GREEN ROOF

Design of Extensive Green Roofs

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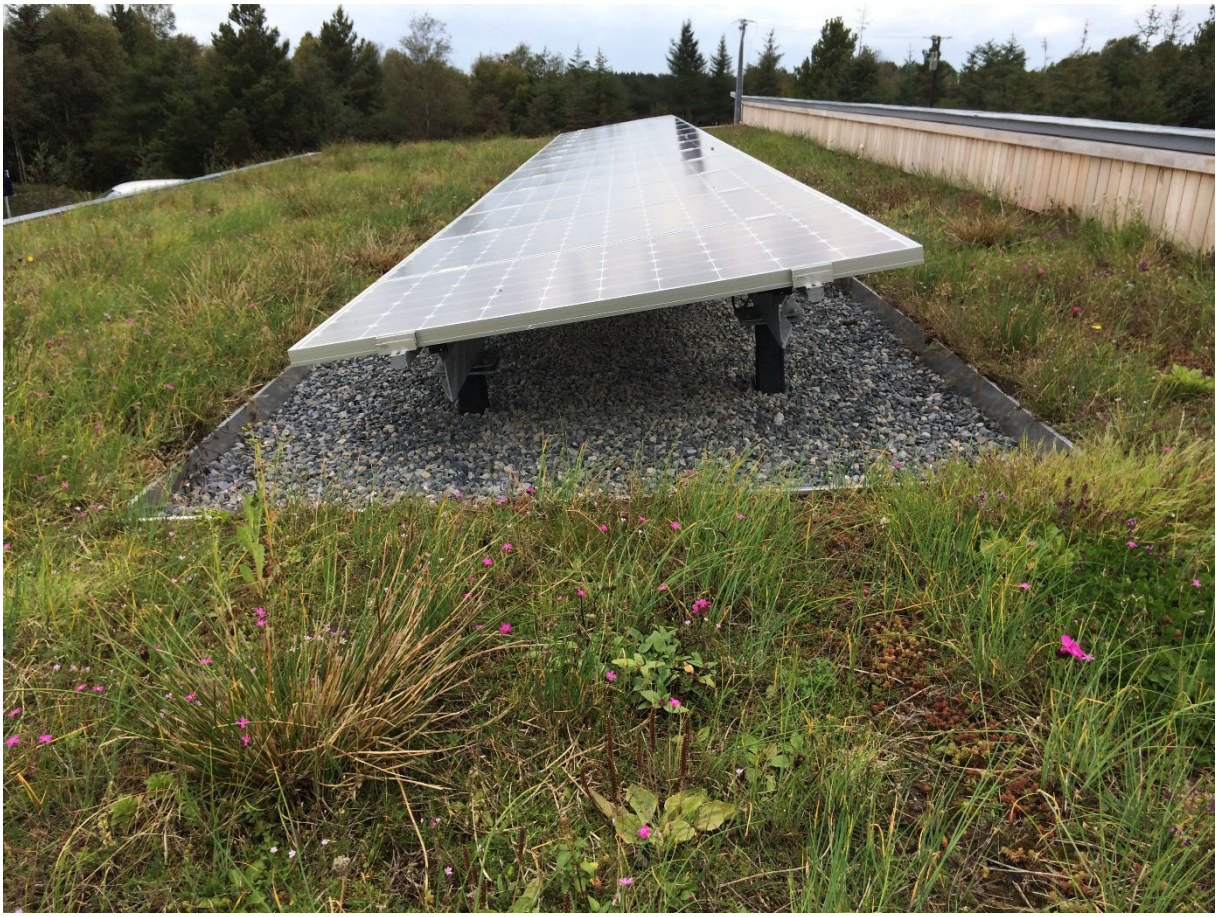
MOY Design Consultation

MOY has over 20 years of experience in the delivery of Intensive and Extensive Green Roofs throughout Ireland, the United Kingdom, and Europe. We have in-depth knowledge of local and national building codes, the requirements of insurers, and the many local authorities.

Design consultations are free of charge and available to members of the design team, general building contractors, roof and landscaping contractors, and building owners.

Book a design consultation with MOY Materials by sending an email to Technical@moy.group.



