Storm water management in public areas

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Abstract. Problems of drought and maximum use of rainwater in public areas, street furniture and convenient search for users of walking routes. Address small natural elements and areas in the city that have both technical and other environmental features. They help mild manifestations of climate change and benefit the city's.

1. General problems
The first major problems were caused by the poorly coordinated construction of public spaces, utilities together with potential leakage areas. In fact, in earlier times, this problem has not been solved and the consequences are felt only now.
The main reasons for the relatively small spatial capacity of streets. There is a presumption of non-compliance with the minimum protection zones of individual networks, insufficient number of parking places, width of pedestrian roads. In general, with increasing demands on public space, the streets themselves become unsatisfactory. The search for space for possible seepage or retention is in most cases insoluble and it is necessary to resort to a radical solution for a specific location.
Nowadays, all networks are most likely to be at the limit of their lifetime, the current technical state, mainly affected by age, requires the necessary reconstruction, because its possible disruption could have the most serious consequences. If the existing technical infrastructure was reconstructed in the near past, it was a temporary solution.
An integral representation of each member is a public space. An accessible, accessible, but secure, secure area is one of the conditions for the functioning of the public space. Seek everyday visitors with his / her visit, your person's public space, technical resources, and influence people's lives. When creating a public space, you need to look for a solution that can only be sought from users' requests, but also your potential technological developments, natural conditions and climate change, threatening a better microclimate. The quality of the public space must be ensured by comprehensive and integrated solutions.

2. Pedestrian areas, surfaces and greenery
In addition to movement, pedestrian areas within the public space must also allow the development of residential activities and the overall revival and attractiveness of the public space. Pedestrian communication must primarily serve walking - the basic movement around the city, but at the same time it has a key impact on urban life, accessibility and permeability of the city for all pedestrians. For smooth movement on the pavement is a suitable surface and free passage space. When choosing a suitable surface, we have to respect two basic criteria - ensuring barrier-free accessibility by means of a flat and solid surface on one side and flat infiltration on the other. This implies that we cannot always apply ideal infiltration surfaces, especially if we are dealing with basic barrier-free walking routes in the area and reserved parking places for people with mobility limitations, especially wheelchair users. In parks, gardens and public areas.
With vegetation, it is suitable and possible to use soft and permeable surfaces, especially grained or rolled gravel surfaces, if these walking paths are not part of the basic barrier-free route. The basic criteria to be met when selecting the ideal surface and technical equipment of a pedestrian road is to ensure the conditions of use of persons with mobility and visual impairments. From the viewpoint of the safe movement of the blind person, it is required that the pavement is always equipped with a guiding line, which, in relation to the lawns, is solved by a raised garden curb. It is therefore not permissible to have a pavement surface in relation to green and other infiltration areas. For persons with mobility impairments, the pavement surface is flat, firm and slip-resistant, with a height difference of not more than 5 mm between individual tiles. When fitting technical equipment in the form of hatches, grilles, etc., the maximum gap size of up to 15 mm must be respected in order to prevent the stick from falling or the wheelchair from rolling. Holes and gaps in hatches, gullies and grilles also represent a dangerous obstacle to the end of the blind cane. From the microclimate point of view, it is advisable to ensure adequate division of areas and representation of greenery (especially trees) also in outdoor parking areas so that undesirable overheating within these areas does not occur and a gradual drainage of rainwater, respectively. It is infiltration on site. When using vegetation paving, it is necessary to respect the principles of surface suitability for reserved barrier-free parking places.

![Ecological Grassy (vegetation) pavement as an infiltration surface is not an ideal solution for barrier-free walking routes and reserved parking places for people with mobility restrictions cities.](image)

The presence of trees makes an important contribution to the quality of living space and the improvement of a healthy environment, but at the same time it must ensure comfortable conditions for pedestrians and must not in any way endanger the safety of users with health restrictions. This is particularly true of respecting the location and shape of the tree cover for rainwater. From the perspective of blind people, it is important that the alley is at a sufficient distance from the guideline and that the tree crown does not jeopardize the safe movement of blind people and the shape of the enclosure does not restrict the fit of the blind rod or wheelchair wheels.
Figure 2. Suitable and inappropriate location of the alley within the pedestrian area. Trees must be placed outside the pedestrian lanes (Figure left). It is not permissible to place them in relation to a possible guide line (figure on the right).

