

070000 ROOFING

Cornell's Design and Construction Standards provide mandatory design constraints and acceptable or required products for all construction at Cornell University. These standards are provided to aid the design professional in the development of contract documents and are not intended to be used verbatim as a contract specification nor replace the work and best judgement of the design professional. Any deviation from the Design and Construction standards shall only be permitted with approval of the University Engineer.

PART 1: GENERAL

1.01 REFERENCES

- A. National Roofing Contractors Association (NRCA) Roofing Manuals
- B. Sheet Metal and Air Conditioning Contractors National Association (SMACCN): Architectural Sheet Metal Manual - Latest Edition
- C. Revere Copper Products Inc. Copper & Common Sense
- D. ANSI SPRI-Wind Design Standard Practice for Roofing Assembly's ANSI/SPRI WD1
- E. Cornell Design and Construction Standard 072500 - Guide for Evaluating Water Leakage of Building Walls (ASTM E2128)
- F. FM Global Standards
- G. Cornell Design and Construction Standard Detail 8.1.4 - Counter Flashing Receiver

1.02 GENERAL GUIDELINES

- A. This document provides design standards only; it is not intended for use as a specification. Do not copy this information into specifications or in notes on drawings. Request for variance, questions and comments regarding this document shall be directed to Cornell University's Facilities Engineering, Roof Asset Management (RAM) Program.
- B. Under no circumstance are more than two (2) layers of roof systems allowed.
- C. Re-covering roofing is highly discouraged and will only be permitted when it is to apply a temporary layover protection for extraordinary water infiltration conditions. Exceptions will only be considered if the conditions meet New York State Building Code *R907.3* 'Re-covering versus replacement'.

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- D. When re-covering roofing is considered, the design professional must verify the structural and loading capacities before application.
- E. Protection will be required for all new and existing roofing during project work. The level and type of protection as well as materials must be identified in the project documents by the design professional.
- F. The roofer and sheet metal workers shall install all roofing flashings, insulation, and sheet metal work required to make a complete waterproof installation. Contractors may provide certain counter flashings and similar materials, but the roofer will be responsible for their proper installation.

1.03 FIXED EQUIPMENT INVENTORY

- A. Fixed Equipment Inventory is required on all roofing projects, regardless of size and scope of work.
- B. Cornell University RAM (Roof Asset Management) will provide Designers and Contractors panel diagrams for each existing building.
- C. Contractors will be required to complete a Roof System Inventory Data Loader, identifying individual roofing panels with its unique identifier and the work done. This has been described in the General Requirements: Section 017822 of Cornell’s Contracts. General Requirements are not part of a roof project contract and the Owner will supply this to the Contractor directly.
- D. Designers will be required to reference unique identifiers on project documents, identifying any panel impacted by the work.

1.04 LIFE CYCLE COST ANALYSIS (LCCA)

- A. Cornell University has a long tradition of designing and constructing high quality buildings. Continuing this tradition, Facilities Engineering seeks to ensure that all buildings meet student, faculty and staff needs as efficiently and cost effectively as possible. Cost effectiveness of a design is therefore a key component and Life Cycle Cost Analysis (LCCA) is a design process for evaluating and controlling the initial and future cost of building ownership. Life Cycle Cost Analysis (LCCA) is defined by the National Institute of Standards and Technology (NIST) Handbook 135 as the total discounted dollar cost of owning, operating, maintaining, and disposing of a building or building system over a period of time. NIST Handbook 135 is available at www.bfrl.nist.gov/oa/publications/handbooks/135.html
- B. LCCA is based on the premise that multiple building design options can meet programmatic needs and achieve acceptable performance, and that these options have differing initial costs, operating costs, maintenance costs, as well as different life cycle costs. By comparing the life cycle costs, LCCA can show the trade-offs between low initial first cost and long-term cost savings. Thus, the most cost-effective system for a given use can be identified, and the length of

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time it will take to “pay back” the incremental cost for this system can also be determined. In keeping with the system’s sustainability practices, LCCA can identify environmentally desirable solutions. Careful design choices that result in efficient use of energy, water and other resources often yield long-term cost savings. In addition, should environmentally friendly choices not save money over time, LCCA may reveal that their additional cost over time is minimal. These guidelines define the LCCA process, and establish the standards and metrics to ensure accurate and consistent life cycle data collection and evaluation across projects.