Green Roof Standard Literature

At the time of writing, there is no harmonized EN standard for green roofing. There are, however, several useful resource documents, that are frequently referred to by designers, these include:

- *FLL (2018) Guidelines for Planning Construction and Maintenance of Green Roofing.* https://commons.bcit.ca/greenroof/files/2019/01/FLL_greenroofguidelines_2018.pdf
- *GRO Code of Best Practice 2021.* https://greenrooforganisation.org/wp-content/uploads/2021/06/GRO_Brochure_v5.pdf
- *GRO Fire Risk Guidance Document 2021.* https://www.greenrooforganisation.org/wp-content/uploads/2020/05/GRO-fire-risk-guidance-document.pdf
- *GRO Fire Performance of Green Roofs Best Practice Guide 2025.* *https://www.greenrooforganisation.org/wp-content/uploads/2025/07/GRO-Fire-Performance-Best-Practice-Guide-June-2025.pdf*
- *FM Global Loss Prevention Data Sheet 1-35.* https://www.fmglobal.com/research-and-resources/fm-global-data-sheets
- *Department for Communities & Local Govt. UK. Fire Performance of Green Roofs and Walls.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/230510/130819_SW3529R_-_Issue_3_-_Green_Roofs_and_Walls_Project_web_version_v3.pdf
- *Dublin City Council. Green & Blue Roof Guide 2021*. https://www.dublincity.ie/sites/default/files/2021-12/dcc-green-blue-roof-guide-2021.pdf

1.0 Green Roof Design Considerations

1.1 Waterproofing

1.1.1 Inspection of Waterproofing

Before installing the extensive green roof finishes, the waterproofing system must be fully inspected and signed off by a MOY representative. Once the waterproofing has been inspected and signed off as completed, the installation of the green roof elements can commence.

1.1.2 Root Resistance

Green roof waterproofing membranes specified by MOY Materials are root resistant. This means that there are no requirements for separate root barrier membranes. Where a green roof is retrospectively installed onto an existing roof it may be necessary to install a root-resistant membrane.

1.2 Load Management

Types of loads to be considered when constructing a green roof:

- Decks and Waterproofing
- Wind Load
- Dead Load
- Shear Force

1.2.1 Structural Deck

In all cases, the decking should be designed by the project structural engineer and should consider the wet weight of the green roof system in addition to other dead and live loads. A structural concrete deck may be preferred over a steel roof deck to support vegetative roof systems, although other deck types can be reviewed/approved by a structural engineer for compliance with anticipated loading.

1.2.2 Wind Load

The green roof design should resist uplift from wind forces by anchoring to the main structure or by having sufficient ballast to prevent the occurrence of uplifting in worst-case design conditions. Where Green roof elements are being used as ballast to provide the roofing system with resistance from wind uplift, sufficient weight must be incorporated into the green roof build-up. A typical saturated MOY extensive green roof system weighs **130 Kg/m^2** and has a minimum dry weight of **80 Kg/m^2**. These weights do not include the weight of the waterproofing system buildup. In these instances, the dry weights of the green roof components must be used to calculate the weight of the green roof system. Subject to the wind uplift value for the project, erosion control measures may be required during establishment. Full rolls of sedum are to be used in corners and perimeters where the wind uplift will be greatest.

1.2.3 Dead Load

Dead loads must account for the saturated weight of the green roof, snow loads, and any further imposed service loads, such as pedestrian access loads and point loads from features such as water features and large planters and plinths. The underlying

roofing system must be capable of withstanding any point loads from the green roof installation and from any support elements included such as decking or paving.

1.2.4 Shear Forces

Green roofs are suitable for flat and gently sloped roof applications. When used in sloped applications there is the risk of substrates being exposed to excessive shear forces as a result of steep roof pitches and slippage must be considered in the design. Anti-shear measures are typically required for roofs with sloped designs. Consult MOY Technical for project-specific advice.

1.3 Slope

1.3.1 Flat Roofs

The field areas of flat roofs should have a minimum built fall of 1 in 80 (0.72°). Gutter channels may be laid flat or sloped, subject to the approval of the project Architects. It is always advisable to consult MOY technical on applications above 10°. Roof slopes below 10° are deemed as flat.

