Design Guidelines 075000
Roofing Systems and Accessories

General

In general, follow the guidelines below when designing and specifying roofing systems.

Related Sections

U-M Design Guideline Sections:
3.2 Energy and Water Conservation
4.8 Fall Protection on Roofs
6.0 DG 051000 Metals
8.2 Architectural Preferred Manufacturer List

Reference Documents:
ANSI/SPRI VF-1 External Fire Design Standard for Vegetative Roofs ANSI/SPRI RP-4 2008 Wind Design for ballasted Single-ply Roofing Systems ANSI/SPRI RP-14 Wind Design Standard for Vegetative Roofing Systems

Roofing Materials

General
Specify that roofing materials for a given project are provided by a single manufacturer, and that all accessory materials be approved by that manufacturer as necessary to obtain the manufacturer's warranty.

Preferred System
Fully Adhered, Single Ply, Black, Ethylene Propylene Diene Monomer (EPDM)

Alternative systems listed below may be preferred for specific applications, such as aesthetics, condition of installation, or chemical resistance. Consult with the Design Manager for advice and consent regarding the use of other systems.

Alternative Single-Ply Systems

- EPDM, White: When considering the use of fully adhered, single ply white Ethylene Propylene Diene Monomer (EPDM) to reduce heat island effects, energy modeling shall be used to determine potential savings for white (high-albedo) vs. black roofs. Discuss results of energy modeling with the Design Manager.
- EPDM, Inverted and Ballasted (IRMA) and CPE: Not acceptable.
- Hypalon (CSPE): Consider fully adhered hypalon systems when resistance to chemical attack is paramount, such as on roofs with a substantial number of fume hood exhaust stacks or where repeated exposure to oil or coolant fluid leakage is likely. Mechanically attached systems are

acceptable when desirable for conditions of installation.

- Poly Vinyl Chloride (PVC) and Thermo-Plastic Olephine (TPO) Membranes: Acceptable under vegetative roof systems only, 60 mils thick minimum.
- Atactic PolyPropylene (APP) and Styrene Butylene Styrene (SBS) Modified Asphalt Membranes: Not approved for use, except for small roof areas and patching.

Alternative Roofing Types

Other types of roofing systems that may be considered include natural slate, clay tile, asphalt shingle, and standing seam sheet metal roofs. There are currently no explicit University standards for these systems. Comply with manufacturer's and industry standards, and professional judgment for materials and installation.

- Composite materials with the appearance of slate or clay tile are generally not approved for use.
- Multiple-ply built-up asphalt roofing systems are not permitted on campus areas due to objectionable odors.
- Vegetative roof systems can be used in select applications. Close coordination with the Design Manager is required for system selection and detailing.

Vapor Retarder

Use of asphaltic vapor retarders are not preferred due to objectionable odors.

Walkway Protection

For single-ply roof systems, provide walkway protection from roof access points to all roof mounted equipment requiring routine maintenance. Walkway protection should generally consist of a minimum 100-mil thick EPDM or Hypalon membrane, to match roofing material.

Provide a minimum of 4 sq. ft. of walkway pad directly adjacent to the equipment access panel for toolbox and parts to be set down during routine maintenance.

Insulation

Comply with DG 3.2 requirements. Polyisocyanurate is the acceptable insulation material. Insulation products shall be 25 psi minimum. Provide insulation coverboard, 200 psi minimum.

Accessories

- Roof sumps - Specify all cast iron components.
- Roof and equipment hatches - Specify the following minimum requirements
  - Anodized aluminum hatches with insulated double wall lids and insulated double wall curb frames
  - Integral mounting flange and counter-flashing.
  - Heavy duty stainless steel hardware.
  - Guardrails around the roof hatch to be used as ladder rungs when climbing in and out. Ladder up safety posts not permitted.
- Access ladders - Specify galvanized steel ladders fabricated from tube steel side rails with 1-3/4" tread grip rungs. Extend side rails above top rung. Paint finish optional.

Quality Assurance

Pre-Installation Conference
Require conference for all University roofing projects, including small repair or penetration work. This conference should be attended by, at least, the general contractor, the roof installer, Design Professional and University Construction Project Manager.

Warranty Requirements
Comply with the following requirements for warranties:

- New Membrane Roofs, Single-Ply Systems: Require a 15 year, single source warranty covering the full roofing system (including all accessories) for materials and labor.
- New Membrane Roofs, Vegetative Roof Systems: Require a 30 year, single source warranty covering the full membrane/waterproofing system (including all accessories) for material and labor.
- Repairs/Modifications: For roofs still under warranty, require that the original manufacturer's material be used and that the installer be approved by the manufacturer. The contractor should notify the roofing manufacturer with the warranty and University Construction Project Manager in writing of the changes to the roof under warranty.

Design Requirements - New and re-roofing projects

General

- Provide permanent access to all areas of the roof. Access is not permitted by use of an aerial lift.
- All roof work should be watertight and weatherproof, on a daily basis, before the contractor leaves the project site.
- The project must comply with the requirements outlined in DG 4.8 Fall Protection on Roofs.
- Maintain a minimum of 36” clear between mechanical units and adjacent structures, units, walls etc. for roofing repair and or replacement in the future.
- Provide exit signs on doors providing roof access. Mount on the roof side of the door. Provide additional exit directional signage in the means of egress is not fully visible from all portions of the roof.
- Document on roof drawing the structural rating of all skylight/sloped glazing and atrium systems.

EPDM, White Roofs (and other high albedo roofing systems) – An energy model shall be completed to determine payback and reviewed with the Design Manager. Also, ensure that the following conditions are met:

- Provide dewpoint calculations.
- Specify conductors and wiring, used to control rooftop HVAC equipment, capable to withstand the reflected heat from the roof.
- Design placement of rooftop equipment to prevent ice buildup and additional risk for maintenance staff.

