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THE NECESSITY FOR RE-THINKING THE WAY WE PLAN OUR CITIES WITH THE FOCUS ON MALMÖ

Towards Urban-Planning Based Urban Runoff Management

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Abstract

The project is proposed in order to highlight the necessity for developing a climate-robust urban planning. The City Blueprint baseline assessment was chosen to evaluate the sustainability of urban water cycle services (UWCS) of Malmö and compare it with Rotterdam, Amsterdam, Hamburg and Copenhagen as cities which experienced extreme water events in their history. Although Swedish Municipalities previously have done many efforts for adaptation to climate changes, at least in case of Malmö the experiences showed that it was not enough. The City of Malmö needs to revise its methodology. The purpose of this paper is to encourage Swedish cities to take more advantage of urban planning and design in order to develop climate-robust planning and appropriate sustainable solutions for urban runoff management. Climate-robust planning is supposed to formulate strategies and reduce the collaboration gap between water and environmental engineers, urban planners, architects and all the cities' decision-makers.

Key words – Adaptive Planning, City Blueprint, Climate change, Climate-robust planning, Urban Design, Urban Planning, Urban runoff, UWCS, Water resilience, Blue-Green infrastructure

Sammanfattning

Projektets syfte är att visa på behovet av utveckling av klimatrobust stadsplannering. City-Blueprint baslinjebedömning valdes för att utvärdera UWCS hållbarhet i Malmö och jämföra det med Rotterdam, Amsterdam, Hamburg och Köpenhamn. Dessa städer har haft erfarenhet av extrema väderförhållanden i sin historia. Trots att svenska kommuner lagt ner mycket ansträngning i försök att anpassa sig till klimatändringar, visar erfarenheten åtminstone i Malmö, att det inte räckte. Malmö kommun måste revidera sin metodologi. Syftet med den här artikeln är att uppmuntra svenska städer att utnyttja fördelarna med stadsplanering och design. Målet är att betona behovet av robust klimatplanering samt hitta passande hållbara lösningar för dagvattenhantering i svenska städer. Den klimatrobusta planeraringens uppgift är att formulera strategier. Att reducera gapet mellan vatten- och miljöingenjörer, stadsplanerare, arkitekter och alla beslutsfattare i staden är av avgörande betydelse för det fortsatta arbetet.

Introduction

According to the United Nations projection, in 2050 around 67 % of the world's population will live in cities and it implies the megatrends in the future. It is documented that urbanization has negative impacts on the hydrology as well as the water quality (Qin et al., 2013). On the other hand the climate change is expected to be more intense and unpredictable and induce more economic instabilities. The severity of the impacts depends on the level of exposure and vulnerability to weather and climate extremes (IPCC, 2012). Sweden, like many other countries, is also believed to be affected by the climate changes and face more rainfalls, storms and sea level rise in the future (Scaife et al., 2012). If cities do not get prepared enough to deal with the situation, they

will be at high risk of facing the consequences of catastrophes with huge stress involved. Minimizing the negative environmental impacts and providing people with safety and security are of crucial importance for all municipalities. Cities need to be developed based on the future challenges and become more resilient. Although the cost for revising the water infrastructures is high, the cost of failure in climate change adaptation strategies will be higher. In other words, early adaptation will be less costly. Accordingly, it is necessary to take the crucial steps of integrating water and urban planning and improving the technical and design aspects together and create more qualified urban environments. Addressing the future challenges are the main objectives for developing theoretical and practical methods for transformation of the cities to water resilient ones. Climate change impacts should be understood and measured during the process of urban planning and design. All departments of municipalities should realize and take advantages of art, technology and design potentials. They have to make sure whether all layers of cities infrastructure (in terms of aesthetical-, social-, environmental-, economical-, functional-, technical aspects, etc.) work together or not.

