

Vegetative Roof PMR – A Design Primer

A protected membrane roof (PMR) design is an ideal solution for “green” roofs where landscaping or plantings are used on the top surface. Preventing leaks is crucial in any roof, and even more so in a vegetative roof, because repairing this type of roof can be costly.

In a vegetative roof PMR, typically a fully adhered membrane is installed over a concrete deck and the desired thickness of **DuPont™ Styrofoam™ Brand Extruded Polystyrene Foam Insulation** and a root barrier are installed above the membrane (Figure 1).

This layer of insulation serves a dual function of providing both long-term thermal insulation value as well as mechanical protection of the crucial waterproofing membrane during the installation of the roof landscaping, including drainage layers, drainage materials and plantings, and the assorted equipment used during the installation process.

Where Should the Drainage Layer be Located?

The drainage layer should always be above the **Styrofoam™ Brand Extruded Polystyrene Foam Insulation** to ensure that any water is quickly drained away and the full value of the insulation is maintained.

In vegetative roof PMR deck designs, a drainage layer above the insulation allows water to drain off the top surface of the insulation, creating a “diffusion open” assembly. If the insulation is sandwiched between a vapor retarder (e.g., saturated drainage felt) and the underlying membrane, vapor cannot escape, so there is the potential for it to be driven back into the insulation (Figures 2 and 3). To create a “diffusion open” layer, ensure that the top surface of the insulation has a ventilating air space as well as provides a good slope for drainage.

Note: *Never install a polyester mat or moisture retention blanket directly on the insulation. If used, ensure a clear drainage layer separates the moisture retention blanket and the insulation.*

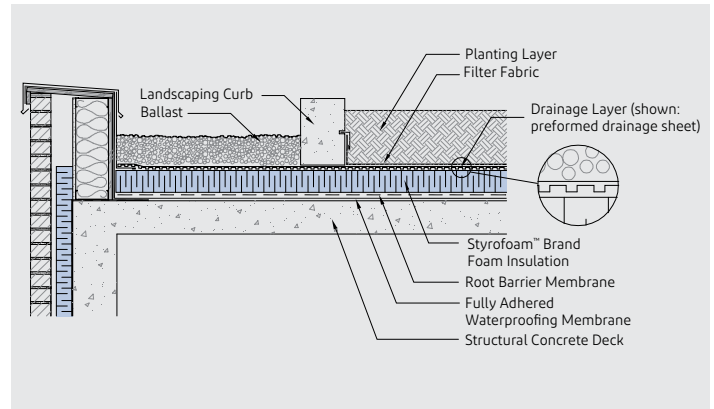


Figure 1 : Vegetative Roof PMR*

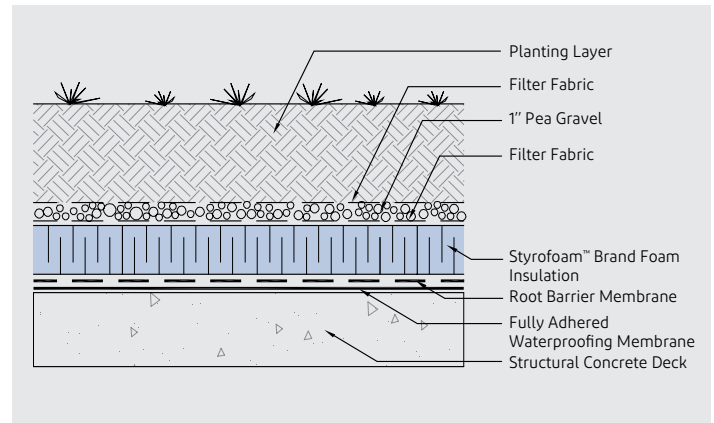


Figure 2: Option 1 – Drainage Layer Consisting of 1” (25 mm Granular Layer*)

Installing the drainage layer under the insulation can potentially minimize the overall benefits of the insulation by Figure 1: Vegetative Roof PMR* creating a convective loop below the thermal insulation (Figure 4). In this case, air can move through the drainage layer and reduce the overall insulation value. Installing the drainage layer above the insulation ensures that the insulation value is maximized.

IMPORTANT: When scheduling or weather conditions delay installation of plaza, patio deck or vegetative roof PMR areas, care must be taken to ensure that dark-colored products, such as black plastic drainage boards (dimple boards) or dark fabric, are not placed over the insulation and then left exposed. Dark-colored products can lead to extremely high surface temperatures, increasing the potential for distortion of rigid foam boards.

If DuPont™ Styrofoam™ Brand Extruded Polystyrene Foam Insulation is already installed, cover it with a white opaque polyethylene film to protect it during the delay. Otherwise, schedule the insulation installation for a time when the entire installation process can be completed in a timely manner.

