

Extensive Green Roofing in a Central European Climate

Environmental, comfort and fire
safety aspects

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Aims of the case studies

- Highlighting environmental, comfort and fire safety aspects and their interrelationship
- Briefly introduce pros and cons and design aspects of roofs with vegetated coverings
- Myths related to extensive vegetated roofs – 2 case studies
- Problematic details of extensive vegetated roofs
- Conclusions

Pros & cons of roof greenery

Construction aspects



• Pros:

- Additional thermal insulation
- Prolonged service life of the underlying roofing
- Serves as fire prevention (when wet)
- Improves acoustics in the neighborhood
- Reduces the load on the sewerage network and the flood risk
- Enhances aesthetics

• Cons:

- Within calculation of the roof's thermal resistance the vegetated part has to be ignored as it is not its integral part
- Danger of damaging the roof membrane, e.g. by plant roots
- Dry plants represent a fire risk in summer
- Increased load on statics of the building, including aerodynamic stability
- Higher labor input
- Higher total price

Pros & Cons of Roof Greenery

Ecological Aspects

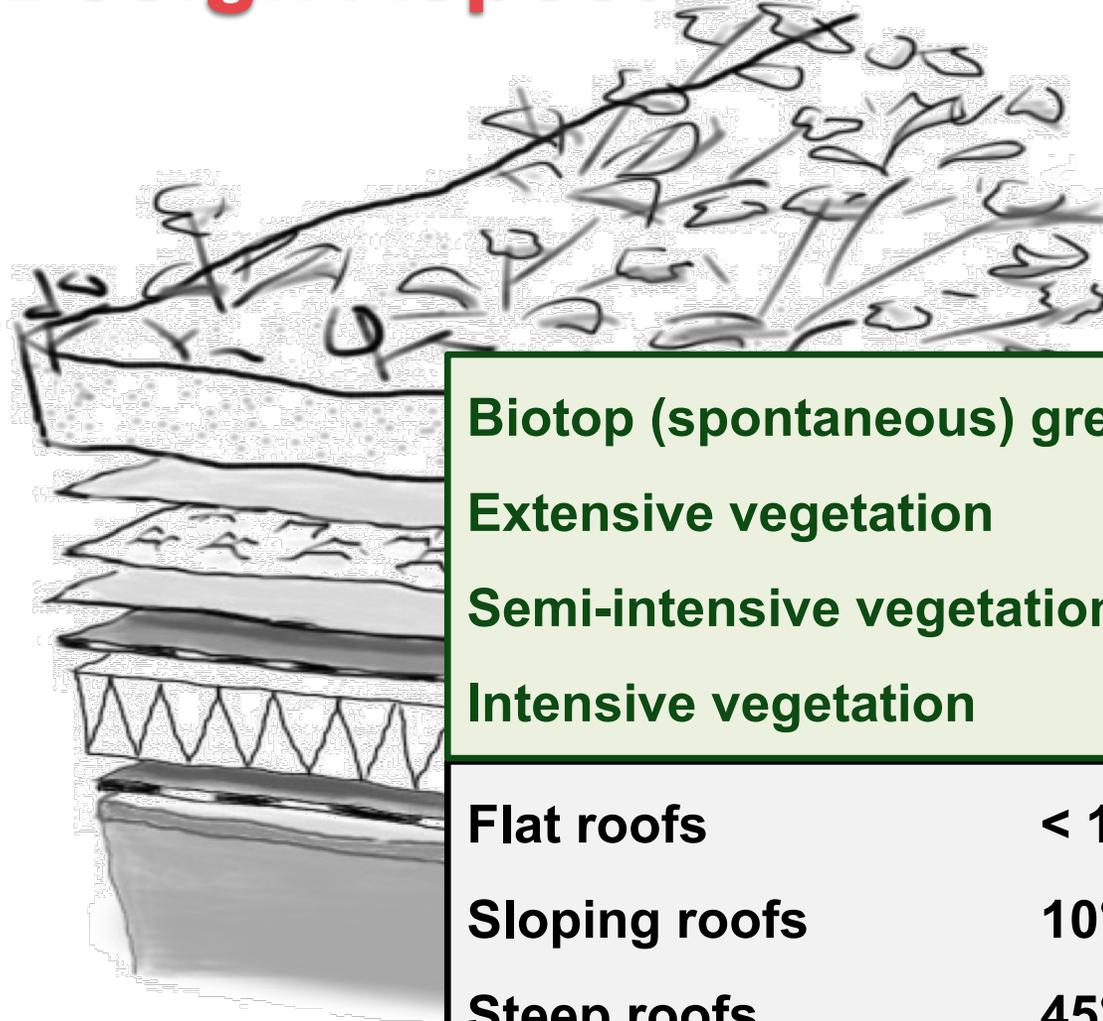
Pros:

