

Green Roof on Underground Parking

FC Zenica

Description of Study Area

The coverage of the Regulatory Plan "Alija Izetbegović Square" is 8.40 ha and includes the city centre. The number of inhabitants is 1.955 (population density 233 inhabitants/ha) due to high proportion of collective housing with high-rise buildings. The total green area is 17,753 m² (1.77 ha) of which the park (recreational greenery) in front of the large residential complex occupies about 10,430 m² (1.04 ha). Green space per inhabitant of this area is 9sqm. The planned underground parking area is to have a green roof. The existing green areas need to be improved and enriched by planting new trees, and creating greener pedestrian paths, urban furniture, and adequate lighting. Given newly planned facilities and increasing number of residents, the existing greenery will not meet minimum standards of green areas per capita. Therefore, integrating greenery in all newly planned facilities (greening of roofs, facades, etc.) is of utmost importance.

Project indicative: Z5.1

Project type: simple investments/interventions

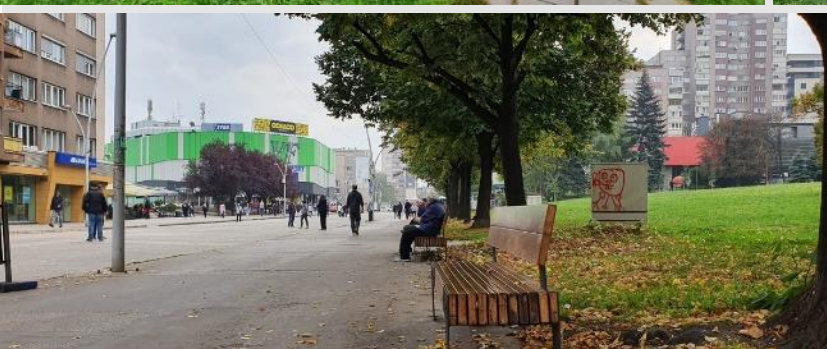
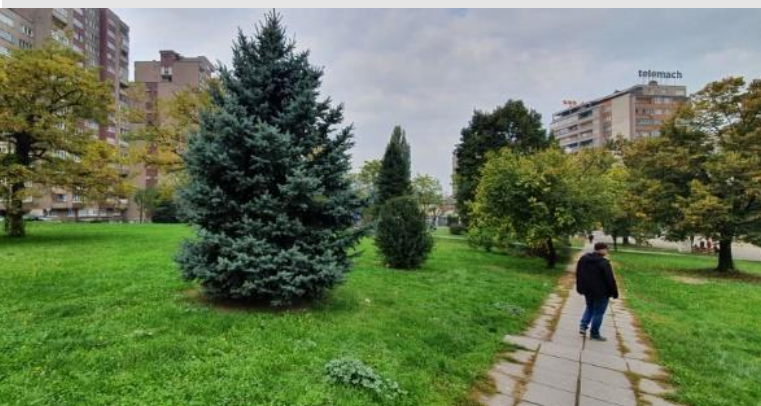
Project starting point: 0-5 yrs.

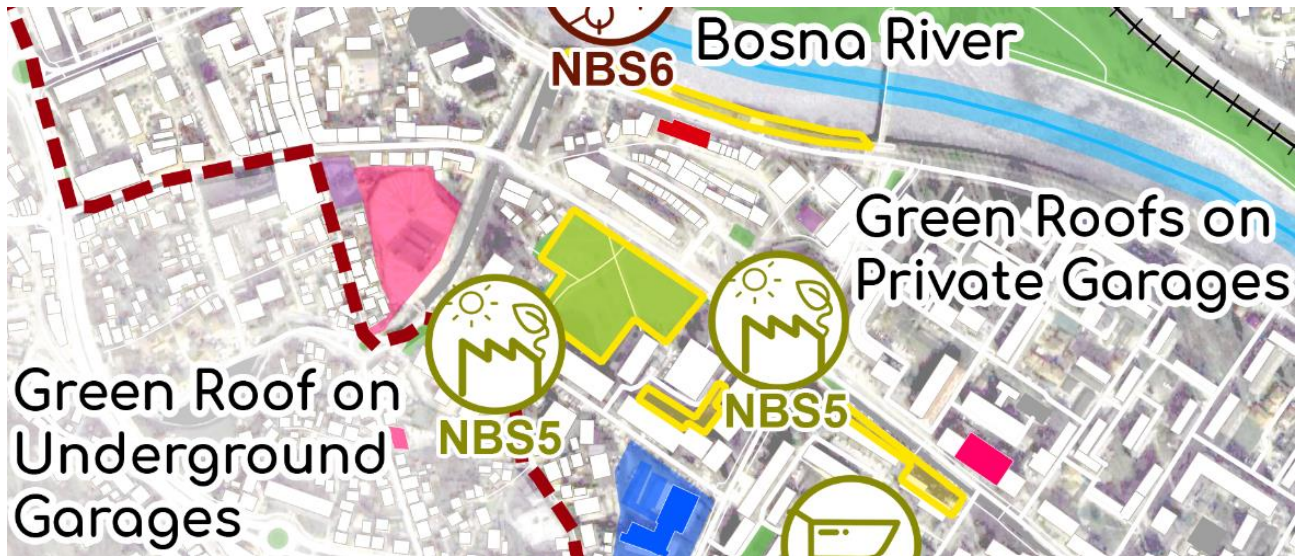
Project ending point: 5-10 yrs.

