



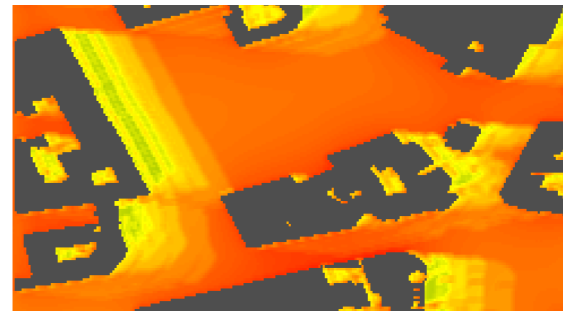
TAKING  
**COOPERATION**  
FORWARD

 22 March 2022 URBAN GREEN ACUPUNCTURE - THE WAY TO ENLARGE GREEN INFRASTRUCTURE IN URBAN AREAS

 Education component in SALUTE4CE, - e-learning course and project Handbook

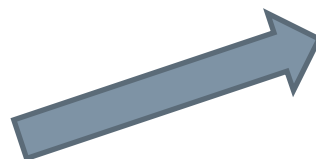
 SALUTE4CE | Barbara Vojvodíková

# WHY?



Full-time - combined or hybrid teaching

- E-learning course
- Trainings based on E-learning course



Module 1 - Introduction  
Module 2 - Challenges that need to be overcome  
Module 3 Connecting UEA with urban planning  
Module 4 Special section - Nature Based Solutions.

Self-study

- Handbook



<https://www.iurs.cz/>

**O nás**

Nestátní nezisková organizace **IURS - Institut pro udržitelný rozvoj sídel z.s.** byla založena v roce 2001. IURS se zabývá problematikou udržitelného rozvoje urbanizovaného území.  
Cílem IURS je:

- poukázat na bariéry udržitelného úrbánního rozvoje,
- identifikovat a podporovat cesty vedoucí k dosažení integrovaného územního rozvoje,
- iniciovat procesy vedoucí k vytvoření vhodných nástrojů udržitelného rozvoje území,
- podporovat vytváření hlubšího oborového porozumění a expertízy,
- poskytovat odborné know-how těm, kdo je potřebují,
- zvýšit společenskou informovanost o podstatě problematiky udržitelného rozvoje.

V současnosti má IURS 30 členů, specialistů v řadě oborů souvisejících s rozvojem měst (úrbánní rozvoj a úrbánní regenerace, územní plánování, regenerace brownfields, architektura, ekologické aspekty úrbánního rozvoje, právo, sociologie) se zkušenostmi s realizací mezinárodních projektů. IURS plní pomyslnou mezeru mezi akademickým sektorem a privátními poradenskými firmami, přičemž nabízí zkušenosti s advokací nových přístupů v oblasti úrbánní regenerace.

**URBAN ENVIRONMENTAL ACUPUNCTURE SPECIALISTS**  
E-learning course



[https://www.iurs.cz/www/files/upload/file/D.T.%204.1.1.e\\_learning%20maual\\_\\_entrance\\_11.pdf](https://www.iurs.cz/www/files/upload/file/D.T.%204.1.1.e_learning%20maual__entrance_11.pdf)



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**URBAN ENVIRONMENTAL  
ACUPUNCTURE SPECIALISTS**

**E-LEARNING - COURSE**





## MODULE 2 - Challenges that need to be overcome

### Chapter 2 Soil Sealing and Soil Degradation Reduction by application of Urban Environmental Acupuncture solution

Authors: Anna Starzewska-Sikorska, Justyna Gorgoń, IETU - The Institute for Ecology of Industrial Areas

[Self evaluation test](#)

### Chapter 3 Urban Environmental Acupuncture as One of the Solutions for Reduction of Heat Stress in Urban Space

Authors: Juliane Mathey, Jessica Hemingway, Peter Wirth, IOER The Leibniz Institute of Ecological Urban and Regional Development

[Self evaluation test](#)

### Chapter 4 Possibilities of application of Urban Environmental Acupuncture in Reducing Problems with Rainwater in the Urban Space

Authors: Barbara Vojvodikova, Božena Schejbalova, IURS - Institute for sustainable development

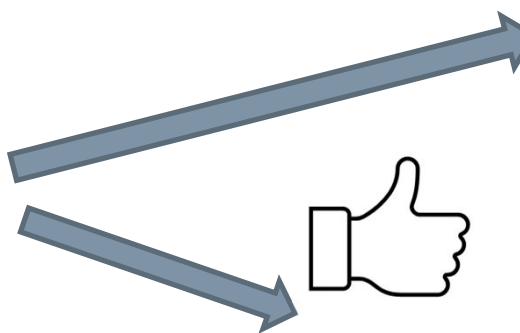
[Self evaluation test](#)

