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The Importance of green roofs and Sustainable development

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The Importance of green roofs and Sustainable development

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Abstract. The sustainable development is the observance to the principles of respect for nature, environmental protection and responsible approach to social and economic standards of urban development. Green roofs are an important and inherent aspect of such development. For current and especially future climate conditions they also represent a significant factor of water management and are one of the ways to keep cities habitable for future generations as well. Green roofs can efficiently retain water and gradually release it back into the environment in a place where was a driving rain without water affected site literally just flowed. The desired side effect of the process may be overall cooling of the environment. Simultaneously, the vegetation constructions contribute to the elimination of the so-called heat island effect, and thus contribute to the natural change of water.

1. Sustainable development

Sustainable development is such a way of developing a human society that naturally combines the full conservation of the environment with social and economic progress. It is wrong to interpret sustainable development only as environmental protection. The right concept of Sustainable development is based on three pillars that support the system equally. These are Social, Economic and Environment dimensions (Figure 1).

1.1. Social dimension

The Social dimension focuses on balancing inequalities between social groups or individuals. The aim of the social dimension is to eliminate poverty locally and globally, to create access to basic medical help and to ensure hygienic conditions. An important part is also the suppression of discrimination, racism, xenophobia, or religious intolerance. The goal is to achieve a higher level of life in conscious modesty.

1.2. Economic dimension

The Economic dimension consists of the economic activities of human society, the interaction of human society with each other and interaction with the environment. In terms of sustainable development, this is the most problematic dimension. It is very difficult to grasp and is a great challenge for sustainable development to deal with it.

1.3. Environment dimension

The Environmental dimension recognizes the importance of ecosystems, which they appropriately appreciate, either materially or spiritually. One of the theses is that the limited system does not allow unlimited growth. Thus, the environmental dimension has a significant impact on both the Social dimension and the Economic dimension. Initial interventions into other dimensions have led to sustainable development. The overriding principle of the Environment dimension is the protection of



biodiversity in all its forms, while: "the highest level is to be understood as a cultural diversity that is of no less importance for the maintenance of the dynamic balance and stability of human society than biological diversity for the preservation of ecosystems" (Rynda).

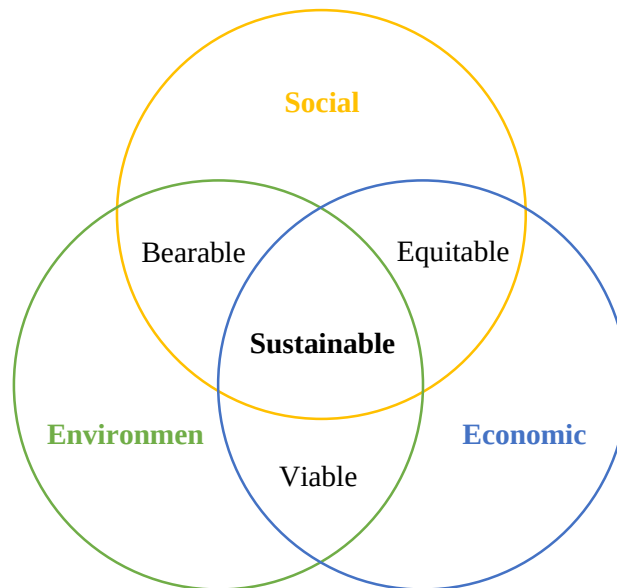


Figure 1. Dimensions of Sustainable development.

1.4. Objectives of Sustainable development

The most well-known definition of the sustainable development objectives comes from the World Commission on Environment and Development (WCED): "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." In addition, one of comprehensible slogans of sustainable construction is quote by Antoine de Saint-Exupéry: "We do not inherit the Earth from our ancestors, we borrow it from our children."

2. Sustainable construction

Sustainable construction responds to the requirements of sustainable development under the principle of a new way of designing, building and using buildings. They respect the principles of all three pillars, social, economic and environment.

The construction industry, including all building activities (eg buildings, silos, roads, bridges, dams, etc.), is the main material and energy consumer of natural resources. At the same time, the construction industry is among the major environmental polluters and the land user.

The traditional, still predominant, approach to designing buildings is based on three basic requirements; the quality of the design solution, the cost and time it takes to build the building. Always looking for the ideal compromise of these three requirements from the point of view of the builder. However, this approach does not include broader aspects from the point of view of the environmental impact and the social and cultural quality of the functions of the realized constructions. The new concept must be more comprehensive and include sets of criteria that can be divided into three areas:

- quality of the environment
- economic efficiency and limitations
- social and cultural contexts

These areas precisely replicate the basic dimensions of sustainable development from which the basic criteria of sustainable construction result for the construction sector. While the traditional approach is based on the principle of maximal economic effect without any more significant impact on the environment, the new concept of sustainable construction emphasizes the importance of reducing the negative environmental effects of buildings. Therefore, the concept of sustainability is not only about the inclusion of environmental aspects related to global climate change.

