

## Description:

The purpose of the section is to highlight the UMD Design Standards for design and installation of vegetated roof coverings, also referred to as green roofs or living roofs. In this section are assemblies of growing media and plants described to be installed over either built-up or waterproofing membrane building roof assemblies.

Criteria contain in this guideline section shall apply to both intensive and extensive green roofs. Tailoring of this “performance” guideline is required to coordinated “fit” the type of designated roof(s) specific to each project’s design condition.

## Related Sections:

- 01 78 36 Warranties
- 01 83 13 Structural
- 31 25 00 Stormwater Management and Sediment and Erosion Control
- 32 80 00 Site Irrigation Systems

## Effective Date:

January 1, 2023

## Applicable Standards:

- ANSI/SPRI RP-14 Wind Design Standard for Vegetative Roofing Systems
- ASTM E-108 Standard Test Methods for Fire Tests of Roof Coverings
- FLL Guidelines for the Planning, Construction and Maintenance of Green Roofing TBD

## General Requirements:

Designers are required to analyze and initially select a green roof system on the basis of key performance criteria. Key performance criteria should include:

- storm water management
- weight
- wind resistance
- fire resistance, and
- vegetative performance

Accordingly, designers are required to:

- Select a green roof system that will provide the necessary storm water retention. Stormwater management credit for the green roof system shall be determined by the 2000 Maryland Stormwater Design Manual, Stormwater Management act of 2007, and the July 2010 (or latest edition) Maryland Department of the Environment Environmental Site Design (ESD) Process & Computations. Calculations shall be prepared by an engineer licensed to practice in the State of Maryland, typically as part of an overall site or project storm water permit application. In addition, a definitive assessment of the water retention potential shall be demonstrated with a measurement of the substrate water holding capacity.
- Select a green roof system that will not exceed the planned (or existing) structural capacity of the building upon which the green roof would be installed, achieving a balance between maximum stormwater retention and treatment and structural limitations.
- Any green roof design should comply with ANSI/SPRI RP-14 “Wind Design Standard for Vegetative Roofing Systems” (latest approved edition) at a minimum. Use of permanent surface-applied nettings as a wind control method is currently not acceptable.
- If using an extensive green roof system, select an extensive green roof system that achieves a Class A fire rating when tested per ASTM E-108 Standard Test Methods for Fire Tests of Roof Coverings. Intensive green roofs are not likely to be available with a Class A fire rating; design intensive green roofs with a regard to fire resistance similar to at-grade landscaping.

## System Profile

- The substrate selected should:
  - Have demonstrated successful performance on prior projects
  - Reliably support perennial vegetation
  - Make nutrients available to vegetation while preventing or minimizing nutrient runoff
  - Resist degradation by UV exposure or other exposure to the elements
  - Be geometrically stable, including resistance to freeze-thaw
  - Resist wind uplift
  - Be fire-resistant
  - Retain water that is available to plants
  - Meet targeted stormwater retention values
  - Not exceed the targeted structural capacity of the building.
- A granular growth media that meets but, is not limited to, the German Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (FLL) Guidelines for the Planning, Construction and Maintenance of Green Roofing may be used pending satisfaction of the above ten (bulleted) requirements.
- A proprietary system profile that meets the above ten requirements may be used.
- Designers of specific projects may add requirements to the requirements listed above as needed to benefit the overall design. For example, the requirements listed above might allow a range of system types that weigh no more than 56 psf, and which retain at least 2 inches of rainfall, but an added project-specific system requirement might be the ability to support a plant palette of specific native grasses.
- Designers may select a proprietary system as the basis of design that, at a minimum, shall meet all the specified performance criteria stated above.
- Innovative systems which meet or exceed the above requirements, except demonstrated performance on prior projects, may be used in conjunction with an approved research project within the UMD Green Roof Research Team.

## Plant Selection

- Desirable plant species include: Plants that contribute toward a low- maintenance, continuous and year-round vegetative cover that is predominantly perennial in nature, but which may accommodate some annual plants. Desirable plants grow and spread at a pace that does not diminish species diversity and that does not require excessive maintenance.
- Mono-culture planting patterns shall not be used in extensive green roofs; if a specific aesthetic patterning is desired, accomplish patterning through the use of a minimum of 3 proven species per area.
- Incorporate native species if practical.
- The UMD Plant Sciences Department (PSD) is actively researching and testing suitability of various species native to Maryland; check with the PSD for current most appropriate plant selections during design.

## Roof Drainage

- Green roof materials, drainage systems internal to the green roof, roof drains, and roof overflow drains shall be designed to accommodate a 100-year storm without structural over-loading of the roof. Engineers shall provide calculations documenting drainage rates for a 100-year storm.
- The green roof may receive stormwater from adjacent surfaces such as higher rooftops. If design calculations support that the green roof will support the additional volume of stormwater flow, design the green roof to absorb the additional water, with appropriate overflow design. Otherwise, direct the downspout to the nearest appropriately sized roof drain via a perforated conduit within the green roof's drainage layer.

