GREEN ROOF

# Design, Installation and Maintenance of Extensive Green Roofs

# Contents

## MOY Design Consultation

Moy have over 20 years' experience in the delivery of Intensive and Extensive Green Roofs throughout Ireland, 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 a mail to technical@moymaterials.com.

## Green Roof Standard Literature

At the time of writing, there is no harmonised EN standard for green roofing. There are however, several useful resource documents, which 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
- *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.*

Issue: January 2024

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*

Structural concrete deck is preferred over 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. In all cases the decking should be designed by the project structural engineer and should take account of the wet weight of the green roof system in addition to other dead and live loads.

### *1.2.2 Wind Load*

The green roof design should resist uplift from wind forces by anchorage 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$^2$**. 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 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 sloped roof applications. When used in sloped applications 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 as built falls of 1 in 80 (0.72 degrees). Gutter channels may be laid flat or to falls, subject to the approval of the project Architects. It is always advisable to consult MOY technical on applications above 10 degrees. Roof slopes below 10 degrees are deemed as flat.

### *1.3.2 Zero Fall Roofs*

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

Zero degrees falls in green roofs should be avoided due 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 roof or roof gardens must be designed correctly, and the following points should be addressed:

- Provision made for access for maintenance purposes.
- For zero falls roofs they should be designed to keep a 20mm distance between the maximum permitted water level of the drainage layer and the filtration fleece geotextile membrane – if this cannot be achieved it should be avoided.
- Dead loads for green roof 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 which offer restraint to the green roof elements. Sloped roof designs above 15 degrees 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 do not recommend slopes above 15 degrees without considering the need for irrigation and maintenance during establishment 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 drainage elements should be avoided above this pitch.

***Figure 1 - FLL Green Roof Guidelines 2018, p. 49***

For guidance on sloped green roofs, MOY **MUST** be aware of all the project details before making the commitment to achieve 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 3) to ensure the system does not slide after installation. Always involve MOY Technical (technical@moymaterials.com) at early design stages when designing green roofs with slopes greater than 10 degrees to ensure the chosen design meets the specific project requirements.

| No. | 1 | 2 | | | | |
|---|---|---|---|---|---|---|
| 1 | **Possible measure** | **pitch** | | | | |
| | | **≥ 0°** | **≥ 3°** | **≥ 10°** | **≥ 20°** | **30-45°** |
| 2 | **Measures against surface erosion from 0° pitch** | | | | | |
| 3 | Temporary measures to protect against water and wind erosion until vegetation acceptance is possible | X | X | X | X | X |
| 4 | Greening with vegetation mats or turf stones at areas at risk from wind | X | X | X | X | X |
| 5 | **Measures for fixing the waterproofing from 3° pitch** | | | | | |
| 6 | Fixing the roof waterproofing in accordance with DIN 18531-3 and the specialist rule for water-proofing (ZVDH/HDB) | | X | X | X | X |
| 7 | **Measures again slipping from 10° pitch** | | | | | |
| 8 | Use of root-resistant roof waterproofing (no separate installation of root barrier membrane) | | | X | X | X |
| 9 | Safeguarding against slipping | | | X | X | X |
| 10 | No loosely laid filter fleece above drainage elements | | | X | X | X |
| 11 | Immediate measures for erosion protection (vegetation mats, wet spraying with glue, erosion protection fabric) | | | | X | X |
| 12 | No loosely laid filter geotextiles for all types of construction | | | | X | X |
| 13 | Safeguarding against slipping with static proof | | | | | X |
| 14 | **Measures against surface erosion from 30° pitch** | | | | | |
| 15 | Measures against material displacement recommended | | | | | X |