The Development of Urban-Planning Based Water Management

Urban-Planning based water management uses the planning and design as a more efficient tool in urban water management. It also helps to apply the full-potential of urban spaces and vegetation in the process of urban water management. Vegetation and open spaces can also take some additional roles in urban runoff management. Techniques such as adaptive urban landscaping or vegetated storm water treatment systems, including bio filters or rain gardens, green roofs and facades, wetlands, swales and so on are some samples of practical methods. Most of the techniques are about mimicking the nature as a resilient system. Creating natural topographies, pavements, using specific vegetation, etc. are some of the elements that enable the creation of attractive urban space.

We need a good understanding of how water catchment areas are connected and how they work together. The same kind of understanding also applies to the cities' green infrastructure. Furthermore, having a comprehensive knowledge of the cities' existing land use and physical plans, as well as the residents' needs, are of crucial importance.

To deal with the urban runoff, different sustainable solutions, as storm water management techniques, have been developed. The techniques are called Water Sensitive Urban Design in Australia, Sustainable Drainage System in UK or Low Impact Development (LID) in US but the objectives are the same. They all depend on the management measures to control the storm water. However, all the techniques have different effectiveness during storm events (Qin et al., 2013). It is very important to study the area to understand the context and the possible rainfall characteristics which might occur in the area.

To describe the storm water management techniques, Water Sensitive Urban Design (WSUD) is explained as an example. WSUD a term in the planning and design of urban environments to make them sensitive to water issues and it is based on integration of urban planning with the urban water cycle management (Wong, 2011). Through WSUD, cities let their communities live in harmony with natural water environments and make them more resilient to the challenges. In a water sensitive city, planning and design are done around the issues of water conservation and risk of flooding in parallel with improving the cities' livability. As a part of WSUD, natural systems and green infrastructure requires effective management to take part in sustainability and livability of our urban environments (Wong et al., 2013).

In all storm water management techniques, management of sectors such as planning, transport, energy and health, functions as a part of integrated water cycle management and provides principles for sustainable development strategies (Langford, 2011). There are several sustainable open drainage systems that provide different functions during the process of drainage. Achieving attractive and functional open urban spaces and open storm-water solutions at the same time, is an ideal situation for cities. Getting to this situation, the comprehensive regional plans needs to be well-matched with storm drainage systems. To start with, "Drain Programs" are required for removing the gap between the water levels that drainage systems can cope with today and the levels that they need to be able to cope with in the future. Since the four main characteristics of climate changes are uncertainty, contentiousness, multiplicity and complexity, adaptation to climate changes requires "adaptive spatial planning". In other words, adaptation measures cannot be implemented as single-purpose strategies. It needs multifunctional adaptation strategies with a clear win-win character (Buuren, 2013). Planning of storm water for any site should be coordinated with planning of land use and the master plan (UDFCD [1], 2008). Drainage facilities require work with both open spaces and transportation simultaneously. Thus, new identified opportunities may assist to solve the drainage problems (UDFCD [1], 2008). Merging urban life and adaptation strategies is very important. As a practical sample,

Figure 1. *Watersquare Benthemplein in Rotterdam combines water storage with urban spaces. Photos are obtained from Rotterdam Climate Initiative Press kit.*

we can mention Watersquares, proposed in some Dutch cities, as multifunctional solutions applied in the flood resilient urban planning (Figure 1).