3. Ecological Technical infrastructure and greenery in public areas
In the complex solution of the new public space, both above ground and below ground level, there are two variants of the solution. In a complex solution, it is always necessary to have space on the surface in accordance with the Decree on General Technical Requirements for Constructions. The street space must be spacious enough both on the surface and below ground level. Storage of new IS by "classical" excavation method, with proper coordination including securing of protection zones and secured against possible future problems with the root system. Such measures are, for example, anti-root barriers, the insertion of pipes in ducts or the choice of a durable pipe material. It is a completely new street space. In this simple area it is necessary to count on the place for possible infiltration of rainwater that will arise in public space. The second way of laying utility lines is in the associated routes, where much more space is available to accommodate the infiltration and containment devices. The combined route solution is also very costly and no administrators plan to invest in this economically demanding solution. Both variants would deal with the issue of rainwater from public areas. Rainwater falling on public land shall be drained into adjacent green belts, which should be part of each paved area. Whenever street space is being reconstructed, the green space should be kept in mind. This space should be lower than the paved surface itself. A simple rule that is not followed during renovations. Rainwater drainage from paved roads will be ensured by slope into adjacent green belts. The transition between roads and green belts should be done by fitting a curb with zero tread to ensure direct drainage of rainwater. Solution of rainwater management system. Human settlements disrupt the natural water cycle and cause floods and water pollution: Natural vegetation is often removed and rivers are drained. Surfaces are impermeable. Groundwater resources are falling, fresh water is scarce.

4. TSES and Rainwater management in public space
Modern ecological strategies for rainwater management emphasize the natural absorption of the Earth and the surrounding vegetation - by far the most efficient and environmentally friendly way to deal with excess rainwater. Mother Nature has become something in cities, we should adapt public spaces to the natural absorption of water into the rock environment. We should propose a public space around
hard surfaces in combination with vegetation, which is a more environmentally friendly way of dealing with excess water. Plants and storms absorb water well. They accumulate water in the roots and then “exhale” their leaves and dispose of excess water. Urban greenery not only addresses water absorption, but also reduces nature pollution and helps filter water. Trees and plants play a major role in controlling water and air pollution.

Another factor is lowering the ambient temperature in the city in the summer. It is a natural phenomenon even in the landscape that in this period people are looking for vegetation to lower their temperature. If these green elements do not line the tall, concrete and glazed buildings, the temperature will rise and people would rather stay in the man-made shopping malls. Parks, storms and water areas in urbanized areas throughout the year offer city dwellers shade, lower temperatures and also help with rainwater management.

Surface runoff has to be reduced to prevent flooding. Especially in urbanized areas where natural infiltration is reduced. Sediments and Pollutants (or nutrients from agriculture) must be removed.

- Temporary storage (e.g. retention ponds, rainwater harvesting)
- Infiltration (e.g. grass filter stripes, infiltration basin).

**Figure 3.** Technical infrastructure and greenery in public space.

Infiltration devices. Local conditions and responsible planners could decide which technique is used. Storm water Management helps to collect, treat and (re-)use runoff water; to avoid contamination and destruction; and to restore the disturbed urban water cycle!

5. Conclusion

Foreign experience shows the way to improvement. This path can lead to environmental, but also economic sustainability of the public environment, also with regard to barrier-free environment. It is well known that in our territory it is necessary to save as much water and try A large part of the solution of the problems of retention and use can be a significant landscape-forming and aesthetic element. The main advantage, however, is the environmental friendliness and often also the improvement of climatic conditions in the villages and its surroundings.
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References
[1] Seybert T A 2015 Stormwater Management for Land Development: Methods and Calculations (John Wiley) p 392
[2] Liptan T W 2017 Sustainable Stormwater Management: A Landscape-Driven Approach to Planning and Design (Oregon: Timber Press)
[3] U.S. Environmental Protection Agency 2015 Stormwater to Street Trees: Engineering Urban Forests for Stormwater Management
[4] Melková P et al. 2014 Manuál tvorby veřejných prostranství hlavního města Prahy (Prague: Institut plánování a rozvoje hlavního města Prahy)
[5] Wiener P 2006 Prostorová orientace zrakově postižených (Prague: Institut rehabilitace zrakově postižených UK FHS)
[6] Zdařilová R 2011 Bezbariérové užívání staveb – metodika k vyhlášce č.398/2009 Sb., o obecných technických požadavcích zabezpečujících bezbariérové užívání staveb (Prague: Informační centrum ČKAIT)