### Chapter 5 Urban Environmental Acupuncture for Increasing Air Quality

Authors: Matteo Tabasso, Elena Masala, LINKS Foundation

[Self evaluation test](#)

Paon 1



### Chapter 3 Urban Environmental Acupuncture as One of the Solutions for Reduction of Heat Stress in Urban Space

Authors: Juliane Mathey, Jessica Hemingway, Leibniz Institute of Ecological Urban and Regional Development (IOER), Dresden

#### Learning targets

By studying this chapter, you will get basic understanding of the potentials of urban green spaces to reduce urban heat stress. You will also learn about the cooling effects of different green space types in the course of the day. Additionally, information will be provided on points to be considered when preparing an action plan for heat stress reduction by urban environmental acupuncture.

#### Keywords

urban environmental acupuncture, urban heat stress, heat stress reduction, adaptation to climate change, urban adaptation strategies, green space planning, urban greening

#### Part 1: Introduction – Urban Heat Stress and Climate Change

Urban areas suffer from special climatic conditions: The phenomenon of the urban heat island (UHI) is characterized by dryness, heat, and lower wind strengths compared to the rural surroundings (Arnfield 2003). Densely built-up and sealed areas (Fig. 1) are heat stores emitting heat to their surroundings, which is especially notable at night with negative influences on human health (Lehmann et al. 2014).

In large cities, heat islands with "tropical nights" above 20°C make it difficult to have the necessary recovery from the heat stress of the day. The sleep can be affected negatively, which may pose health hazards (Höppe 1999). Vulnerable people such as elderly people, sick persons, and young infants (toddlers) are thus exposed to higher health hazards (Scherber et al. 2013). The urban heat island and extreme heat events can increase heat-related morbidity and mortality (Endlicher et al. 2016).

Have you ever thought about what this means for residents?

Perhaps you remember that the 2003 summer heat wave during August caused 35,000 heat-related deaths across Europe (Larsen 2006).

**Self Test Q2**

On the following pictures you see two urban situations. How you can bring them together concerning heat stress (Fig. 1 with Fig. 2)?

Fig. 1: Densely built-up district (Photo: R. Eandner).

Fig. 2: Greened wall (Photo: J. Mathey).

Valse odpoved

On the following pictures you see two urban situations. How you can bring them together concerning heat stress (Fig. 3 with Fig. 4)?

Fig. 3: Shade offered by trees (Photo: U. Wolf).

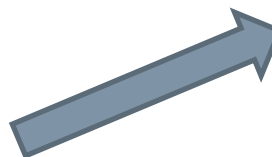
Fig. 4: Dry lawn (Photo: S. Röllner).

Valse odpoved





1.	<a href="#">Urban meadows</a>	16.	<a href="#">Herb spiral</a>
2.	<a href="#">Verges / flower beds with native perennials</a>	17.	<a href="#">Urban wilderness / succession area</a>
3.	<a href="#">Ground cover plants</a>	18.	<a href="#">Ground crops of vegetables / herbs</a>
4.	<a href="#">Lawn</a>	19.	<a href="#">Vegetated reinforced soil slopes with green fences</a>
5.	<a href="#">Green pavements</a>	20.	<a href="#">Green pergolas / green arbors</a>
6.	<a href="#">Street trees</a>	21.	<a href="#">Green facades with climbing plants</a>
7.	<a href="#">Park trees</a>	22.	<a href="#">Wall-mounted living walls</a>
8.	<a href="#">Fruit trees / shrubs /</a>	23.	<a href="#">Hydroponic mobile living walls / vertical gardens</a>
9.	<a href="#">Large shrubs</a>	24.	<a href="#">Vertical vegetable / herb gardens</a>
10.	<a href="#">Rain gardens (under-drained)</a>	25.	<a href="#">Hanging wall planters (as green street furniture)</a>
11.	<a href="#">Road-side swales for retention and infiltration</a>	26.	<a href="#">Compacted pollinators' module</a>
12.	<a href="#">Linear wetlands for stormwater filtration</a>	27.	<a href="#">Rain gardens in planter (=self-contained)</a>
13.	<a href="#">Natural pollinators' modules</a>	28.	<a href="#">Street planters (as green street furniture)</a>
14.	<a href="#">Hedge/hedgerow</a>	29.	<a href="#">Green covering shelters</a>