Assessment of Malmö Urban Water Cycle Management

The urban water management objective is to ensure that no damage has been caused in the city or on the countryside, even when the precipitation or drought are at their peaks (Pötz, 2012). The City Blueprint baseline assessment is used to give a quick image of the sustainability of urban water cycle services (UWCS) of Malmö as the third largest city of Sweden. This is a methodology which has been developed by KWR, Watercycle Research Institute in the Netherlands and has been applied further in the EU Research Project TRUST, and elaborated as contribution to the European Innovation Partnership on water (EIP Water), as a part of the City Blueprint Action Group. It is based on 24 indicators, where each has a score between 0 and 10 (Van Leeuwen, 2014). The City Blueprint tries to promote the best practices through sharing knowledge and experiences between cities. The objective is increasing awareness among decision makers to develop the appropriate frameworks for transforming cities to more water resilient ones. The key elements of the City Blueprint are simplicity, transparency and ease of communication (Van Leeuwen et al., 2012). The goal for choosing the City Blueprint assessment method, for the evaluation of Malmö's UWCS, was comparing it with some other European cities like Rotterdam, Amsterdam, Hamburg and Copenhagen. All these cities are located along the North Sea and share some similarities with southern Sweden when it comes to the climate challenges. All of them have been exposed to devastating water catastrophes in their history.

The study showed that, Malmö achieves a very good score for the Blue City Index (BCI) (Figure 2). BCI is the average of 24 indicators with the maximum of 10. Although Malmö Blue City Index gets one of the highest scores, almost equal to Hamburg and Amsterdam, the indicators which are categorized under the groups of Water Security, Water Quality, Drinking water, Sanitation and infrastructure are the ones that score highest. On the other hand for some of the indicators related to the climate robustness and governance with focus on water resilience and integration between blue and green structures, Malmö gets almost the lowest score among all these cities. The low scores of Malmö belong mainly to indicators of Commitments to climate change, Climate change adaptation measures, Climate-robust buildings, Attractiveness and Management and action plans (Table 1).

Referring to other countries' experiences shows that, depending on local conditions, the management process is picked up differently. Countries such as the Netherlands started to rethink the way they plan their cities after extreme events and enormous damages. It was no other choice for the municipalities but taking a holistic approach towards water resilience. Another very good example is Copenhagen, just 40 kilometers away from Malmö. After enormous damage from the extreme rainfall in July 2011 with the precipitation of almost 100 mm/hour, two plans were developed. One is the Copenhagen Climate Adaptation Plan (2011) which sets the framework for implementation of climate adaptive measures in the city administration area. The plan con-

Tabel 1. *Comparison between the five indicators which have a strong relation to planning. The information is obtained from EIP Water. City Blueprints® of 30 cities and regions and its Annex 3. Reports of cities/regions Van Leeuwen (2014).*

Indicator	Commitments to climate change	Climate change adaptation measures	Climate robust buildings	Attractiveness	Management and action plans
Rotterdam	9	10	9	8	8
Amsterdam	8	10	7	9	7
Hamburg	10	10	10	10	10
Copenhagen	8	8	6	10	8
Malmö	6	6	7	5	6

