URBACT Health&Greenspace network

Health-responsive planning and management of urban green infrastructure

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Street Greening for Health and Wellbeing Outcomes

Authors:

Lucia Vecchi *(GMLV arquitectura del paisaje, URBACT Ad-Hoc Expert)*

Tamás Kállay *(Lead Expert of the URBACT Health&Greenspace network)*

The authors of this report were Lucia Vecchi (GMLV arquitectura del paisaje) and Tamás Kállay (Lead Expert of the URBACT Health&Greenspace network).

Key contributors:

Lucy Saunders (Healthy Streets Ltd.)

Anna-Liisa Unt (City of Tartu)

Juhan Teppart (KINO landscape architects)

Karin Bachmann (KINO landscape architects)

cover image: Jorge Fernandez Salas, Unsplash

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Intro: What is a green street?

In European cities, streets occupy on an average 25-35% of the urban space. This means that a large amount of public space is dedicated to cars. A city is a complex ecosystem, and each part of the system has a function: streets are supposed to be used to move goods and humans. But can they also have other functions?

In order to decrease the space dedicated to cars, the big challenge would be to change the city structure to a more walkable city. If we want the car to be less prominent than nowadays, changing the uses of city streets and the attitude of users can be a huge opportunity for changing also the way we live in our cities.

A green street can provide numerous services for the city, through mitigating urban heat island effects, recollecting runoff water, enhancing biodiversity, and also through offering a social place where residents can stay and meet other people or stroll around in a friendly environment. Street greening enhances features of the urban environment that have significant benefits for physical and mental health.

A city street can be transformed into a green street through nature-based solutions at different scales: planning, design, environmental management and engineering practices, to promote adaptation to climate change, and a healthier environment for its inhabitants.

A green street can be designed to calm traffic, to provide safer pedestrian and bicycle paths, to improve aesthetics of the streetscape and to promote a sense of place.

Source: Michal Knotek, Pexels

Macro scale to urban scale: Ecological connectivity and green infrastructure

From a landscape ecology point of view[1], ecosystems and habitats are structured basically by two elements, defined by their form: corridors and patches. A continuous corridor can make connections between different patches, and therefore enhance the movement of wildlife and living material, both on ground and aerial level (*Figure 1*).

Green streets can become ecological corridors within the urban environment, if their design includes linear planting of trees and shrubs, ensuring the continuity to the green infrastructure network.

Green Infrastructures refers to the network of green spaces and water systems that deliver multiple environmental, economic and social benefits for the sustainable development of a territory. On an urban scale, on streets and parking lots the most relevant types of green infrastructure include green alleys, rain gardens, bioswales, green roofs, green walls and green façades.

These green infrastructure elements are nature-based solutions that through the management and use of natural features and processes tackle various socio-environmental challenges, such as water security, climate change, human health and biodiversity loss[2,3]. Nature-based solutions used on streets promote adaptation to and resilience to the built environment. Green Infrastructures directly or indirectly has an impact on living things, and on their health and wellbeing (*Figure 2*).

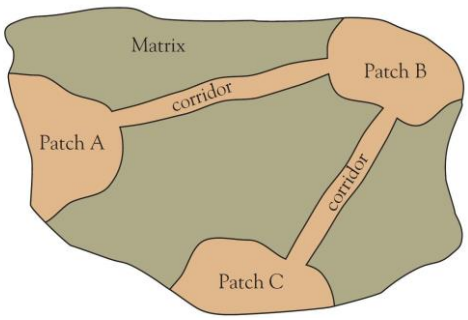


***Figure 1**: A network of ecological corridors*

Source: Forman, 1995

***Figure 2**: An extensive network of urban green infrastructure*

Source: Plan del Verde y de la Biodiversidad de Barcelona, 2020

Benefits of green streets

The benefits of street greening can enhance the ecological, economic and social environment around a city street.

Ecological benefits

Improves water quality

During episodes of heavy rains, green infrastructure is temporarily storing runoff water and filtering it from pollutants, improving the quality of water entering water bodies.

Increases groundwater recharge

In an urban environment the high share of impermeable pavement aggravates the problem of flooding and negatively affects runoff water management. Therefore, increasing the permeability city surfaces is a priority. Green infrastructure, such as rain gardens and bioswales fulfil this function: they catch stormwater, with the help of plants they remove pollutants from pollutants, and they infiltrate water into the groundwater plate.

Improves air quality

Trees and other vegetation can improve air quality by directly removing air pollution and slowing temperature-dependent reactions that form particulate matter that is hazardous to human health.

Reduces urban heat island effects

Vegetation blocks the short-wave solar radiation, but also absorbs long-wave radiation emitted by surrounding materials, lowering temperatures especially during the day. Permeable pavements and vegetation will evapotranspire water and cool air temperatures.

