

NC State University Design and Construction Guidelines

Division 07 Thermal and Moisture Protection

1.0 Purpose

- A. This section provides NC State's minimum requirements for thermal and moisture protection.

2.0 Materials and Standards

- A. Roofing Program Sequence of Priorities
 - 1. Any new or replacement roof project shall include the installation of a fall protection system.
 - 2. New or replacement roof type shall be selected from the tables included in this document.
- B. Designs for existing low sloped roofs (<3:12 slope) shall consider a coating application under the following conditions:
 - a) 25% or less of warranty remaining.
 - b) No major flaws or damages visually observed.
 - c) Evaluation (infrared, resistance) determines any sub-membrane deficiencies to be remedied.
 - d) All repairs have been completed.
- C. Roof Replacement
 - 1. Designer shall examine the roof and make a recommendation regarding replacement if any of the following criteria is met:
 - a) When the project includes significant mechanical upgrades that alter the number of penetrations to the surface of the roof, roof traffic and loads are increased, or PV/Solar panels are added.
 - b) When only 25% of the warranty remains in effect.
 - c) When the roof has a documented history of leaks caused by material failure.
- D. Roofing Systems (see table for types)
 - 1. Built up or Modified Bitumen
 - a) Shall be used when 15% or more of total roof area is occupied by mechanical equipment.
 - b) Shall utilize either lightweight insulating concrete with adhered or hot mopped Oriented Strand Board (OSB) covered polyisocyanurate, or extruded polystyrene (XPS).
 - c) Shall not employ mechanical fasteners on a high-traffic roof.

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2. Single-ply membrane
 - a) Shall be used when less than 15% of total roof area is occupied by mechanical equipment.
 - b) Shall utilize 25 psi polyisocyanurate or XPS, and be mechanically attached, adhered, hot mopped or installed in conjunction with a pressure equalizing vent system.
 - c) Shall include rigid insulation that sustains the weight of all roof traffic and loads. Roof insulation must be specified to make up a “total roofing system” and shall be warranted by roofing manufacturer.
3. Ballasted single ply roofs are not acceptable

NCSU Roof Type Selection Matrix - Slope > 3:12		
Roof Type	Warranty	Comments
Metal	20 yrs	Sheet metal roofing shall be supported by a continuous structural deck. [Corrosion-resistant metals shall be specified for roofs having vents or fume hoods that emit acidic, caustic, and oxidizing agents of a corrosive nature].
Composite Slate	50 yrs	Slate shingles shall have an expected 75 year minimum life. Minimum slope for slate shingled roofs shall be 6:12. The contractor shall supply one (1) square of replacement slate shingles for future maintenance.
Asphalt Shingles	30 yrs	Asphalt shingles shall have a 30 year minimum warranty. Slope for shingled roofs shall be a minimum of 4:12. Shingles shall comply with the latest version of ASTM

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NCSU Roof Type Selection Matrix - Slope ≤ 3:12						
Application	HVAC Density	Roof Type	Insulation Type	Material Warranty	Installer's Warranty	Comments
High Traffic Lab	>15%	BUR	OSB/ISO OSB/XPS	30 yrs	2 yrs	
High Traffic	>15%	2-Ply Modified Bitumen	OSB/ISO OSB/XPS	20 yrs	2 yrs	
Med Traffic	<15%	Thermoplastic	ISO/XPS	15 yrs	2 yrs	Avoid use of highly reflective material where occupants would experience glare. Specified single-ply roofing systems must have been used in similar applications successfully for a minimum of five (5) years. Protection shall be provided to single-ply membranes subject to mechanical damage from dropped tools, equipment, or mechanical equipment covers. Protection shall also be provided in areas subject to chemical attack from lubricants or exhaust fan emissions per roofing manufacturer recommendations.
Low Traffic	<15%	EPDM 60 mil	ISO/XPS	10 yrs	2 yrs	Specified single-ply roofing systems must have been used in similar applications successfully for a minimum of five (5) years. Protection shall be provided to single-ply membranes subject to mechanical damage from dropped tools, equipment, or mechanical equipment covers. Protection shall also be provided in areas subject to chemical attack from lubricants or exhaust fan emissions per roofing manufacturer recommendations.