- Reduces dust in environment
- Stores and filters rain water, participates in the natural water cycle
- Humidifies, cools and cleans air
- Produces oxygen and reduces carbon dioxide
- Reduces temperature fluctuations
- Extends living space, compensates land occupation, has positive psychological effects

Cons:

- A high degree of uncertainty from garden design to implementation
- May cause allergies
- Pollutes the environment with bio-waste, e.g. falling leaves, flowers, branches, production of honeydew, bark peeling
- Requires regular care with high portion of human labor
- Can be costly

Design Aspects



Plants

Substrate

Biotop (spontaneous) greening

Extensive vegetation

Semi-intensive vegetation

Intensive vegetation

Flat roofs

< 10°

Sloping roofs

10° - 45°

Steep roofs

45° - 50°

Garden design

Construction

Extensive Green – Pitched Roof



Extensive Green – Pitched Roof

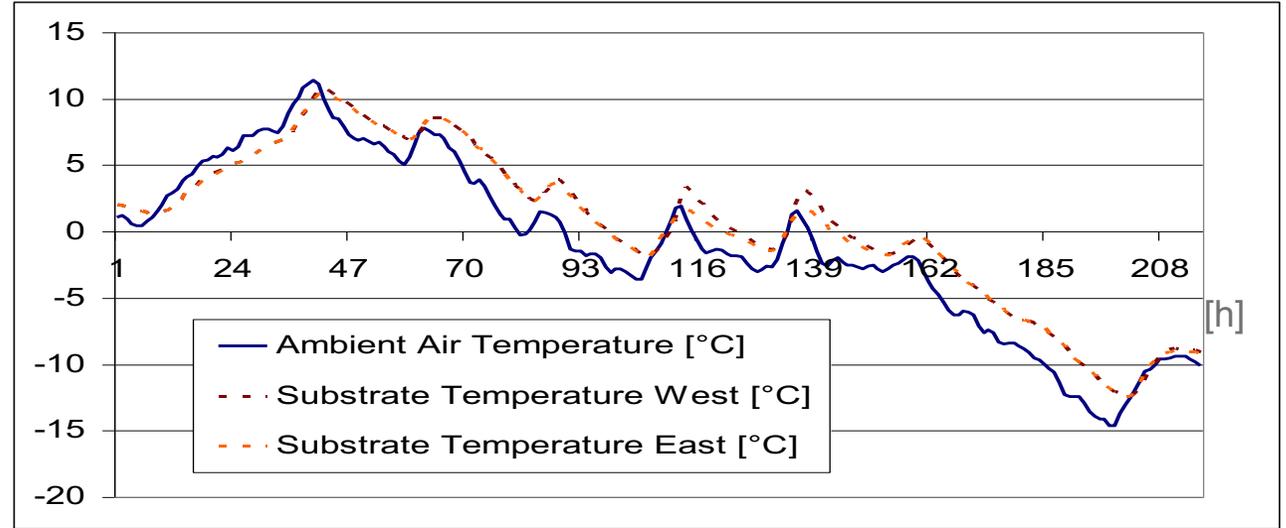
Possible causes of failure

- Extremely windy area / insufficiently rooted plants were blown away
- No irrigation system / relying on rain water is not sufficient enough
- In upper third of the roof precautions should have been made in order to keep and slow down fast draining of rainwater, e.g. by using porous additives in lower part of the substrate
- The roof was built by owners self / normally, in case of sedums (stonecrops) at least 60 to 75% of the future vegetation area should be covered with plants at the time of construction acceptance (when delivered by external supplier)