Enhances wildlife habitat

Green infrastructure can offer a better environment to live, find food and shelter for wildlife living in an urban environment.

Economic benefits

Reduces water treatment costs

Green infrastructure practices that increase infiltration or use water on-site (bioretention systems, permeable surfaces) can reduce the amount of water being conveyed to wastewater treatment facilities and reduce the volume of water discharged to the sewage system.

Reduces infrastructure costs

Green infrastructure can reduce investment costs through reducing the need for infrastructure expansion.

Increases property values

Increased greenery within urban areas enhances the aesthetic value of neighbourhoods. The positive impact of green infrastructure practices on aesthetics can be reflected in the relationship between urban greening and property value.

Social benefits

Increases pedestrian safety and traffic calming

Bump-out curbs, swales and segregated bike lanes offer security to bikers and pedestrians, and stimulate a healthier kind of mobility. By promoting walking and cycling, the risk of obesity and related heart diseases will decrease.

Enhances well-being of individuals

Aesthetically pleasing pathways, trees and other vegetation, enhance well-being and help the mind recover from mental fatigue or stress[4].

Increases the sense of community

Green street projects provide an opportunity to involve the community in the process of designing and proposing ideas for their communal environment. For this reason, it is important to implement green infrastructure practices together with placemaking and the participation of the community.

Greening streets for improved health and wellbeing outcomes

Positive impacts of green streets on physical and mental health

A greater exposure to green space is linked to improved physical and mental health across all socioeconomic groups[5]. A 2021 study at Harvard T.H. Chan School of Public Health[6] shows that regularly spending time around trees provides a wide range of health benefits, from lowering stress to improving cognition to increasing longevity.

Reducing heat stress with street greening

Vegetation blocks the short-wave solar radiation, but also absorbs long-wave radiation emitted by surrounding materials, lowering temperatures especially during the day. Using reflective and lighter surfaces in pavements and incorporating vegetation can reduce temperature impacts. Permeable pavements and vegetation contribute to increased evapotranspiration of water that help cool air temperatures.[7]

Street greening contributing to improved air quality

Trees and other vegetation can improve air quality by directly capturing air pollutants and slowing temperature-dependent atmospheric reactions that form hazardous particulate matter.[8]

Positive impacts of green streets on social wellbeing and community cohesion

Green spaces can strengthen social ties among neighbours[9]. Neighbourhoods with strong social cohesion have lower rates of anxiety and depression. The contact with greenery enhances well-being and helps the mind recover from mental fatigue or stress[10]. A study has found a link between increased vegetation and the use of outdoor spaces for social activity, concluding that urban greening can foster interactions that build social capital.[11]

Green streets for noise reduction

Vegetation has been considered as a means to reduce outdoor noise pollution, mainly in areas with high volumes of traffic. But also the use of porous pavement in city streets was found to reduce noise level by up to 10 decibels[12]. In some cases, linear tree buffers can even replace conventional noise mitigation strategies, such as concrete noise walls[13].

Design considerations

Green verges and swales

Green verges on the side of a street provide habitats for animals, insects, plants and trees, and at the same time the added green elements enhance health and wellbeing. Direct contact with greenery brings aesthetic pleasure to the users of the street. Rain gardens or bioswales, in the form of shallow surface depressions, usually planted with native vegetation, will retain, infiltrate and filter both runoff and pollutants. The volume of runoff is reduced by infiltration and retention in the soils and through interception, uptake and evapotranspiration by the plants. Physical, chemical and biological processes in plants and soils help absorb and treat pollutants (*Figure 3*). Bioretention has significant advantages over other practices as it can vary in size, shape and placement[14], and requires minimal maintenance[15]. Bioretention practices can be designed to accommodate large volumes of stormwater runoff or to treat small drainage areas. Depending on the source of runoff, they can be placed either directly adjacent to the area generating runoff or further away on sidewalks or street medians. Bioretention can also be

designed as a series of multiple cells along the roadways or parking lots.