<b>Green pergolas / green arbours</b>	
Main impact on:	
Photo:	
Main ecosystem services:	<p>Linderhof Palace and Park, King Ludwig's castle (Germany)  <a href="https://c8.alamy.com/comp/BWKJ6E/pergola-arbor-tunnel-green-plants-covered-shoots-bower-germany-europe-BWKJ6E.jpg">https://c8.alamy.com/comp/BWKJ6E/pergola-arbor-tunnel-green-plants-covered-shoots-bower-germany-europe-BWKJ6E.jpg</a></p> <p>Regulation of air quality (mainly by urban trees, forests, shrubs), Noise mitigated by urban vegetation, <b>Urban temperature regulation</b>, <b>Nature based recreation</b>, Climate regulation by reduction of CO2, Water flow regulation and runoff mitigation, Habitat services – stopping loss of biodiversity, <b>Insect pollination</b></p>
Short description:	<ul style="list-style-type: none"> <li>- Spatial characteristic: point</li> <li>- Scale of application: Neighbourhood, Parking area such as carport, Urban space</li> <li>- Labour intensity of maintenance: moderate</li> <li>- Expected efficacy: up to 5 years</li> <li>- Approximate lifespan: long (more than 30 years)</li> <li>- Investment costs: high</li> </ul>
Possible locations:	<p>Green town square (pedestrian zone); Green municipal recreational area; Community garden; Green pedestrian area in roadside zones; Green walkway &amp; bicycle path; Green boulevards/promenades (pedestrian zone); Pocket park; Front garden (in housing area); Green backyard/courtyard; Green a. a. to retirement houses; Green a. a. to cultural/educational facilities; Educational garden (school or other educational facilities); Green a. a. to office-, industrial-, or business buildings; Green a. a. to low-rise building estate; Green a. a. to multi-story housing; Green a. a. to children facilities or youth recreational facilities; Green memorial site</p>
	[1] FassadenGrün (2020a): Greening of a Pergola.



Meanwhile, thanks to the inclusion of an additional list of references, every participant has the opportunity to improve their knowledge on specific issues. . At the same time, the course also includes additional List of references to improve the knowledge of specific issues. For further self-study, the Salute4CE Handbook is also prepared which solves individual problem areas in greater detail, or expands the basic portfolio of knowledge.

#### Who can participate?

The course is open to all who are interested in sustainable urban development. It is primarily intended for urban planners, architects, students, citizens, local and regional authorities ect.

#### Why attend the course?

Thanks to the chosen form, the participant has the opportunity to gain an intensive overview of the entire UEA issue. Thanks to the self-evaluation system, the participant has the opportunity to find out if he / she has understood the given issue correctly

#### How the e-learning course is divided?

The course is divided into two parts. Educational part and certificated part-

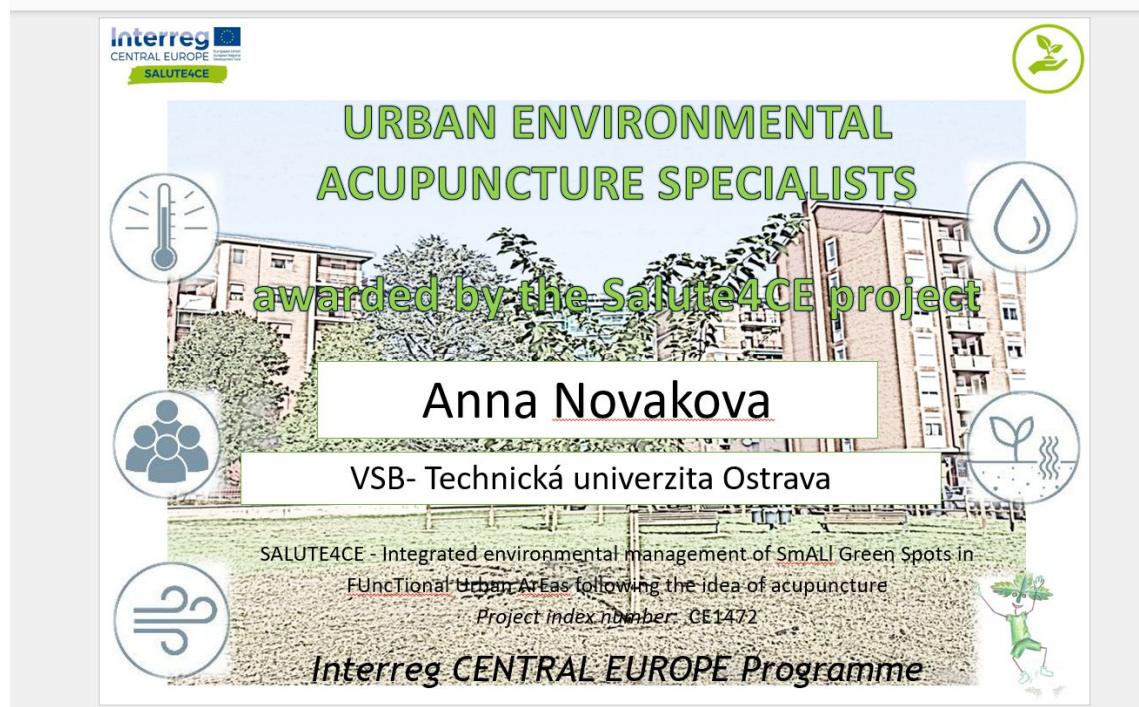
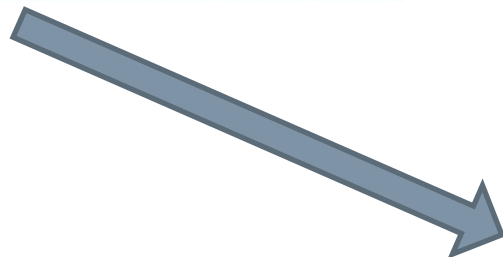
The educational part is accessible to everyone without registration. This part includes all educational modules, including the possibility of self-evaluation.