*Figure 2 - FLL Green Roof Guidelines 2018, p.50*

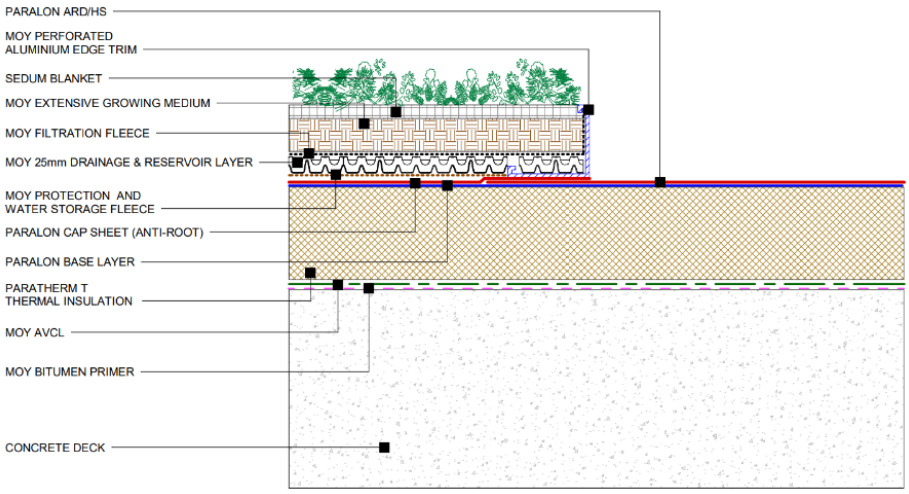


*Figure 3 - Hard Stop Edge Detail*

## 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.

### *1.4.1 Irrigation*

Irrigation is typically required for the initial establishment of an extensive green roof for a period of 6-8 weeks until established depending on natural rainfall during this time. However, once plant cover is achieved, irrigation can be avoided for extensive roofs unless in cases of extreme drought (period of more than six weeks without any rain) where irrigation will be necessary. Extensive green roofs need irrigation, at 2L/M2 for 3 times a week using a gentle sprinkler until the extensive green Roof has been fully established. 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 etc. It is advisable to plan a water supply point for all green roof projects, to facilitate irrigation if the need arises during the roof service life.

### *1.4.2 Standing Water*

The main effects of standing water on plant health are plant failure. As well as plant failure standing water can cause vegetation reshuffling and increased settlement of non-native vegetation. The use of additional drainage layers is to raise the substrate and living elements above the standing water.

### *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:

- Those that are tolerant to drought and temperature extremes.
- Demonstrate successful self-propagation.
- Provide good ground cover density.
- Have a strong horizontal root system.
- Have a non-aggressive vertical root system

Most common are those from the Sedum family. Sedums are a stonecrop grown in rocky landscapes that are well-suited to many vegetative roof environments and are commonly specified for that use.

### *1.4.4 Shade*

Sedum species require natural sunlight each day. Shaded and North facing sites may not receive enough sunlight to sustain 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 out and should be considered carefully when choosing roof types.

Extensive green roofs will help to mitigate the risk of hail damage to roof 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 > 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 be very windy, such as coastal or mountain areas and on taller buildings. Please contact Moy technical for further project specific guidance.

### *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 can create a “green corridor” through an urban environment helping the movement and dispersal of wildlife. Planting should be considered for attraction of insects, which will provide food sources for urban birds. Known nesting sites should be avoided. Consult Moy technical for further info.

## 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 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, e.g., gravel, and must be made permanently accessible. Gutters must not be overgrown and thereby functionally impaired.

Roof rainwater outlets should be of the **Gravity** type and should be sized in accordance with a project specific roof drainage calculation. If a secondary system or emergency overflow is required by insurance regulation or local codes, this should also be calculated at design stage.

