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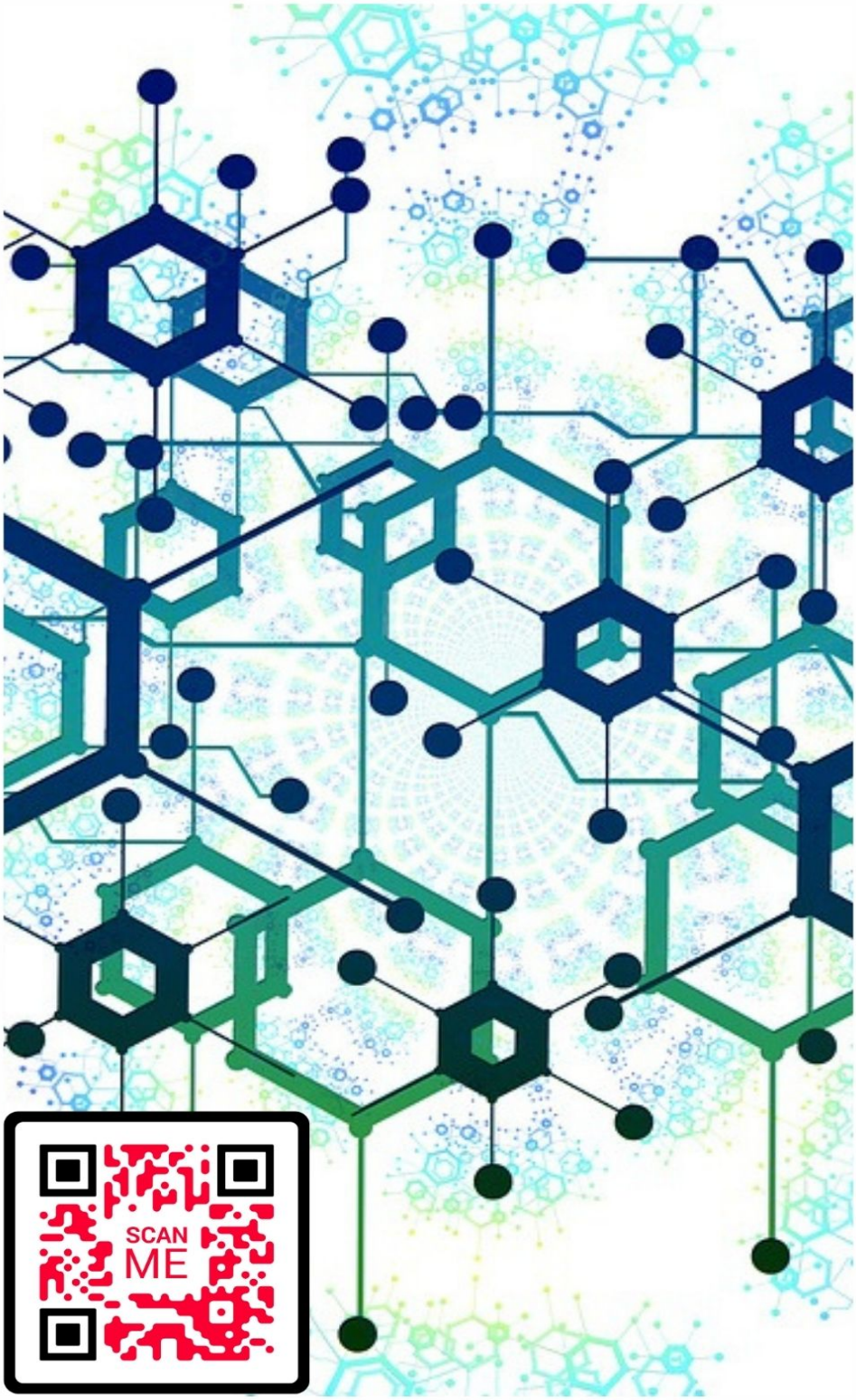

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Technology of Forming Roof Top Flowers: Basic Principles