Estimated costs: n.d.



NBS 5





Site challenges

- Expensive infrastructure works
- Limited awareness and experience among private contractors, including designers and construction workers
- Lack of examples in the area/region
- Coordination and cooperation between different stakeholders
- Ensuring the proper maintenance and sustainability of the green roof
- Potential technical challenges related to drainage, soil composition, and plant selection
- Addressing any potential concerns from the community regarding the use and functionality of the green roof

Relevant Legislation

Construction of the underground garage is part of the draft Regulatory Plan "Alija Izetbegović Square".

Developing an extensive green roof above the underground garage was decided through planning documentation (regulatory plan) that indicated the reorganization of a park above the current site. It also imposes the obligation to plant low-rooted plants in belts, depending on the depth of the earthen embankment above the underground garage.





Source: ZinCo Intensive Green Roofs

Scenarios

Do-it-all (best-case)

The green roofs have already been integrated into the draft Regulation Plan for the City Centre and a new Green Roofs Policy for green interventions on existing buildings will be elaborated. The Policy will include an incentive scheme and strategy for maintenance to ensure long-term sustainability.

The project documentation will be elaborated with a team of experts. Financing will be covered by private sector investments.

Participative processes will be advanced in parallel, engaging local communities in defining different characteristics of the future public space and result in co-management plan, sharing the responsibilities for the maintenance between Municipality and interested stakeholders (companies or institutions with knowledge and resources to provide the needed services)

Do-something-meaningful

Installing green roofs on top of public and private garages has been already integrated into the draft of the Regulatory Plan of the city centre.

Incentives will be granted to private investors, but the Municipality will share most of the responsibilities.

A strong awareness raising campaign accompanying the initiative may accompany the process.



Source: ZinCo Intensive Green Roofs

NBS intervention specifics

NBS5

Green walls and roofs

Create a green roof with the function of public space on top of underground parking, providing valuable ecosystemic services to the neighbourhood.

Green roofs rely on nature to generate environmental (conservation of biodiversity, climate change adaptation, etc.), economic (property valuation, potential job creation) and social (water drainage, aesthetical values, etc.) benefits.

Operational Objectives

Operational Objectives for implementation

1. Develop an underground parking with integrated green roof (intensive green roof)
(Mitigating the effects of urbanisation and strengthening the urban ecosystem to be more resilient to the challenges of climate change, contributing to the transition to a low-carbon economy and circularity of urban metabolism.)
2. Sustainable green roof solutions and practices (ex: using local vegetation and vegetation adapted to the specificities of underground parking - CO2 absorption)
3. Valorising resulting green space:
 - Multipurpose leisure spaces
 - Aesthetic value
 - Community involvement in the design and management process
 - *The project will contribute to converting monofunctional areas to multifunctional areas using NBS solutions with the support of pre-existing infrastructure.*
 - *The underground parking will shift from a static to a dynamic and interactive status with their surroundings and with citizens.*

Partners/Stakeholders

Beneficiaries: identify organisations able to deliver large-scale implementation of NBS and market development

- design team may include the following professionals: architect, landscape architect, green roof consultant, roofing consultant designers and contractor, engineers (structural, civil, environmental, mechanical), energy manager, general contractor, horticulturist/agronomist, irrigation specialist, growing medium consultant, landscape contractor, manufacturers, stormwater management, cost estimator, leak detection specialist, quality assurance manager, landscape maintenance contractor, future maintenance staff, underground parking operator, government agents and decision-makers, regulatory agency representative

Additional Investors/ 'Shareholders':