1.3.2 Zero Fall Roofs

Roofs designed as Zero fall roofs may have slopes between 0 – 0.7°, however, may not have back falls or deflections.

Zero-degree falls on green roofs are not recommended by MOY due to waterlogging problems. Ponding over the entire roof or even partial areas can be problematic for standard green roofing systems.

The drainage system for zero-fall roofs, green roofs, or roof gardens must be designed correctly, and the following points should be addressed:

- Provision made for access for maintenance purposes.
- If they cannot be avoided, zero falls roofs should be designed to keep a 20mm distance between the maximum permitted water level of the drainage layer and the filtration fleece geotextile membrane.
- Dead loads for green roofs and roof gardens can increase if the drains become partially or completely blocked causing waterlogging of the drainage layer.

1.3.3 Sloping Roofs

Roofs with high slopes must be designed with edges that offer restraint to the green roof elements. Sloped roof designs above 15° and slopes on curved or barrel vault roofs may require specific slope stability measures. Please contact MOY Technical to discuss options suited to your project.

MOY does not recommend slopes above 15° without considering the need for year round irrigation and maintenance and the need for slope stability and erosion control measures.

> *Above a roof pitch of 10°, safeguarding measures against slipping are required. These measures may, in the simplest embodiment, consist of drainage elements, if in the form of rolled material and having the tensile strength, being placed over the ridge or attached to it. If the construction is inherently rigid, the drainage elements can be supported on the eaves. It must be determined that the ridge and/or eaves can bear the resulting loads and the required attachment is sufficiently strong. Loosely laid geotextiles above drainages elements should be avoided above this pitch*. – FLL Green Roof Guidelines 2018, p. 49

For guidance on sloped green roofs, MOY must be aware of all the project details before committing to achieve the same. For sloped roof designs, the drainage board must be bonded to the finished MOY waterproofing membrane with MOY PU Adhesive, termination details will also involve a hard stop at perimeters (see Figure 2) to ensure the system does not slide after installation. Always involve MOY Technical Assistance (technical@moy.group) at early design stages when designing green roofs with slopes greater than 10° to ensure the chosen design meets the specific project requirements.

Possible Measure	**Pitch**				
	≥3°	**≥3°**	**≥3°**	**≥3°**	**30-45°**
Measures against surface erosion from 0°					
Temporary measures to protect against water and wind erosion until vegetation acceptance is possible	X	X	X	X	X
Greening with vegetation mats or turf stones at areas at risk from wind	X	X	X	X	X
Measures or fixing the waterproofing from 3° pitch					
Fixing the roof waterproofing in accordance with DIN 18531-3 and specialist rule for waterproofing (ZVDH/HDB)		X	X	X	X
Measures against slipping from 10° pitch					
Use of root-resistant roof waterproofing (no separate installation of root barrier membrane)			X	X	X

Safeguarding against slipping			X	X	X
No loosely laid filter fleece above drainage elements			X	X	X
Immediate measures for erosion protection (vegetation mats, wet spraying with glue, erosion protection fabric)				X	X
No loosely laid filter geotextiles for all types of construction				X	X
Safeguarding against slipping with static proof					X
Measures against surface erosion from 30° pitch					
Measures against material displacement recommended					X