Teknologi pembentukan atap berbentuk bunga: Prinsip Dasar

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Abstract

This scientific article rigorously investigates the formation of rooftop flowers, addressing key factors such as climate characteristics, construction requirements, rules, and drainage considerations. Employing a scientific and theoretical approach, the study delves into the technological aspects, including the filter layer and other relevant techniques. The goals encompass understanding the intricate relationship between rooftop vegetation and environmental factors. The research employs systematic methods to explore the theoretical underpinnings and practical implications of rooftop flower construction. Results highlight the significance of meticulous design, robust roof structures, efficient irrigation, suitable plant selection, and sustainable practices. The concluding remarks underscore the importance of these findings in enhancing both the aesthetic appeal and functionality of green rooftops, providing valuable insights for global researchers and practitioners in related fields.

Highlights:

- *Innovative Design:* Meticulous design principles play a pivotal role in achieving visually appealing and environmentally beneficial rooftop flower formations.
- *Climate-Responsive Construction:* The study emphasizes the significance of constructing rooftop gardens resilient to diverse climatic conditions, ensuring long-term viability and adaptability.
- *Effective Drainage Management:* Successful implementation relies on optimized drainage systems, preventing water stagnation and safeguarding both the rooftop structure and the underlying environment.

Keywords: Irrigation, Drainage, Rooftop Flowers, Green Roof Technology, Sustainable Urban Design

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Introduction

The increase in the demand for a comfortable life in the material and household lifestyle of mankind, the growth of industry and technology, the emergence of innovative types of building materials provide an opportunity to implement modern greening project developments in architecture, especially in landscape design. In this regard, the greening of the roof surfaces of residential and public buildings, in particular, the introduction of flower gardens, mainly in urban areas, is widely practiced today in a number of developed countries in Europe (UK, USA, Germany) and Asia (China, Japan, Korea, Singapore, Malaysia) done [1].

In order to implement the idea of forming flower beds on roof surfaces, it is necessary to solve the following issues:

- the location and technical characteristics of the building (climate zone, building height, lighting of the roof during the day, its slope and strength) make it possible to engage in landscaping;

- if necessary, know how to strengthen the roof;

- it is necessary to know how to waterproof it.

Methods

The analysis of the research results shows that by using today's technologies wisely and effectively, it is possible to green the roof of any building, as long as it is not located in the shadow of other buildings or tall trees, because without good lighting, flowers will not grow and the soil will become dry can stay.

The decisive factor (factor) limiting the possibility of greening the roof surfaces is its slope angle. It is difficult to prevent soil movement on steep roofs. Roofs with a slope of 45° are landscaped with difficulty and high costs. Roofs with a pitch of less than 20° or none at all have the least problems. Starting from a slope of 8°, it is necessary to install a fence on the canopy (above the canopy-balcony, gate, window, etc.) to prevent the soil from shifting, and at 20° it is laid in rows up to the ridge of the roof. The fence is made of compacted peat (meniral fertilizer made from a mixture of plant humus or animal dung with dung), wood made of triangular or rectangular pieces (15x15 cm) depending on the slope of the roof. it can. On steep roofs, the soil is held by special frame structures laid along all green slopes. This type of frame was used in old Scandinavian houses with steep roofs. In modern landscaping, slats (50x100 mm) are installed on the roof surface in longitudinal rows (every 1.5-2 m) and in the spaces between them are placed plates of moisture-resistant heat insulator (extruded polystyrene foam). An alternative to wood can be large-compartment honeycombs made of moisture-resistant and mechanically strong plastic [2].

Result and Discussion

In regions with a continental (regions far from the sea: dry, hot summers; cold winters) climate, green roofs should be approached very carefully: periodic cold winters punish mistakes made during the construction of buildings that cause serious damage. Experiments can be done with confidence in the southern regions. And the most important thing is to apply this work only to specialized organizations that have proven themselves in performing such work.

The location of the building determines what kind of plants can grow on the roof of the building. If there is no shade on the roof of the building during the day, the soil can dry out. On such roofs, only succulent and thick-leaved plants (plants with special tissues for storing water) are resistant, for example: sedum similar ones can be used. During the flowering period, they form a dense and very beautiful carpet, but do not create as good thermal insulation as a pure grass cover.