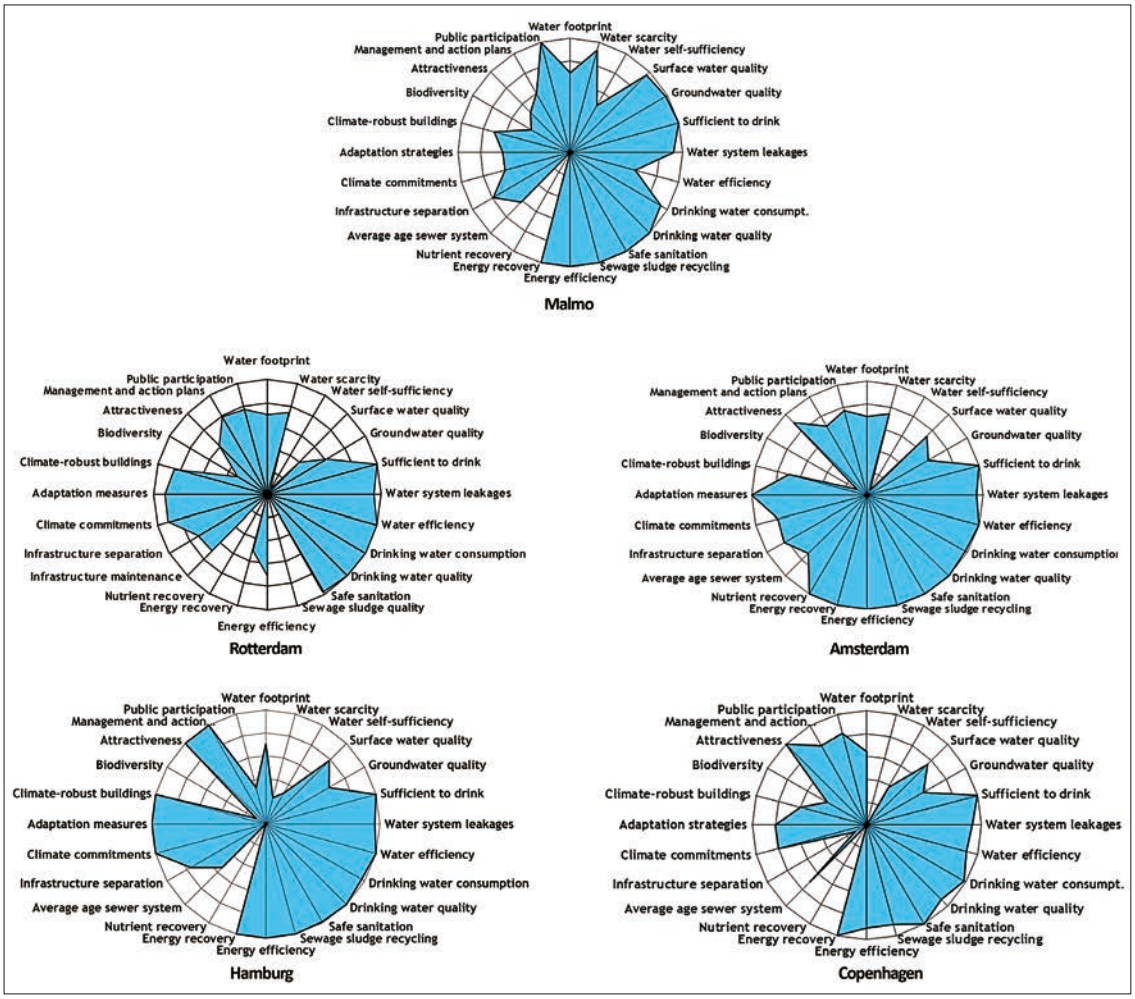

Figure 2. *Comparison between City Blueprints of Malmö and cities of Rotterdam, Amsterdam, Hamburg and Copenhagen. The diagrams are obtained from EIP Water. City Blueprints® of 30 cities and regions and its Annex 3. Reports of cities/regions Van Leeuwen (2014).*

sists of three adaptation levels in Region Scale, Municipality Scale, District Scale, Street Scale and Building scale. The three levels are reducing likelihood of the event; reducing the scale of the event and reducing vulnerability to the event. The second plan is The City of Copenhagen Cloudburst Management Plan (2012) as a branch of the first one. It is mostly defining the methods, priorities and measures. In Copenhagen, surplus water is not addressed as a problematic challenge but a resource for pleasure and value. It is supposed to provide the city with a robust framework for sustainable design solutions in the future. For a better management, Copenhagen was divided into seven water catchment plans and followed by breaking down all the seven areas into projects. All the planning and design within the city should pass the Climate Unit City of Copenhagen and need to be in parallel with each other and match Copenhagen climate adaptation strategies. Balancing between robustness and flexibility is a challenge within the process of both spatial and physical planning of our cities (Buuren, 2013). Cities need to exhibit a good level of adaptation before the climate changes start reaching the peaks of their destructiveness (Figure 3). All the cities that have been pioneers in considering the climate changes in urban water cycle services, have been going through water catastrophes in their past. Swedish cities do not need to wait for a real catastrophe to understand how to set and transform strategies and analysis into actual projects. Other cities' experiences should be our wake-up calls. "The longer political leaders wait, the more expensive adaptation will become and the danger to citizens and the economy will increase" (Jacqueline McGlade, former EEA Executive Director).