- nature-based enterprise, associated to an economic activity ('use nature as a core element of their product/service offering for the planting, delivery and/or stewardship of NBS and engage in economic activity')
- nature-based organisation, not associated to an economic activity ('use nature as a core element of their product/service offering for planning, delivery, and/or stewardship of NBS but not engage in economic activity')

Users: local communities, persons transiting the area

Targets

- Develop 1.04 ha green roof that will be integrated in a sustainable way within the existing urban context.
- Provide 1.290 additional parking spaces.
- Reduced development value (whole life cost, life cycle analysis)
- yield increase of the building (lower building energy costs over the life)
- Reduction of void periods
- Reduced energy consumption (for instance reduced AC use)
- Reduced CO2 emissions, remove pollutants from the air - NOx and VOC levels (before and after)
- No. of users
- Increase of local economic activities

Development stages

0-5 year

- adopt regulatory plan enabling the construction of such garages in the city centre,
- conduct public call for potential investors

5-10 year

- build garages and plant green roof
- implement the co-management plan

Description of the planned interventions

1. Identify local barriers
 - possibility to increase costs concerning design, construction and maintenance,
 - lack of incentive from the government towards developers and owners of buildings
 - technical difficulties during the design and construction process
 - age of existing building structures
 - poor structural integrity of the buildings to deal with green roof loading
 - lack of awareness about green roofs in private sectors
 - lack of promotion from the local authority/government among the public and private sectors
2. Develop guidelines and standardizations based on scientific knowledge and best practices (requirements for planning, design, execution and maintenance)
3. Develop solutions specific to the local climate and context
 - major design objectives, budget - taking into consideration that green roofs require a budget that extends beyond the initial phases and construction) - consider using Life Cycle Assessment for green roofs.
 - building - design and implementation conditions (structural integrity and site
 - conditions are appropriate for green roof installation); understanding structural loads
4. Establish policies/ incentives/ strategies (such as: direct/indirect financial incentives, ecological compensation measures/ integration into development regulations)
5. Leverage organisations delivering NBS services (organisations delivering NBS products and services: nature-based enterprises, associated to an economic activity; nature-based organisations, not associated to an economic activity), organise international contest for solutions, develop a private investment plan.
6. Promote awareness, dissemination and invest in education: awareness and dissemination of green roofs in order to deliver trust and knowledge about technology - informing about the benefits and impact on the end-users, to ensure their willingness to pay for the implementation. Showcasing the benefits for the larger community

Design requirements

Landscaping

- Performant irrigation will be required.
- Vegetation to be locally adapted: criteria for roof vegetation must be selected from plants adaptable to the local area and climate (vegetation with the growing season corresponding to the wet season is preferred).
- Diversity: polyculture and diversity of beneficial species will sustain a productive and interactive green roof. Rather than focusing on several different elements within the system, focusing on functional connections (e.g. plants that are in synergetic relationships, such as sage and lavender, chamomile – increases plant recovery, etc)
- Heavier materials such as trees can be placed on higher weight bearing areas, such as columns or roof perimeters.
- Biological resources aiming for energy and material recycling should be used (to determine the sustainability of the system).

Community survey was conducted to assess options: appropriate selection of plants and other natural elements for the environment on the roof; selecting plants and other elements that can provide for the environment, such as improvement of air quality or decrease the effect of urban thermal Islands; corresponding soil depth and irrigation systems to ensure the health and growth of plants; use of light soil and other materials to minimise the structural load of the underground garage;

Accessibility

- Based on preliminary community survey, the area is considered safe and frequently crossed. This highlights the site's potential to become an area of interest at neighbourhood level.
- Access to the green roof should be decided according to site location (avoid hindering pedestrian/vehicle accessibility)
- Ensure connections with pedestrian routes and green infrastructure elements in proximity (connection between elements that can benefit from each other) - establish circular relationships.
- Inclusive design: adequate access to the roof through elevator or stairs for users with disabilities, a clear signalling, and a signpost to direct users to the access point
- Provide benches and other benefits to accommodate user with disabilities or limited mobility.

Aesthetics/Ambiance

- Green roof to be integrated into local urban image and landscape, considering surrounding buildings, vegetation, and valuable perspectives.
- Potential connections to other leisure activities can be established.