Grasses grow well in partial shade, where the soil stays moist for a long time. Drought-tolerant grasses or weed mixes can be used for unshaded roofs, which don't look too bad on a building roof. It should be remembered that the soil on the roof is much hotter than the ground: at the same time, on the one hand, the growth of plants accelerates, on the other hand, rapid evaporation of moisture occurs.

If the building is protected from constant sunlight and the climate is favorable for growing plants in open areas, then various flower beds are created on the roof surfaces along with lawns.

Due to the plant soil, the surface of the roof should be wet in any weather, but it should never be wet or dry inside the building. This can be achieved only by laying a hermetic membrane on the entire roof surface. The requirements for the production of the membrane (strong welded and glued seams, precise cutting and the absence of tension in the fabric), as well as for its material (absolutely sealed, vapor permeability, plastic and mechanically strong in a wide temperature range), are extremely high. Membrane fabric should be purchased only from specialized stores.

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The joints of membrane fabrics are welded or coated with additional oil. Covering fabrics are laid freely and without tension, and their edges should hang from the roof. This is the only way to avoid stress on the finished membrane when soil is placed on top of it and it rains or snows. In order to protect the membrane from damage from the side of the board, first a layer of dense geomaterial ("Dornit-type for drainage, strengthening and filtering" or "Taipar" between soil layers) is laid under it. Another layer of geomaterial is laid on top of the interlocking welded membrane, which protects it from damage from plant roots and soil from above. After that, extruded polystyrene panels (thickness 50 mm) are laid in rows, separating them along the roof slope with boards (50x100 mm) - this is considered a barrier that prevents the soil from sliding.

For this, boards impregnated with moisture-resistant material or covered with waterproofing are used. Another layer of geomaterial is laid on top, it should extend from the edge of the roof to the same length as the canopy. In the future, it will be surrounded by a drainage system consisting of pipes and gravel. After laying the soil, all the coverings are laid gently and tightly so that no tension appears.

It is not difficult to carefully weld the coated membrane on the flat part of the roof. It is more difficult to do this work in corners, edges, corners and places of connection with exits (smoke and ventilation pipes). Work in these areas is carried out with special attention - here and with a traditional roof, water leaks often appear.

Therefore, it is necessary to use ready-made hermetic aprons for the exits of smoke and ventilation pipes, etc., which can be easily installed on the roof.

An important link of this unusual roof is a mechanism for controlling the water balance in the soil: drainage pipes are laid on the gravel to drain and remove excess water during rain or snowmelt, and an expanded soil layer is laid, and the entire along the roof absorbs the water under the soil and gradually gives it to the plants.

To install drainage, the canopy of the roof is filled with a barrier, and a membrane (a thin flexible film or plate, usually fixed along the perimeter) is also placed on top of it.

Whether the beams can withstand the additional load when placing a flower bed on the roof can only be answered by a construction engineer after a full inspection and static calculations. For old houses, as a rule, when the project documents are submitted, the information is unclear, and in this case, calculations need to be made anew.

Greening flat roofs with a reinforced concrete coating is the easiest way, and they can withstand a large additional load. The fact is that before greening 1 m2 of such a roof, all layers of the old coating must be removed: 16 to 18 kg of gravel (a bad roof does not have it), about 10 kg of multi-layer waterproofing, 25 kg of concrete styajkani and about 5-10 kg of expanded clay type serve as a heat insulator. Thus, the roof literally experiences relief after greening.

The situation is different in buildings with a system of beams on the roofs that are not designed for additional loads. As a rule, it should be additionally reinforced according to static calculations.

When installing lawns on the surface of the roof, the following data are taken to calculate the additional static load on the beams: 16-20 kg per centimeter of plant soil layer per square meter when completely saturated with water, sand - 20-22 kg, gravel - 16-18 kg, expanded clay - 8-10 kg, a mixture of expanded clay and soil (1:1) - 13-15 kg. Static load reduction can be achieved only by laying lighter substrates in thin layers.