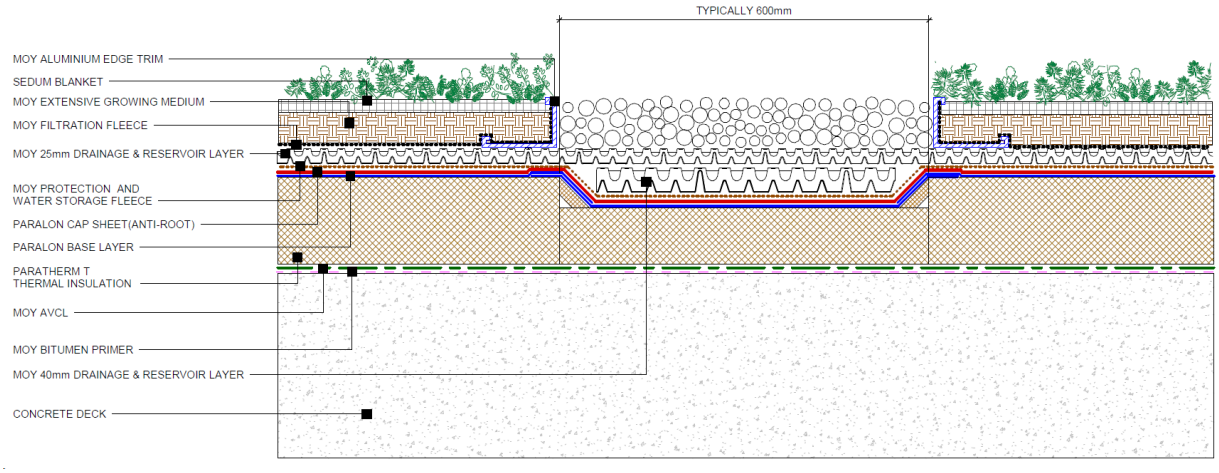


***Figure 4 - Gutter Channel with Pebbles Detail***

### *1.5.2 Rainwater outlet inspection chambers*

The roof drains are critically important to the functionality of any flat roof and therefore it is essential that the roof drains are kept clear of debris and 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 recycled polypropylene and incorporates a locking lid with an emergency drainage grille. The inspection chamber is raised above the waterproofing surface by corner base plates, ensuring water may flow unimpeded to the roof drain.

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. MOY Inspection chambers also facilitate drainage.

## 1.6 Gravel

### *1.6.1 Perimeters*

The perimeter zone will typically be constructed at all roof edges and at any opening through the structural deck, such as roof lights or roof ventilation ducts. The gravel margin is typically a minimum of 300mm wide around all perimeters and penetrations (roof lights, soil vent pipes, rainwater outlets), 500mm wide where there are openings to the buildings (doors, windows and opening roof lights). All gravel margins should be 900 mm wide for FM approved installations. Gravel margins but 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 25mm, being 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 to 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 and 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. 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 Rubber paving slabs.

## 1.7 Fire

The 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 use 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.

# Summary of Classification Report No. 23059C

## PRODUCT

**Paralon Total Green Roof System**

## SPONSOR

MOY MATERIALS LTD.

## PRODUCT DETAILS

| Green roof system | Waterproofing | Paratherm T | Parabase 3kg |
|---|---|---|---|
| Green roof system comprised of: MOY Extensive Sedum Mat, MOY Extensive Green Roof Substrate, MOY Filtration Fleece, MOY Drainage Board and MOY Protection Fleece | 2-layered waterproofing system comprised of Paralon Antiroot and Paralon TOP/S | Polyisocyanurate (PIR) insulation with a bitumen upper facing and a glass tissue backing. | Modified bitumen membrane with a stabilized polyester reinforcement. |
| | 7,0 mm (4,0 mm cap sheet & 3,0 mm underlayer) | 40 mm | 2,0 mm |
| The product and end-use parameters of the separate layers can be found in 23059B. | 7500 g/m² (4000 g/m² cap sheet & 3500 g/m² underlayer) | 32 kg/m³ | 3000 g/m² |
| | Torch bonded | Adhered | Torch bonded |

## FIELD OF APPLICATION

- Range of pitches: ≤ 10°
- Range of substrates: OSB/3 (18 mm or more ; ± 630 kg/m³)

## CLASSIFICATION

**$B_{ROOF}$(t4)**

## STANDARDS

Test standard: CEN/TS 1187:2012 – Test method 4

Classification standard: EN 13501-5:2016

SIGNED

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*For and on behalf of WFRGENT nv*

This summary of classification report has been drafted according to EGOLF agreement EGA 039:2021 "Application note: clause 7.8 [7.8/1] – Types of reports". It has not been drafted under the requirements of EN ISO/IEC 17025 accreditation and is not valid to officially classify a product. The full classification report No. **23059B** is available at **MOY MATERIALS LTD.**.

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*Figure 5 - Paralon Total Green Roof System Broof(t4) Classification Report*

## 1.8 Safety and Access

### *1.8.1 Safety Systems*

The Diasafe Fall Protection System is installed without penetrating the waterproofing membrane. The system utilizes a ballasting mat to provide the loading required to safely hold the user or users in the event of a fall. The system carries CE approvals to standard EN795:2012 as a class A and C certified system. Stainless steel cable and accessories are resistant to corrosion. Height-marking lines on the posts give a reference to help with the measurement of the ballasted materials in dry conditions at a minimum of **80 kg/m²** distributed evenly over the whole ballasting mat surface. All safety systems require annual maintenance, and this must be accounted for in the contract of installation.

