Green areas

Green areas in urban settlements start playing a specific role in relation to global warming and climate change, especially with expected:
- temperature increase (especially extremely hot summers)
- decrease of relative air humidity

Moreover, the green areas play other important roles:

- **Micro-climate role** is understood as a capability of green areas to affect by its transpiration the air humidity, provide shade, reduce temperature fluctuation, etc. e.g., a 50 year-old maple (Acer platanoides) absorbs during a vegetation period 0.0295 kg of sulphur, 0.0860 kg of chlorine and 0.0039 kg of fluorine. Filtration effects of vegetation are well known. Trees and bushes have positive impacts on air quality and serve as a filter for particulate matter (20 g of dust particles per 1 m² of leaf area). The role of reducing noise in the urban environment and wind speed is also important.

By measuring in terrain in 2006 it was confirmed that vegetation cover with various structure has a considerable micro-climate effect. Differences in measured values of temperature of air and relative humidity show that use of various vegetation formations in order to improve micro-climate in the urban environment is reasonable. Considerable differences were detected in measuring selected indicators — e.g., maximum temperature difference was up to 14.6 °C between the temperature on grass and under a solitary tree (on the ground level). Cooling effect was manifested on all surfaces with woody vegetation. Air temperature on grass was surprisingly high as it was in some cases comparable with the air temperature on asphalt surfaces (road and parking).

Even larger difference in temperature displays itself, following the ratio of impermeable built-up areas to the green areas with high share of trees where maximum temperature difference was 17 °C (temperature of 48 °C measured in areas of technical and transport facilities compare to 22 °C measured in park areas with pre-vailing trees and shrubs) even till 22 °C (difference in temperature measurement in the surroundings of the water-course and on the parking lot without vegetation).

**Conclusions:**
- Increasing the share of vegetation in urban areas, in particular in built-up city centres (including use of green roofs, climbing plants, planting trees on streets, parking areas with green pavement, etc.)
- In green spaces, the ratio of wooden vegetation (trees) to grass should be more than 60%
- Taking into consideration shift of vegetation zones during the tree planting
- Increasing use of water component — fountains, water courses, rain water retention
- Looking after sufficient thermal insulation of buildings
- Shading of transparent parts of buildings. Parts of buildings providing shade are a simple but very important element to maintain optimal internal temperature in a building
- Bright colours and glittering surfaces should be used on facades which reflect radiation better than dark colours.

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Presentation of possibilities to mitigate negative climate change in cities
Introduction
In accordance with the latest estimates by scientists, the warming and related climate changes proceed more rapidly than generally expected before. The Fourth Summary Report on Climate Change, prepared by a group of more than 600 scientists of the world, is unambiguous in its outcome. It anticipates a considerable increase of temperature in the course of this century and the growth will continue in much longer perspective. The scientists expect that the average global temperature of the Earth surface could increase by 1.8 – 4.5°C by 2100.

The warming will lead to increased evaporation and subsequently to increasing average global precipitation. Temperature will decrease in many regions and intensive rains will probably become more frequent. Along with long periods of drought, melting of glaciers, frequent floods and shortage of drinking water the scientists point out at further adverse impacts – millions of climate refugees, tornados and hurricanes.

Climate changes and cities
At present, more than 75% of Europeans live in urban areas (56.5% in Slovakia). The urban environment differs from the neighbouring landscape in a number of characteristics (temperature, humidity and air quality and others). It can be expected that due to climate changes these adverse trends will even strengthen.

Air temperature is the most important characteristic of climate. In urban settlements the temperature of air layers over the city increases and to surrounding landscape reaching up to 2.5 to 3°C.

There is high concentration of surfaces with large thermal capacity which are strongly warmed up. This causes considerable heat accumulation in cities. Temperature growth is also affected by the heat released from industrial processes, combusting engines in transport and the heat coming from buildings.

The warming will lead to increase amount of clouds – potential local floods

• Rainfall of storm nature – potential local floods
• Considerable decrease of relative air humidity
• Increased temperature (in case of heat waves the heat in cities can grow by 6 – 7 degrees when compared to surrounding landscape)
• Considerable decrease of relative air humidity
• Rainfall increase – irrigation of residential houses
• Increased evaporation and subsequently to increasing average global temperature

Temperature increase in cities is affected mainly by building materials, lining and paving, which are warmed-up to various extent depending on colour, structure and orientation.

Large fixed areas can be on direct sun radiation warmed up to 50 degrees and radiate for many hours, which depends in particular on volume. These areas contribute in this way to warming up the air during nights.

Some negative impacts of climate change, described above, will be more apparent in urban areas especially in and around the built-up areas. Therefore new approaches for energy and transport systems and infrastructure, to renew and extend green areas in cities so that they are well adapted to extreme weather phenomena; to re-construct buildings, energy and transport systems and infrastructure, to renew and extend green areas in cities so that they are well adapted to extreme weather phenomena;

The most important factors affecting urban climate:
- Size and structure of the city
- Climatic and hydrological properties of surfaces
- Manure and nature of construction

Possibilities to mitigate impacts – preparing to climate change
The time gap between reduction of greenhouse gas emissions and reduction of their real concentration is large. It is likely that, if we do not manage to reduce emissions to acceptable level, we will not avoid a certain degree of climate change, which will occur due to greenhouse gas emissions that are already in the atmosphere.

Therefore we need to identify and implement measures to adapt to the climate change consequences.

The studies bring a number of areas where measures are necessary:

a) in planning cities and new construction activities
b) in existing urban structure

c) in existing infrastructure systems

d) in energy and transport systems and infrastructure, to renew and extend green areas in cities so that they are well adapted to extreme weather phenomena;

e) to re-construct buildings, energy and transport systems and infrastructure, to renew and extend green areas in cities so that they are well adapted to extreme weather phenomena;

The most important factors affecting urban climate:

- Size and structure of the city
- Climatic and hydrological properties of surfaces
- Manure and nature of construction

Climate changes will cause large changes in the distribution of precipitation. Global precipitation will increase by 1.8 – 4.5%

Architecture
Based on comparison of heat persistence of various materials used in cities, the data show that areas covered by dark asphalt surfaces under which there is often concrete and after warming it has a capacity to radiate for a long time. Speed of heat transfer depends on temperature difference between the heat source and the area where the heat is being released.

Large fixed areas can be on direct sun radiation warmed up to 50 degrees and radiate for many hours, which depends in particular on volume. These areas contribute in this way to warming up the air during nights.

Bright colours and glittering surfaces should be used on facades as they reflect radiation generally better than dark colours. In case of dark colours there is larger absorption and radiation in infrared spectrum which is perceived as Heat. Heat is strongly absorbed mainly by dark asphalt surfaces under which there is often concrete and after warming it has a capacity to radiate for a long time. Speed of heat transfer depends on temperature difference between the heat source and the area where the heat is being released.

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