2.1. Main tasks of sustainable construction

Professor Ing. Petr Hájek, CSc. presents these tasks (magazine Stavebnictví, issue 11-12/07):

Environmental aspects

- Energy; the aim is to increase the energy efficiency of construction and using of buildings.
- Materials; the aim is to make more efficient use of material resources.
- Emissions / Waste; the aim is to reduce emissions and waste.
- Water; the aim is to reduce the consumption of quality water.
- Soil; the aim is to contribute to the sustainable development of settlements.

Economic aspects

- Costs of implementation; the aim is to optimize the costs of building implementation while ensuring maximum functional quality and minimal environmental waste throughout the life cycle.
- Operating costs; the aim is to optimize operating costs throughout the life cycle.
- Durability; the aim is to ensure long-term durability of the building.
- Local economy; the aim is to support the development of the local economy and employment.

Socio-cultural aspects

- Quality; the aim is to improve the quality and functionality of the indoor and outdoor environments of buildings.
- Safety; the aim is to ensure the safety of the indoor environment and surrounding buildings.
- Society; the aim is to positively influence the local social climate and employment.
- Culture; the aim is to protect and maintain the cultural heritage.

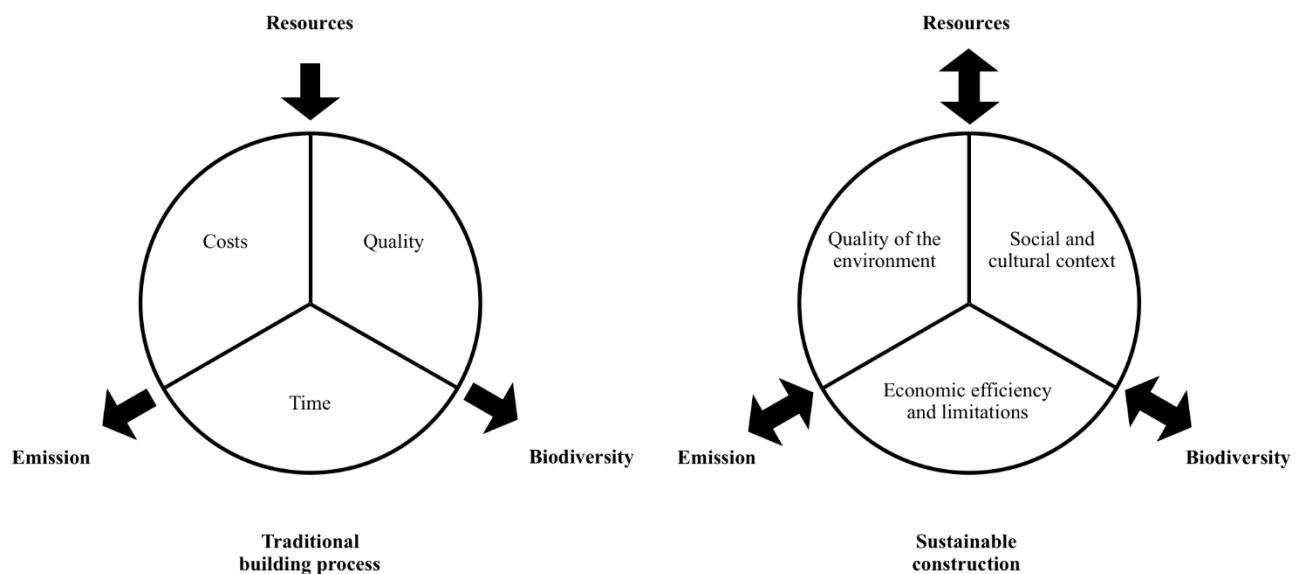


Figure 2. Traditional building process and Sustainable construction.

The road to sustainable construction is not a search for one or several universal technical solutions, but the application of new design principles, new materials and technologies for their development, new construction technologies, including its organization, new methods of assessment and evaluation of buildings, etc., while preserving the architectural and structural variations and variability in design of buildings. Such an approach, however, requires accepting certain changes in the concept of design architecture, but also in the concept of a design solution.

3. Water, Urban Heat Island effect and sustainable cities

The phenomenon of urban heat islands is not new. In Australia or the USA, this is a topic that is being discussed at all levels of government. Even the Czech architectural community is aware of the temperature differences between the countryside and the built-up urban areas and is trying to design new or reconstructed areas to mitigate them. New low-emission materials and green solutions play a major role in this fight.