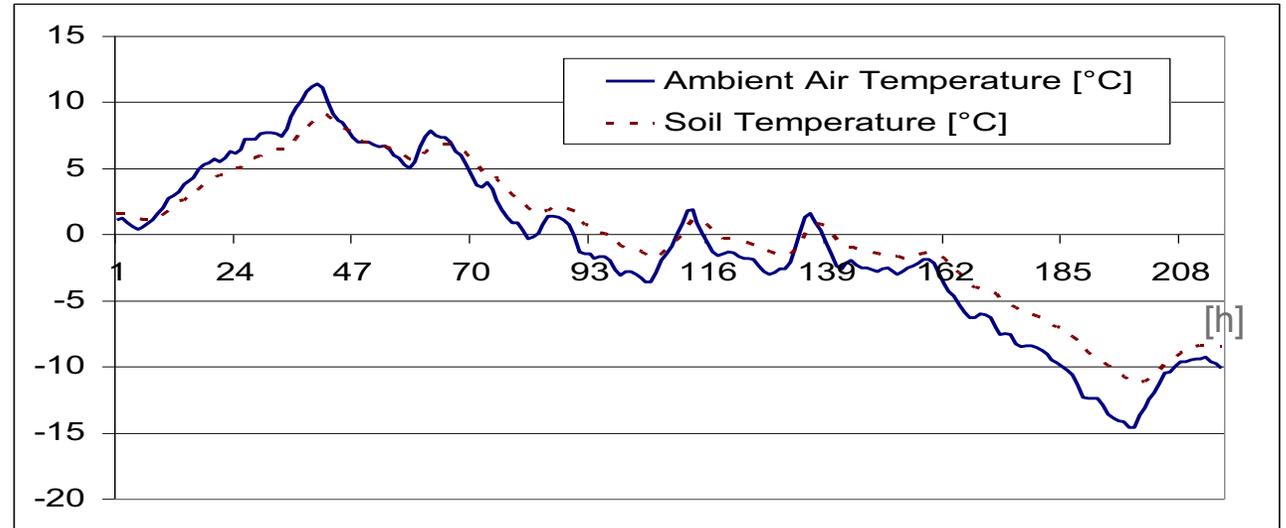
Extensive Green – Pitched Roof

WINTER

Substrate temperatures in 6 cm depth below surface



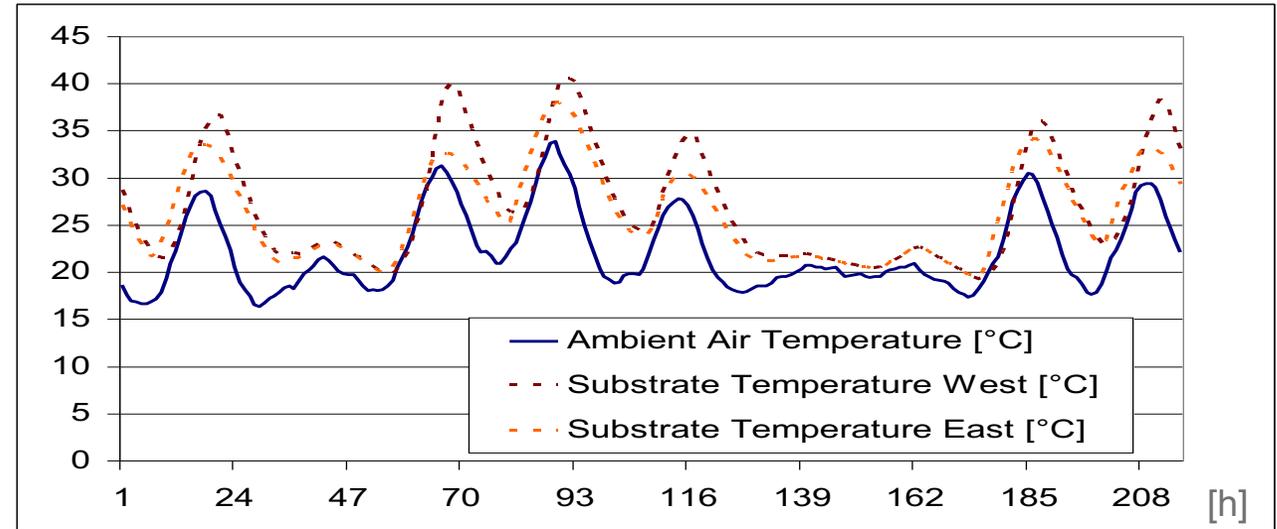
Temperatures in 6 cm depth below soil surface of the terrain ground surrounding the building