Flat Roof Design
Generally comply with good roofing design practices outlined in the NRCA "Handbook of Accepted

Roofing Knowledge." Specifically, ensure that the following conditions are met:

- Slope roof as required by Code and not less than ¼ -inch per foot. Pitch roof by either sloping structure or by using tapered insulation.
- Slopes to drain should be unobstructed by above-roof building elements, equipment curbs, or similar objects. Where such obstructions are unavoidable, provide cants, saddles or other means to restore positive pitch to drain.
- Maximize parapet heights and run single-ply roofing materials up, over the top and down the face of parapets beneath stone coping caps and beneath metal trim.
  - Optional roof edge is preferred to be a snap on type gravel stop trim.
  - Metal edging such as gravel stops or coping caps require ES-1 testing approval.
- Specify that no EPDM single-ply membrane field seams be located within 5 feet of sumps (3 feet for Hypalon).
- Specify that no buck laps are permitted anywhere in single-ply roofing membranes.
- Specifically reference Factory Mutual 1-60, 1-75, or 1-90 roof requirements, as appropriate for the application.

<u>Vegetative Roof Design</u>
Generally comply with good roofing design practices outlined in the NRCA "Vegetative Roof Systems Manual". Specifically ensure that the following conditions are met:

- Limit slope design to a 2 to 12 pitch. A sloped structure is preferred to achieve necessary roof pitch in lieu of the use of tapered insulation.
- Provide a 6 foot minimum continuous fire break around roof edge, rooftop structures and rooftop equipment that contain combustible vertical surfaces. Non-vegetative fire breaks should consist of an ASTM E108, Class A system.
- Provide an 18 inch minimum continuous break around roof edge, rooftop structures and rooftop equipment that contain non-combustible surfaces.
- Comply with all manufacturer requirements to maintain warranties for underlayment systems.
- Provide access to at least one fire hydrant.
- Underlayment systems should consist of, at a minimum, a waterproof membrane system, membrane protection, root barrier, drainage/water retention layer, aeration/water retention layer, filter layer and soil substrate.
- Install indigenous and/or adaptive plantings only.
- Inverted insulation systems are not acceptable. Insulation must be installed below the waterproof membrane; the compressive strength must be appropriate for the expected dead and live loads of the selected system.
- Waterproofing membrane should be fully adhered to the substrate, not mechanically fastened or loosely laid.
- Membrane flashings should be a minimum of 4 inches above the surface of the growth medium.
- For existing buildings, coordinate with a structural engineer to determine the live load capacity of the existing structure.
- Structures supporting vegetative roofs should have a minimum live load capacity of 100 pounds per square foot or meet the requirements of the code, whichever is more strict.
- Vector mapping systems are recommended, but not required. For projects including vector mapping, coordinate with the Design Manager.

- Where tray systems are used over an existing conventional roof membrane, membrane protection is required.
- Water test(s) of waterproof membranes prior to installation of subsequent systems is required. Coordinate with the Design Manager.

Equipment Supports for Mechanical and Electrical Equipment and Panels
Generally, steel support frames are preferred wherever practicable, since curbs tend to interfere with roof drainage. Coordinate the following roofing issues with mechanical engineers.

Steel Frames
Steel angle, channel or wide-flange shape frames with pipe column supports. Comply with the following requirements:

- Carry support legs down to solid structural framing (i.e. steel joists or beams, or concrete beams or deck, if analyzed and known to be structurally adequate). Do not place support legs on a metal deck.
- The column supports round or square tubes only.
- Minimize the number of legs. For example, use 1 support centered on a gang of pipes instead of 2 wherever possible.
- Design supports for not less than 18 inches clearance above finished roofing surface. 24-inches is preferred clearance where possible and aesthetically permissible for smaller equipment units that can be reached just past the center of the unit from each side.
- Larger equipment shall be mounted 36”-48” above roof surface to allow for re-roofing and repair of equipment from underside.

Curb Type Supports
Construct curbs of pre-fabricated metal or site-built, preservative treated, lumber.

- For length or width dimensions greater than 48-inches, provide a saddle at the high side of the curb (against direction of slope-to-drain) to prevent water ponding behind the curb.
- Generally limit the longest dimension of curb to 60 inches. Use steel support frames where a longer dimension is required.
- Do not use open-ended (two-sided) curbs. These curbs make re-roofing beneath equipment impossible.

Special Requirements - Re-roofing Projects

Noise and Vibration
Attachment of underlayment, insulation, and other roofing materials may cause noise and vibration problems during construction. This is especially true for applications over concrete roof structures where the structure may transmit noise throughout the building. Consult Design Manager to determine whether special requirements for evening or weekend work are necessary.

Dust Protection
Specify the provision of dust protection over occupant's equipment and furnishings where appropriate. For example, specify protection for top floor areas that are occupied (not penthouses) and that do not have suspended ceilings. Where occupant's activities may be particularly sensitive to dust, specify protection regardless of presence of suspended ceiling. Note that dust protection should be applied and removed in coordination with occupant's operations. Consult Design Manager.

Special Requirements - Construction Projects Impacting Existing Roofs

Quality Assurance

- Standards: Require cutting and patching work in compliance with UM Facilities and Operations Maintenance Department and with recommendations of the National Roofing Contractors Association "Roofing and Waterproofing Manual".
- Installer qualifications: Require that cutting and patching of existing roof systems is completed by a contractor licensed by the manufacturer of existing roofing systems.

Temporary Roof Protection

- Require protective measures for areas of existing roof used for construction access, work, or material storage - ¾" plywood tied together over 1 ½ " ISO insulation.
- Require filter fabric over roof drains.