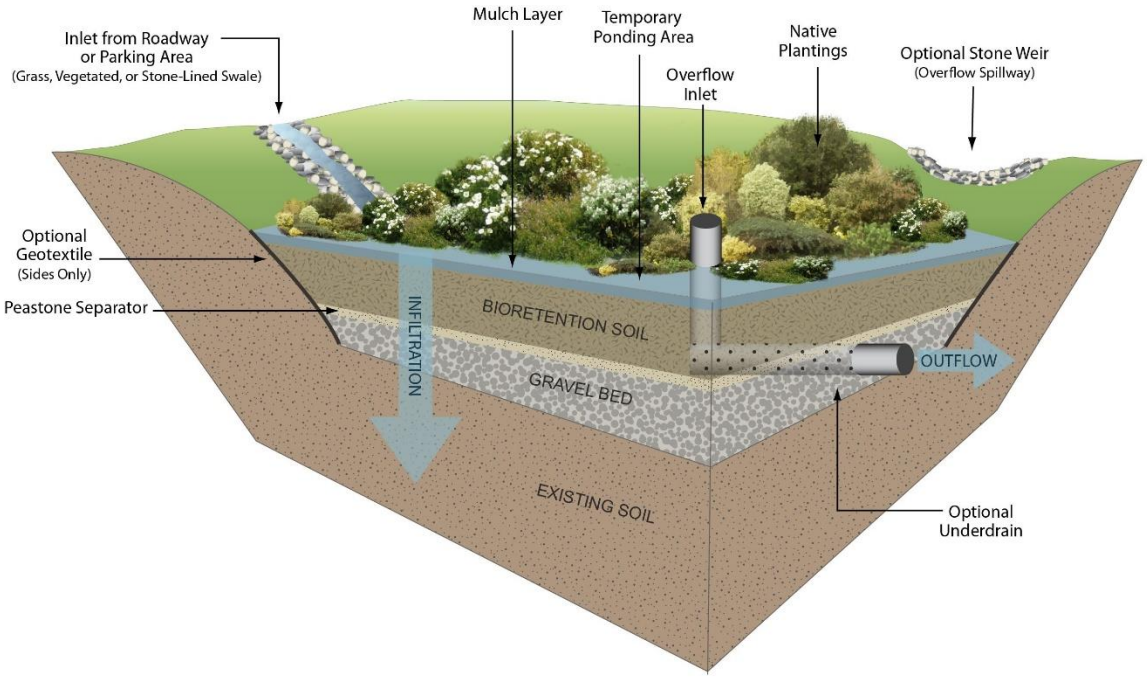


Figure 3: Bioretention area

Source: Massachusetts Department of Environmental Protection

Trees and hedges

Trees in an urban environment have to be planted with a big volume of topsoil, in order to have space for roots to expand and to grow healthy and vigorous (*Figure 4*). Trees and shrubs contribute to good mental health by improving the quality of life and wellbeing of local communities and establishing links between people and nature, by creating individual landscapes and shapes, colours and seasonal variability that help define streets and even whole neighbourhoods.

Street trees increase road traffic safety. By creating vertical walls urban street trees contribute to traffic calming, slowing down average driving speeds[16]. On medians strips that separate opposing lanes of traffic, they reduce the chance of crashes. Street trees, through improving the aesthetics of the streetscape and through increasing the perception of safety, promote biking and create walk appeal[17]. Roadside trees also provide protection from heat, solar radiation and rain[18].

The tree or shrub pits can be also designed with an infiltration function (*Box 1*). If infiltration is not desirable because of a groundwater contamination threat, poorly draining native soils, or a high groundwater table, systems can be designed with an underdrain that directs treated runoff to a stormwater conveyance system. Through filtration and adsorption these practices improve the quality of the water and at the same time can reduce the runoff volume through the uptake and evapo-transpiration by plants.[19]