The certificated part is intended for those e-learning participants who want to obtain a certificate URBAN ENVIRONMENTAL ACUPUNCTURE SPECIALISTS, awarded by the Salute4CE project.

#### How to proceed in the e-learning course to get a certificate?

In the beginning is necessary to study the information in materials from the educational part. After you feel that you are familiar with UEA, then it is necessary to register. After [registration](#) project representatives will open a special on-line test. Before you start with registration please read [Private Policy - GDPR information](#). By registering, you agree to the terms of the GDPR

Page 1



# TRAININGS BASED ON E-LEARNING COURSE

**GRÜN-BLAUE INFRASTRUKTUR (GI)**

Multifunktionaler Stadtpark

- Biotopeflächen → Biodiversität
- Regenwasserflächen → Flutschutz
- Bäume → Mikroklimaregulation
- Freizeitanlage → Erholung

**GRÜN-BLAUE INFRASTRUKTUR (GI)**

Anlage von Kleinlebensräumen in Dresden-Prohlis

Temperaturabsenkung, Bodenvervitalisierung, soziale Integration, Wohnqualität, Naturerleben, öffentliche Nutzung etc.

- Synergien
- Bewusstseins- und Unterstützung

**ÖKOSYSTEMLEISTUNGEN (ÖSL)**

Definition

Sammelbegriff für die vielfältigen Vorteile, die Ökosysteme für das menschliche Wohlbefinden liefern

Vier Kategorien von ÖSL

- unterstützende Leistungen → z.B. Bodenbildung, Photosynthese
- Versorgungsleistungen → z.B. Ernährung, Beschäftigung
- Regulierende Leistungen → z.B. Mikroklima & Wasserhaushalt
- Kulturelle Leistungen → z.B. Erholung, Ästhetik, Lernen

**ERHÖLUNG & MENSCHLICHE GESUNDHEIT**

- Erholungsflächen
- Naturerlebnisräume
- Bewegung an der frischen Luft
- Treffpunkt im Freien
- Umweltbildung, Forschung
- Stadtstruktur, ästhetische

**BODEN, LUFT & WASSERHAUSHALT**

Grundwasserhaushalt

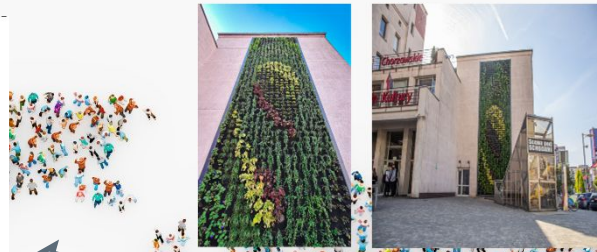
- Regeneration des Grund- und Oberflächenwassers
- Bodenschutz (Pflanz, Puffer)

**POTENZIELLE KLIMATISCHE WIRKUNGEN (EMV-MET, TU DRESDEN)**

Lebensmittelproduktion in La Ancher

5. Szenarien

- 1. Unverändertes Klima
- 2.3. Szenario: Starkes Erwärmung
- 4.4. Szenario: Starkes Erwärmung
- 5.5. Szenario: Starkes Erwärmung



