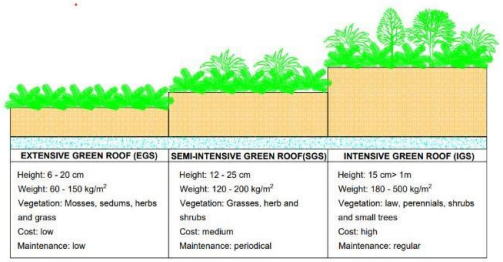
INSTRUCTIONS OF GREEN ROOF SYSTEMS INSTALLATION

1. Introduction

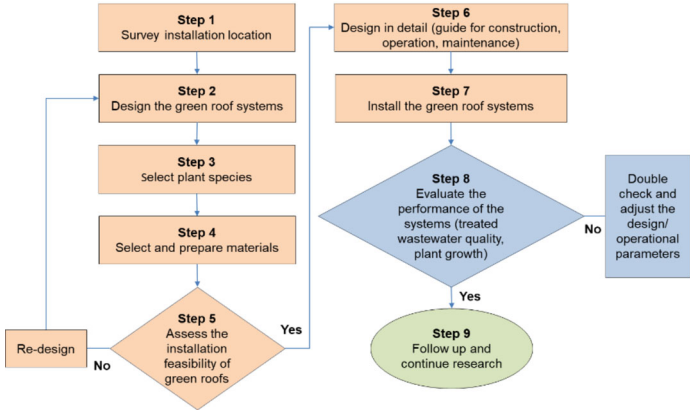
Green roofs (GRs) are one of the innovative architectural and urban development options based on sustainable development concepts that can increase urban green areas, improve environmental quality, and generate sustainable urban development. Additionally, Green roofs also improve building insulation and reduce cooling costs. Green roofs are classified into extensive, intense, and semi-intensive active plant layers.



EXTENSIVE GREEN ROOF (EGS)	SEMI-INTENSIVE GREEN ROOF(SGS)	INTENSIVE GREEN ROOF (IGS)
Height: 6 - 20 cm Weight: 60 - 150 kg/m^2 Vegetation: Mosses, sedums, herbs and grass Cost: low Maintenance: low	Height: 12 - 25 cm Weight: 120 - 200 kg/m^2 Vegetation: Grasses, herb and shrubs Cost: medium Maintenance: periodical	Height: 15 cm> 1m Weight: 180 - 500 kg/m^2 Vegetation: law, perennials, shrubs and small trees Cost: high Maintenance: regular

2. Installation instructions

2.1. Installation and evaluation steps for the GRs



2.2. Surveying the location of installation

Surveying and selecting the placement of the green roof is a very important step in the installation process. GRs have been widely employed in apartments, households, schools, etc. So, characteristics of the buildings such as structure, height, area, permeability of roofing materials, and wastewater drainage system are considered for selecting the location.

2.3. Plant species selection

Plants cover the surface of the media and create a green space. The root system may help physical filtration, avoid clogging, absorb nutrients and metals, and serve as media for microorganisms that are attached to it. So, plant species suitable for green roofs should have the following characteristics: easy to grow, thrives in harsh conditions (rain/storm in winter and high temperature in summer), capable of treating wastewater, have a long life, and good coverage.

Vernonia elliptica

Campsis radicans

Tristellateia australasiae

Hedera helix

2.4. Selection of materials

Materials of the layers that support plant growth are considered one of the most important design parameters due to their strong impact on the performance of GRs in terms of vegetation, physical and biochemical processes, hydrodynamics, wastewater treatment, and other functions. Porous media act as adsorbents of pollutants and provide an environment for macrophytes to grow. Materials applied in GRs must have high-performance (e.g., lighter, high absorption capacity and long life).

Cobble

Oyster shell

Coconut shell

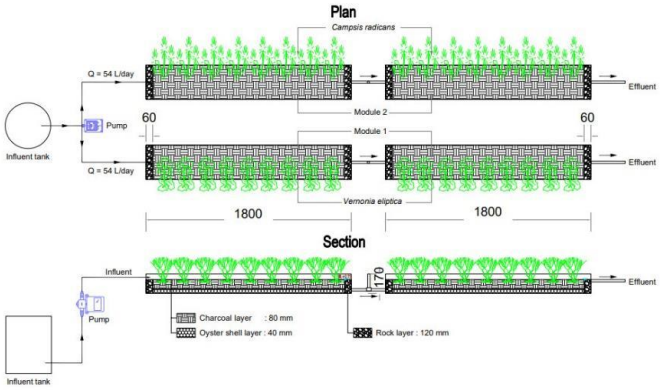
Charcoal

Ceramsite

Mussel shell

3. Installation instructions of GRs

3.1. Design parameters



3.2. Steps taken to install GRs

Step 1. Preparation of charcoal and oyster shells

Step 2. Plant selection

Step 3. Installation of the tray, pump, pipe, and electrical systems

Step 4. Adding oyster shell layer onto the tray

Step 5. Adding charcoal on top of the oyster shell layer

Step 6. Adding rock to the tray

Step 7. Adding plants in the green roof system.

4. Operation and maintenance

The domestic wastewater is collected and transferred to an influent tank before being pumped into GRs through water pipes. Plants use nutrients present in the wastewater to grow. Besides, regular maintenance will increase the lifespan of the roofing materials, limit the leakage, and improve the performance of GRs.

When plants have matured (two months after planting), pruning and harvesting of pruned biomass are carried out. No need to replace new plants unless the plants are not growing well.

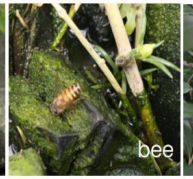
5. Caring for the plants and harvesting biomass

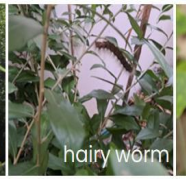
To ensure the optimal growth of plants on GRs and maintain their aesthetic appeal, regular care and periodic pruning are necessary. Weeds should be cleared bimonthly from the systems to promote plant growth. Dead plants should be replaced with new ones. Additionally, during pruning and harvesting care must be taken to avoid damaging the plant root system.

6. Positive impacts of GRs

- Create landscape and provide domestic wastewater treatment

- Provide habitats for local wildlife (Biodiversity)





- Stakeholders involvement

Integrated assessment of existing practices and development of pathways for the effective integration of nature-based water treatment in urban areas in Sri Lanka, the Philippines and Vietnam (APN 2021 – 2023): APN Project number: CRRP2021-06MY-Jegatheesan

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