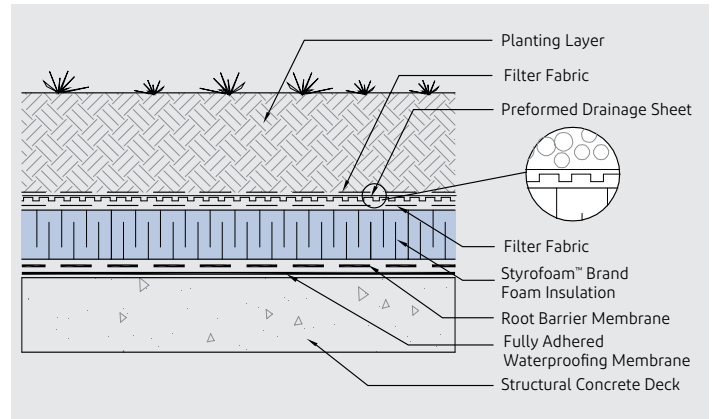


Figure 3: Option 2 – Drainage Layer Consisting of a Preformed Plastic Drainage Sheet*

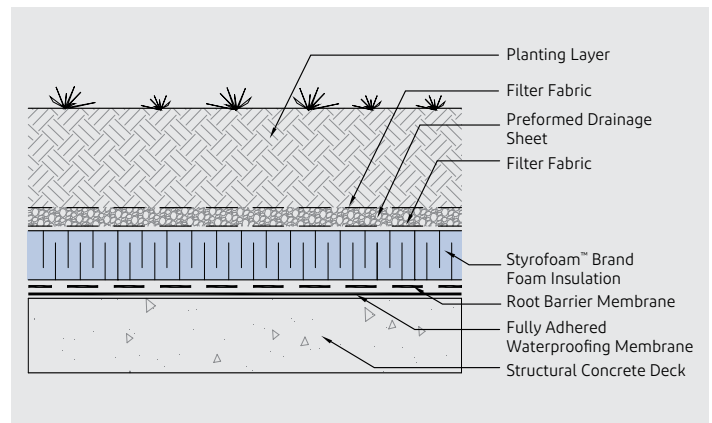


Figure 4: Option 3 – Drainage Layer Consisting of a Commercially Available Mat and Filter*

What Products Can be used to Create a Drainage Layer?

A number of products can be easily incorporated, depending on the drainage requirements, budget and other preferences. The main categories of products include:

- 1" (25 mm) (min) layer of pea gravel, free of fines, with a filter fabric above and below the ballast (Figure 5)
- 3/8" to 1/2" (12 mm to 12.7 mm) dimpled, preformed plastic drainage sheet. Where possible, specify a product that minimizes contact with the insulation (e.g., place dimpled side down) (Figure 6)
- Any other product that provides adequate drainage while providing minimal direct contact on the underlying insulation (Figure 7)

What Type of Styrofoam™ Brand Insulation Should be Specified?

The insulation must be able to perform long term under both sustained (dead loads from plantings, planters, etc.) and cyclic loading (live loads from maintenance vehicles, foot traffic, etc.). Because the design of each vegetative roof is unique, it is important that the designers calculate both the live and dead loads created on the insulation layer.

Styrofoam™ Brand Extruded Polystyrene Foam Insulation is available in a range of compressive strengths from 35-100 psi (240-690 kPa) to address the specific design loading requirements for each project.

For a vegetative roof PMR that is exposed to limited pedestrian traffic and minor landscape maintenance using light power tools, typically **Styrofoam™ Brand Roofmate™ Insulation** or **Styrofoam™ Brand Highload 40 Insulation** may be specified, depending on design loads from the planting layer and other dead loads. Where vehicular traffic .or large design loads are anticipated, **Styrofoam™ Brand Highload 60** or **Styrofoam™ Brand Highload 100 Insulation** may be required. **Styrofoam™ Brand Plazamate™ Insulation** (U.S. only) is also available.

Regardless of the type of insulation, where more than one layer of insulation is required, follow these guidelines

- The bottom layer of insulation (the layer directly on the root barrier) must be at least 2" (50 mm) thick.
- The bottom layer must be the thickest or, at minimum, equal to the top layer (e.g., 3" [75 mm] bottom and 3" [75 mm] top).
- Lay succeeding layers of insulation unbonded or unadhered.
- Stagger or offset all joints from those of the underlying layer.

