

GREEN LIVING ROOFS AS A PART OF GREEN INFRASTRUCTURE

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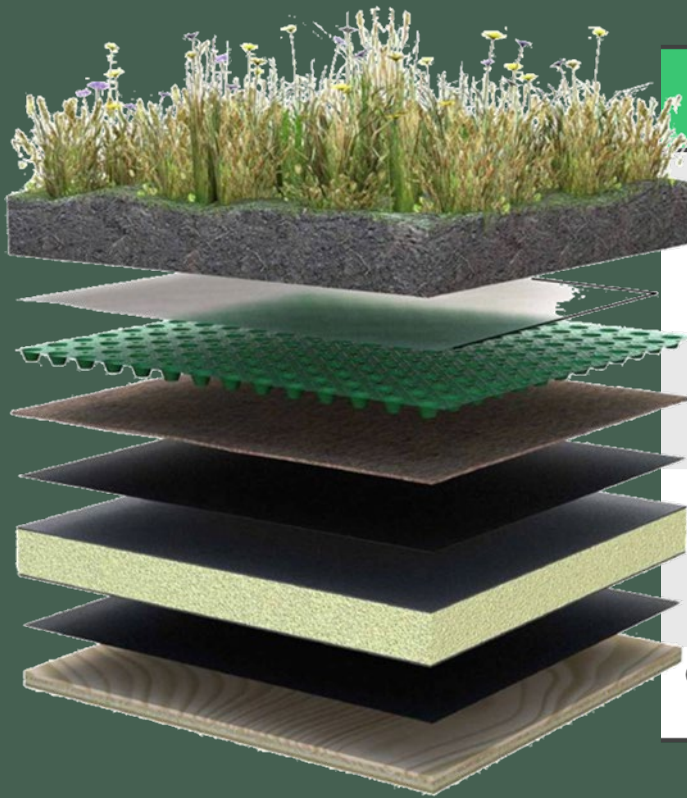
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GREEN LIVING ROOFS

- Greening the building envelope is innovating technology in architecture that can regain losses of natural environment produced by erecting buildings.
- Green roofs are considered to be an effective contribution to the resolution of some environmental problems at the building and urban levels.

CLASSIFICATION OF GREEN ROOFS



	Extensive	Simple-Intensive	Intensive
Growing Media Depth [cm]	4 to 20, 10 to 15 typical	10 to 50	10 to 200 +
Plant Heights [cm]	5 to 30	30 to 60	30 to 90 +
Roof Slopes	Slopes up to 30 degrees	Only used on low slopes or terraced roofs	Only used on low slopes or terraced roofs
Irrigation	No	Periodic	Regular
Stormwater Reduction	Low	Medium	High
General Weights [kg/m ²]	60 to 145	120 to 195	170 to 500 +



BENEFITS OF THE GREEN ROOFS

- Improvement of the microclimate;
- Contribution to flood protection;
- Noise and radiation protection;
- Building maintenance improvement;
- Reduction of interventions in nature and landscape;
- Increase in value;
- Modern urban planning;

GREEN ROOFS POLICIES AND INCENTIVES

The first guideline concerning Green Roofs appeared in 1982 as the Principles of Green Roofing published by the FLL. It is the benchmark set of regulations for green roofing in Germany, linked into the DIN and EN standards and other regulatory publications.

In many countries, governments and municipalities began implementing public policy and incentives to encourage the construction of green roofs through:

- Regulations and standards that mandate or encourage green roof installations;
- Indirect financial incentives such as fee reductions and floor space density bonuses;
- Direct financial incentives such as grants and subsidies;

GREEN ROOF MANDATES

- The cities with the highest density of green roofs are located in Switzerland, Germany, and Austria, these countries were the first to introduced mandatory policies and incentives for green roofs.
- Linz was one of the first cities in world to implement a mandatory policy for green roof construction in 1985. At present, the city has mandatory green roofs on new buildings with a roof area of over 100 m².
- In 2002, in Basel, an amendment to the Building and Construction Law was adopted, which required that all new and renovated flat roofs must be greened considering specific design guidelines.
- Basel is one of leading green roof cities in Europe and world, which has the densest green roof areas per inhabitant, about 5.7m² followed by Stuttgart and Linz with 3.4m² and 2.6m² per inhabitant respectively.