- C. During the Schematic Design (SD) and Design Development (DD) phases of a project, the Architect/Engineer (A/E) is required to perform a minimum of three (3) LCCA comparative analysis from several roofing systems. Each LCCA comparative analysis can have up to four (4), or more, alternatives (one base case plus three alternate cases).

1.05 SPECIAL DOCUMENTATION REQUIREMENTS

- A. Drawings, roof plans, sections, and details shall fully depict the extent of work and methods of construction. Shop drawings shall be used only for verification that the A/E's intentions are understood and are not to relieve the A/E from any design responsibility.
- B. Specifications for the roof system manufacturers and materials shall be non-proprietary, unless specifically approved by the University.
- C. Specifications shall not be performance based, and shall provide three (3) acceptable manufacturers, unless fewer are approved by the University, and shall provide specific and comparable products, by name, for each specified manufacturer.
- D. Single-source specifications with provisions for "or equals" are not acceptable unless authorized in writing by the University.
- E. Since several manufacturers are to be specified, and the manufacturer’s "typical" details may vary, it is the responsibility of the A/E to select the construction judged to be in the best interest of the University, and provide construction documents that reflect construction as the minimum acceptable project standard.
- F. Details shall be project specific.

PART 2: SYSTEM REQUIREMENTS

2.01 SHINGLES AND STEEP SLOPE ROOFING

- A. Steep-slope roof systems shall not be less than 4:12 pitch.
- B. Nails used for slate or clay tile roofs shall be copper and long enough to conform to the requirements of the NRCA Steep Slope Roofing Manual.

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- C. All other nails shall be standard barbed or die-formed shank shingle nail of hot-dipped zinc-coated steel. Minimum 3/8-inch diameter round head and 10 to 12 gage shank, length sufficient to penetrate through the wood deck. Staples are not acceptable.
- D. Eave, valley, rake and ridge protection shall be a minimum 40-mil self-adhering protection in the form of self-adhering sheets of rubberized asphalt bonded to polyethylene or modified asphalt reinforced with fiberglass: minimum 40-mil total thickness is required on all sloped roofs.
- E. Eave, valley, rake and ridge protection shall be provided at all eaves, valleys, hips, rakes and ridges, and intersections with vertical surfaces. Surfaces such as chimneys and dormers shall have ice dam protection along low eave, extending up slope to a point a minimum of 36 inches from the inside of the exterior wall line of the building. It is also required around openings for skylights.
- F. Design Team shall consider target patches for all penetrations.

2.02 ASPHALT SHINGLES

- A. Shingles shall be hand nailed and set to the proper depth.
- B. Shingles shall have a minimum Twenty (25) Year Unlimited Warranty and a Thirty Five (35) Year Unlimited Warranty is preferred.
- C. Underlayment shall be a minimum 40-mil self-adhering high temperature underlayment from roof edge, continues to 36 inches from the inside of the exterior wall line of the building. Including a full covering of 30 lbs. felt paper or synthetic underlayment. Use of staples is prohibited.

2.03 SLATE SHINGLES

- A. Slates shingles shall be natural slate, artificial slate shingles are prohibited.
- B. A minimum 40-mil self-adhering high temperature guard-type. Use of sanded or granulated is prohibited. Underlayment shall be a minimum of one layer of 30lbs. felt or synthetic underlayment.
- C. Slate shingle installation shall conform to the National Roofing Contractors Association (NRCA) Steep Roofing Manual recommendations. Sheet metal shingle flashing installation for slate shingles shall conform to the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACCNA) Architectural Sheet Metal Manual recommendations.
- D. Since slate shingles do not come with standard manufacturer’s guarantees as is typical for low-slope and some other types of steep-slope roof systems, the documents are to include provisions for a Contractor’s Five Year Water Tight Guarantee on all roofing and related work, including all sheet metal flashing and trim associated with the roof installation. This guarantee will be in addition to any other guarantees required by Contract.