For site specific designs please contact MOY Technical for further information.

*Figure 6 - MOY Diasafe Fall Arrest System*

## 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:

1) Traffic of the vegetation layer for maintenance purposes.
2) Designated walking paths for regular foot traffic.
3) Shading by units that can have a sun dial effect.
4) 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 needed to other roof mounted plant or equipment with regards to shading and Roof Mounted Plant. Rainwater from flat PV panel may cause scouring to occur. Integrated PV systems should permit sufficient sunlight to reach plants.

### *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, the its effectiveness during longer storms will decrease.

Blue Roofs are designed to retain rainwater for an extended period of time 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, through the formation of a water storage void under the growing media and the use of flow restrictors. 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@moymaterials.com.

## 2.0 Green Roof Installation

Once the waterproofing has been inspected by a Moy representative, no other trades, other than the waterproofing installer, should be allowed to access or traffic the roof surface.

### 2.1 Typical Extensive Green Roof

- **Clean the roof:** Sweep away any small debris or materials likely to cause damage to the waterproofing such as screws, wire, nails etc.
- **Apply protection:** Moy Protection and water storage fleece (300g/$m^2$), is rolled out, loose laid and over lapped by 100mm. **NB:** Roll size is 2m x 50m.
- **Apply drainage layer:** Moy 25mm Reservoir and Drainage board is laid loose and butt joined at side and head laps. It may also be overlapped by one cup to prevent the boards moving, particularly on sloping roofs. **NB:** For roofs over 10˚ use MOY PU adhesive and Consult with MOY Technical Services Dept.
- **Apply drainage layer to gutters:** Moy 40mm Reservoir and Drainage board is laid loose in the gutter channels, if present (later to be covered with pebble ballast). Cut a piece out of the drainage layer at the location of the rainwater outlets. **NB:** Moy 40mm Reservoir and Drainage board will give greater drainage clearance for the channel area.
- **Apply inspection chambers:** Rainwater outlets should be covered with Moy roof outlet inspection chambers. The inspection chamber is then surrounded by 350mm wide band of pebble ballast to prevent the spread of fire.
- **Apply separation profile:** Position Moy Aluminium Edge Trims using a string line to ensure a straight line. Edge trims should be temporarily ballasted, bonded or patched by roofer while the green roof materials are installed on each side and remove the ballast weight on completion. Alternatively, the edge trims can be permanently bonded by the installing roofer contactor.
- **Apply substrate:** Extensive green roof substrate is spread at a depth of 50mm approximately, this is supplied in slung bags of 1 $M^3$ each, each bag shall cover approx. 16$m^2$. Substrate may be spread evenly with rakes to the required depth. The depth of substrate may be increased at ballasted fall arrest posts or mounded

for green roof features such as burrowing mounds and log pile habitat replacement.

- **Apply gravel:** Install round washed pebble to Architects Specification on the outside edge of the trim taking care to maintain the straight line. Pebble diameter should be 20– 40mm in diameter and must be rounded stone free from fines and any cracked or sharp edges which may damage the waterproofing layers.
- **Apply vegetation blankets:** Sedum or Mixed Vegetation blanket is unrolled, tightly butt joined and staggered over the prepared substrate, install full blankets always at edges and perimeters where wind uplift is higher, and cut off pieces may be used to fill the center of the roof.

  **Note:** It is important that the sedum blanket does not remain rolled up for over 24 hours, as it is a perishable material. Sedum delivery should be timed to arrive after preparation of the bedding layers.
- At pathways and perimeter edges paving flags may be used. Paving flags should be laid onto the clean and dry filter fleece layer, supported upon the reservoir & drainage board. Sedum and substrate to butt to the side of slabs.

