Ingenieurbüro Blumberg

Wetland roofs, an innovative and versatile type of green roof

The wetland roof is an innovative special type of an extensive green roof. The wetland roof is evenly planted with wetland or marsh plants, which are regularly irrigated on a daily basis. Besides the aesthetic aspect, this particular type of green roof offers significant functional advantages.

Wetland roofs are natural air-conditioning systems. During the hot season, the heat of the rooms below is reduced by the evapotranspiration of water.

A cowshed roof covered with helophyte (marsh plants) mats in Brunswick, Germany (2006), designed by Blumberg Engineers and constructed by Rhizotech (900 m²).

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A wetland roof on a two-story office building in Jena, Germany.

Special textile water storage mats planted with moisture preferring plants (helophytes) are installed on the roof and cooling the rooms below and the surrounding environment.

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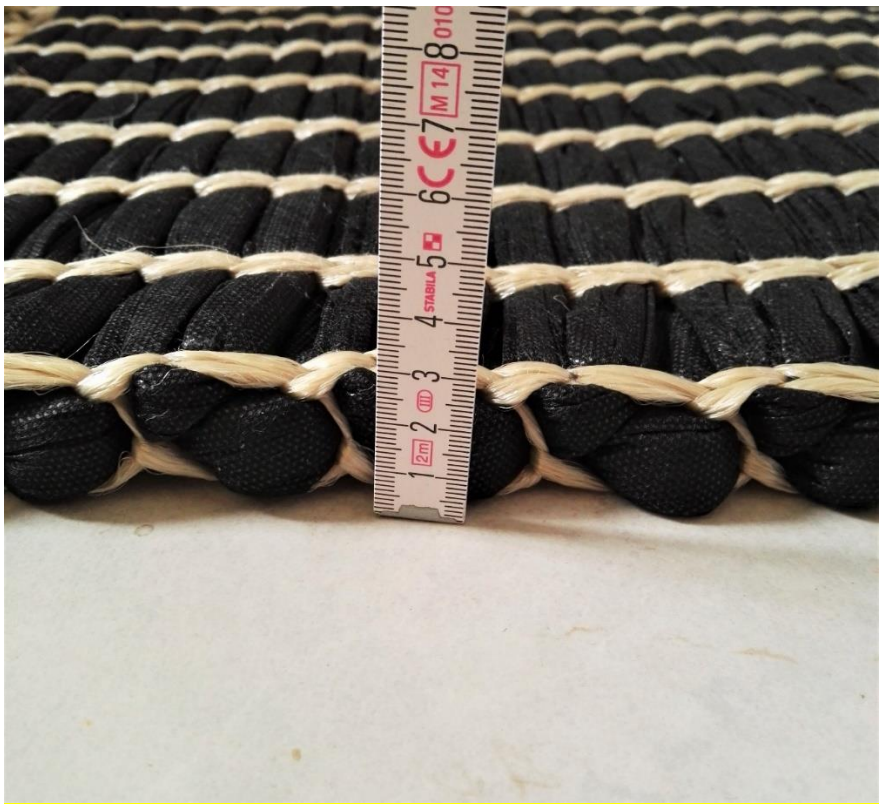

Some materials used as water storage and plant carrier mats.