**03.2022**  
**TRAINING**

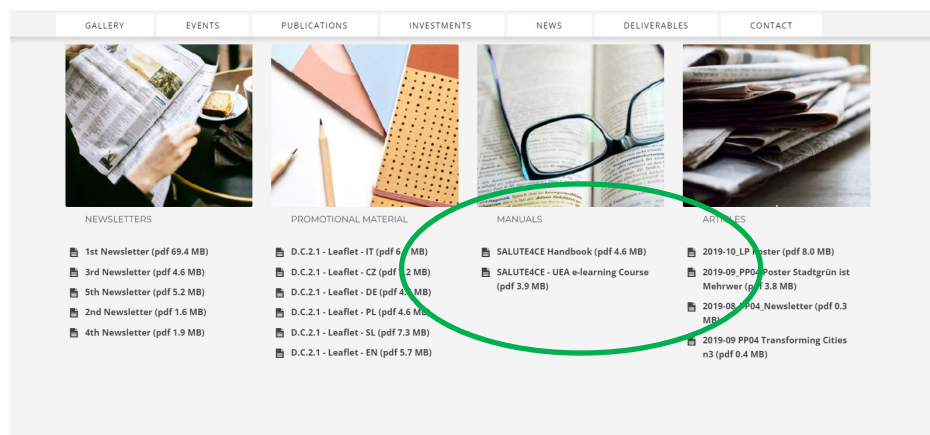
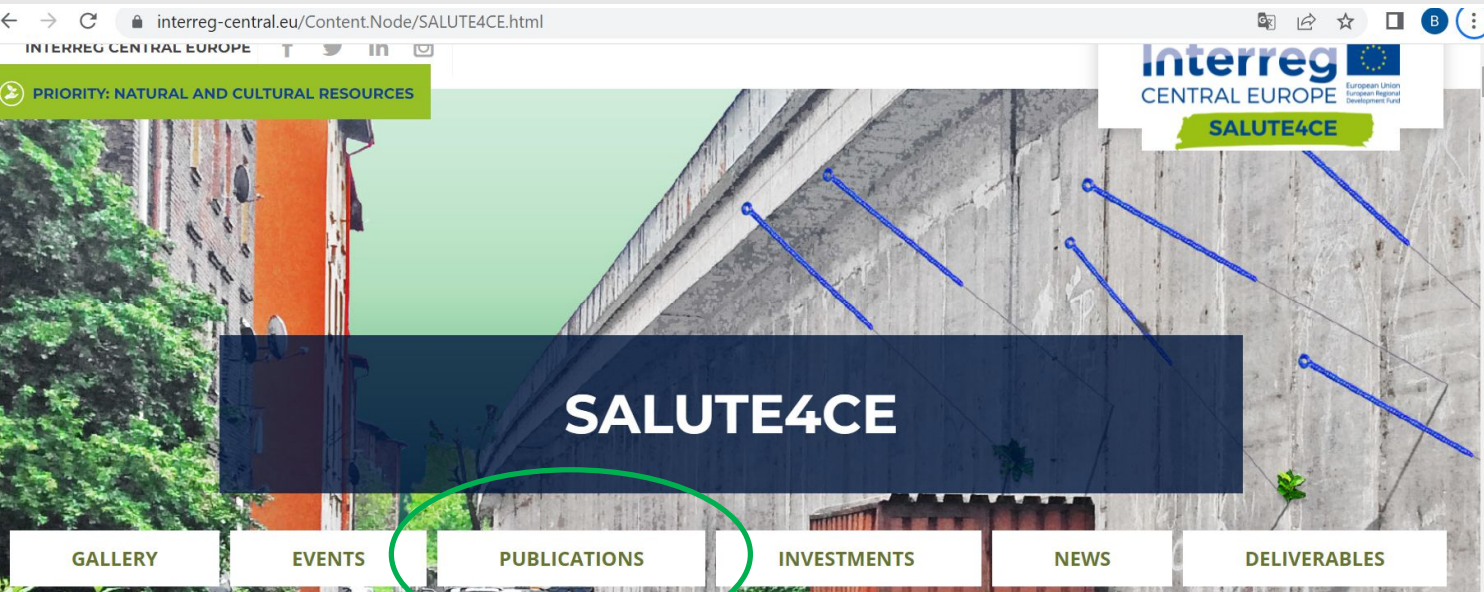
**TRAINING FOR PROS IN ALESSANDRIA, ITALY**

Training on UEA for professionals through a webinar - h.15.00-17.00

Read more...