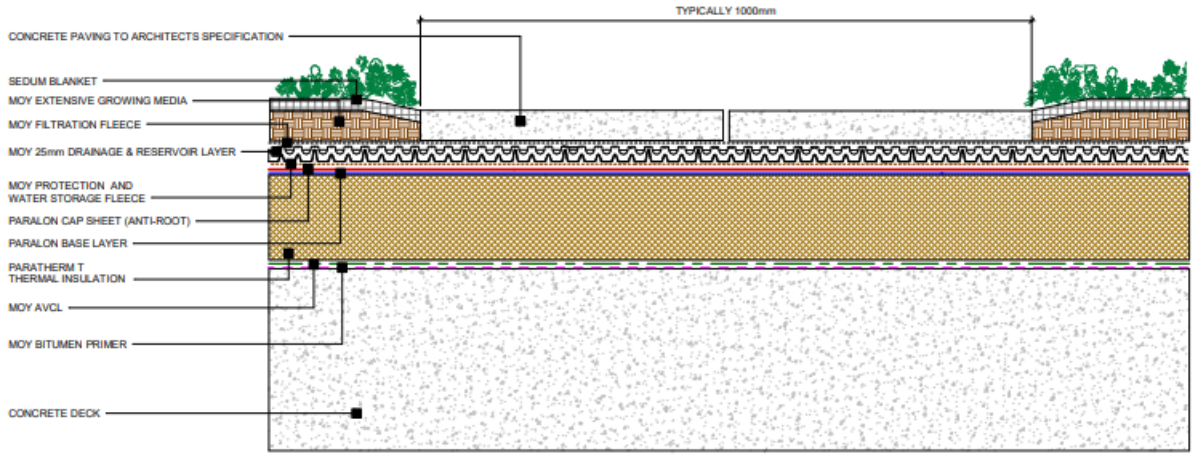


*Figure 7 - Footpath Concrete Slab Detail*

## 2.2 Blue-Green Roof

- **Clean roof:** Sweep away any small debris or materials likely to cause damage to the waterproofing such as screws, wire, nails etc.
- **Apply protection:** Moy Protection and water storage fleece (300g/m$^2$), is rolled out, loose laid and over lapped by 100mm. **NB:** Roll size is 2m x 50m.

- **Apply drainage layer:** Moy 120-WM Void Former is laid loose and butt joined at side and head laps. Moy 120-WM Void Former is laid loose in the gutter channels, if present (later to be covered with pebble ballast). Moy 25mm and 40mm Drainage and reservoir boards can be used in areas too small for the 120mm void former. Cut a piece out of the drainage layer at the location of the rainwater outlets.
- **Blue roofs restrict the flow of water from a roof, it is important that the flow restrictor is not installed until the roof is fully complete and all activity by other trades has ceased.**

  Flow restriction outlets should be covered with Moy roof outlet inspection chambers. It is essential that there is a skirting piece of filter fleece wrapped around the inspection chamber to prevent particles from blocking the flow restrictor. The inspection chamber is then surrounded by 350mm wide band of pebble ballast to prevent the spread of fire.
- **The installation of edge trims, substrate, sedum, gravel/pebbles and pavers as Section 4.1.**