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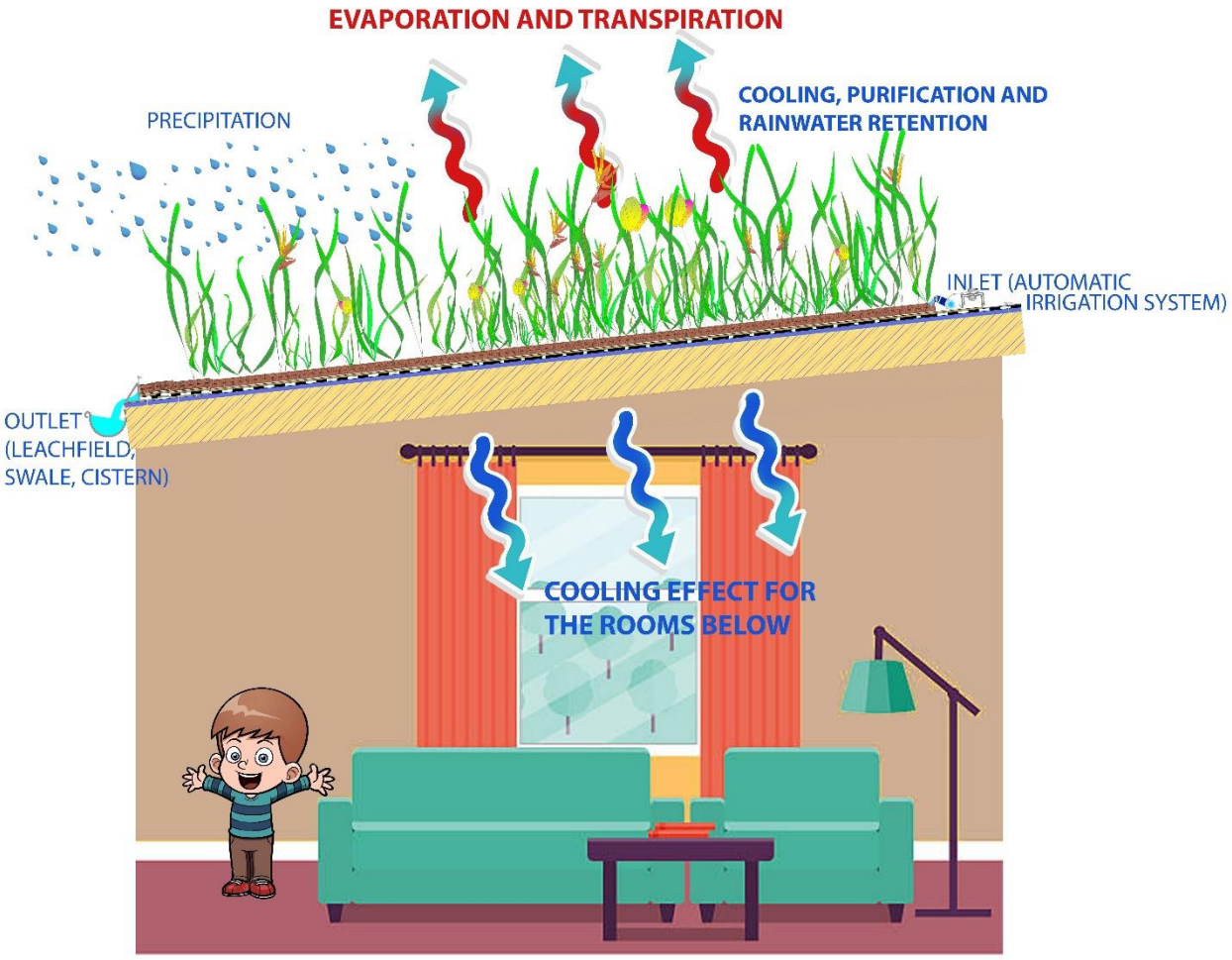
Both the plants themselves and the microorganisms living on their roots remove nutrients from the irrigation water to be used for growth and for metabolism. Wetland roofs are used for retention and purification of stormwater and are also an option for greywater treatment. The effluent water may be reused for irrigation (e.g. gardening), for groundwater recharge by seepage into the ground or for sanitary facilities (toilet flushing) by greywater recycling.

Wetland or marsh plants are especially appropriate for the filtration of airborne particles (dry deposition), due to their active vegetation mainly during the summer months. Dust particles accumulate on the surface of the vegetation layer and will then be rinsed into the mats by rainwater. There, most of the nutrients are absorbed and incorporated into the plant biomass.
The protection of the roof skin by the permanent plant cover (shadow) increases the durability of the roof.