## HANDBOOK SALUTE4CE – HANDBOOK ON URBAN ENVIRONMENTAL ACUPUNCTURE

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of solutions mainly address the situation at the point of impact or in the immediate vicinity. Almost all of these solutions are closely linked to vegetation, which needs water for its existence. It is always advisable to consider whether something better could be done when installing such solutions. The seemingly obvious and banal advice, or rather the follow-up issue, is documented in the following examples. Fig. 4.4, and Fig. 4.5 show an example of a tree planting solution for two parking areas in Opatowitz, Czech Republic.

In the picture with green pavement, the trees receive a large amount of water running off the parking area without restricting the parking area. The constant parking causes consolidation of the soil around the tree. The second example is a tree that is covered with gravel such that a car cannot park in the immediate vicinity, but the curb around the tree prevents water from flowing directly to the tree. Thus, the tree is only watered by rain falling on the derived area.

Other possibility can be included in the group of solutions includes green and paved green sidewalks (Fig. 4.6). Although green pavements are characterized by high permeability, walking on them is difficult and, for example, practically impossible for a person in a wheelchair. Therefore, decisions should always be made in relation to the functionality of the related area. The solution is to divide the pavement into two parts with different surfaces. Smaller solutions such as flower beds or lawns should always be positioned so that water does not run off from onto the surrounding pavements and roads, but rather that water from the pavements runs into these areas. Fig. 4.7 shows a depression in the turf around the tree that allows water to be retained and the tree to be irrigated.



Figure 4.4 Green pavement. Photo: K. Hřístková



Figure 4.5 Tree surrounded by gravelly water retention. Photo: K. Hřístková



Figure 4.6 An example of green sidewalks with high permeability. Photo: K. Hřístková

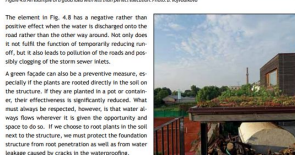


Figure 4.7 Green roof on a small building. Photo: K. Hřístková

The element in Fig. 4.8 has a negative rather than positive effect when the water is discharged onto the road rather than the other way around. Not only does it not fulfil the function of temporarily reducing runoff, but it also leads to pollution of the roads and possible clogging of the storm sewer inlets.

A green facade can also be a preventive measure, especially if the plants are rooted directly in the soil on the structure. If they are planted in a pot or container, their effectiveness is significantly reduced. What must always be requested, however, is that water of any flow wherever it is given the opportunity and space to do so. If we choose to root plants in the soil next to the structure, we must protect the foundation structure from root penetration as well as from water leakage caused by cracks in the waterproofing.

Green roofs are a separate problem. Their recipients services are mentioned and are understandable, but if we opt for a green roof, in addition to its very precise design and implementation, we must also be aware of the load on the roof structure, and entire building.



This style of gardening focuses on creating an ideal growing site for alpine plants. Plants need to be relatively low growing and have a growth habit that counteracts the natural effects of the rocks. When laying rocks and stones, it is necessary to leave free spaces of different sizes, which are then covered by the ground. It is necessary to provide good drainage because most plants suitable for rock gardens require a well-drained soil.

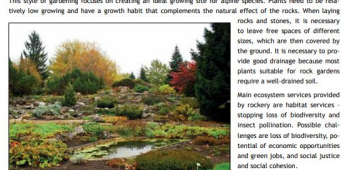


Figure 7.1.15.1 Rockery. Photo: K. Gálgy Csik

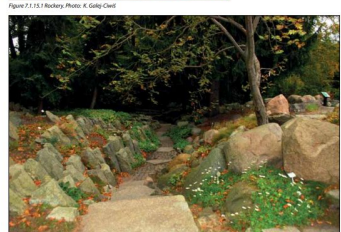


Figure 7.1.15.2 Rockery. Photo: K. Gálgy Csik

### 7.1.16. HERB SPIRAL

László Tóth, Károlyina Gálgy Csik, Sándor Botnariuc Garden and Polish Association of Societies Botanical Garden Center for Biological Diversity Conservation in Poznań

Herb spiral is a structure typically measuring 1-2 meters wide at the diameter, spiralling up to a height of 1-1.5 meters. There is a planting path running up it. To increase biodiversity, there is also potential to create a small pond or bog at the base of the spiral. Almost all building materials can be used to construct it: stones, bricks, wooden stakes, even terracotta tiles and bottles. In the vertical section, the spiral should consist of a layer of small rocks, gravel, sand, and compost on the top layers create the drainage preferred by most herbs. It is possible to use multiple spirals to create a more complex design (Fig. 7.1.16.1).

