PLANTS
IN URBAN AREAS AND LANDSCAPE

CONTEMPORARY ISSUES IN LANDSCAPE ARCHITECTURE THE CHALLENGE OF DESIGNING GREEN INFRASTRUCTURE

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This paper explores contemporary issues and challenges involved in designing urban open space in growing cities. The goal is to stimulate discussion about the quality of urban open space by integrating green infrastructure. Urban development and urban densification have an impact on open space in the city – both quantitatively and qualitatively. Urban heat islands also influence the quality of open space. It is argued that green infrastructure can help mitigate these effects on different levels. Site-specific solutions need to be elaborated and should be monitored to enhance our knowledge of multifunctional open-space design in growing cities.

Keywords: design, green infrastructure, landscape architecture, urban open space

1 Introduction

Urban open spaces are an essential part of the built environment. Open spaces in general and green spaces in particular contribute to the quality of life in a city in various ways. For example, they structure the city, influence its image and its walkability, and, last but not least, they affect the microclimate and the well-being of the city's inhabitants.

Urban open spaces need to fulfil many different functions. Rather than taking a one-dimensional approach and attributing a single function to a specific site, social, ecological, economic and technical functions need to be addressed in parallel.

In growing cities multifunctionality gains even more importance, the faster and denser cities grow. Population growth leads to increased construction activity not only to provide houses for the city's inhabitants but also to create the necessary technical and social infrastructure. This is a significant challenge, but at the same time, a major opportunity to incorporate green infrastructure as a means to enhance the quality of life in cities. In light of the social and climatic changes in European cities, landscape architecture has an important role to play in urban development because it is a matter not only of generating more green spaces but also of creating better green spaces.

Vienna is used as an example to describe some challenging issues that are similar in all expanding European cities.

2 Challenging Issues for Open Space Design

2.1 Urban Development and Densification

Vienna has been a growing city for several years. A further population increase is predicted, from the current 1.8 million inhabitants to 2 million in 2030 (MA23, 2014). The increase in population has led to intensified construction activity all over the city. The result of this development was – and is – an increase in residential areas and inner city densification, and a loss of open and unsealed spaces.

The increased construction activity is taking place in every district in Vienna, but it entails a variety of different implications for open space.

Densely built-up city neighbourhoods are characterized by a lack of green space; the public open spaces are streets, squares and small parks. In inner-city areas, as well as in urban renewal areas, the densification takes place in the form of upward extensions with further floors being added to existing buildings, which puts more pressure on the open spaces currently provided. The question is, how can a qualitative upgrading of public and private open space be achieved? Can new types of open space be developed and how should they be designed? How can a multiple use of open space be realized?

Residential areas constructed in the period from the 1950s to the 1970s have a better open-space ratio, but very often these open spaces are of poor quality.

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Densification takes place by adding new buildings on the sites. The question is, how can this type of densification lead to upgraded private and public open spaces and not just to a quantitative reduction in open space? The overall goal must be to enhance the living quality of the old and new residents.

Large new housing and business areas are constructed on sites that have been repurposed and were formerly used, for example, as railway yards, slaughterhouses, or airfields. In this case, new open spaces are planned and built. A complete new network of streets, plazas, parks and gardens can be developed. The main question in these areas is, how can "urbanity" be planned and constructed? What role do different types of open space play in structuring the new neighbourhood? How are they interconnected and what are their specific qualities?

2.2 Urban Heat Islands

One of the consequences of ongoing densification and the loss of open and unsealed open space is an intensification of the urban heat island. This means that there is a higher temperature within the city than in the surrounding area. This trend is exacerbated by global warming. Urban heat islands impact heat-related illnesses and entail a higher cooling demand and cost. But they also mean having to cope with more damaging storms and storm surges, increased river flooding, and combined sewer overflows that are more frequent and more intense.

The trend toward longer and hotter heat waves can be seen very clearly in Vienna. Between 1961 and 1990, the average number of "heatwave days" was 9.6; in the period from 1981 to 2010, this increased to 15.2 days per year (ZAMG, 2012). But also within a city there can be significant differences in temperature depending on the degree of surface sealing and the existence of green and blue infrastructure. It is now commonly accepted that an increase in green (parks, gardens, avenue trees, etc.) and blue infrastructure (rivers, creeks, ponds, water elements, etc.) and an increase of albedo lead to a reduction in urban heat effects (MA22, 2015).

A major strategy in the urban development plan for Vienna, STEP 2025, is to initiate a positive influence on the urban climate by introducing more "green" into the city. The motto is "city-green instead of air-conditioning." The concrete possibilities include the construction of high-quality open and green spaces, the greening of roofs and facades, and the planting of trees on streets (MA18, 2015). The value of green infrastructure is recognized – the question is, how can it be better integrated in urban planning and open-space design?