Areas covered by the large-emission materials (concrete, asphalt), massive construction of buildings, lack of green areas (parks, trees), road surfaces and pavements with zero water permeability, inappropriately organized city, which produces reduced wind speed in the streets. All of these are aspects that significantly increase the temperature in cities and create urban heat islands (UHI). For the construction of roads and buildings, mainly low-reflectivity materials are used. Thanks to this, heat from the sun is accumulated in them. In cities, of course, is heat not produced only from sun, but as well from households is produced additional heat. Nonporous surfaces in cities do not allow rainwater to sink into the soil, contribute to the drainage of water from torrential rains to sewers, rivers and seas. So there is less groundwater, floods and consequently soil erosion. Water is contaminated with chemicals. Higher temperatures cause the formation of groundlevel ozone and change the climate to local and wider levels. Humidity and ecosystem disturbances occur. Urban canyons are formed - on streets lined by higher buildings, either air is standing or undesired drafts or dust-raising beliefs and a higher carbon dioxide concentration. Urban heat islands (UHI) are worsening the warmth of the population. In connection with this, the thermoregulation system of a person, which often causes cardiovascular and respiratory diseases, is damaged. UHI radiation also causes higher rainfall over urban areas, more frequent fog and in the winter intensifies the presence of smog.

Sustainability of cities can be promoted by limiting the remote import of energy, water and food, etc., as well as waste (heat, air and water pollution, etc.). Meanwhile, the sustainable city is just a paper concept, but it has to be said that cities like Paris and New York were supplied from nearby large gardens at the turn of the 21th century, and Havana returned to the model of city farms after the loss of cheap Soviet oil.

4. The potential of green roofs

There are several ways to cool the UHI. The first is planting greenery. Research suggests that greening (trees with dense crowns, hedges, shrubs, grass, vegetation roofs) reduces the temperature difference between the city and the surrounding countryside. Besides, the greenery has aesthetic character of the city. Greenery, or parks, helps to develop social relationships in the cities and influence the harmonious arrangement of the human psyche.

The effect of urban heat islands is also exacerbated by the inappropriate selection of material and color of roofing. The large topic is, for example, white roofs. Aesthetically pleasing, but above all very environmentally beneficial, are roofs covered with greenery. The so-called green roofs regulate overheatings as well as standard greenery in cities, so they retain water at the point where it lands. So the water can gradually evaporate back into the atmosphere and take away the heat from the environment. This leads to cooling of the climate in which the building is located (although increased humidity may in part cause a sensational increase in temperature). Green roofs also isolate, shade, cool and therefore reduce the energy consumption of refrigeration equipment. The resulting quality of the green roof, of course, depends on the height and quality of the soil, but also on the particular climate in which the object is located. For example, strong and frequent rains exclude the use of some granular soils, etc. Green roofs regulate the drainage of surplus water away, but it does not already address its supply to deficient groundwater. Some studies also suggest that water flowing from green roofs into surface water can be contaminated with nitrogen and phosphorus from the substrate used.

5. Case study: EXPO 2000 Kronsberg

On the southeast edge of Hannover, the first part of the unique Kronsberg housing estate was built on the occasion of the EXPO 2000 exhibition, which should have 15, 000 inhabitants after completion.

Basically, it was an exhibit that was to show the model sustainable living of the future with the inclusion of not only urban and social planning, but also environmental considerations.

Kronsberg is characterized by a considerable amount of greenery. From the early stages, not only the gardens and private land tenants, but also park and green areas as community centers were also planned to be used for sports and games. The plan of the landscape counts with the planting of the woods at the top of the Kronsberg hill and with plenty of others extensive green areas for recreation, but also as a wildlife and plant environment.

The construction of Kronsberg has several objectives; serve as an accommodation capacity for visitors of exhibition and then to become an integral part of the city - and as such to be a model and a standard of sustainable urban construction with an emphasis on ecology, in the widest possible definition of the concept.

The ecological dimension of the housing estate begins with a thoughtful modeling of its landscape, where, among other things, natural water features (retention reservoirs, water absorption systems) have been applied and a natural element in the form of forests, wetlands and pastures, which form green corridors. Kronsberg, of course, has an ecological energy system that corresponds to the energy-saving nature of all the buildings in the housing estate.

If Kronsberg is written or spoken, usually facts and figures from the technical field of ecology usually appear. However, the psychological and social ecology plays a role in the experimental Hannover's housing estate. The authors of the concept have not only tried to create a city space that will not only burden the environment but will also be pleasant for its inhabitants, it will be user friendly.

Hanover's attempt to create a city for the 21st century is generally considered to be a success. The Kronsberg technical and environmental parameters have become benchmarks for similar sustainable projects, internationally. In Germany itself, Kronsberg is a model for similar housing estates, such as the Munich Nest Soltau. And the settlement itself has further development before it.

6. Conclusion

Each municipality has other conditions; in modern urban planning we should stick to the saying „nothing must be exaggerated“. The basis is to work with all possible, affordable solutions that allow space and combine low-emission materials (high-reflex, light colors) with designs that work on the principle of consumption of evaporation heat (greenery, permeable materials).

For the time being, the effect of urban heat islands in the Czech Republic, despite its provability, is often underestimated or ignored. Exceptions, however, confirm the rule, mentioning, for example, the international conference *Adaptace měst na změnu klimatu* (Adaptation of cities to climate change), which was held in Ostrava last September. Particularly green examples such as Ljubljana, Essen and Vienna were discussed.

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