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Green structure plans in the urban landscape; the role of green space after the Covid-19 pandemic

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1. Abstract
After the recent pandemic of Covid 19, the issue of green space in the urban landscape has gained more attention. Since the outbreak of Covid 19 a new dimension has been added to the function and role of green space in the urban landscape; how can green space create conditions for healthy environments for people? In this paper I will investigate in what ways existing design knowledge on urban green structure plans can contribute to this new demand from society and what role greenways can play in the process of planning and design. The research methods are mixed; comparative analysis of plans, fieldwork and research on existing literature. All fit into the case study approach as integrative research approach in landscape architecture. In the first part I will analyse the relation between pandemics and organisation of space in the daily environment; what are spatial factors related to form, function and use of the daily living environment that can influence pandemics and the public health in general? In the second part a brief overview of urban green structure plans will be given; history, content and context of landscape plans and green structure plans in the Netherlands. Here the research question is how existing design knowledge on the issue can be used in these new context. In the third part the implications for planning and design will be elaborated. At what levels of intervention and how can green space be integrated in the making of urban green structure plans? One of the conclusions is that the design knowledge and approach developed in urban green structure plans could be further elaborated towards integration of public health by focussing on structure which includes the road system. Further attention is needed for the role of mobility and traffic systems; separating car traffic, public transport and slow traffic seems to be an option with more attention for slow traffic in the urban landscape.

Keywords: Landscape architecture, Level of structure, Design knowledge, Precedent analysis, urban mobility

2. Introduction
After the Covid-19 pandemic broke out, the question what design can contribute to the creation of healthy environments for people, has become even more pregnant. In the development of a new approach for planning and design to integrate the issue of health in urban landscape architecture, this question will be worked out by making use of and building forth on existing design knowledge in plan making in green structure plans in urban landscapes. In Dutch landscape architecture, the tradition of green structure plans for cities and urban landscapes in general, is well developed (Visie, 1977; Meeus et al., 1992, Vroom, 1992, Visie, 1995; Bos & Bosch, 2008). Green structure plans were developed in the second part of the last century and were based on the principles of plan making in landscape plans. These principles can also be used as a basis for integrating the new demands for creating healthy environments for people into a new design approach.

Terms and definitions

landscape plan; the landscape plan developed in the Netherlands from the beginning of the last century on. We have defined 'landscape plan' in the Dutch context as follows: *A landscape plan is a plan for the future development of the landscape be it rural, urban or infralandscapes, so they are in most cases project-based. Landscape plans seek to integrate the existing landscape before intervention, the program and the design concept in a new meaningful order in the context of contemporary society and users. Searching for coherence and unity is the core of 'designerly ways of thinking and doing' and is based on a conceptual approach (Cross 2006). A landscape plan sets out the main levels of intervention; a strategy of the landscape development in the long run, a new landscape structure and the materialisation of form. A landscape plan as document often comprises a landscape structure plan and a landscape policy plan. For the realisation of a landscape plan — depending on the type of intervention — a technical construction plan (landscape engineering) and a plantation plan is needed.*

green structure plan; the green structure plan is a later development of the landscape plan, based on the same principles but focussed on the urban landscape, defined as: *The green structure plan provides a long-term vision for the management and direction of public space, with special attention to elements, structures and processes as part of the landscape as a natural system. At first, it is a qualitative story and is mainly about the coherence of buildings, paving and open space with a special focus on green space. The quality of neighbourhoods, squares, ribbons, streets, avenues, parks and city edges is mapped; green space that functions as part of the natural system, that can be used for recreational purposes, brings cohesion to the urban landscape, is representative in selected places and ensures the survival of plants and animals living in nature.* (after: Meeus et al. 1992)

urban green structure; u*rban green structure is the entirety of parks, public gardens, canals and other water bodies, linear plantations along avenues, boulevards, roads and other green zones within a municipality. It includes both private and public green space but the green space as part of public space in the urban landscape is the most important* (Visie 1995).

3. Background, literature review and problem analysis

Green structure plans, the Dutch experience

Green structure plans have been developed in a period of about fifty years in practice of making landscape plans, resulting in a coherent set of design principles. These principles comprise first of all to depart from the existing landscape and its characteristics in functioning, form and use, secondly to consider the landscape as a system (natural, socio-economic, cultural) and finally to distinguish in the design process different levels of intervention each with their own design means (Benthem, 1946, Nieuwenhuijze et al., 1986, Harsema et al., 1991, Vroom, 1992; Visser, 1996, Bos & Bosch, 2008). The levels of intervention can be distinguished but not separated. The experience and design knowledge in plan making of landscape plans is not unique for the Dutch landscape architecture; for instance in the UK and in France, landscape plans are used and a well known plan figure (Hackett, 1971, Dauvergne, 1980, Pernet, 2014).