Note: *These are guidelines only; it is the responsibility of designers and/or engineers to calculate and accommodate live and dead loads in a vegetative roof PMR design. If required, contact a DuPont representative for additional information on the live and dead load design limits for Styrofoam™ Brand Extruded Polystyrene Foam Insulation.*

What are the Weight Recommendations For Ballast and the Planting Layer?

When designing a vegetative roof PMR, the stone ballast typically specified in a PMR is effectively replaced by the planting layer to minimize any potential for flotation. As detailed in DuPont literature and Tech Solutions 508.1 (Ballast Design Guide for PMR Systems [U.S.]), the minimum stone ballast requirement of 10-12 lb/ft² (50-60 kg/m²) can be replaced with a similar weight of a dry and unsaturated planting layer, with additional ballast required around any penetration(s) and the roof perimeter. Refer to Table 1 for either weight or thickness of additional ballast, depending on the thickness of insulation. For additional literature, visit building.dupont.com or call 1-866-583-2583.

Can This PMR Type Qualify for LEED Credits?

A vegetative roof PMR can provide valuable credits when obtaining the U.S. Green Building Council's LEED** (Leadership in Energy and Environmental Design) rating. Refer to Table 2 for examples of possible credits.

For more details, refer to the "Styrofoam™ Brand Insulation, LEED and Green Roof Assemblies" brochure (Form # 179-05082/178-00698) at www.dowpmr.com

For more information on LEED, refer to www.usgbc.org (U.S.) or www.cagbc.org (Canada).

What Products Can Be Used in Maintaining This PMR Type?

Often chemicals are used in maintaining a vegetative roof PMR, including fertilizers, pesticides and herbicides. Because of the many different components in the roof assembly, it is recommended that chemical compatibility be checked for each component (e.g., filter products, preformed drainage layers and membranes).

In general, for DuPont™ Styrofoam™ Brand Extruded Polystyrene Foam Insulation, always use a solvent-free product. Contact your DuPont representative or call 1-866-583-2583 for more information.

Table 1: Required Ballast Around Perimeters and Penetrations

Styrofoam™, Thickness, IN (MM)	Required weight of stone ballast, LB/FT ² (KG/M ²)	Approximate Thickness of ballast, IN (MM)
Up to 2 (50)	12 (60)	1 ¼ (40)
3 (75)	17 (84)	2 ¼ (60)
4 (100)	22 (108)	3 (75)
5 (125)	27 (132)	3 ½ (90)
6 (150)	32 (156)	4 ¼ (105)
7 (175)	37 (180)	5 (125)
8 (200)	42 (204)	5 ½ (140)

Table 2: Potential LEED Points for Green Roof Systems based on LEED Reference Guide for Green Building Design and Construction 2009 Edition

Credit Number	Credit Name	Number of Points
SS Credit 5.1	Site Development, protect or restore habitat	1
SS Credit 5.2	Site Development, maximize open space	1
SS Credit 6.1	Stormwater Design, quantity control	1
SS Credit 6.2	Stormwater Design, quantity control	1
SS Credit 7.2	Heat Island Effect, roof	1
WE Credit 1	Water Efficient Landscaping	2-4
EA Prerequisite 2	Minimum Energy Performance	Required
EA Credit 1	Optimize Energy Performance	1-19
MR Credit 3	Material Reuse	1-2
MR Credit 4	Recycled Content (post consumer+1/2 preconsumer	1-2
MR Credit 5	Regional Materials, 10%/20% extracted processed and manufactured regionally	1-2
EQ Credit 7.1	Thermal Comfort, design	1
ID Credit 1.1	100% Green Roof for exemplary performance of SS Credit 7.2	1
ID Credit 1.2	Green Roof accounts for 40% of the site area for SS Credit 5.1	1
ID Credit 1.3	Green Roof area doubles the requirements of SS Credit 5.2 depending on local zoning open space requirements.	1



**For more information visit
building.dupont.com
 or call 1-866-583-2583**

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DuPont™ Styrofoam™ Brand Spray Polyurethane Foam contains isocyanate, hydrofluorocarbon blowing agent and polyol. Read all the instructions and (M)SDS carefully before use. Wear protective clothing (including long sleeves), gloves, goggles and proper respiratory protection. Supplied air or an approved air-purifying respirator equipped with an organic vapor sorbent and a P100 particulate filter is required to maintain exposure levels below ACGIH, OSHA, WEEL or other applicable limits. Provide adequate ventilation. Contents under pressure. Styrofoam™ Brand SPF should be installed by a trained SPF applicator.

Building and/or construction practices unrelated to building materials could greatly affect moisture and the potential for mold formation. No material supplier including Dow can give assurance that mold will not develop in any specific system.

WARNING: Rigid foam insulation does not constitute a working walkable surface or qualify as a fall protection product.

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