GREEN ROOF MANDATES

- In Germany the widely used construction law (The German Federal Building Code) established in 1998, set requirements for green roofs.
- In the late 1980s, many cities in German have integrated various green roof policies.
- Stuttgart, Berlin, and Munich have similar mandatory green roof policy refer to all new buildings with flat roofs larger than 100m² and all new roofs below 12° slope in Stuttgart.
- In addition, the Federal Nature Conservation Act, since 1993 requires compensation for the loss of valuable nature/landscape for all new buildings.

GREEN ROOF MANDATES

- France is the only country in the world that has nationwide law (Biodiversity Act and Green Roof Statement, 2015), which requires partial integration of either green roofs or solar panels on all new commercial buildings.
- Regarding Scandinavia, Danish capital is the only city where green roofs are mandated.
- Since 2010, all the Municipalities buildings and new roofs in Copenhagen with below 30° slope must be covered with a green roof, according to Green Roof Policy. Today green roofs are integrated into the Wastewater Plan, Climate Plan, and Climate Adaptation Plan as well in the Strategy for Biodiversity.
- The Antwerp recognized green roof as a good solution to sea-level rise, floods risk, and urban heat island problems and in 2011 made mandatory storm-water management plans for new buildings and buildings that are being renovated in case it is possible.

GREEN ROOF MANDATES

- Toronto in Canada was the first local government in North America to adopt mandatory polices in terms of green roof construction (Green Roof Bylaw, 2009). All new residential, commercial and industrial buildings with a floor area greater than 2000m² must include a green roof covering between 20 and 60% of roof area, according to legislation.
- Instead of constructing the required green roof the developers can seek approval to pay 200\$/m². Collected funds are directed to the Eco-Roof Incentive Program.

GREEN ROOF MANDATES

- In USA, San Francisco became the first city that makes mandatory incorporation of green roof, in 2017. As stated in Better Roof Ordinance between 15 to 30% of roof area on most new buildings must be covered with green roof and/or solar panels.
- Until 2015, Washington DC was the leading city in North American, which had the highest density of green roofs per inhabitant, as a result of its River Smart Rooftops Program.

GREEN ROOF MANDATES

- The problem with urban heat island effect forced the Tokyo Metropolitan Government (TMG) to respond to adopting the policies requiring green roofs on buildings (Green Roof Law, 2001).
- The TMG has mandated green roofs on a percentage of the area of every new building, over 20% of the total site must be set as the green roof in cases where the facility is over 1000m² for private developments and 250m² for public developments.
- Failure to provide green roofs results in a penalty for developers in 200000 yen.

GREEN ROOF INCENTIVES

- The incentives policies such as financial substitute or various fees reduction to enforce the installation of green roofs appear to be growing worldwide.
- Munster, Munich, Düsseldorf, and Cologne offer a reduction in storm-water fees for green roofs.
- The Green vs. Gray Program in Muster greened roughly 1000m² of rooftop each year granted 25000€. If a green roof is installed, the storm-water fee is reduced by 80% to 0.09/m² of green roof annually.
- Since 1986, Stuttgart has a financial support program for green roofs and walls, which covers 50% of installation costs up to a maximum of 10000€.
- Hamburg and Frankfurt adopted similar incentive programs in 2018.

GREEN ROOF INCENTIVES

- Besides mandatory polices Linz implement financial incentives in 1989. The policy reimbursed rebates up to 30% of the cost of installing a green roof.
- Vienna has financial incentives of 8-25€ per m², since 2003. The maximum subsidy can be 2200€. Furthermore, Vienna provides financial support for the maintenance costs for green roofs in the amount of approximately 0.19€·m².
- By 2008, Rotterdam in the Netherlands had also begun to apply incentives for storm-water management to increase the number of green roofs to 600000 m² by 2025.