Figure 1 - FLL Green Roof Guidelines 2018, p.50

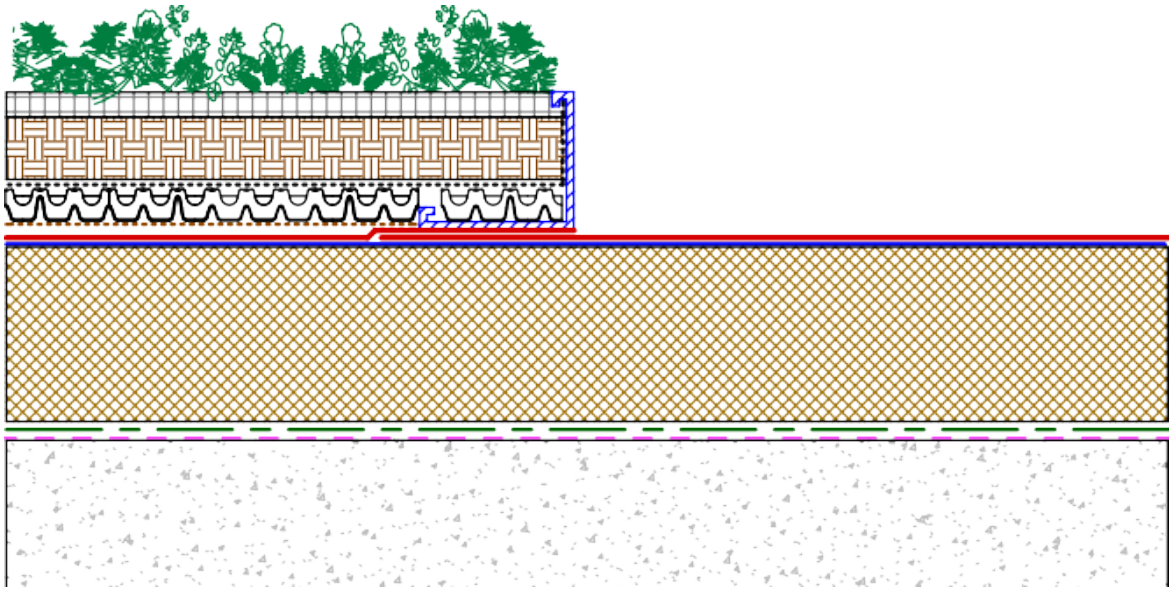


Figure 2 - Hard Stop Edge Detail

1.4 Vegetation

The vegetation type of the Green Roof should be decided in consultation with the project design team to ensure it meets the desired aesthetics of the project client.

Alternative planting palettes may be suggested for varying local environmental conditions.

1.4.1 Irrigation

Irrigate the plant layer at a minimum rate of **2 liters per M^2** 2-3 times weekly until established, during the growing season this may take 6-8 weeks. Irrigation during this time is crucial to the plant layer, neglect will lead to vegetation death and increase the potential harm from bird strikes, wind, severe storms and any other unordinary weather patterns or environmental conditions. However, once plant cover is achieved, irrigation can be avoided for extensive roofs unless in cases of extreme drought (more than six weeks without any rain) where irrigation will be necessary. For sloped roofs additional irrigation may be needed to avoid plant failures, contact MOY Technical for further advice.

Typical examples of irrigation used on green roofs are:

- Hose.
- Hose and sprinkler.
- Spray hose.
- Drip line.
- Sprinkler System.
- Automatic irrigation system with water ponding capillary tube.

The requirements for irrigation should be discussed with the project landscape architect and will depend on the building design, planting scheme, location, wind exposure etc. A water supply point must be accessible for all green roof projects, to facilitate irrigation if the need arises during the roof service life.

1.4.2 Standing Water

Standing water can have a negative impact on plant health, leading to plant failure. In addition to plant failure, standing water can cause vegetation reshuffling and increased settlement of non-native vegetation. A solution is the use of additional or deeper drainage layers which will raise the substrate and living elements above the standing water eliminating any potential risks.

1.4.3 Sedum species and drought resilience

Extensive Green roof vegetation typically consists of low-growing, herbaceous plants, including succulents, mosses, and grasses.

The ideal plant characteristics for extensive green roofs are:

- Tolerance to drought and temperature extremes.
- Demonstrates successful self-propagation.
- Provide good ground cover density.
- Has a strong horizontal root system.

- Has a non-aggressive vertical root system.

Most common plants for extensive roofs are those from the Sedum family. Sedums are stonecrop type succulents grown in rocky landscapes that are well-suited to many vegetative roof environments.

1.4.4 Shade

Sedum species require natural sunlight each day. Shaded and north-facing sites may not receive enough sunlight to sustain the growth and overall health of living elements. It is not recommended to use sedum on a roof that would be shaded most of the year. Any surrounding buildings in the vicinity, tall parapets, and M&E equipment may all have a shading effect and should be considered carefully when planning the extent of any green roof.