## **Rooftop Access**

- All green roofs must allow pedestrian access for trained maintenance crews and other intended roof users.
- Design each roof area to be accessible via doorway or, roof hatch to the extent practical. Use permanently mounted ladders between roof elevations as needed. An access plan for the green roof shall use portable ladders only as a last resort for pedestrian access.
- Design must conform to all applicable MOSH, OSHA standards, the State of Maryland Fire Prevention Code, and ADA standards.
- Design a fall protection system appropriate for the intended use. A passive fall restraint system (protective of trained and untrained persons) and engineered as part of the roof is strongly preferred in all cases. Options include minimum 42" high parapets, guard rails or combination of the two to prevent persons from walking to the edge or falling to a lower level. Guardrails visible from grade level or a prominent location are subject to ALRB review. If visitor and/or research access is not intended and guardrails or parapets are not feasible, permanently installed and rated anchor points, self-ballasted anchor systems or lifelines to which trained maintenance personnel can attach their harnesses are acceptable.
- Design access routes for general rooftop maintenance. For routes that will receive predictable and recurrent foot traffic, install designated walking surfaces at least 24 inches wide, such as precast concrete pavers set within the green roof system, gravel walking paths, or metal grates that allow plants to grow beneath. Provide a minimum of one designated and properly sized access route from a doorway or roof hatch to rooftop equipment, preferably a minimum of 6 ft. from the roof edge.
- If the rooftop design incorporates rooftop congregation spaces as well as green roofs, separate the green roof from the congregation space by a curb of at least 4 inches tall, a railing or pedestrian guard, a planter wall, or a similar containment device to prevent faculty, staff, students, or visitors from walking on the green roof.

## **Waterproofing Membrane**

- Below green roofs, waterproofing membranes (which are designed to withstand hydrostatic pressure) are generally preferred over roofing membranes (which are designed only to withstand hydrodynamic pressure).
- All green roofs for new construction and re-roofing projects shall be installed over waterproofing membranes. The waterproofing membrane shall be eligible for a manufacturer's warranty when used below a green roof. Use a root barrier if required by the waterproofing manufacturer.

## **Warranty**

- Each green roof shall be covered by a manufacturer's guarantee covering the complete green roof system, including all layers placed above the building's roofing system.
- The vegetated green roof system warranty may be separate or combined with the roof waterproofing membrane warranty.
- The vegetated green roof system warranty shall be for twenty (20) years or same period as associated supportive roof weatherproof assembly.
- All vegetation associated with green roof system shall be warranted for two (2) years from point of acceptance (substantial completion).
- Warranty shall include but, not be limited to:
  - System functionality
  - Removal and replacement of overburden
  - Vegetative performance
  - Installation workmanship.

## **Maintenance Program**

- Ensure that a maintenance program is in-place as part of the initial installation of the green roof. The green roof will require permanent, ongoing maintenance. Maintenance may be performed by the University staff, or contracted to specialists in green roof maintenance.
- An accredited Green Roof Professional (GRP) who is familiar with nutrient requirements of thin-profile substrates shall determine a nutrient management program for the green roof as needed. Nutrient inputs should be selected and sequenced to minimize the potential for nutrient runoff, meeting the requirements of the vegetation during the growing period.

- Weeds shall be extracted by manual (hand) pulling.
  - Weeds include: Plants that are considered noxious or invasive, and plants which are aggressively spreading or very fast-growing that, if not removed would destabilize the plant community to diminish the quality or quantity of desirable species. Weeds also include plants whose root systems are not suited for long-term growth within the growing media (e.g. tree saplings in a 4-inch depth media) or whose ultimate size or type would pose damage to the roofing membrane.
  - A typical green roof should be designed with a plant density to achieve at least 75% plant coverage by the end of the first year after planting and at least 95% plant coverage by the end of the second year after planting.

## **Irrigation:**

- If required, a temporary irrigation system may be installed for the first year of growth in order to allow the plants to become established.
- If a permanent irrigation system is designated to ensure continued heartiness of the plants it should:
  - Use non-potable water (i.e. filtered rainwater or condensate) and,
  - Employ water saving techniques such as moisture sensors, rain sensors, and timers.
- If no permanent irrigation system is installed, a water source that can be diverted to the green roof area should be readily available.

## **Additional Design Considerations**

- Provide a vegetation free zone under rooftop ventilation hoods and equipment. Continue vegetation free zone within the affected zone of rooftop hoods that spew grease or oil.
- Consider the carbon footprint and life-cycle cost of the green roof system. Consider low-carbon and locally sourced materials as design criteria during the green roof selection process.
- All green roofs installed on substrates that pitch more steeply than 2:12 will require an engineered slope stabilization system that concept of which must be submitted and approved by the university before final integration into any building. The stormwater retention of most green roof products is tested for flat and low-slope conditions; therefore, stormwater retention for slopes over 2:12 shall be supported by appropriate calculations and certified testing lab documentation.
- Extensive green roofs may be installed as either modular or built-in-place. Built-in-place green roofs are strongly preferred, as built-in-place green roofs provide greater hydrologic continuity, and rooftop ecology is more robust without unnecessary segregation. Built-in-place green roofs are commonly planted via pre-vegetated mat, cuttings, or plugs. All are acceptable methods.
- Where there is a building educational visual “dashboard” included in the program of the project, the green roof design should include sensors to capture, at a minimum, rainwater inflows and outflows. This data will be included and displayed in the monitoring system.