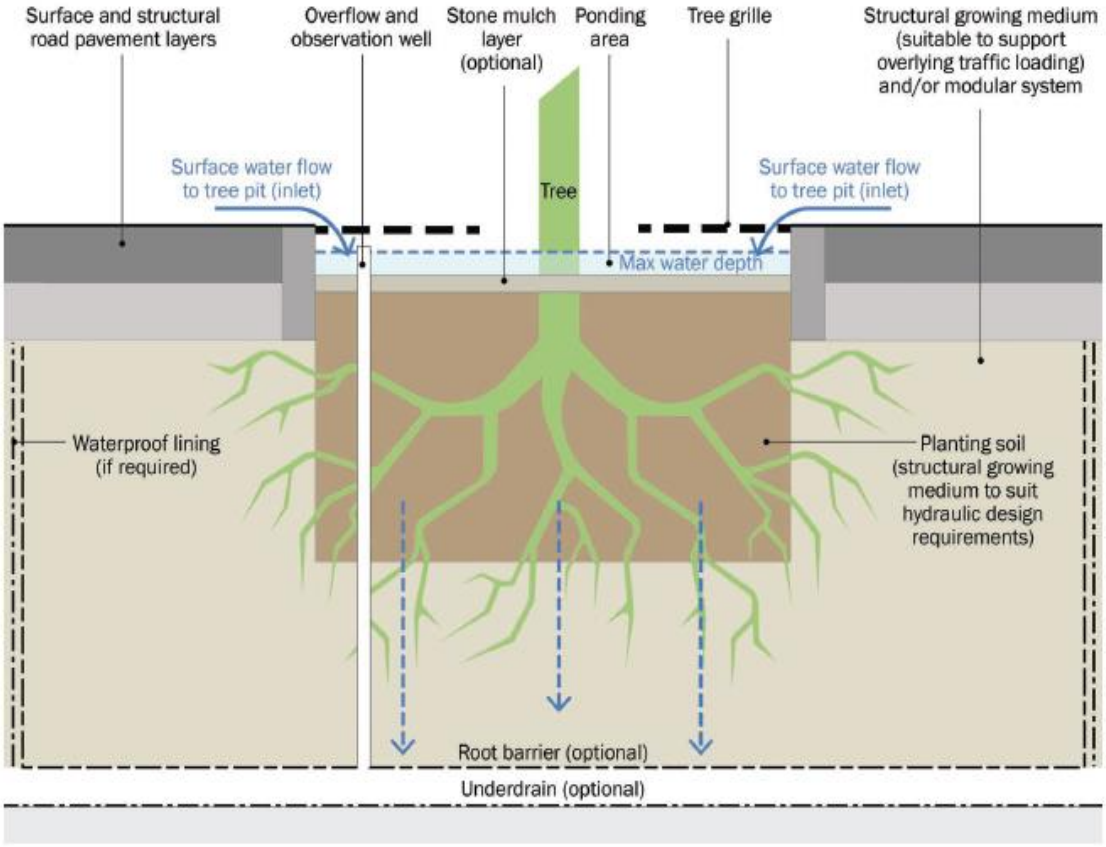


***Figure 4**: Tree pit enabling infiltration and root growth*

Source: The SuDS manual, CIRIA

Green façades and green roofs

Both green façades and green roofs contribute to the reduction of the concentration of air pollutants, to the mitigation of the street canyon effect and reduce urban heat island, delivering positive health and wellbeing outcomes.

Green façades are walls that are created by climbing plants that are rooted in the soil at the base of the wall[20]. They offer economic, environmental as well as physiological benefits to urban environments, apart from aesthetic benefits[21]. As compared to green walls, or vertical gardens, in which plants are not rooting directly in the soil and need intensive care, green façades are easier to maintain and inexpensive.

Although green roofs are generally more expensive to construct and maintain than conventional roofs, they can provide many long-term benefits. They significantly reduce the runoff from a normal rainfall, they store water and, due to evapo-transpiration processes, they cool down the buildings, reducing the cost of cooling during the summer. Green roofs can be designed to provide a high ecological value, by offering a safe space for nesting and foraging for birds, bees, butterflies and other insects and invertebrates. Green rooftops can also provide a micro 'stepping stone' habitat for birds and insects, connecting natural isolated patches with each other, or providing an 'island' habitat at an aerial level.

Box 1 - The Stockholm solution for improving growth of street trees

In Stockholm a very successful street tree planting program has been developed since 2001, that resulted in tree growth in downtown sidewalks that is equal to or even better than trees growing in nearby parks.
In sidewalks trees are typically lacking space, oxygen, nutrients, water, and suffer from ground compaction and soil damage. Under the program of Stockholm trees are provided with a specific growing bed that dramatically improves the growing conditions for the plants in an urban environment. The solution applied in the Swedish capital is based on the use of specially constructed structural or skeletal soils that effectively hinders the soil compaction and at the same time functions as a substrate for the roots of the trees.
The trees are planted in holes that are surrounded by structural soil from below and from the side. The structural soil consists of layers crushed rocks. These layers have 25% – 30% pore space that is filled with soil. The crushed rock bears the load and the roots can grow in the soil.
Following the compaction of the first layer of rocks, soil and a slow-release fertilizer is washed into the voids between the stones. Then a second layer of stone is added, the pore space of which is filled up with soil and humus. The layers of rock are covered by a finely crushed stone layer. A geotextile fabric separates the entire planting pit and the surface layer. The geotextile prevents the pavement base material from sinking down into the planting pit and roots from growing up into the pavement.
Over 2000 projects have been completed across Stockholm, since the program was launched, and the practice is planned to be taken up elsewhere in Sweden.

Sources:

https://www.klimatanpassning.se/en/cases/trees-in-an-urban-environment-1.114276

https://www.linkedin.com/pulse/stockholm-solution-planting-trees-len-phillips/

Image: City of Stockholm

Permeable pavement

Permeable pavements mitigate the heat island effect by cooling the air through evapo-transpiration. They also absorb noise from the street traffic, enhancing the wellbeing of walkers and bikers.

Permeable pavements are specific paving systems that allow runoff to infiltrate through void space within the paved surface into the ground below instead of becoming surface runoff. They can be used for bike lanes and pedestrian paths or designed for only a partial area of the street section or parking places and combined with impermeable pavement.[22]

If the subbase of the pavement is connected to the root area of the plants, these kinds of hard surfaces can contribute to the irrigation of the tree roots across a larger area (*Box 1*). Permeable pavements through providing better growing conditions for street trees can significantly increase the longevity of plants and through this indirectly improve health and wellbeing outcomes of the users of the street.