Urban green space, health and pandemics from a spatial point of view

Specific attention for green space in green structure plans has resulted in specifying requirements

and demands for green space in the urban landscape as a whole. Attention for urban green space is not new (Ward Thompson, 2011); in the past there have been comparative analysis between different cities and urban landscapes, on the surface per capita, the psychological effects of green space for well being (Frumkin, 2003; Vlahov et al., 2004; Urban, 2017; Braubach et al., 2021) and the need for daily physical activity (Leeuw et al., 2014; Oliveira & Ward Thompson, 2015). What adds the new demands from pandemics to a design approach? In general for all pandemics, population density is a key factor in the mitigation and prevention. Although density of population is one factor which should always be considered in its context, there are also other influences such as the public health system, the impact of urban mobility and pollution (Berghauser Pont et al. 2020; Tuts et al. 2021).

Sharifi & Khavarian-Garmsir, (2020) conclude that the initial hypothesis was that densely populated and well-connected areas could become hotspots for the rapid spread of the pandemic due to high levels of face-to-face interaction. However, reported evidence on the association between density and Covid-19 is contrasting and inconclusive although some studies have shown significant relationships between density and the spread of the virus.

Health of a population is not only defined by physical and spatial factors, the social and cultural aspects are equally important. For instance in the recent Covid-19 pandemic we have seen that in the US, having overall a low density of population due to the large surface of suburban developments, the country was still severely hit because of the inadequacies in the public health system which is part of the social system. In that context Brownson et al. (2020) put a strong focus on improving the public health system. Next to the social system there are also other factors; for instance in the cities the possibility to work online are far larger than outside the cities. Mueller & Lutz (2022) state that looking at the healthcare systems of all of the countries with lower death rates, compared to theirs, the US system is dismal for those who have a low income or are unemployed. Another issue is the ill health of many Americans due to poor eating habits and an inactive life style, which is a major contributor as well.

In this paper we focus on the spatial aspects as they can be found in the daily living environments of people living in urban landscapes. The question is what spatial aspects are relevant in the mitigating and even prevention of pandemics?

Problem analysis; what are relations between green space and health?
The problem is of health in general and pandemics in particular is not only a matter of density but is multi-facetted (physical, social and mental health) and is specific for different levels. It requires — for the physical environment — an integrated approach, which is characteristic for planning and design in urban landscape architecture. It means that at the level of the city as a whole, the size of urban green space in the urban landscape as a whole is at stake. At the level of the urban quarter the location of different types of green spaces needs to be taken into account. On the level of the dwelling the access to green space by foot or bicycle are key issues in planning and design from the viewpoint of health. Overall it refers to the pivotal role of infrastructure, mobility and traffic systems that connect and give access to different types of green space, which is also related to the organisation and functioning of the three networks; water system, green system, traffic system. In their mutual relation to the structure of the landscape, the three networks form a key point in green structure plans.

This problem gives rise to the following sequence of research questions; what are factors that influence the relation between health and the spatial organisation of the daily environment? secondly, how have green structure plans dealt with the relation between function, form and use of the city at a structural level? Finally how can the design knowledge built up in plan making of green structure plans be used in the development of a design approach for integrating promoting health and mitigating pandemics for the urban landscape?

4. Methods and research materials

While in science the scientific method is acknowledged as the 'standard' for the logic-deductive process of scientific enquiry, in design disciplines the methods are always mixed in qualitative and quantitative methods. Even though since the 80s of the last century the case study approach has been used more and more in design disciplines, it always needs further elaboration on methods and materials. From the problem analysis, three research questions can be formulated; 1. What are relations between pandemics and the form of the urban landscape? 2. How can the experience of making urban green structure plans be used in the prevention, mitigation of pandemics and what is the role of greenways? 3. How could the integration of pandemics in urban green structure plans be further developed in the context of pandemics by making use design knowledge from landscape architecture? For this last question, a distinction should be made between existing situations and on the other hand for newly designed urban extensions.

The overall research method is mixed, both quantitative and qualitative, and based on the principles of case study research; they comprise comparative analysis, exploratory research and developing design methods (Zeisel, 2006). In the first part — the background and problem analysis — the method is a comparative analysis of publications, projects on public, open and green space in the urban landscape to search for similarities and differences. In the second part the relation with public health is at stake; how does urban green space influence public health? The method is based on a comparative analysis of plans and research on evidence as found in publications. Finally, the question of implementing and integrating this knowledge into the planning and design of urban landscapes is elaborated by means of research on design methods and experimental design. The research materials are publications, design projects and existing design knowledge in the form of guidelines and methods.