Green roofs have a multi-layer structure, which includes a welded waterproofing membrane cover made of plastic material; geomaterial layers protecting from mechanical damage from above and below; expanded clay to create a uniform soil moisture regime; soil The thickness of such multi-layered "Pie" is 10-20 centimeters.

Greening of flat roofs with a slope of no more than 20° is effective, otherwise it will be difficult to prevent soil slippage during rainy and snowy climate seasons. Also, the roof should not leak or fail after the first heavy rain (which can double the load on the rafter system if the ground is flooded). At the same time, plants need moist soil and nutrients.

An example is the use of pitched two-slope roofs in good condition, covered with bitumen cheripies (roofing materials in the form of shingles-wood, ceramic tiles) for landscaping. This coating (lack of relief, as in slate or tiles) greatly simplifies the work - there is no need to prepare a new, flat base. Ruberoid (a special cardboard that is covered with a roof and used as insulation material) covered with slate, metal tiles or gravel would have to be removed. The reason for this is that the membrane plate must lie on a stable base that does not move at all.

The bottom covering is sewn immediately on the shingles. Then a 19 mm thick pazo-grebnev board (for installing walls and curtain wall parts) is laid on top of the coating.

Due to the curb, gravel is stored in the canopy with a drainage pipe surrounded by geomaterial.

Manufacturers supply ready-to-use water inlet pipes, and they manufacture the funnel so that it can be welded directly. In order to prevent water from leaking from the joints, they are covered with a protective profile and

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elastic hermetic (paste-like or sticky based on polymers or oligomers used on bolts, screws and other joints to prevent leakage of internal liquid for waterproofing and welding joints of constructions compound) glued with.

For roofs with complex shapes, sheets (a thicker type of gauze) are cut on site. They are laid "on top of each other" with an excess margin. The excess can be cut off, but the deficiency will need to be corrected with additional patches. For such roofs, canvas fasteners (a device that fixes things in a certain position) holders are used. Membrane fabric (canvas) is also welded to them.

Below is a diagram of the roof profile prepared for landscaping (Fig. 1).