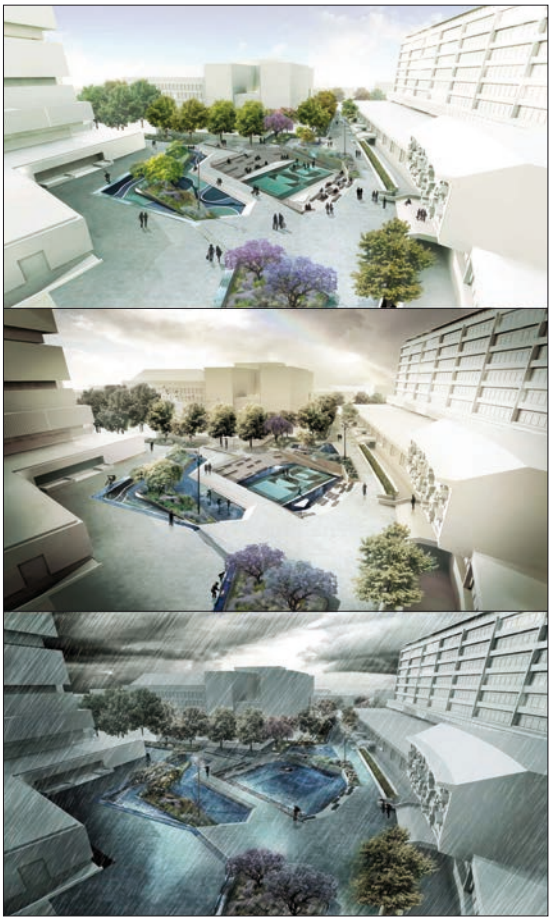

Figure 3. *Watersquare Benthemplein on a dry and sunny day (upper image), after a heavy rainfall (middle) and during a cloudburst (lower image). Photos are obtained from Rotterdam Climate Initiative Press kit.*

Planning the Swedish Cities

It was always hard to accept that the drainage of storm water should be one of the important parameters that should influence the city planning. There were always priority related conflicts between city planners, developers and drainage engineers. According to Peter Stahre; "the best way of tackling the conflict, is to establish a spirit of close and trustful co-operation between the involved municipal departments" (Stahre, 2006). Realizing the importance of highlighting storm water issues at a very early stage of the planning is the key to achieve sustainable urban drainage which should be addressed in the different levels of the physical planning (Stahre, 2006). In case of Malmö, the municipality was always trying hard to give this city a Blue-Green character. It was initiated in 2000 by publishing the Storm-water Strategy for Malmö and setting the principles for storm water management. The book Blue-Green fingerprints in the city of Malmö, written by Peter Stahre in 2008 is also a document proving how important this issue was for Malmö. The book tries to set a framework for the transition from a traditional urban drainage to more sustainable urban drainage. By overviewing the implemented facilities for Malmö and its storm water runoff, the document shows how the approach was developed from the end of 1980ies.

As one of the best practices of Malmö that shows the design power and the necessity of interdisciplinary urban design, we can mention Augustenborg Eco-City which was formed based on integrated urban-water planning. The Augustenborg settlement was developed in the 1950's. In the 1970's people started to move out and social status of the area started to decline. The Eco-City of Augustenborg started 1998 as a good example of transforming an urban area within the framework of sustainability. The goal was solving the overloaded sewer

system problem during heavy rains with ecological techniques such as green roofs, green gardens, different drainage canals, mini wetland, pond, swale, permeable pavements etc. (Stahre, 2008). The municipality not only implemented solutions for water challenges of the area, but also made the area more attractive and popular through ecological storm water techniques (Figure 4). The techniques have both appealing appearance and fulfil their purpose. Figure 5 shows the area during the storm in Malmö on 31 of August 2014. There is no official report on the damages of the city available yet, but the field studies show that Augustenborg managed the runoff much better than before the constructed retrofit.