GREEN ROOF INCENTIVES

- In 2017, the Czech Republic adopted a National Green Savings Program under which green roofs are eligible for support.
- In 2019, Brno has invested 780000€ in funding for green roofs. The program was the first of its kind in the country.
- Based on the incentive adopted in Wroclaw, Poland in 2015, the usable areas of residential premises in buildings, on which green roofs were constructed, were exempt from tax, while the resolution was effective.
- The city of Malmö was the first to widely implemented green roofs in Scandinavia, and support urban greening by encouraging the use of a landscape planning tool (the Green Space Factor).
- Stockholm also requires the use of Green Space Factor for all property developers building on city land.

GREEN ROOF INCENTIVES

- Through the Eco-Roof Incentive Program, Toronto encourages the installation of green roofs on existing and some new buildings by offering 100\$/m² for green roof projects. In addition, Structural Assessment Grant gives up to 1000\$ to assess whether the existing building is suitable for green roof construction.
- Vancouver also gives exempt from developer permit fees for buildings with green roofs (Plant Connection Inc., 2016).
- The Chicago Department of Planning and Development has been actively encouraging the installation of green roofs since early 2003. The Green Permit Program launched in 2005 consists of a faster building license through which developers can save both time and money. If at least 50% of the roof surface area or a minimum of 185.8 m² is covered with vegetation, the City of Chicago grants a density bonus, which permits an increased number of units allowed on a piece of property.

GREEN ROOF INCENTIVES

- In Singapore, rooftop greenery is promoted by not including certain portions of the areas used for greenery in the calculation of a building gross floor area.
- To increase greenery provision in Singapore, the National Parks Board introduced the Skyrise Greenery Incentive Scheme (SGIS) in 2009, where NPB will fund up to 50% of installation costs of rooftop greenery and vertical greenery.
- The incentive scheme was effective from 1 April 2015 and until 31 March 2020.

GREEN ROOFS OF SERBIA

- In Serbia green infrastructure still has no firm support in legislation, although The Law on Planning and Construction provides a minimal framework for its planning.
- It is up to local authorities to prescribe requirements and ways of compensation for destroying green space.
- Decision of the City of Belgrade for green roofs from 2011 was the first step forward, unfortunately, this Decision was questionable and has not been implemented yet.
- Another step was made in 2015, the city of Belgrade adopted the Action Plan for Climate Change Adaptation (hereinafter APCCA), emphasizing the planning and implementation of green infrastructure networks throughout the metropolitan territory as a measure of the highest priority.
- According to the current legal framework, types of green spaces such as green roofs, as well as green walls and green parking lots, are NOT included in the total amount of greenery.

GREEN ROOFS OF SERBIA

- In 2018, the National Green Roof Association was founded in Novi Sad. Together with the Faculty of Technical sciences, they are currently working on draft document Green Factor for Novi Sad trying to address the issue of an extremely low percentage of green areas in the city, which was below 5%.
- National Green Roof Association proposed communal tax exemption for the accessible green roof in (tax is 100€/m² of the roof area in the city zone and 50€/m² of roof area outside of the city zone). This incentive for green roofs in Novi Sad is still in the procedure by the local authorities.

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CONCLUSIONS

- Development of an education and awareness program is needed.
- Linking the policy to a financial gain can make acceptance of the policy easier.
- Failure to provide some percentage of green roofs should result in a penalty for developers.
- Initial support from high role individual or pilot project retrofitting the governmental building could provide a good start.

Standards and practices from other countries could provide a basis for the development of Serbian Green Roof standards. Currently, the lack of information represents an obstacle for most investors and property owners for green roof implementation.

From the examples above we found that raising public awareness of green roofs has a significant role in implementing a green roof policy. **At the same time, Serbia needs to conduct locally oriented research relate to green roof benefits in our climate.** There is a knowledge already accumulated by decades of experience worldwide and Serbia could gain from applying data in starting a national green roof initiative.