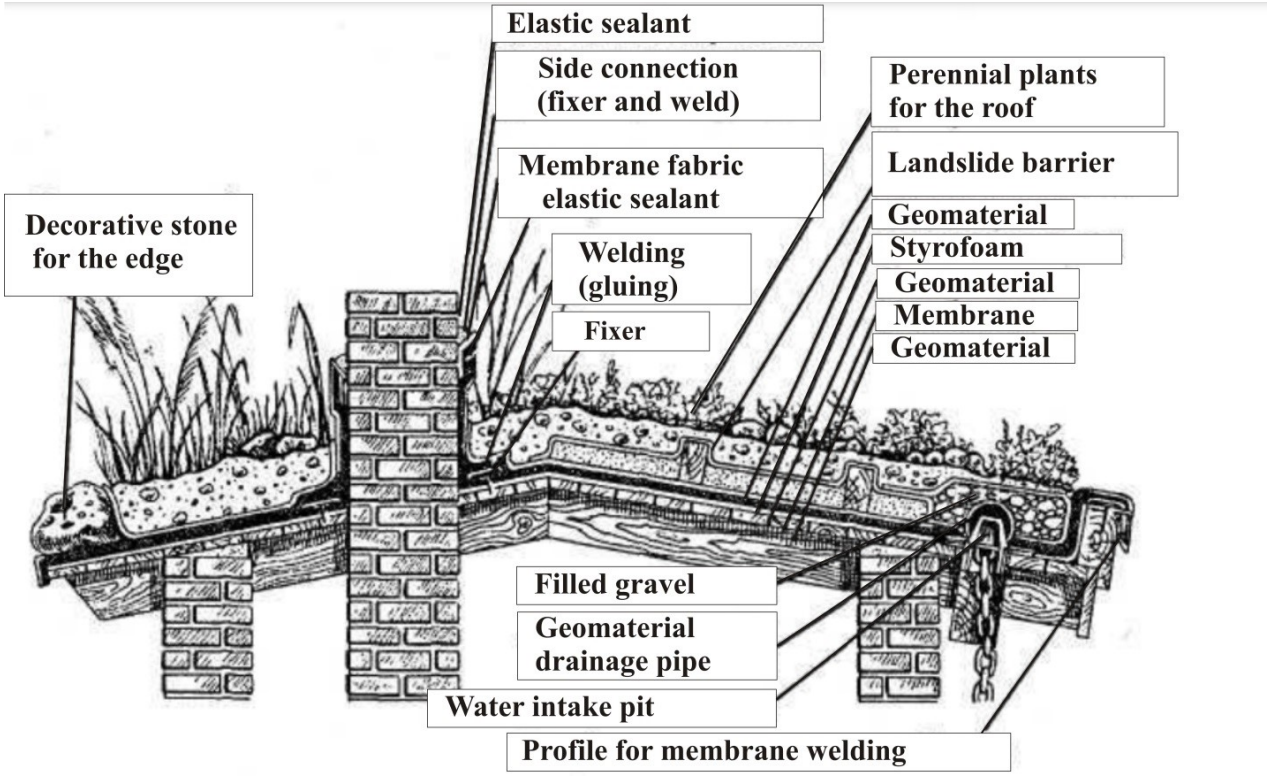

Figure 1. *The side cutting scheme of the roof intended for landscaping*

There are other technologies for roof preparation in landscaping. For example, during the construction and operation of a flower garden, a protective layer is created from concrete slabs, asphalt, fiberglass and polyvinyl chloride films to protect the roof. Most often, concrete slabs are used, they are laid on a layer of mineral material (crushed stone, gravel) that fills the main area to the surface under the bottom layer of beams or other supports, sand with a size of 1-3 mm. sand is impregnated with phenol (carbonic acid) to prevent grass growth [3].

KAST-V, STPL-2T fiberglass laminate with a thickness of 0.5-1 mm is used for fiberglass plastics. Separate sheets are glued with BF-2, BF-4, BF-6 glue.

A vapor barrier layer is usually installed on flat, non-ventilated roofs. For this purpose, metal foil (a very thin metal sheet), individual or roofing cardboard layers, polyethylene film with a thickness of 0.04-0.2 mm and other materials are used.

The necessary conditions for the normal development and growth of flowering plants can be provided only by creating three main layers: drainage, filtration and the substrate (soil rich in mineral fertilizer) itself (Fig. 2).

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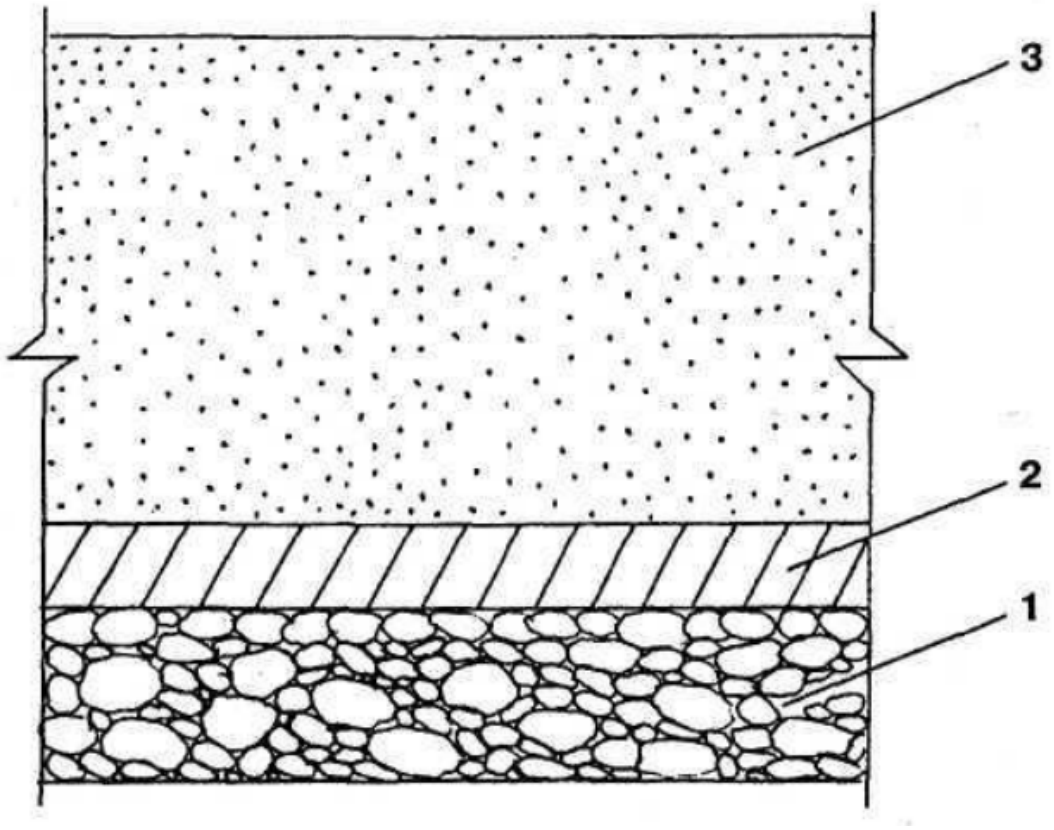