1.4.5 Natural Hazards

Certain natural and environmental hazards are particularly difficult to design for and should be considered carefully when choosing roof types.

Green roofs can help prevent hail damage to waterproofing systems and may be factored in reducing building insurance premiums. European Severe Storms Laboratory reported 8,224 large hail events in 2022, with some records of hail

reaching greater than 10cm in diameter, resulting in 4.8 billion euros in insurance losses throughout France, Southern Germany, and North Italy.

1.4.6 Wind

High wind forces can cause difficulty with the establishment of green roofs and sedum blankets. Wind may cause damage where the green roof materials are very dry and have a low self-weight. Extra measures should be taken on sites known to receive strong winds, such as coastal or mountainous areas, and on taller buildings. Erosion control substrate or netting may be required. Proper irrigation is particularly important on these sites.

Please contact MOY Technical for further project-specific guidance at Technical@Moy.group

1.4.7 Birds and Animals

Bird attacks are an environmental problem and must be considered on a case-by-case basis with a pest control specialist. As many species are protected under law the advice of specialist pest controllers is advised. Extensive green roofs which are designed not to be trafficked and therefore relatively undisturbed, can offer a very good habitat for birds and insects.

Green roofs offer a “green corridor” through an urban environment helping the movement and dispersal of wildlife. Planting should be considered for the attraction of insects, which will provide food sources for urban birds. Known nesting sites should

Design G

be avoided. If damage occurs from bird attacks, assess and document the damage. Check if the waterproofing is compromised. If damage is found, notify the installing contractors and MOY. See repairs to sedum section.

Prevent future damage by installing bird deterrents or consider consulting a specialist pest control professional. Use bird spikes, netting, or decoys to discourage birds form landing on the roof and ripping up vegetation blankets. Fertilizing the green roof each spring can also accelerate recovery from bird attacks. Regularly clean the roof to remove bird droppings and nesting materials as part of the scheduled maintenance. If the damage is a re-occurring problem, consider consulting a specialist pest control professional.

1.5 Drainage

1.5.1 Drainage Channels

Drainage channels of **600mm width** and **50mm depth** are advised. The channel may be infilled with a void former cut from the MOY 40mm drainage board.

Drainage facilities must be capable of collecting and removing both excess water from the drainage course and surface water from the vegetation layer.

Roof drains and emergency overflows must not be allowed to become covered with greenery or loose material such as gravel and must be made permanently accessible. Gutters must not be overgrown and thereby functionally impaired.

Gravity draining rainwater outlets should be used and supplied by MOY as part of the overall waterproofing system. The type, size and number of rainwater outlets are determined following a project specific calculation conducted to EN 12056, BS EN 12056 and IS EN 12056. If a secondary system or emergency overflow is required by insurance regulations or local codes, this should also be calculated at the design stage. Refer to TGN 25.1 Siphonic Drainage with Green Roof Finishes.

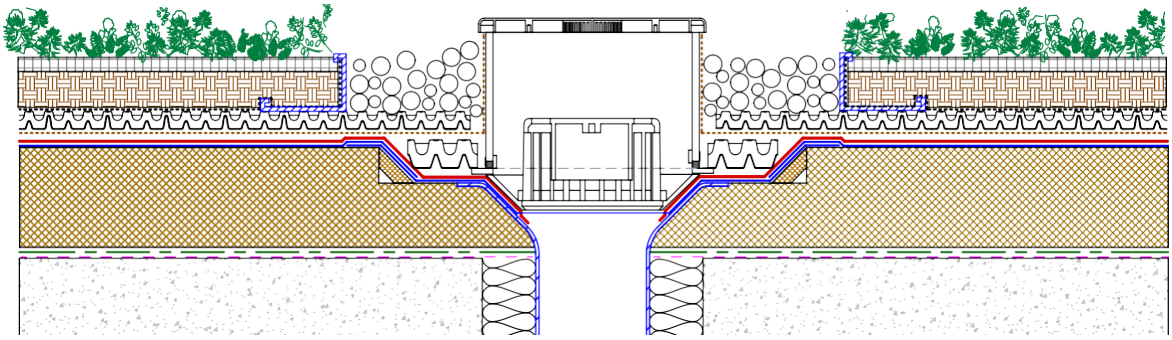


Figure 3 - Gutter Channel with Pebbles Detail

1.5.2 Rainwater Outlet Inspection Chambers

The roof drains are critically important to the functionality of any flat roof and therefore the roof drains must be kept clear of debris so that they may be easily inspected and maintained. Roof drains should never be over-covered with the green roof assembly.