Identification of priority areas for street greening

In cities there are countless of opportunities for introducing green streets into the townscape. But, when resources available for interventions aiming at the use of nature-based solutions across streets are limited, then urban authorities need to be careful with the prioritization of target areas. A number of aspects need to be considered during the selection of priority areas for street greening[23, 24, 25, 26, 27, 28]:

- The current built environment should be carefully mapped to capitalize on *inefficient use of space*.
- It is essential to *distribute greening in streets fairly* across various neighbourhoods. The amount of greening and the access to canopy cover across the local government area should be assessed to identify hotspots lacking sufficient greenery.
- *Low-cost and simple* projects should be ranked as high-priority.
- In case of *streets* that are *wider than necessary*, greening interventions combined with street width narrowing actions (such as the elimination of travel lanes on multi-streets or the reduction of the number or the size of on-street parking places) should be considered, contributing thus to traffic calming and a balance and healthy streetscape.
- The *space* under and above ground should be *suitable for increased canopy*.
- *Heat hotspot* and *vulnerability hotspot* mapping should be used determine the priority zones for greening streets. Neighbourhoods with a high proportion of elderly or children, or with large numbers of aged care facilities can we considered particularly vulnerable to heat stress. Wide street canyons and also narrow canyons with low buildings can be considered priority streets for cooling with greenery.
- Areas/streets should be mapped that can effectively contribute to the establishment of a *calm space network* through targeted greening actions. In sections where permanent greening is not available, the use of temporary and 'pop-up' green spaces can be considered to offer respite.
- It is worth combining street greening efforts with planned *road or footpath upgrades* due to occur in the street.
- Capital improvement projects, weather resiliency plans, stormwater management plans or citywide initiatives can help identify potential green infrastructure sites.
- *Large-scale development projects* can offer opportunities for greening the streetscape in the vicinity of the development site.

Species selection

Urban trees and street trees in particular are growing under exceptionally harsh conditions in the presence of multiple stress factors. Soil compaction, caused by heavy traffic, construction work, and dense buildings is one of the major problems affecting street trees. In compacted soil the water and air permeability are poor and the roots grow more slowly. Increased surface runoff and poor water retention in urban areas result in soil drought. In addition, street trees typically need to cope with contamination, nutrient deficiency, limited light access in densely built-up areas, or excessive illumination due to the use of reflective materials on buildings, or light pollution disrupting plant physiology[29]. Therefore, in an urban environment it is of paramount importance to select species that are tolerant to various stress factors. As urban habitats do not favour tree growth and shortens the lifetime of the plants, more durable species should be selected for a street environment[30].

Here some basic principles are summarized for the selections of species[31, 32, 33, 34]:

- When possible, it is preferable to use native species, although many native species do not adapt well to harsh urban conditions, or might not meet desired functions.
- Consideration should be given to watering needs and heat resistance of the species in light of a changing climate.
- Where it is desired to maintain canopy during the winter season (e.g., for pollution reduction), evergreen species should be used, but if the goal is to let through the sunlight during winter, then deciduous trees should be selected.
- Vegetation placed along roads should be tolerant to air pollution as well as salt and other de-icing compounds.
- An increase in tree diversity in the city can reduce the vulnerability of trees to pests and diseases. On the other hand, forced diversity of trees may results in planting unsuitable species of trees.

Planning for maintenance

Without designing with maintenance in mind, green streets will not perform as expected over the long-term. There are several maintenance factors to consider before project implementation. During the green streets design process, designers should be in close contact with municipal staff to be able to understand the human resources available for long-term maintenance. If the new greenery will require duties that is different from current practices, the training of staff needs to be undertaken prior to project completion.[35]

Maintenance of green infrastructure needs to take account of a wider landscape context (biodiversity, amenity) together with drainage requirements. All maintenance will need to consider the protection of habitats and biodiversity, the correct functioning of the drainage system, and the management of waste materials and polluted sediments generated by the maintenance during periodic operations.[36]

At a minimum, green infrastructure practices should be inspected annually to remove trash, clean inlets and outlets, remove invasive species and prune vegetation. Maintenance should be performed more frequently while vegetation becomes established.

When green infrastructure is used for stormwater management, like in case of bioretention basins and swales, annually minimum one inspection is recommended in order to monitor infiltration and drainage[37]. For the first one to two months of vegetation establishment, watering is recommended once every 2 to 3 days. If infiltration rates are lower than expected, for its improvement it might be necessary to cultivate or replace the media.