2.3 Integrating Green and Blue Infrastructure

The European Commission broadly defines Green Infrastructure "as a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings" (European Union, 2013). The advantage of green infrastructure as opposed to grey infrastructure lies in its multifunctionality and in the fact that it generates human and ecosystem benefits – from environmental, social, climate change adaptation, and mitigation benefits to biodiversity benefits (European Union, 2013). Green infrastructure is made up of a wide variety of "nature-based solutions" that can operate at different scales and ideally form an interconnected network. The measures may be applied to individual buildings, sites, and neighbourhoods or to entire regions, and the benefits vary in scale accordingly. So called "blue" landscape elements are linked to water. They can be rivers, creeks, pools, ponds, artificial water elements, etc. Together they form the green-blue infrastructure network. Many of the nature-based solutions apply to water management or at least have an influence on the water balance. Because green infrastructure has the ability to moderate the impacts of heavy rainfall or high temperatures, many municipalities have started to implement green infrastructure to meet storm water management goals or to promote local adaptation to climate change.

The slogan "Parks Not Pipes" was created by researchers and students from the University of Arkansas, and it neatly encapsulates why there is a strong link between urban drainage, green infrastructure, and landscape architecture (University of Arkansas, 2006).

3 Designing Green Infrastructure

Urban densification and the effects of urban heat island have implications for open space on various levels. Measures to mitigate the effects of the urban heat island are closely connected with measures relating to rainwater management. They target infiltration, evaporation, and evapotranspiration.

With regard to the application of Green Stormwater Infrastructure (GSI) in landscape architecture, we can distinguish three main approaches in design. The first approach is "concealment," which means that rainwater is removed from view as rapidly and unobtrusively

■ **Figure 1:** Rain garden at University Campus Technikerstrasse, Innsbruck, Austria
Source: Design by Karl Grimm Landschaftsarchitekten, image © schreinerkastler

as possible and diverted to underground systems. The second approach is "integration": the water flow is open but the system and its components are not highlighted. It is an unobtrusive integration of the infrastructure in the overall design of the site and the everyday use of the open space. The third approach involves "showcasing rainwater." The design not only addresses storm water management but transforms these systems into storm water-based amenities. Designs create site-specific features and interactions. A major consideration when designing for rainwater is that open space is used less when it rains, so showcasing rainwater should also point out the system in dry weather. The term "artful rainwater design" was coined by Stuart Echols and Eliza Pennypacker (2015) to describe this approach.

A planting design approach is a "rain garden." Swales are planted as herbaceous or mixed borders. It is a popular design approach in the USA that originated as a concept for making infiltration in front yards popular, but the term is now applied to any infiltration measure using specific planting.

In practice, these three design approaches are combined and the overall goal is to achieve an integrative solution serving social, technical, ecological, and economic needs. Landscape architecture merges rainwater management, planting design and irrigation planning. This means optimizing a system of nature-based solutions for various functions, incorporating these in a design concept and – usually – working within a tight cost frame.

Implementing and designing green infrastructure in densely built-up city districts aims at the multiple use of open spaces to cope with the increasing pressure on the few existing open spaces. Classical types of green spaces, like green spaces at educational institutions, kindergartens, schools, or sports facilities, additionally need to meet various infrastructural requirements. Urban drainage, irrigation, or measures for improving the microclimate must be key considerations from the very beginning of the design process so that green infrastructure can be successfully implemented. The same applies to residential areas and business districts.

Furthermore, there is a need to reinterpret open spaces for mobility. Green infrastructure can be a means to enhance the quality of streets and pathways. Elements to achieve these effects are green roofs, green facades and trees. Walking and cycling in the city call for additional qualities in open space. Footpaths and cycling routes should be considered an essential part of the urban green network.

The newly constructed neighbourhoods present a major opportunity to create a new

network of open spaces, incorporating innovative solutions for private and public open spaces, such as new multifunctional streets or parks.

4 Conclusions

Qualifying green space and designing for multifunctionality

Problems in open space are site-specific – therefore the solutions should also be site-specific. The more functions an open space has to take on, the more complex the analysis of the site needs to be to achieve a specific design solution.

Site-specific designs with "nature-based solutions"

Knowledge of a broad palette of nature-based solutions is the basis for generating a complete open-space design that integrates social, technical, ecological, and economic needs. The city should be made "readable," and the various functions of green infrastructure are made visible by design.

Strengthening and linking research

"Research by design" should be intensified to explore new types of open and green spaces that incorporate green infrastructure. For this purpose and with a view to establishing multifunctional streets, more research is also needed to understand the social dimensions of densification of use and multifunctionality.

To increase the number of healthy trees in the city, research on "structural soils" is essential to enhance the living conditions for street trees and to prolong their lifespan. This technical research needs to be combined with research on plant selection, water balance, and water quality, as well as contributions to evapotranspiration and the microclimate.

Monitoring realized projects

In a phase of intensified construction many projects are realized – some of them with innovative technical, ecological, or social approaches – but hardly any of them is monitored to check if the goals have been met. In the process, important information that could help improve future projects is lost.

Landscape Architecture should not be confined to planting design but must also take the lead in designing new urban open spaces.

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