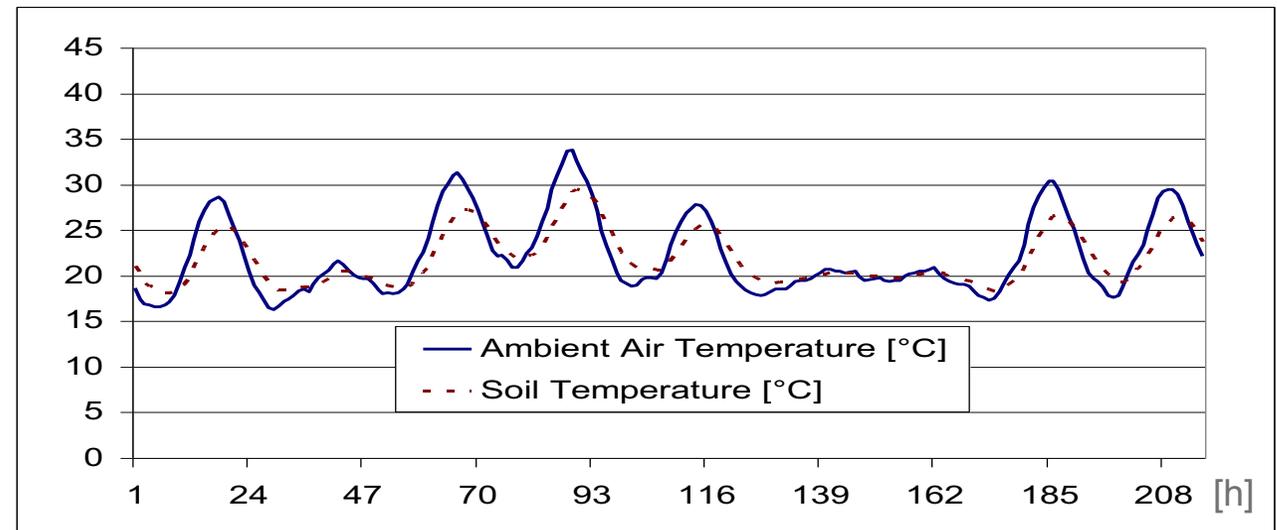
Extensive Green – Pitched Roof

Summer

Substrate temperatures in 6 cm depth below surface



Temperatures in 6 cm depth below soil surface of the terrain ground surrounding the building

