller et al., 2020) and a lack of public open green space in relation to a dense population. The main transportation mean is the car since it is welcome everywhere in this metropolitan area, adding a more social-economical problem where mobility is related to the given if you are in the financial position to poses a car. This focus on motorized transport and mobility is the cause and reason of these problems.

In their battle for a cleaner, more equal and more vibrant city the Barcelona city council started to rethink their urban structures. A solution was found around the principle of a strict masterplan, rethinking the role of the existing grid. The local government formed a PPC[8] to found the UEA[9], an organization that designed a plan to develop 503 Superblocks all over Barcelona. Main intents at stake were the reduction of UHI-effect, air and noise pollution to lower the mortality rate in the city and a change of mobility behavior. As well as reclaiming the streets for their inhabitants so that the monopoly of the motorized vehicle would be transformed in a street where men, nature and other means of transportation would have a better position. Central in this notion was the SDG 11 (UN, 2019) to aim for a more equal distribution of the cities facilities among rich and poor (Mueller et al., 2020).

The Superblock is built on a 4x4 grid structure with nine blocks (size: ±400x400m), in the previous situation all the roads would be equal one-way roads. In the new situation only the roads around the Superblock are destined for car-use, within the blocks through-traffic is blocked. The space that is now vacant becomes open for greenery, plaza's and active forms of transportation.[10] To connect the different blocks the outer roads are adapted to house a separate bike and bus lanes, with a bus network that will stop at each Superblock with a high frequency. Comparing what was and what is planned we see that the different parts of greenery now form a connected GI to let people and nature reclaim the city (see figure 1).

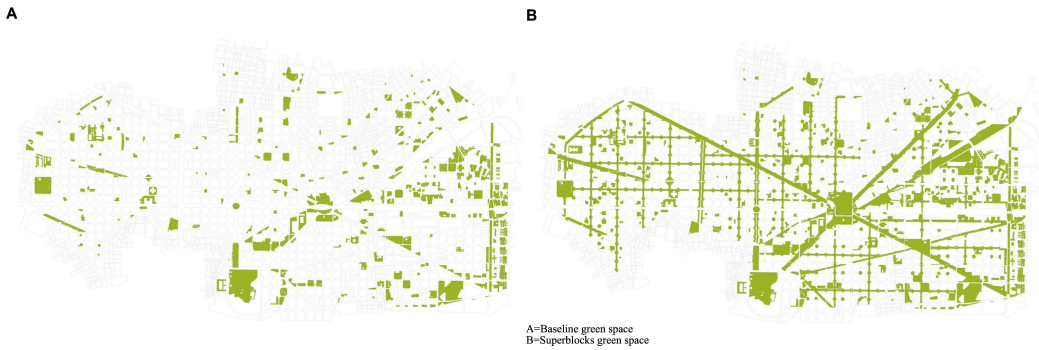

Figure 1. Green space development for the Eixample neighborhood related to Superblock-plan (Mueller et al., 2020).

Concluding the Superblock model forms a tactical urbanist base to the redesign of urban structures towards a more social, equal neighborhood. The imposed greenery is very effective against the noise and air pollution as well it provides a new GI for natural systems to regain their position within the city. In terms of redesign on building scale this plan allows for private initiatives, providing a shared

[8] Private-public-consortium

[9] Urban Ecology Agency (BCNecologia)

[10] The Mueller et al. (2020) describes cycling and walking as active forms of transportation

base to the city. The chosen strategy of a top-down method using the masterplan to achieve the goal proves in this situation very effective.

2. Private executed masterplan: Victoria business district (London, UK)

In London's business district of Victoria a different approach was chosen, the sustainable redesign was based on buildings rather than public space. This way the plan uses a more guiding masterplan, a structured way of implying small initiatives in stead of using a grid system of public spaces. Implying green infrastructure through renovations of roofs and walls a higher level of biodiversity was aimed for. The project is again founded in a PPC where the goal of the organization was to redesign the business district to create more value, make people stay longer, increase biodiversity, to battle the urban heat and flooding rains (Victoria business improvement district, 2013).

At first a plan was made by landscapists, ecologists and green roof experts to imply a vision of where green spaces should come and how it would fit to the already present GI. After an analysis, a planning and design were completed a GI audit was communicated so every participant could imply a set of standard solutions to their building. Thanks to this standard, biodiversity was consequently a part of projects in the area. After the realization they kept monitoring the effects of the project through the presence of bats as an indicator for biodiversity (Apfelbeck et al., 2020).

This plan provided a base for several projects and with the research afterwards the effects are there. The green wall of the *Rubens at the palace hotel* cools its surroundings up to ten degrees Celsius and five species of bats were seen (Victoria business improvement district, 2021). Concluding, this shared base through specialists to make a guide for green building redesign proved to be effective.