5. Results

5.1 Experiences in pandemics and daily living environment

While the focus on structure in green structure plans is one of the key issues in the integrated approach of the urban landscape as a whole, the questions about the role of density and pandemics is pregnant. In the study of Berghauser Pont et al. (2020), they conclude with an intrinsic contradiction between urban density and the pandemics. Urban density is a key factor for urban living but also for the efficiency of services, public transport and social functions while at the same time this is also favourable for the spreading of pandemics.

On the basis of empirical research, Tuts et al. (2021) refer to other factors that seem to influence the spreading and effects of pandemics such as age, socio-economic factors but also access to green space. The relation between green space and health in general is already agreed upon in different types of research, but at the same time is also related to socio-economic factors (Spatial, 2020). In

middle income and higher residential areas there is more green space, so leading to lower rates of contamination. In other research the role of mobility and traffic systems is focussed on; Litman, (2013) puts forward the direct and indirect effects of mobility and traffic systems. Reserving less space for car traffic in urban centres and more space for slow traffic has a double effect; at the short distances in the city centre it gets more attractive for pedestrians and cyclists but at the same time air pollution will be far less. Chapman (2007) extends this results to effects on climates change for landscapes outside the cities and to other modes of transport. Overall, the planning and design of mobility and traffic systems can play also a key role in the spreading, mitigation and even prevention of pandemics. It means that in this context, the focus on mobility and traffic systems can have more effect than the relation between density and pandemics.

Even though all these studies refer to cases outside the Netherlands, the common denominator is the high density.

5.2 How can the experience of making urban green structure plans be used in the prevention, mitigation of pandemics?

In the Netherlands, in the urban landscape the 'green structure plan' is a well known plan figure. Characteristic for the green structure plan is its focus on the level of structure that forms an intermediary level between the strategy for the landscape development in the long run and the level of element and materialisation. In landscape architecture the concept of structure comprises three aspects; the system & flows, the form of the pattern, organisation and hierarchy. At the structural level, we distinguish between the structure of the existing landscape and the urban structure. The structure of the existing landscape is based on the topographic form that at the same time gives the basics of the natural drainage pattern. The urban structure is defined by the pattern of the road system, mass & space and urban green structure. In green structure plans in Dutch cases, the relation between landscape structure and urban structure can be considered the framework of the plan. It means that the urban green structure can play a pivotal role in its relation to built-up area, public space, blue space and traffic space. If we take a closer look at the example in the city of Utrecht, we see that interventions at the level of structure can have major effects on the urban landscape as a whole (Groenstructuurplan, 2007). The role of urban mobility and traffic systems is getting more and more the key issue in reorganising the urban structure at large. In the most recent plan (dichtbij, 2021) outside the old city centre, new urban centres have been planned. This decentralisation at the strategic level has been supported by a reorganisation of the urban mobility and traffic systems. In the city centres — both the historic and the newly designed — preference for slow traffic and public transport has been the main guideline. In the surrounding residential quarters, in the neighbourhoods, car traffic has been slowed down to 30 km/h. This is possible at the level of neighbourhoods since there are no through roads in neighbourhoods. Moreover slowing down provides more safety and lower pollution. In the context of pandemics, a structure can be a basis for making 'compartments' or units that can be easily isolated, but urban green structure can also accommodate space for slow traffic so that people can still move around in the open air in a limited residential radius from their dwelling. In such a structural approach, greenways can be part of the urban green structure or define it.

5.3 Towards an integrated approach for planning and design; urban green structure

How could health become part of an integrated approach to planning and design of urban landscapes? Despite the large number of publications on specific issues on design of open space and green space, there are far less studies on an integrated approach. Lynch (1972) did — already

50 years ago — a remarkable job to plea for such an approach. He worked out in a systematic way an integrated approach for the planning and design of urban landscapes and also put forward a hierarchy in steps in the design process and in levels of intervention. In his later study on 'Site planning' (Lynch, 1974) this approach is worked out much further with ample background information. Lynch achieved this integration both with the context of the city at large and with the landscape and climate. In fact he integrated the landscape as a natural, as a socio-economic and a cultural system. It is remarkable how much attention he paid already at that time to the climate, the micro-climate also in relation soils, water systems and plant materials. In a recent study, Pinto et al. (2017) focussed on public health integrating health at different levels.