The MOY rainwater outlet inspection chamber is manufactured from high quality aluminum which prevents substrate and gravel from being washed into the gutters. The inspection chamber is raised above the waterproofing surface by corner base plates, ensuring water may flow unimpeded to the roof drain.

MOY Inspection chambers are available in a range of heights and a range of lid types including walkable grilles, a recessed lid for paving insets, and cast-iron covers for terraces to facilitate drainage.

Technical Data	
Material	Aluminium
Material Thickness (mm)	1.5
Length (mm)	300
Width (mm)	300
Height (mm)	100
Weight (kg)	1.2

1.6 Gravel

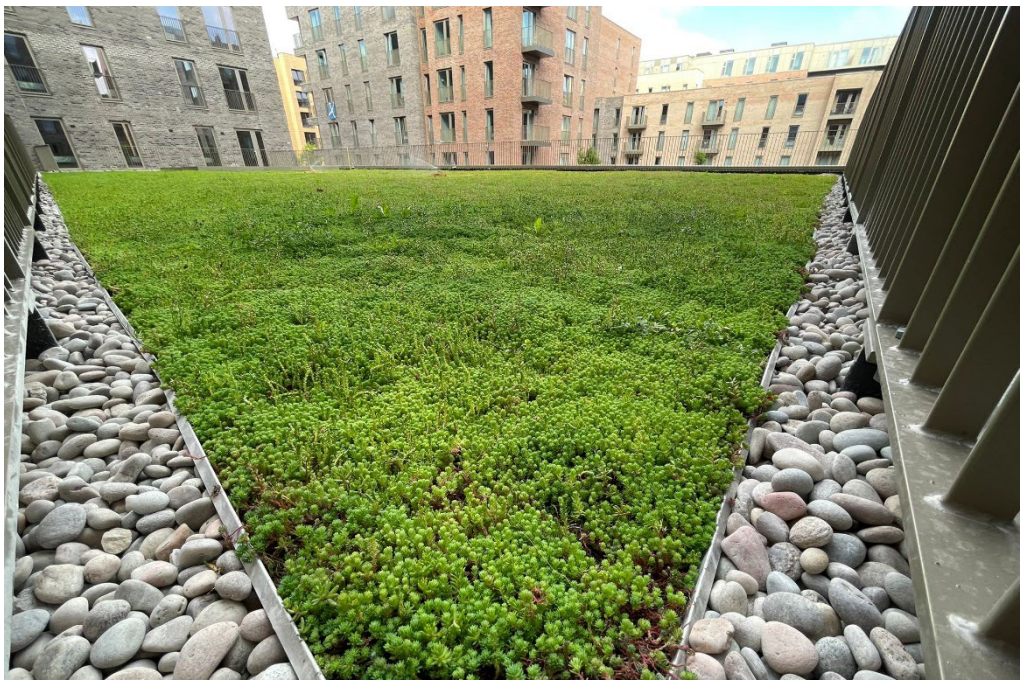
1.6.1 Perimeters

The perimeter zone will typically be constructed at all roof edges and any opening through the structural deck, such as roof lights or roof ventilation ducts. The gravel margin is typically a minimum of 500mm wide or 900 mm wide for FM approved installations. Gravel margins may be wider when adjacent walls have window and door sills. The depth of the gravel layer should be at least 75mm.

The perimeter zone serves several technical purposes:

- Protection from wind uplift effects.
- Provision of emergency drainage for water run-off.
- Prevention of over-shading by parapet walls.
- Fire Protection.

The material used to create the gravel perimeter should be a rounded washed stone pebble with a nominal diameter of 20-40mm, free from broken chips and smaller fine materials. Some types of sedimentary stone such as Mudstone and Shale break down into smaller pieces and are generally unsuitable for use in green roofing.