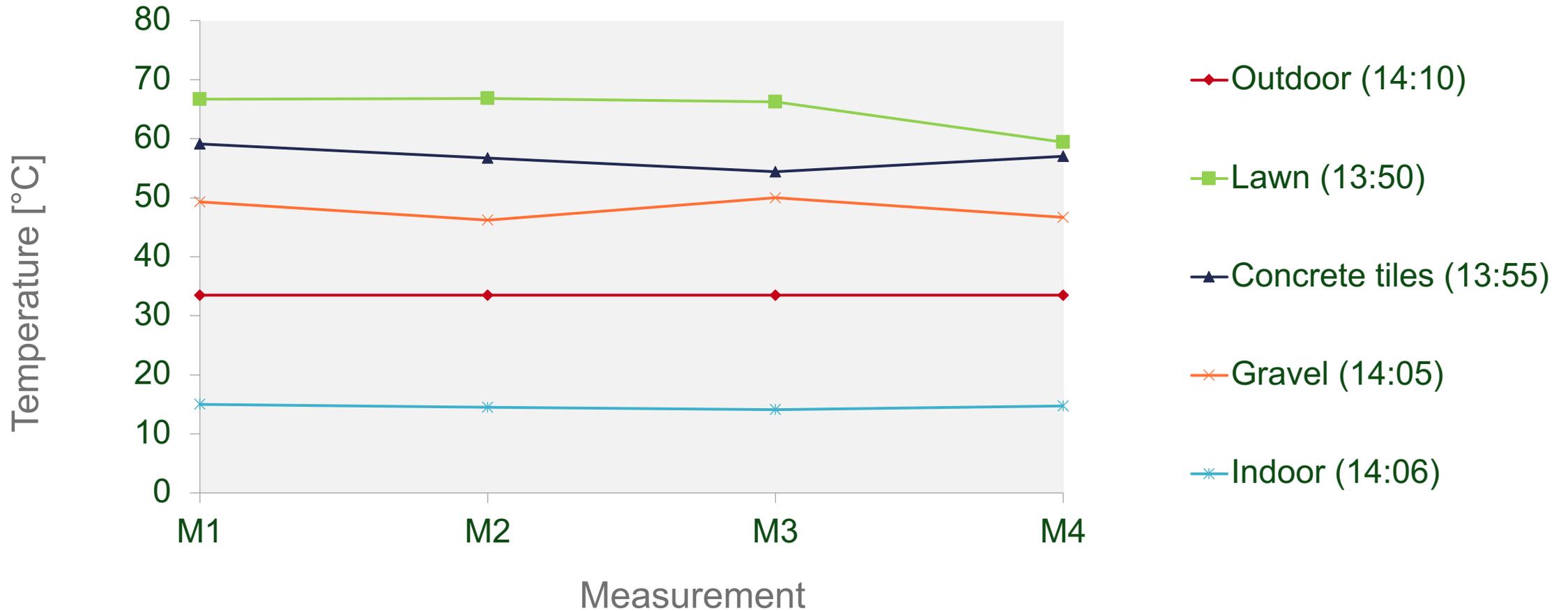




Extensive Green – Flat Roof

Underground Garage

Extensive Green – Flat Roof

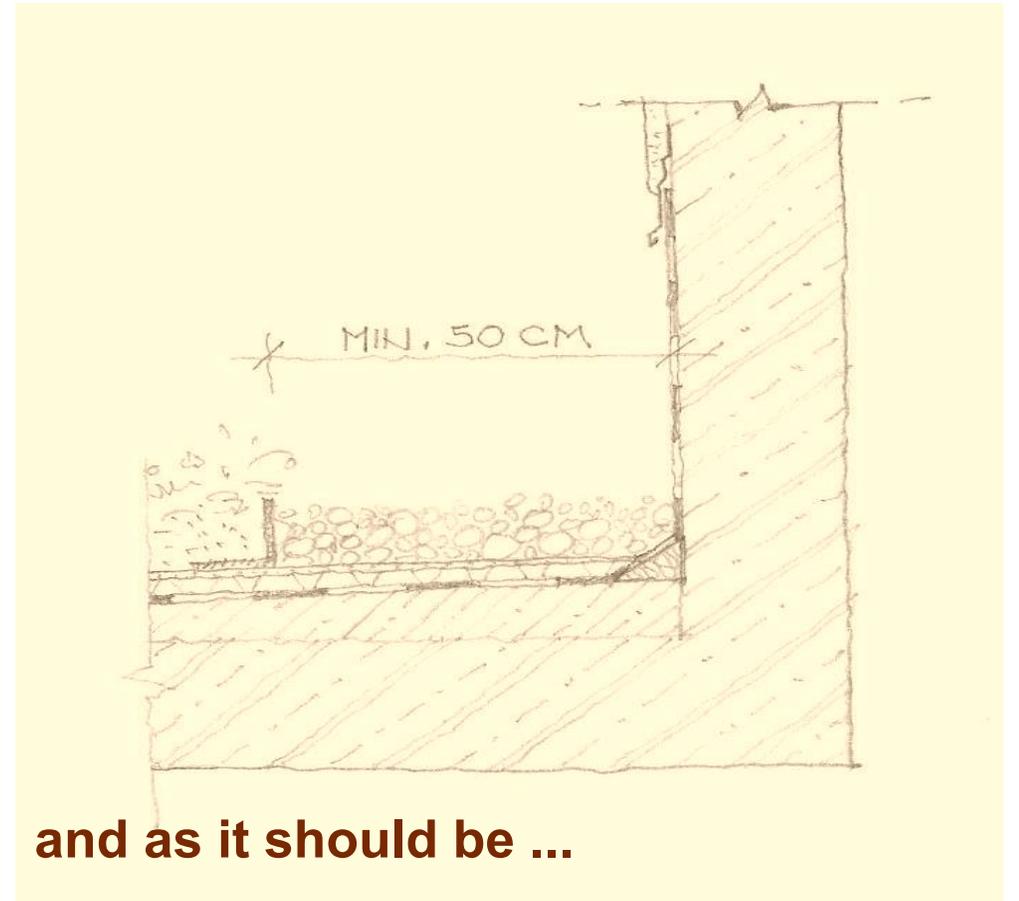


Temperatures on the garage roof on July 31, 2017, afternoon, measured