Focussing on the structural level, how could the mitigation and prevention of pandemics become part of such an integrated approach? In general the structural level organises urban land use, different spaces and the daily urban life by organising location and access (Meeus et al., 1992; Toorn & Fekete, 2016). It comprises all infrastructure including the water system, the traffic system and the natural system (Turner, 1995). In urban landscape architecture the relation to the landscape as a natural system (relations between ground level, climate and underground) is a key issue. Relating urban structure to the structure of the existing landscape at the scale of the city as a whole, is not only favourable for the natural system but is in most cases also more efficient, think for instance of drainage. After the recent pandemic of Covid-19, it has become clear that mobility and traffic systems play a key role in spreading of contagious diseases (Xie et al., 2020). Urban life and culture is based on the proximity of other people for different social groups that need different modes of access (Ward Thompson, 2016). In this context car traffic is largely individually/family isolated, public transport is to be closed off in times of pandemics while slow traffic is in the open air and can be used individually or by keeping interpersonal distance. Taking these considerations into account, what can planning and design then contribute?

To illustrate the role and effect of the structural level, I have chosen three basic urban structures; a grid, a radial pattern and isolated units such as satellite towns. Comparing this three basic models of urban development, the green structure can follow the urban structure, adapt to it but not really follow and be autonomous. At the level of structure, the different networks are interrelated and the design problem is how they are related to the structure of the existing landscape. Here I have focussed on how urban green structure can be related to mobility/traffic systems in the urban landscape at large. First of all by enabling slow traffic on a residential level and further by connecting different green spaces. Creating better conditions for slow traffic is not only a matter of planning and design (physical and social aspects), but also should stimulate the creation of daily environments for people that could enable a different lifestyle (mental and cultural aspects) by creating conditions for physical exercise in daily life. A second principle is to separate the different traffic modes; car traffic, public transport and slow traffic. By creating separate networks for different traffic modes, the effect of contamination and spreading is further diminished. Most public transport — with most favourable conditions for contamination — is in most cases already separated.

6. Discussion and conclusions

In all pandemics the role of public health is crucial because of an epidemic of an infectious disease that spreads across international boundaries and continents in short time. As we have seen with the Covid-19, it is the responsibility of the national government to deal with this large-scale

phenomena by means of a public health system. In pandemics there are two types of spatial measures taken; isolation for individuals and lockdown for groups and populations and on the other hand providing green space in residential areas. In many countries and situations the principle of isolation and lockdown has been the core of government interventions. Apart from the civic rights of people to move freely, it gradually becomes clear that in the long run lockdowns and isolation might be not so effective because after the lockdowns the virus starts to spread again as we see at the moment with new variants of Covid-19. At the moment it is too early to draw conclusions. Even though the lockdowns have proven to be effective on the short term, the question remains how it will work out in the long run. The providing of green space at close distance from the dwelling provides more reliable conditions in case of pandemics. Moreover, green space in the urban landscape does also contribute to a healthier daily living environment in general.

Crucial for creating conditions for a healthy environment for people, is to make sure that the landscape as a natural system can function well on different levels. This typically a long term goal in which green space is a key factor but not the only one.
Nowadays social contacts can also be maintained through the internet, although the pandemic has painfully shown how the social media, email, video-calling did not comply with the needs of people for social contact. They have proven to be only supplementary to interpersonal contacts although they are commercially extremely important, hence the rare attention to this issue in research. In this context urban green space has proven to be a far better basis for social contacts during lockdowns.

There is not a striking difference in the publications before and after Covid-19 on the need of green space in cities in general but there have been changes in function and use. Covid-19 has again emphasised the need for green space in the urban landscape and has put special focus on the spatial location of green space and the access. Moreover, landscape architects and policy makers need to pay more attention to the quality of urban green space and not only to the quantity. The strong dichotomy between, on the one hand, the positive effects of density on transport and economics and, on the other hand, the negative effects for the landscape as a natural system, social issues and human health, is striking.

Apart from the quantity of green space, access by foot and or bicycle from the dwelling in a short time is essential. After Covid-19, a new function for green space in the city has emerged. The overall form, functioning and use of the urban landscape remains an overarching issue. A next step is the amount and location of green space, while urban green infrastructure is often mentioned as part of it. In most studies green and blue infrastructure are considered as strongly related especially for the urban landscape as a whole.

The structural level is a key level in landscape plans and urban green structure plans in the Netherlands; it forms an intermediary between the level of strategy for the landscape development in the long run and the level of materialisation. In meeting the challenges to integrate the experience of the recent pandemic in planning and design in the urban landscape, this design principle remains valid. In existing and newly designed urban landscapes, different approaches are needed. Greenways focus on interventions on the structural level, in some cases the urban green structure can form the basis for the structure of the urban landscape as a whole (Toorn& Fekete, 2016; Grant, 2020). Except for publications specifically on green-way planning, most publications related to this issue do include the other networks such as 'blueways' and other parts of the landscape structure.

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