3. Bottom-up initiatives: Funding policies for urban greenery

The final showcase of urban strategies for an improvement, uses a different strategy. Governmental organizations fully fund or subsidize private persons to improve their plots and buildings or adopt a piece of public ground to plant and maintain it. Examples are the public street gardens and facade gardens in cities across Belgium and the Netherlands.[11] The municipalities use this kind of funding to enhance a network of small spots on public ground which contain food and shelter for different kinds of animals on the surface of the existing rigid morphology. The adding of this greenery along the city has also a positive effect on the UHI-effect since the plants cool down their environment.

On the private plots subsidies are given to persons who detach their roof drainage from the sewage system and let rain infiltrate in their garden and to persons who open up their garden and plant native species back. This way the municipalities use the dynamic spaces in-between the rigid morphology of urban structures and more costly legal processes. A new system is created on top of the existing one, without a central structure but built bottom up so that a denser network of these micro habitats create a new form of Green Infrastructure. This added layer creates a base for biodiversity without big interventions as the plan in Barcelona. Although the potential of these subsidy policies are very rich, the amount of research data on these topics is very low.

Conclusion

Rethinking our urban systems is a vital part of the challenge that is presented to our society. With the problems of a decrease of biodiversity, climate change, polluted cities, social inequality, increasing UHI-effect and flooding showers the consequences of our choices in urban design become clear.

[11] Local governmental organizations such as the province of Zuid-Holland (NL) , the municipality of Ghent (BE), Rotterdam (NL) and Utrecht (NL) all have a policy of subsidizing green initiatives adding green spaces, planting native species and offer the possibilities to adopt a piece of public soil to plant and maintain.

These problems resulting in increasing health issues, higher mortality, more heat-stress, distinction of animal and plant species in cities. An increase of green spaces, plants and a more dynamic green urban system is needed.

To define which approach to take, it is important to define what is seen as a good solution in terms of systems and to then define a methodology. In general (on regional level) a system of *Natura 2000* areas and migration areas represent such a system for birds and important nature. Secondly the Dutch *National Ecology Network (NEN)* tries to keep the current level of biodiversity at least at its current level by creating a network of hotspots and nature friendly private plots. This network notion is a good base to set as base for urban design, constructing a network city-wide to connect and enlarge the migrations through the city. Although the Dutch network focusses on the advantages for the natural systems only, the English agency of Nature England defines its solution differently. They like to speak about *Green Infrastructure (GI)*, defining it as a multifunctional high quality spaces organized in a system that contributes to a high level of benefits towards the local community. Improving its surroundings in quality of life and environmentally. This shows a more incremental approach towards the problems for men and nature.

Defining the theoretical framework of approaches towards solutions with the NEN and the GI to guid this discussion, three case studies are reviewed. The three show different levels of governmental policy making, municipalities in the role of executor or something in-between.

The first case study of the Superblock of Barcelona took a very big step to reclaim the public soil, using a grid structure that offers a great deal of possibilities through its morphology. Although this plan is very successful in terms of dealing with pollution, social inequality and UHI-effect; it is a plan that is not applicable in every situation since the morphology of this particular city is unique. Also the focus of this plan is rather on human parameters, rather than natural ones.

Secondly, the case study scale took a step down. This case study is located in the Victoria business district in London. Here, a central guiding masterplan was set up to improve the GI. This masterplan was then used as a plan to let local initiatives take part (subsidized) in this plan, so that on tactical places a strengthening of this GI was placed. The results where measured in natural parameters, as well as in human ones. This proves how the intend of adding commercial value can go hand in hand with biodiversity strengthening.

At last, the most primitive form of adding natural elements to the city was reviewed. In the Netherlands and Belgium municipalities subsidize their inhabitants to create green spaces on their private plot and offer them a subsidized possibility to adopt a piece of public soil to create small public gardens. These initiatives are very low profile and have no central masterplan, but depend on the involvement of their inhabitants. This strategy adds a new layer of small hotspots without big interferences.

Finally, the role of the existing urban structures as rigid morphological beings is addressed. Defining the possible approaches and the different strategies how to deal with them is explained above. In these case studies the buildings themselves have very different meanings in terms of their masterplans. Case study one saw the urban building as a non-active part, as case study two saw it as a resource to cooperate in green solutions. And case study three saw the superficial base which the facade and roof of buildings offer to construct greenery along. The role of the existing urban buildings are very interpretive to the planners at stake. It is therefore important to take part in the discussion which role these buildings in their urban setting should fulfill based on their historical value, social value and their environmental and biological base for improvement. Measured by natural and human parameters to then discuss the results of the measures that were taken.

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