Accommodating utilities during of green infrastructure

Utilities in the streetscape above and below ground can often hinder the implementation of green streets projects. Yet, with the right site conditions, careful planning and stakeholder support, green infrastructure can coexist with utility systems. Close cooperation with the local utility companies during the design phase of green infrastructure interventions can ensure that utility needs and concerns are also addressed.[38]

The Green Streets Handbook published by the United States Environmental Protection Agency (EPA)[39] provides a summary of basic principles that should be considered for accommodating utilities during the implementation of green street projects.

During project design among other the following requirements might arise associated with utility systems:

- providing access to utility lines for repair or replacement and sufficient space for accommodating utility vaults and utility valve boxes, and
- providing adequate protection around utility lines.

To avoid any utility conflict, the simplest and most cost-effective option is to locate green infrastructure clear of any utility or to reduce its size to provide sufficient distance from the utility lines. In case sufficient protection and clearance is ensured on the site, then utility companies can be encouraged to coexist with the new greenery. Modifications to the design of both the green elements or the utility system can also be effective in specific urban situations. As a last resort, the utility can be replaced or relocated. Ideally utility lines can be rearranged as a compact system rather than separate infrastructure.

In many cases, a number of solutions are available to address utility challenges and enable the realization of green infrastructure projects in streets. Options provided by the handbook to avoid problems include:

- placing utility vaults outside the wet zones,
- protecting utility trenches with impermeable geotextile or liners or clay or other impermeable plugs to prevent the infiltration of stormwater,
- installing a clay or other impermeable plug within the utility trench to inhibit movement of stormwater within the trench line,
- construction of a deep curb profile to separate the layer of native soil on which the foundation of a road is laid from the green verge.

The Green Streets Guide of Vermont[40] provides some additional considerations in this context:

- in case overhead utilities are present on the site, then during the selection of plants, the mature height of various tree species needs to be carefully considered,
- the minimum required setback distances for maintenance of above and below ground utility systems need to be applied,
- the cost of underground utility access for repairs might be lower in case of greenery systems (and pervious pavers) since they are easier to remove or replace than traditional hardscapes.

Green infrastructure contributing to healthy street design

Due to car-centric planning, in most of the modern cities across the globe the air is poor, noise levels are high, there is little space for cycling and walking, the amount of greenery is often negligible, and in certain cases it is particularly dangerous not to drive a car.

A Healthy Streets Approach was developed by Lucy Saunders, according to which streets need to be made much more pleasant, welcoming and safe to promote an active urban life[41] (See *Boxes 2* and *3*).

According to the approach, in a typical healthy street there is a wide sidewalk for pedestrians urging people to take a leisurely walk, conditions for two-way bicycle traffic are provided, car traffic is limited, and there are facilities around, such as

cafes, stores, benches or fountains that motivate people to stay longer and socialize.[42]

Well designed and maintained green infrastructure can effectively contribute to the creation of a healthy street[43]:

- good-quality and attractive street greenery feels welcoming, and encourages people to be more physically active on the street,
- well maintained green infrastructure by improving the ambience of a street, increases the perception of safety of pedestrians,
- vegetation on streets (e.g., parklets, trees with benches around and under them, or planter boxes next to benches) can provide a sheltered resting place,
- greenery, such as hedges, can reduce the exposure to air pollutants on the street,
- trees and hedges can mitigate heat, providing shade from the sun,
- green infrastructure can function as a sound barrier and can reduce the perception of noise,
- street greenery has a calming effect on people contributing to stress reduction.

Box 2 - Healthy Streets Approach of Greater London Authority

The Healthy Streets Approach developed by Lucy Saunders was first adopted by the Greater London Authority and the Transport for London in 2014. The programme aims to combat inactivity and to promote walking, cycling and public transport to create a healthy city. The Healthy Streets Approach is a framework of policies and strategies the goal of which is to design physical activity back into the everyday lives of city dwellers.
The Healthy Streets Approach is based on 10 evidence-based indicators that addresses different aspects that are linked to positive health and wellbeing aspects. A 'healthy street' in line with the 10 indicators is a welcoming place for everyone to spend time in and engage in social life, urges people to walk, cycle and use public transport, provides places to stop and rest, makes people feel relaxed, offers street-based activities and things to see, has clean air, it is safe and quiet, provides shade mitigating heat stress, and makes it easy for pedestrians to cross.
The ambition of the programme is that by 2041 in London 80 % of all trips will be made by walking, cycling and public transport, and that Londoners will do at least 20 minutes of active travel each day.

The Healthy Streets Approach is also taken up across the globe in Singapore, Auckland, Sydney, Bristol, Budapest, Portsmouth.