using Voltcraft infrared thermometer



Existing state

Extensive Green – Flat Roof

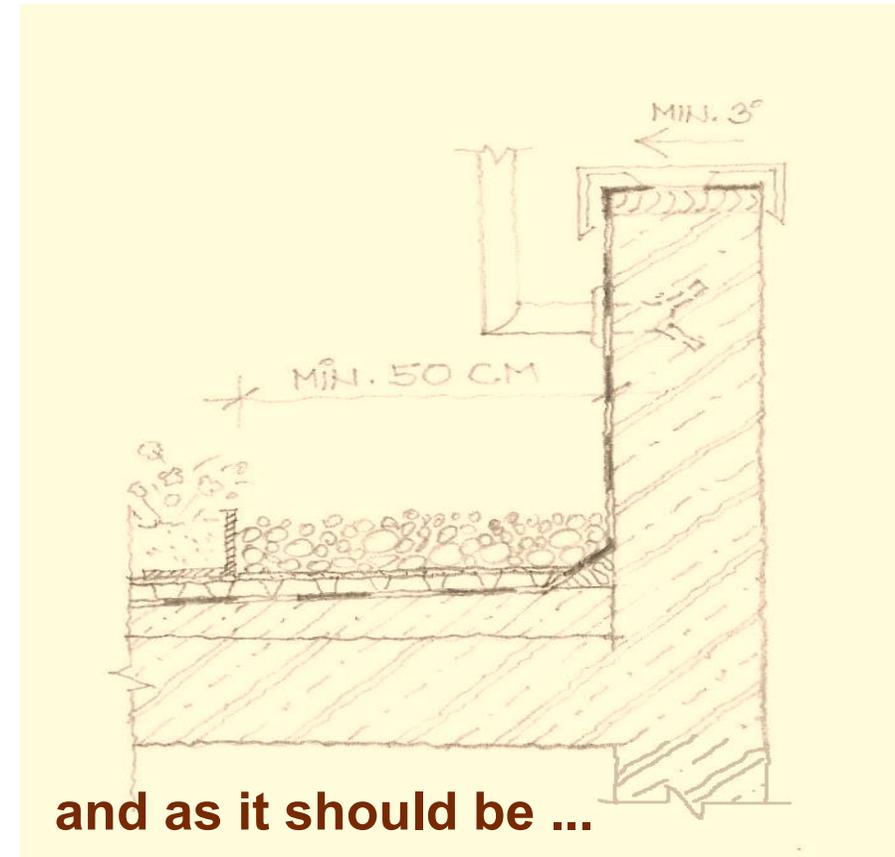


and as it should be ...

Extensive Green – Flat Roof



Existing state



and as it should be ...