Making use of both vertical and horizontal space, and by the circle shape of herb spiral, allows maximum use of small area. It offers both sun and shaded positions for plants, gravity drainage from top to bottom, and creates good conditions for dry plants on top and moisture-loving plants at the bottom.

Main ecosystem services provided by rockery are habitat services: increasing loss of biodiversity and insect pollination. Possible challenges are loss of biodiversity, potential of economic opportunities and green jobs, and social justice and social cohesion.



Figure 7.1.16.1 Herb spiral. Photo: K. Gálgy Csik



As can be seen in Fig. 4.2, despite the great difficulty, part of the water in the built-up area reaches the groundwater, which forms an important part of the hydrological cycle. In built-up agglomerations there are major changes in the proportion of the different elements of the water balance. This is due to changes in land use and very often changes in groundwater use. In urban agglomerations, precipitation infiltration is mainly reduced. Building roofs, roads, other paved surfaces and drains radically affect surface runoff. For Barcelona, it is reported that 80% to 90% of the rainfall is discharged into the sewers immediately after it falls. The remainder is divided into surface runoff (which is negligible for rainfall with a frequency of less than 10 years), surface retention and infiltration. It has been verified that rainfall below 1 mm does not cause any increase in infiltration to the sewer. This value is therefore considered as representative for the quantification of surface retention. In an average rainfall year, such light rainfall represents 10% of the total. This leaves only a few, at most 5% of the rainfall to infiltrate into groundwater (Váquez Sanz, 2002). Compared to the open countryside, evapotranspiration is also radically reduced in urban agglomerations.

### 4.1. Effects of storm water arrival in the urban area, and solution for the reduction problem

A concomitant of climate change is a change in the seasonal distribution of precipitation. More often than in the past, we are faced with climatic extremes such as droughts followed by heavy rainfall and then localized flooding. The phenomenon of torrential rainfall has an impact on the capacity of the sewerage network, which may not be sufficient during these events.

The amount of water that falls on the surface (especially at the beginning of the rainy season) is only absorbed in a small percentage - in the case of lawns, it is often the sponginess of the soil that does not allow immediate absorption. The paved surfaces of roads, car parks, roofs, and squares play a role, as mentioned several times above. Over a noticeably short period of time, large volumes of water run off the surface. Within a truly short time, the capacity of the stormwater drains and sewerage, the drainage system at the entrances to the

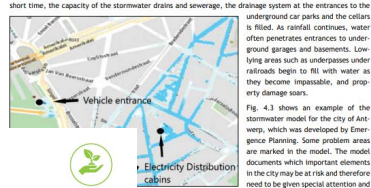


Figure 4.3 Map showing stormwater drainage system and vehicle entrance. Photo: K. Hřístková

underground car parks and the cellars is filled. As rainfall continues, water often penetrates entrances to underground garages and basements. Lying areas such as underpasses under railroads begin to fill with water as they become impassable, and property damage occurs.

Fig. 4.3 shows an example of the stormwater model for the city of Antwerp, which was developed by Emergence Planning. Some problem areas are marked in the model. The model documents which important elements in the city may be at risk and therefore need to be given special attention and protected against heavy rainfall.

There are generally two basic solutions to stormwater problems.

- The first is to increase the capacity of the stormwater sewer drains, to significantly increase the capacity of the entire piping system, and to significantly increase the capacity of the drainage basins. These solutions are technically awfully expensive and often difficult to implement.
- The second option is to reduce the instantaneous volume of water. Divide the water so that it leaves the sewer gradually or allow it to infiltrate in or evaporate. To improve ecosystem services through infiltration and allowing evaporation, we also improve the environment of the site. For the proposed solutions to deliver these benefits they must be high quality and well thought-out systems. Poor quality or unconsidered element design can lead to foundation waterlogging, basement flooding, conflicts with underground infrastructure in the area, and clogging of sewer drains with runoff.

Based on the inspiration from the Štěpánová et al. (2021), we have divided the solution options into two basic groups:

- The first group is the measures to improve the microclimate and prevent the occurrence of rainfall runoff.
- The second group consists of infiltration and retention facilities.

Both groups do not have strictly defined boundaries, often sharing elements at the intersection of the two groups. Despite these impressions, the division provides a good illustration of the design options. Although other chapters of this handbook are devoted to a more detailed description of the individual elements of the UEA, some are only given in this chapter to illustrate possible solutions or the shortcomings of these solutions.