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- E. Rooftop equipment installations:
 - 1. Concrete pavers and splash blocks shall be specifically designed for rooftop use, of materials approved for use by roof system manufacturer.
 - 2. Roofs supporting towers greater than six (6) feet tall shall be protected from damage by falling ice.
 - 3. All roof equipment shall be mounted on curbs or raised support frames.
 - a) Curbs must extend eight (8) inches minimum high above the finished roof surface.
 - b) Support frames must maintain 18" min. clearance from the lowest point of the frame to the finished roof surface.
- F. Green Roof Systems shall include:
 - 1. Root barrier.
 - 2. Filter fabric.
 - 3. Modular tray system.
 - 4. Intensive type systems (less than eight inches soil depth).
 - 5. Pre-engineered growth medium (80% Lightweight - 20% organic).
 - 6. Plants specifically based on geographical location (drought tolerant).
- G. PV (Photovoltaic)/Solar Panel installations shall:
 - 1. Be installed on roofs less than five (5) years old.
 - 2. Maintain a 12 inch minimum lateral clearance from any parapet, rooftop equipment, or penetration.
 - 3. Require panels to attach to top of sleepers (curbs) at a minimum of 12 inches o.c.
 - 4. Maintain 48 inch clearance between adjacent curbs.
 - 5. Use post and beam support construction:
 - a) Vertical members at a minimum of 48 inches o.c.
 - b) Horizontal members with a minimum of 18 inch clearance above membrane.
- H. Flashing and Trim
 - 1. Provide flashing for all roof drains and scuppers.
 - 2. Gutters, down spouts, and all other exposed metal work shall be specified for durability and resistance to corrosion. Sixteen/twenty-ounce copper, lead-coated copper, and Kynar-coated 24 gauge galvanized steel are acceptable.

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- I. Other Design Criteria
 1. Designer shall ensure that structure can support roof system and that the roof is compatible with all building systems. All components of the roof system shall be adequately supported and detailed.
 2. Designer shall utilize reflective roofing systems when possible.
 3. Wood blocking must be pressure treated. Treated wood shall not be left exposed.
 4. In roof replacement, all existing wood blocking and other edge securement materials' anchorage strength must comply with roof manufacturer's requirements.
 5. A vapor retarder below the roof insulation shall be used where the indoor relative humidity during winter months exceeds 45%.
 6. Flood testing of completed roofing systems is required. NC State shall be notified seven (7) days in advance of testing.
 7. Roof drain placement shall be symmetrical and no greater than 40 feet apart. Interior roof drains shall be accessible with interior cleanouts. Any horizontal leg of an internal roof drain must be insulated.

- J. Warranty
 1. The designer shall require a contractor warranty of at least two (2) years. The warranty shall cover all materials (insulation, roof membrane, flashings, sheet metal, sealants, etc.), and workmanship to maintain the roofing system and flashings watertight and weathertight, effective from the date of substantial completion. Contractor must be on site within twenty-four hours to make necessary leakage repairs.
 2. The roofing system manufacturer must provide a 10-year minimum roofing system watertight warranty. A separate, extended membrane weathering 20 year warranty shall be included.
 3. Work on existing roofs shall preserve any existing roof warranties.
 4. Warrantor shall define a leak as water or moisture entering the building or the roof system.
 5. Warrantor shall state that observations of blisters, soft insulation, and thermal anomalies etc. at the roof shall be considered sufficient evidence of a leak, with repairs within the first two (2) years covered under the workmanship warranty.

- K. Waterproofing
 1. Composite sheet waterproofing shall be placed under concrete topping in habitually wet areas.

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2. Flashing shall be provided in the following locations:
 - a) Openings in laboratory and kitchen floors. Sleeves shall also be provided at all locations.
 - b) Floor drains.
 - c) Flashing pans under all showers.
 - d) Openings in exterior walls.
 3. All foundation walls and below grade walls shall be waterproofed with a minimum of three layers bituminous waterproofing and a layer of protection board. Waterproofing shall be back-filled with clean, crushed stone. A continuous drainage tile shall be provided to the foundation drains.
- L. Building Insulation thermal calculations must include the use of Aged R-Values