Extensive Green – Flat Roof

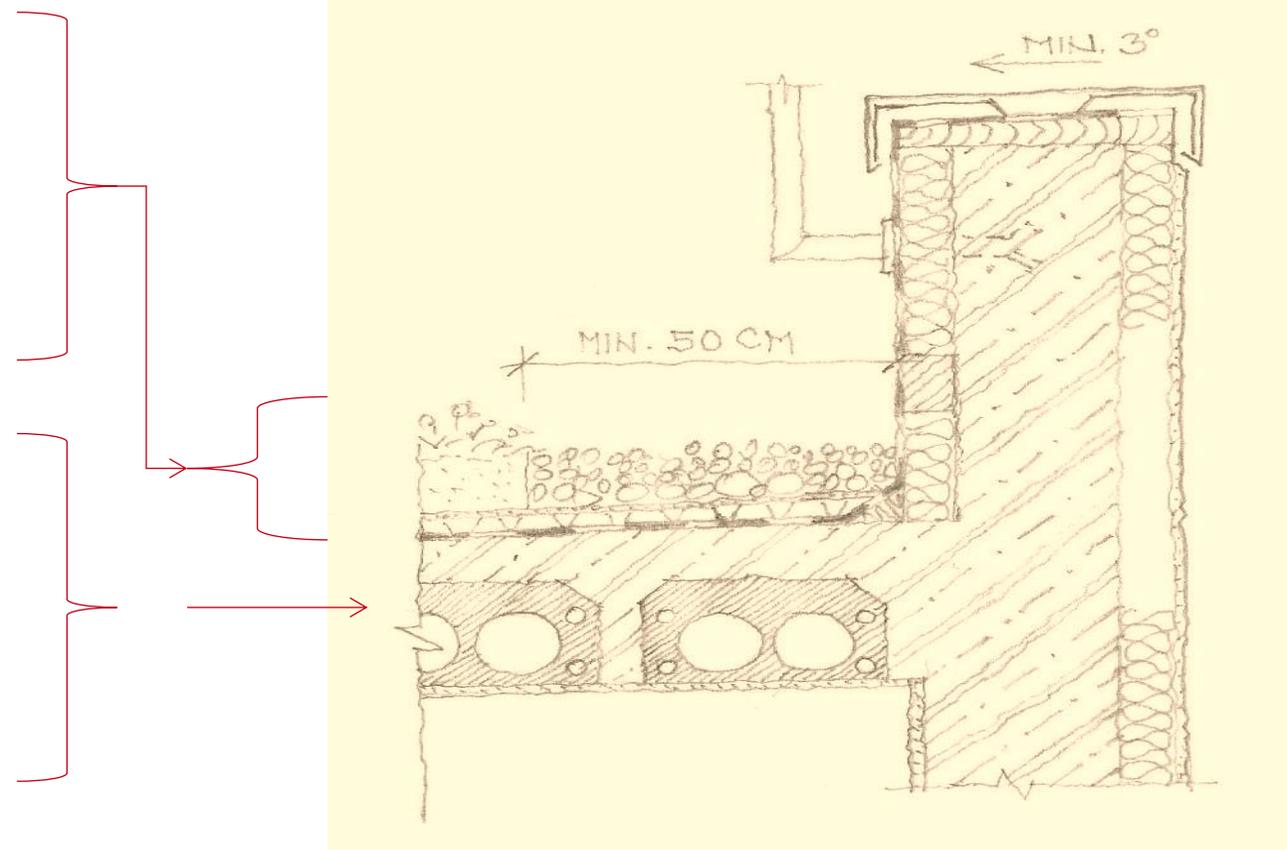
Heated / Cooled Vegetation Roof

- Tested in overseas, but at the present would be likely to encounter administrative difficulties in Central Europe as this type of roofing does not contain thermal insulation and therefore would not reach the required level of thermal resistance without the use of a heating system (spaces with permanent presence of people)
- Requires reliable heating / cooling system
- Waterproofing membrane is exposed to high temperature differences in winter

Extensive Green – Flat Roof

Heated / Cooled Vegetation Roof

- Plants
- Growing medium
- Filter Layer
- Drainage Layer
- Root Barrier
- Waterproofing
- Inclined surface
- Reinforced Concrete
- Deck Panels with TABS
- Plaster



Conclusions

- The Nordic lush turf pitched roofs are not possible in Central Europe unless heavily irrigated in summer time!
- Even though extensive vegetated roofs are considered (and promoted) in Central Europe as maintenance- and irrigation-free they need both – a year round maintenance and regular irrigation during summer months
- When creating details, special attention must be paid to fire safety, protection against the growth of roots, and the selection of suitable plants (not simply some kind of succulents)

Conclusions

- The intensive vegetated roofs are considered to be reliable and failure-free. However, in case of special requirements the details and deviations must be thought over very well. Otherwise problems are programmed.
- The design of green roofing is a complex matter, which requires highly professional attitude and strong cooperation between architect /planner on one side and garden designer on the other side
- Even though there is not too much standardization and legislation regarding the roof vegetation, the recommendations of specialized professional associations should be kept.

Thank you for your attention!

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