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- E. The project manual shall include a roofing-specific Guarantee Document, and will be executed by the Contractor and submitted to Cornell at project completion.

2.04 CLAY ROOFING TILES

- A. Tiles shall be clay only. Underlayment shall be a minimum 40-mil self-adhering high temperature underlayment, with coverage based on structural assembly’s permeability requirements. Sanded or granulated is not acceptable.
- B. The roofing tile installation shall conform to the National Roofing Contractors Association (NRCA) Steep Roofing Manual recommendations.
- C. Sheet metal shingle flashing installation for clay tile installation shall conform to the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACCN) Architectural Sheet Metal Manual Recommendations.

2.05 PREFORMED ROOFING AND SIDING PANELS

- A. Design Team shall review preformed roofing underlayment. Use of #15 and #30 is prohibited.
- B. Acceptable types of preformed roofing and siding materials and finishes are metal materials with a natural finish, anodized finish or Kynar AAMA 2604/2605 High Quality Finish.
- C. Finish materials and colors for roof structures and rooftop equipment screens are subject to the approval of the University Architect.

2.06 MEMBRANE ROOFING

- A. Roof decks must be built with a slope of at least 1/4 in. per ft. for new construction toward a minimum 4’x 4’ drain sumps.
- B. Dead level roofs are prohibited.
- C. Ensure that drains are at low points of roofed area and drains have been flow tested prior to installation of new roof. All drain baskets must be steel or cast iron. Use of plastic is prohibited.
- D. Install crickets or saddles to divert water flow around curbs to avoid interference with designed drainage system. Crickets or saddles shall be installed behind curbs with a dimension of 24 inches or greater, measured perpendicular to the slope of the roof.
- E. Re-roofing projects will require individual assessment for design to provide adequate drainage slope. 1/8 inch slope is desired.
- F. Single ply ballasted and IRMA roofs are prohibited.

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- G. At all locations where a membrane roof terminates, such as an adjacent wall, parapet, coping, chimney, equipment curb, etc., flashing and counter flashing shall be designed to facilitate the replacement of the membrane with a 2-piece detail. Refer to Cornell Standard Detail 8.1.4 – Counter Flashing Receiver. Bending up and pinning the regleted counter flashing is prohibited.
- H. Provide manufactures recommended walkway pads from roof access points to and around all mechanical equipment.
- I. Flashing shall be designed so that at the time the membrane requires replacement, it is possible to achieve watertight integrity equivalent to that of the original construction without having to:
 - 1. Remove major building elements
 - 2. Disturb adjacent materials and systems
 - 3. Involve trades other than roofers and sheet metal workers

2.07 MODIFIED BITUMEN SHEET ROOFING

- A. Systems composed of at least two plies, one of which can be a heavy base sheet, are preferred. Mineral (granule) surface weathering is preferred.
- B. Torch/hot applied systems must comply with CERTA open flame protection requirements.
- C. At all locations where a membrane roof terminates, such as an adjacent wall, parapet, coping, chimney, equipment curb, etc., flashing and counter flashing shall be designed to facilitate the replacement of the membrane with a 2-piece detail. Refer to Cornell Standard Detail 8.1.4 – Counter Flashing Receiver. Bending up and pinning the reglet counter flashing is prohibited.
- D. Flashing shall be designed so that at the time the membrane requires replacement it is possible to achieve watertight integrity equivalent to that of the original construction without having to:
 - 1. Remove major building elements
 - 2. Disturb adjacent materials and systems
 - 3. Involve trades other than roofers and sheet metal workers

2.08 THERMO-PLASTIC MEMBRANES

- A. A robot shall be used to weld as many seams as possible.
- B. 110-120-volt/15-amp robots are prohibited.
- C. Robot welders must use a generator. A minimum 10,000-watt generator is required with a 220-volt/30-amp plug with the use of 10/3-gauge extension cord 100 feet or less in length.
- D. Contractors shall take a test weld sample every 200-400 feet for seam welding. The sample must be marked with the time, date, ambient condition, and location.