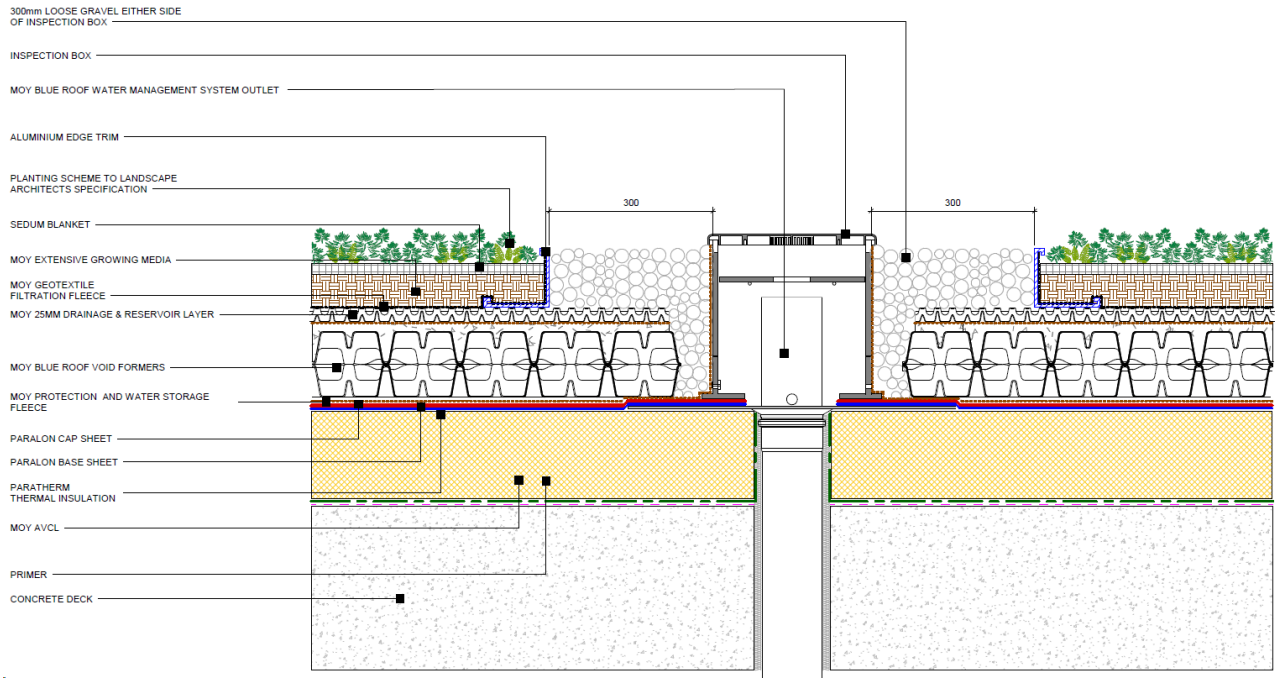


*Figure 8 - Blue-Green roof rainwater outlet and inspection box*

# 3.0 Green Roof Maintenance

## 3.1 Maintenance immediately following installation (by roofing contractor)

Sedum roofs require care and attention in the weeks following their installation. Each roof is subjected to various weathering conditions. Roofs do not wear uniformly since certain areas may be affected more severely than others.

After a period of **6 to 8 weeks** during the growing season, the edges of the sedum blankets will knit together, and the roots of the sedum plants will extend into the growing media.

All living roofs must be carefully monitored through their first summer flowering cycle.

## 3.2 Maintenance post-establishment (by client/building owner)

Certain procedures are recommended, particularly in the first year, to ensure the long-term success of the plants.

As a general guide, it is recommended that maintenance be carried out **three times in the first year** and **twice per year in each subsequent year**, but this depends on the type of system installed and the rate of plant cover. Clients may engage the installing contractor or any other landscape maintenance contractor with suitable green roof experience.

Inspect the roof at least twice yearly, in spring and autumn, and inspect all roofs after any severe storm. Make frequent inspections on buildings that house manufacturing facilities that evacuate exhaust debris onto the roof.

The following steps should be undertaken during each roof inspection:

- Clean roof drains of debris.
- Remove leaves, twigs, cans, balls, etc. which could plug roof drains.
- Bag and remove all debris from the roof as debris on the roof surface will be quickly swept into drains by heavy rains and drainage problems may occur.
- Notify the roofing contractor **immediately** if a roof leak occurs.

- If possible, note conditions resulting in leakage - Heavy or light rain, wind direction, temperature and the time of year that the leak occurs are all important clues to tracing roof leaks.
- Note whether the leaks stop shortly after each rain event or if it continues to drip until the roof is dry.

If the owner is prepared with facts, the diagnosis and repair of roof problems can proceed more rapidly.

File all job records, plans and specifications for future reference. Set up a maintenance schedule. Record maintenance procedures as they occur. Log all access times and parties working on the roof in case damage should occur.

### 3.3 Safe Access

Appropriate measures should be taken at both design and construction stages to ensure safe access and passage over the planted roof areas for maintenance personnel. To facilitate this a proprietary Diasafe or similar safety / fall-arrest system should be installed as part of the roof works.

### 3.4 Gutters and Outlets

The checking of gutters and outlets should be carried out routinely during any maintenance check to ensure drainage is not impeded. All rainwater outlets should be protected within an outlet inspection box with a lockable cover. Open the cover with a coin or screwdriver and ensure the leaf grate is in position and that no debris blocks the outlet. Lock the lid on completion.