1.6.2 Edge Trims

The gravel edge trim is a folded aluminum trim designed to separate the living portion of the roof from the gravel perimeter. The folded metal trim is provided with drainage slots so that it does not impede the flow of water. MOY gravel trims are easy to fold into corners and are provided with alignment pieces to maintain a neat and straight edge. The edge trim is restrained by the weight of the green roof materials, so it is not necessary to affix the trim to the roof surface, although this is permitted where the green roof installers have also carried out the installation of the MOY waterproofing system or on MOY edge restraint on sloped green roofs. MOY edge trims are generally manufactured from 1.0mm mill-finished aluminum and supplied uncoated. Heavy gauge material and powder coating to specified RAL colours are possible and may be noted in MOY project specifications through the consultation process.

1.6.3 Pathways

Pathways may be made of:

- Large elements such as – hydraulically pressed concrete paving slabs or square-cut natural stone slabs on suitable pedestal supports
- Suitable gravel infill to the drainage board.
- Non-slip Timber or Composite decking on suitable support systems.
- MOY Castleflex rubber tiles.

1.7 Fire

Guidance generally states that green roofs should be designed to provide the necessary resistance to the external spread of fire by the following measures:

- Increasing the non-combustible content of the growing medium. MOY uses a mix that meets and exceeds local government requirements.
- Decreasing the organic content of the growing medium.
- Preventing the system from drying out through irrigation.
- Subject to FLL and GRO guidance, extensive roofs are not generally irrigated therefore the risk of fire is mitigated by the specification of the build-up and the fire breaks, and by reducing the organic content. FLL and GRO guidelines state that the substrate depth should be greater than 80mm and the organic content should not exceed 20%. Succulent plants are also recommended as these retain water within their structure and thus reduce the risk of the substrate drying out.
- MOY have completed BRoof T4 fire testing on a full extensive green roof build up to EN1187.

1.9 Mechanical and Electrical Plant

Trafficking of the planted roof based on maintenance of 2-3 times a year will have no detrimental effect on the plant layer. When considering roof mounted plant, it is important to consider the implications:

- The traffic of the vegetation layer for maintenance purposes.
- Designated walking paths for regular foot traffic.
- Shading by units can have a sundial effect.
- Air wash from the roof-mounted plant and Air Handling Units etc.

All of which can have an impact on the sedum or green roof finishes.

1.9.1 PV Arrays

Green roofs and solar panels can be combined. Similar consideration is needed for other roof-mounted plant or equipment. Rainwater from flat PV panels may cause scouring to occur. Integrated PV systems should permit sufficient sunlight to reach plants. Rain discharge from solar panels may cause linear growth patterns to develop.

1.9.2 Cable and Pipe Runs

Cable and pipe runs are to be mounted on suitable non-penetrative modular support systems to allow for access and periodic maintenance as required. It is important not to overload the waterproofing system or living elements of the roof.

1.10 Blue-Green Roofs

Green roofs will naturally retain rainwater within the pores of the growing media and the reservoir boards used. However, once the Green Roof is saturated, its effectiveness during longer storms will decrease.

Blue Roofs are designed to retain rainwater for an extended period and delay the flow of rainwater into the public drainage system during and after a rainstorm event. Blue Roofs will be designed to meet the maximum permitted outflow rate set by the local authority. MOY Blue roof design calculations are prepared using project-specific data.

Blue Roofs with Green Roof finishes are designed through the formation of a water storage void under the growing media and the use of flow restrictors to rainwater outlets. All Blue Roof designs are project specific.

Blue Roof design guidance is available on a project-by-project basis is available from MOY. Please enquire about Blue-Roofs through technical@moy.group.

Notes

Roofing System Supplier

Moy Materials Ltd.

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Tel: (01) 463 3900

Fax: 01 450 0033

Email: Info@moy.group

URL: Moy.group

Roofing Contractor

Date of Issue……..…….

Recipient…...…….

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Specifier / Designer

Date of Issue……..…….

Recipient…….

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Building Contractor

Date of Issue…….

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