Prevention of rainfall runoff (we do not deal with drains or sewerage), is aimed at dealing with the stormwater directly at the point of impact (retention, allowing infiltration, evaporation). Evaporation of water contributes positively to the microclimate, lowers the temperature and makes the environment more pleasant. This group



Figure 4.4 Tree planting on an element of UEA - green pavement. Photo: K. Hřístková

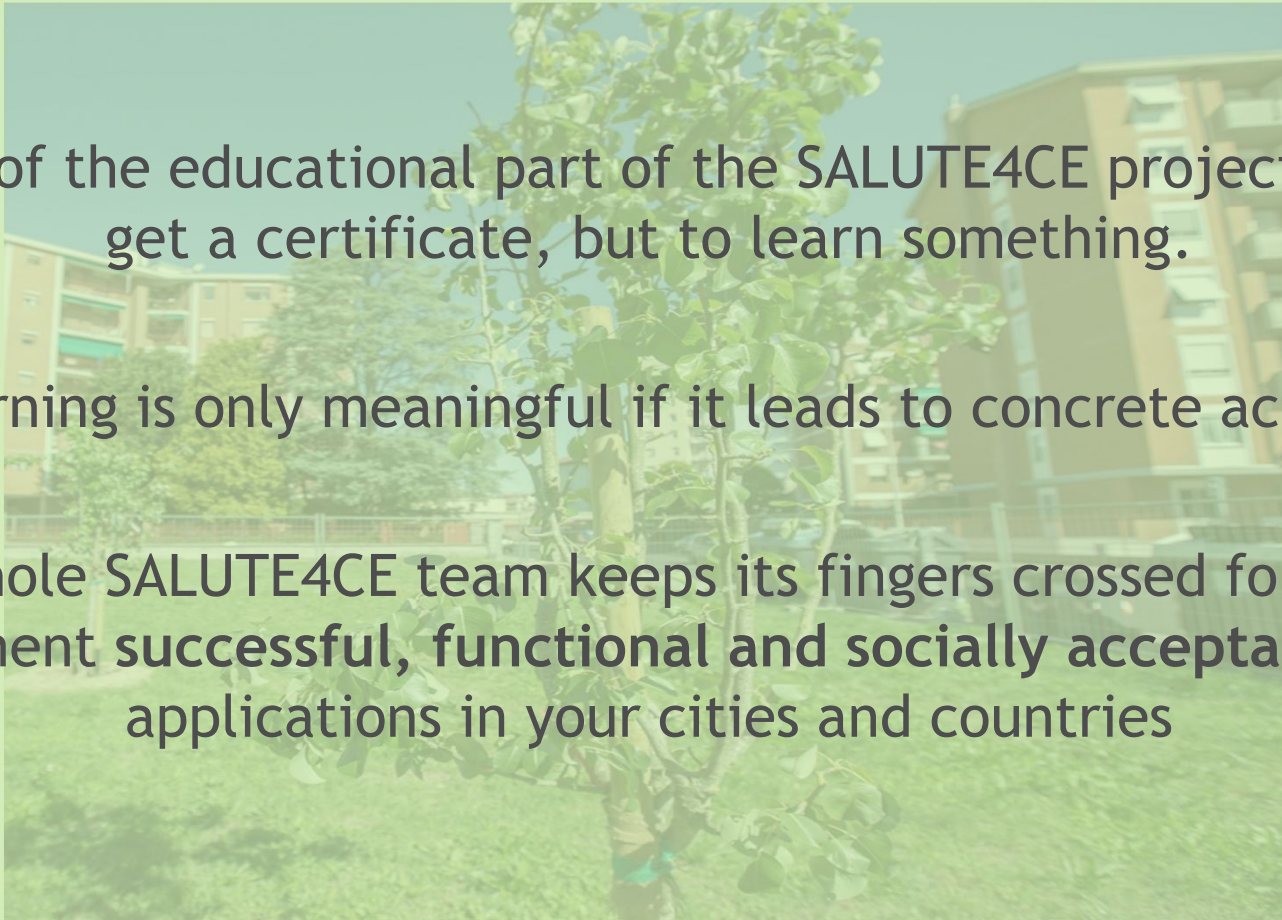
Figure 4.5 Tree planting on an element of UEA - cobble. Photo: I. Tóth



The aim of the educational part of the SALUTE4CE project is not to get a certificate, but to learn something.

Learning is only meaningful if it leads to concrete action.

The whole SALUTE4CE team keeps its fingers crossed for you to implement **successful, functional and socially acceptable** UEA applications in your cities and countries





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[www.interreg-central.eu/SALUTE4CE](http://www.interreg-central.eu/SALUTE4CE)



[iurs@email.cz](mailto:iurs@email.cz)



+420 725 117 244