Sources:

https://www.designingbuildings.co.uk/wiki/Healthy_Streets#:~:text=This%20approach%20to%20urban%20development,walk%20and%20cycle%20throughout%20London

https://www.healthystreets.com/

https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/healthy-streets#on-this-page-2

https://taylorburrellbarnett.com.au/2021/11/healthy-streets-indicators-wa/

Box 3 - Healthy Street guidelines, Tartu

In Tartu, Estonia a Healthy Street guidelines was prepared in 2022 that promotes:

- the development of street green infrastructure with an aim to provide a healthier streetscape for residents,
- improved social interactions in urban green spaces,
- the use of green infrastructure for absorbing excess water from rainfall,
- the installation of nature-based solutions to improve the cooling capacity of the urban environment, and
- the use of street greenery for locally improving air quality and reducing noise.

The guide supports the application of a new strategic approach when constructing or renovating streets (e.g., the rearrangement of underground utility lines as a compact system rather than separate and sparse entities). The guidelines function as a link between vision documents and actions in practice. The document was compiled by a mixed team of landscape architects and technical consultants.

A key component of the guide is a unique street quality evaluation method, which consists of four sections – walkability, bicycles, biodiversity and continuity. All four sections are divided into series of different qualities that indicate the overall condition of the street. The qualities are measured on a scale from 0 to 3, first evaluating the current situation and also proposing the desired score for reconstruction.

Source: City of Tartu

Tactical urbanism and placemaking to enhance social wellbeing and community cohesion

In line of the Healthy Streets approach, tactical urbanism is a type of action, that allows cities, communities, activists shape short-term projects to ameliorate a public space, together with a vision to advance long-term goals for the future of their social and ecological environment.

Tactical interventions aim at the creation of temporary spaces, performances in the public space, and all forms of community activism, in order to trigger processes of change. Change in the perception of spaces, in the status quo, or change towards wellbeing of the community.

Tactical urbanism for a city administration is a valuable tool to realize effective and low-cost projects in the streets, giving some of the space back to the pedestrians and for the organization of different community activities (*Figure 5*).

Longer-term changes can be made in community public spaces such as green streets by placemaking.

Placemaking is a collective process that involves the planning, design, management and programming of shared use spaces, and brings together diverse stakeholders: professionals, elected officials, residents and businesses, to improve a community's cultural, economic, social and ecological situation. Through a bottom-up approach and promoting participation practices, placemaking is providing the opportunity for people of all ages, abilities, and socio-economic backgrounds not only to access and enjoy a place, but also to play a key role in its identity, creation, and maintenance. This shared decisional process enhances indirectly social wellbeing and community cohesion.

A tactical urbanism approach for street greening, for instance, would be to add temporary green elements to a street section, as planters or parklets, to ameliorate a space for sitting and meeting in the public space. After that, a process of placemaking would generate a collective design with the participation of the local community, to shape the same temporary space into a more stable green

space, with trees and other green elements, directly planted into the soil. This collective process could also lead to an increased participation of local residents, and stimulate community cohesion and maintenance. One example illustrating this practice is described in *Box 4*.

Source: publicspace.org

Box 4 – Superblock in Barcelona

Barcelona superblock unit was imagined in the Eixample neighbourhood, measuring approximately 400 square metres (nine square blocks). It contains a network of basic vehicle routes connecting starting points and destinations throughout the city. The interior routes constitute a local network where the speed limit is 10 km/h. The roads inside a superblock are local, and less polluted, less noisy, and with less crashes. It also frees up more than 70% of the space currently occupied by motor vehicle traffic passing through the area, making it available for pedestrians and cyclists.

The idea was developed by Salvador Rueda, urban ecologist and head of the environmental department of the city of Barcelona.

The pilot project was developed in 2016 in the neighbourhood of Poble Nou, and it was a first step of a low-cost intervention on a street as a public space: colourfully painted asphalt, signalling, new urban furniture. The second step, during the pandemic period, was to implement car free spots or axes, in different neighbourhoods of the city, offering places to sit, to chat, and to be surrounded by green planters. Now the next step, that will start its implementation in 2022, is to convert four axes and four nodes of the Eixample neighbourhood into green avenues and plazas, car free and with a special emphasis on social wellbeing, community cohesion, and ecological amelioration through permeable surfaces and stormwater treatment solutions to fight climate change.