### 3.5 Trafficking of the Plant Layer

Trafficking of the planted roof for maintenance 2-3 times a year will have no detrimental effect on the plant layer. If works are to be carried out on the roof surface or to adjacent structures care should be taken to minimise damage to the plant layer resulting from repeated trafficking. We would advise that should this be required access routes to the works are closely defined to ensure damage is minimized. If the plant material is damaged re growth normally occurs. However, the speed of recovery

will be dependent upon the level of damage and the duration of the trafficking period. **Do not leave items such as boards or planks on the planting layer**.

### 3.6 Watering and Irrigation

The extensive green roof is quite resistant to drought. If an extended period of dry weather should occur (14 or more dry days), periodic checks should be made on the roof to examine the reservoir and drainage board to determine if all the water contained has been used by the plant layer.

Apply water using a sprinkler attachment or porous or perforated pipe until the substrate is thoroughly saturated and the reservoir cups are filled. Do not use power hose or fire hose units as they may damage the plants. Irrigate the plant layer at a minimum rate of **2 litres per M$^2$** 2-3 times weekly until established, during the growing season this may take 6-8 weeks.

### 3.7 Application of nutrient and soil conditioner

The correct level of nutrients in the growing medium is important.

The fertilization procedure is determined by the following:

- Levels of previously applied fertiliser.
- Condition of the plant material.
- Type of growing medium.
- Location and season.

*Extensive Roofs Nutrient Guidelines **(Example - 35g/M2 Osmocote Exact)** in April / May. If the ambient daily temperatures are greater than 5° the application of nutrient may proceed. Application of nutrient during colder periods may result in that nutrient washing out without effect.*

*Fertiliser should be applied sparingly, several light applications will give a better outcome, a single concentrated dose of fertiliser can be problematic. Other fertiliser products applied in accordance with manufacturers recommendations.*

## 3.8 Planting

### *3.8.1 Removal of undesirable plant material*

The Sedum and other species planted at the time of installation are well adapted to life on the roof and quickly become established, however, a few other native species may intrude. Some people welcome the colonisation of so-called ‘weeds’ to promote biodiversity. However, you may prefer them to be removed.  Dependent upon material and site requirements, this can be done by hand or by a careful point application of herbicide using a weed wipe device to target individual plants. The use of sprayers to apply herbicide is not advisable. Manufacturers guidance notes on the use of any chemicals or herbicides must be followed.

There are invasive weeds and although biodiversity is important it is important to note the following weeds are known to be invasive, chickweed, clover, dandelion, thistle and sycamore shoots.

### *3.8.2 Removal of flower heads after flowering*

This depends on the individual aesthetic requirements of the client. Dead flowers will eventually disintegrate but the heads may be removed in late summer or early autumn if required by careful clipping.

### *3.8.3 Removal of leaf litter*

The ideal position for a green roof is in full sun. In certain situations, adjacent trees could shed leaves onto the roof surface resulting in sedum loss. Depending on quantity, these may need to be removed with a leaf-blowing machine. This would be a seasonal requirement.

## 3.9 Pests and diseases

Sedums are generally pest and disease resistant but, like many plants, can suffer from aphids or vine weevil. The care we take in production of our plants and the formulation of our Sedum Mat product discourages such problems but, if they occur, they can be controlled by environmentally friendly means. Advise Moy Materials Ltd. if an outbreak of pests or disease should occur. We can then advise on remedial measures appropriate to the problem.

### 3.10 Cutting back or altering the green roof

It should be noted that Extensive green roofs have a very shallow layer of growth media (soil). If alterations are made to the layout of the green roof care must be taken not to damage the waterproofing membrane and the fleece layers and gravel trims must be reinstated properly.  Where openings must be made to accommodate ducts or pipe work from within the building, the installing roofing contractor must be engaged to weather the opening and trim the green roof elements around any such penetrations.

### 3.11 Use of edged tools

The maintenance of the extensive green roof does not require the use of any sharp-edged tools. The use of shovels, spades, edging tools, rakes, hoes etc. are not required and should not be used in the maintenance of the extensive green roof. Care should always be taken not to damage the underlying waterproofing.

# Notes

**Roofing System Supplier**

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**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*……

*Recipient*...…….

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