Role of Planning and Design

Regardless of what has been so far the BCI results of Malmö clearly indicate the necessity of making Malmö more resilient and that water issues should be more effectively integrated in the urban planning process. Since all the five mentioned indicators (Table 1) are somehow related to physical and spatial planning, Malmö as a sample of Swedish cities needs more improvement in its blue-green infrastructure. There are also other signs emphasizing this need, such as the storms which recently struck Sweden. Just within the year 2013, four heavy storms happened in Sweden and two of them, Simone and Sven, affected the Öresund region. In August 2014 flash flood led to chaos in Southern Sweden and caused serious damages in transportation network and buildings in Malmö. Furthermore the climate change is believed to be a cause of very unpredictable weather. According to IPCC (Intergovernmental Panel on Climate Change) the rainfall increase will be up to 20 % by 2100 in northern Europe during the winter period (IPCC, 2007).

Obviously the cities still need a better understanding of tackling large quantities of water, either from the sea level rise or the extreme rainfalls. Water challenges needs

Figure 4. *Storm water Ecological techniques on a usual day in Augustenborg EcoCity. Photos are obtained from VA SYD.*

Figure 5. *Storm water Ecological techniques in Augustenborg EcoCity during the rainfall 31 of August 2014. Photos are taken by Henrik Thorén. The places are the same as the Figure 4.*

to be considered through the process of developing cities. The capacity of existing sewage pipe systems is limited. The drainage systems will be overloaded while the urban runoff has more volume than the predicted. Planning strategies and measures within a well-organized framework are needed when dealing with larger quantities of urban runoff. Every stage of urban planning should be done in parallel with planning of green spaces and water facilities. On the other hand adaptation needs to take place through an interdisciplinary procedure. A combination of artistic and scientific approach is essential to take us towards climate-robust urban planning. This is where design, architecture and engineering knowledge needs to meet and stimulate each other.

Considering the expected and unexpected water challenges during the planning will help cities to achieve a more resilient environment. Integrating the planning process with the climate adaptation strategies and techniques minimizes the flooding risks and negative impacts. Of course it will be a long run process but an early start is vital. We need an effective management which covers mitigation of side-effects as well as adaptation to the extreme situations. In other words, it is necessary to make the cities ready for both preventing the challenges and dealing with the already occurring ones. To implement the approach, all departments and administrations should start working together from the initial stages of planning. In Sweden, planning has three steps. *Comprehensive Planning* as a general one for the total area, *Local Planning* which is more about the detailed development planning like specifying the land use or height and finally it comes to the *Building Planning*. In each and every step, the planning needs to be integrated with adaptation to climate change. Many urban design elements such as green structures and roads should be applied in the direction of flood resilience. Therefore, cities need to be planned based on inclusive climate adaptation strategies.

Conclusion

Although, in general, the sustainability of urban water cycle services in Malmö seems good, climate changes adaptation has not yet been a part of the agenda of the Swedish cities' urban water management. It is inescapable for Swedish cities to take comprehensive approach towards the urban run-off management. Since the pipe systems are limited, open urban spaces have some potential to assist the urban runoff management. Although, in general, the sustainability of urban water cycle services in Malmö is good, climate change adaptations have not yet been a part of the agenda of the Swedish cities' urban water management. Therefore, it is crucial to prioritize the goals and set a new planning hierarchy. Learning from other cities' experiences and sharing the knowledge, provides us shortcuts. Malmö also needs to start defining the urban planning objectives, and go all the way down to integrating urban planning and water system planning and creating conditions for change. All the planning steps should be elaborated down to finest details and offer drainage guides for the future watersheds. As a result, urban and architectural design should be used as a helpful tool to overcome water challenges and at the same time reply to all different needs of society.

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