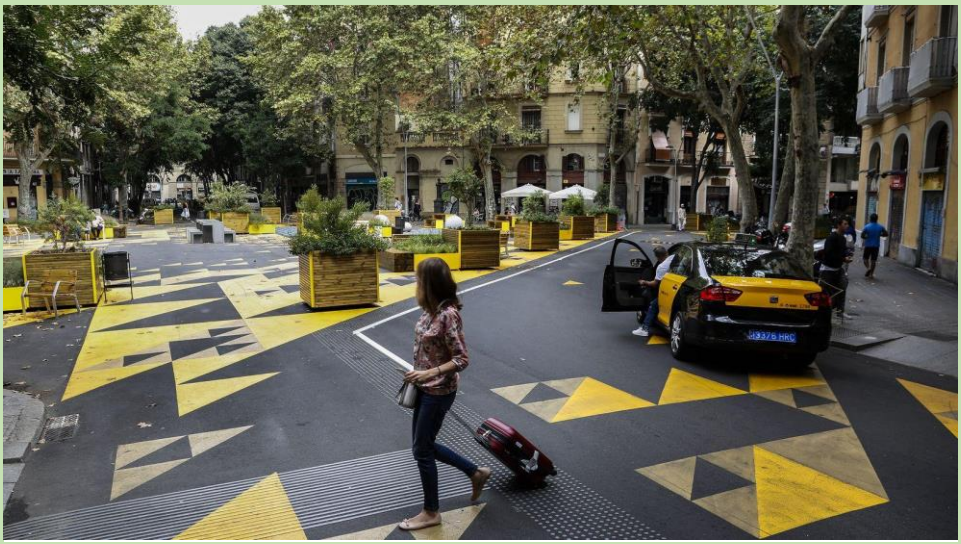


Image: Cèlia Atset

Planning for walkability and bikeability

Street space is not only for car traffic. Automobiles cannot dominate the space and preclude the comfort of other modes. This is generally accomplished by slowing speeds and sharing street space with a range of transportation options[44]. Traffic engineers can and should do better, by designing streets where people can walk, bicycle, work, and cross paths safely[45].

A green street that can provide space to stimulate walking, running and biking, not only to undertake physical activity, but also to use other modalities to commute and move in the city.

One of the proposals of the Mayor of the City of Paris, developed by Carlos Moreno, in this line is the '15 minutes city'. It promotes walkability and cycling in big cities through the concept of urban proximity.

Carlos Moreno's 15-minute city framework highlights four key characteristics[46]:

- Proximity: Things must be close.
- Diversity: Land uses must be mixed to provide a wide variety of urban amenities nearby.

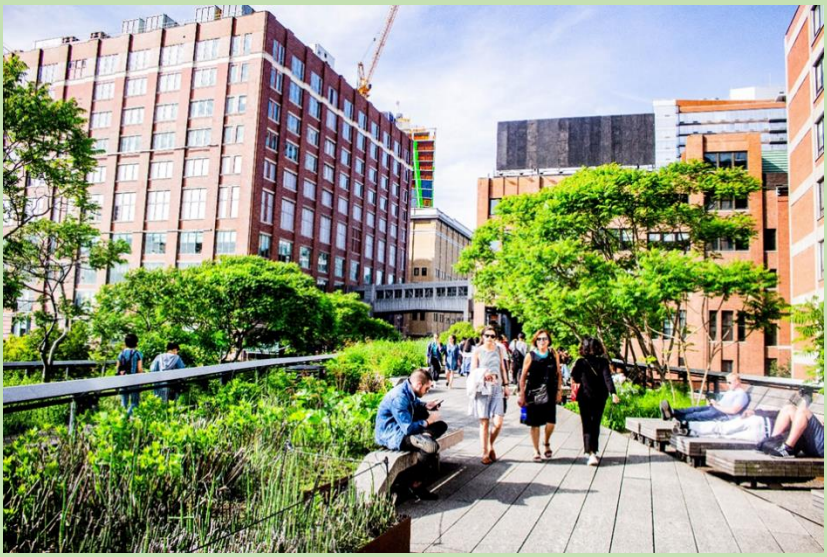
- Density: There must be enough people to support a diversity of businesses in a compact land area.
- Ubiquity: These neighbourhoods must be available and affordable to anyone who wants to live in one of them.

Walkable and bikeable streets and cities start by planning with a human-centred design, that aims to enhance a sense of proximity and ease of access to an ameliorated urban way of living.

Box 5 - High Line elevated park in New York

In Manhattan, New York an abandoned 2.4 km long elevated rail structure was transformed into an iconic green corridor and promenade. The first section of the High Line was opened in 2009. The park features individual and group seating areas, a sun deck, an observation area and social spaces. The landscape architecture of the High Line imitates wild and spontaneous growth, and emphasizes native plants that had colonized the structure after 1980, when the rail line had been stopped being used. One section of the park was even left in its previously uncultivated state. As a result of the green transformation, the structure hosts more than 1500 species of plants, birds and insects.
Various kinds of facilitated activities are organized on the High Line, such as Pilates classes, astronomy classes or guided tours. The activities are free, and are led by volunteers. The High Line is also home to rotating public art exhibitions.

The linear park quickly became one of New York's defining features, triggering a building boom nearby, and attracting over 7 million visitors every year. The project has won numerous national and international awards and recognition.



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