Figure 2. *Vegetation layer structure cross-section scheme: 1-drainage layer; 2nd filtering layer; 3rd substrate (soil) layer.*

Drainage layer: it is placed on the protective layer or on the bottom of the container (vase, vase, container) in which flowering plants are grown. Its purpose is to absorb the runoff that is inevitable during heavy irrigation or during rains and to ensure its rapid drainage (water reserve) when necessary. As plants develop, roots penetrate this layer, so water reserves can be created in it. The average thickness of this layer is 10-15 centimeters.

In the past, gravel and small stones were mainly used for drainage, but due to their weight, their use is not recommended today. For example, 1 m3 of round gravel weighs 1.8 tons, and 1 m3 of polystyrene board weighs only 0.035 tons. Therefore, light materials such as bleton (Optima system), styrofoam plates (BAZF system) or special reinforcing mats made of artificial fibers are used for the drainage layer. In addition, lavalite (filter material), perlite (stone of volcanic origin), pinoplast plates, pumice (pumice stone, chert-light volcanic rock), gravel, perlite coke (coal, oil peat and the like, solid fuel prepared by heating without air) and expanded clay (light porous building material obtained by burning clay heated in a furnace at a temperature of 1100-1200°C) can be used.

Filter layer: prevents the leaching of fine mineral soil from the substrate to the drainage layer. The thickness is about 5 cm. Due to its heavy weight, the previously used washed sand has been replaced by artificial materials such as fiberglass and polypropylene mats, lutraflor, foam (light, elastic, porous synthetic material). The filter layer can also store water. For this purpose, foam plastic, volcanic sand and hygromul plates are used.

Experts use the word "substrate" in two senses.

First, this is the name given to the upper layer where plant roots develop. The substrate provides mineral and water nutrition for plants. Compared to the natural environment, its volume is very limited, therefore, high demands are placed on substrates for flower gardens on roofs. They should accumulate and retain water as long as possible, have a sufficient amount of easily digestible nutrients, a stable structure and aeration.

Secondly, the substrate means the actual composition of the upper layer artificially created to feed and develop the root system of plants [4].

Conclusion

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Greening of buildings and constructions, especially the roof surfaces of public and residential buildings, is today considered the most effective solution to ensure the ecological stability of the environment. However, there are a number of basic requirements for the technology of forming flower beds, especially roof gardens.

Examples of these include:

- analysis of the environment when planning a rooftop flower garden (climatic: movement of the sun, wind blowing, relative humidity, etc.);

- structural requirements for creating a rooftop flower garden (building height, roof slope, external protection, waterproofing, drainage, filter, substrate, etc.);

- the method of organizing a rooftop flower garden (intensive, extensive);

- it will be necessary to solve a number of requirements such as seasonal agrotechnics (spring, summer, autumn and winter) of care.

Due to the fact that the climatic conditions of Uzbekistan are mainly hot and dry, in the buildings with operational roofs, plants that do not require excessive maintenance, and at the same time are resistant to dehydration, mainly ground cover grasses i.e. succulents (tom molodila, achitok, etc.) and lawns (wild, decorative and sports) will be an effective solution.

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