The selected types of wetland or marsh plants will be pre-cultivated on mats of non-woven material for one year before becoming part of a wetland roof structure. For the cultivation, these non-woven or textile based mats are equipped with suitable plants and are raised in a plant nursery for one vegetation period. After approximately six months precultivation, the plant carrier mats are completely penetrated by roots and the mat strips are then ready to be installed on the roof.
The mats as shown above, have a considerable water storage capacity (10 l/m²), thereby ensuring a water supply for the plants for at least one week in case of failure of the irrigation pump.

Installation of plants on a wetland roof in Zofingen, Switzerland.

Installation of the plant carrier and water storage mats on a wetland roof.



Structure and principle of a wetland roof.

A penetration of the plant roots into the roof skin is prevented by a substructure consisting of a root barrier layer and non-woven material. Since wetland or marsh plants need a certain degree of moisture, an artificial irrigation system, adaptable to the weather conditions of the prevailing season, including a water distribution pipeline network with several outlets (drippers) in defined distances, has to be installed on the ridge of the roof.

Outlet drippers of the water feed system

Irrigation along the ridge of the roof

The rainwater usually stored by cisterns will be pumped on the plant mats in intervals, thus ensuring a sufficient water supply.

Surplus water will be collected in the rain gutters, conveyed back into the rainwater cistern and will then be pumped back on the roof. The automatic watering of the wetland roof is steered by an irrigation computer.

Purple loosestrife (Lythrum ssp.) and monkey flowers (Mimulus ssp.) on our wetland roof (2006) in Brunswick, Germany.

Summary of the efficient components of a wetland roof

1. Compensation of temperature amplitudes (of the roof skin, of the building, of the ambient microclimate) and cooling
   - due to the irradiation shielding
   - due to the evapotranspiration[1] of the artificially irrigated roof caused by the lush roof vegetation even during the hottest months.

2. Stormwater discharge reduction (retaining 80 % of runoff).

3. Increase of the durability of the roof structure by temperature reduction and protection against a direct impact of UV-radiation leading to a reduced surface ageing (reduced membrane replacement costs).

[1] For the evaporation of 1 g of water, an energy amount of 2.450 kJ will be removed from the ambient air and will only be released back into the atmosphere during the condensation process.

4. Compensation of surface impermeability of the sealed roof area (factor ≥ 50 %).

5. Considerable reduction of the need for technical air-conditioning (supplied by fossil sources of energy) because of a passive cooling of the building (energy savings); Temperature reduction on the floor below the roof by 8 – 10°C.

6. Improvement of the microclimate and contribution to the prevention of an overheating of urban conglomerates during the summer months (hot spots).

7. Filtration of dust emissions and of other air polluting contaminants.

8. Higher short-wave radiative reflexion compared to a dark bitumen roof.

9. Reduced roof loads due to a substrate-free planting procedure with only one textile water accumulating mat on which the selected types of wetland plant have been pre-cultivated. This procedure ensures that the roof surface is fully covered by plants after one vegetation period.

10. Possible design as a roof garden (in case of a flat roof) with a highly aesthetic component due to the variety of usually untypical types of green roof plants like wetland or marsh plants (aquatic macrophytes) and by the animals preferring such a kind of ecosystem (e.g. butterflies and other insects and birds) instead of succulent or grass roofs with their poor vegetation during hot periods. Employees may use the green roof area for recreational purposes during breaks.

11. Possible use as a roof based sewage treatment plant for greywater recycling and for stormwater treatment[2].

12. Daily watering intervals controlled by means of an irrigation computer with weather sensors and automatically steered water supply for the vegetation cover.

[2] Zehnsdorf, A., Blumberg, M., Müller, R. A. (2018): Helophyte mats (wetland roofs) with high evapotranspiration rates as a tool for decentralised rainwater management – process stability improved by simultaneous greywater treatment, Water Science and Technology: Water Supply, Dezember 2018