Z5.1

Community survey was conducted to assess options: The use of visually attractive and diverse plant species to create an aesthetically pleasing environment; installing design elements (walking trails, sitting and artistic installations); the use of natural materials (wood or stone, in seats and other content design); integration of the green roof design with surrounding environment (adjacent buildings or street landscapes); creating a quiet and relaxing ambience (use of water elements, etc.), use of sustainable design

practices (use of recycled materials, to improve sustainability); the involvement of the community contributions and engagement in the design and maintenance phase

Security/Safety

- Ensure safety of users by securing the green roof (i.e.: to avoid water infiltration)
- Ensure safe surfaces for walking on the green roof, such as non-slip materials with appropriate sloping.

Preliminary community survey: Setting safety fences to prevent falling; regular security inspection and maintenance to ensure stability of the structure; proper installation and maintenance of the irrigation and drainage systems; Fire protection measures, (i.e.: providing fire extinguishers and securing adequate access for fire trucks); Lighting system for night use adapted to the current needs (i.e.: highlighting ramps); regular monitoring for pest control and illness; using sustainable methods whenever possible; safety measures (i.e.: surveillance cameras or security staff in case of vandalism).

Infrastructure works (if needed)

- Planting: according to standards - usually 150-300mm inches deep with a saturated weight of 1.4 – 2.4kN/m². The planting layer should be sufficiently deep to provide capacity within the pore space of to capture 80% of the average annual runoff.
- Components of the green roof (general overview of standard technologies – other options are viable as well):
 - structural support
 - roofing membrane/ waterproof membrane
 - root repellent membrane/ barrier (membrane protection and root barrier)
 - insulation* (optional)
 - the drainage system and water storage (for excess water)
 - filter cloth/fabric for fine soils (to allow water to drain but prevent soil escaping)
 - growing medium: soil substrate or engineered growing medium
 - last layer: vegetation: grasses, flowerbeds, shrubs, and trees.

Urban furniture and equipment

- Natural materials should be used in urban furniture.
- Max. 30% hard paved areas.
- Develop 'keyhole paths' to ensure accessibility, avoid stepping on the soil to prevent soil compaction (which hinders plant growth).

Preliminary community survey: urban furniture (benches, tables, chairs); use of weather resistant materials; shade structures (pergola or parasols), ambience lighting for evening use, providing waste and recycling trash cans, water elements (fountains/water walls); signs to guide visitors and provide information; provide equipment.

Annexed functions and activities

- Include raised-bed plantation for aromatic plants and fruits (also creating a productive component that is community oriented).
- Include fruit trees – creating a small-scale urban orchard, mixed with public spaces for leisure and socializing.

Preliminary community survey: Providing recreational and social areas (seating spaces, walking trails and social facilities); sustainable practices (urban agriculture or

beekeeping, to provide additional environmental and educational benefits), Installing spaces for events and programs (yoga classes or educational workshops); use the green roof as a public space; promote biodiversity by creating space for wildlife habitats (bird or insect shelters,); educational signalling about the benefits of engaging with nature; partnerships with local organisations.

Sustainability/Maintenance

- Design within scope of energy efficient systems achieving maximum productivity with few resources.
- Material selection and material ageing should be considered (i.e.: ageing roofs can become a source of metal pollution)
- Stormwater control measures should be in areas accessible at any given time (for operating, maintenance, and inspection purposes)
'Maintenance Agreement' - can be issued by the municipality, stating the parties' responsibility for maintenance and upkeep.
- Inspections should be conducted by the project owner at least semi-annually. Confirm adequate irrigation.
- Care for plants and replenish growing media as specified by the landscape designer and as needed for plant health (green roof plants require regular attention including irrigation, weeding, fertilising, pruning, and replanting)
- A maintenance plan should be established prior to the completion of the green roof. Plant maintenance, the inspection of membrane flashing points and various roof structural elements that are used frequently (Membrane maintenance, drain inspection, irrigation. Some maintenance procedures should be scheduled after events - such as storms, while others can be scheduled according to seasonal events - germination period, invasive species season and in the fall after leaf fall).
- Ensure that each relevant function of the system is supported by other elements:
- Identify critical functions of the system (such as: water drainage, energy conservation, thermal benefits)
- Ensuring that those functions are supported in two or more ways (resilient design). If an element of the system fails, critical functions will continue to operate.

Preliminary community study: sustainable practices (use of organic fertilisers and pest control methods to reduce the negative impact on a living environment); use of water conservation measures (drop by drop or rainwater collection); use of lightweight materials to minimise the structural load; agree on a regular maintenance schedule (watering, pruning and removal of weeds); ensure plan implementation (regular inspections and repairs guaranty structural integrity; staff training on sustainable practices; making a long-term management plan (includes regular plant health and growth monitoring, budgeting for liquid maintenance and replacement of materials if needed.)