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- E. Robot operators shall mark all stop and start areas on the membrane to ensure that the seam area is properly detailed and finished.
- F. Material rolled out and put in place shall be welded the same day, includes welding of any detail work.
- G. All seams shall be probed.
- H. Hand welding shall consist of a two-pass weld.
- I. At all locations where a membrane roof terminates, such as an adjacent wall, parapet, coping, chimney, equipment curb, etc., flashing and counter flashing shall be designed to facilitate the replacement of the membrane with a 2-piece detail. Refer to Cornell Standard Detail 8.1.4 – Counter Flashing Receiver. Bending up and pinning the reglet counter flashing is prohibited.
- J. Flashing shall be designed so that at the time the membrane requires replacement, it is possible to achieve watertight integrity equivalent to that of the original construction without having to:
 - 1. Remove major building elements
 - 2. Disturb adjacent materials and systems
 - 3. Involve trades other than roofers and sheet metal workers
- K. Cornell requires clean white rags for cleaning membrane.
- L. Provide manufactures recommended walkway pads from roof access points to and around all mechanical equipment.

2.09 INSULATION

- A. Insulation must meet New York State Energy Codes.
- B. Roof deck insulation, including cant strips and tapered edge strips shall be non-hygroscopic. Hygroscopic materials are prohibited in any part of the roof system.
- C. Daily installation of roof insulation materials shall be limited to that amount which can be covered with the roofing membrane prior to the end of the day or prior to the onset of inclement weather.
- D. Anchor roof insulation in accordance with manufacturer’s recommendations for fastener type, size, placement, and density. Installation shall comply with Factory Mutual project specific requirements for rating against uplift.
- E. Insulation protection shall be a minimum of 1/2-inch hardboard/cover board and installed over all insulation.

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2.10 FLASHING AND SHEET METAL

- A. Fabrication and installation must conform to the latest edition of the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACCNA) Architectural Sheet Metal Manual Recommendations. Copper, when used, to conform to SMACCNA and to the latest edition of Revere Copper Products, Inc. Copper & Common Sense recommendations.
- B. The National Roofing Contractors Association (NRCA) provides metal roof system detailing and enhancement recommendations in the NRCA Roofing and Waterproofing Manual Latest Edition. The A/E must utilize the Manual for the design and specification of all metal roof systems, including incorporation of all recommended details and enhancements. The A/E should note that NRCA’s recommended details might differ from many metal roof systems manufacturer’s standard details. During the design phase, it is the responsibility of the A/E to detail in accordance with NRCA recommendations and bring any standard detailing differences to the attention of the manufacturer prior to listing the manufacturer in the specifications. Any problems with a manufacturer’s unwillingness to accept and guarantee details designed in accordance with NRCA recommendations must be brought to the attention of the University, Facilities Engineering.
- C. Metal roof panels vary in configuration, including seam style and height, pan stiffening (i.e. ribs, striations, etc.) and metal type (i.e. aluminum, galvanized or galvalume coated steel) and metal thickness. During the design phase, it is the responsibility of the A/E to confirm that potential metal roof panels can be installed in accordance with the details developed using NRCA recommendations. As an example, if details require a panel end to be “hemmed”, the A/E may need to request a “hemmed” panel sample from the manufacturer, confirming that the potential panel profile can be “hemmed” without detrimental effect to the panel and/or is aesthetically acceptable.
- D. Valleys are to be open, with “w-style” metal flashing and tapered. All valleys should have a minimum 40-mil high temperature membrane installed, covered with rosin paper, before installation of the metal valley flashing. Closed valleys should be avoided unless required due to historic considerations, in which case the closed valley should utilize stepped metal flashing, not continuous metal flashing.
- E. Metal crickets shall be used on the up-slope side of all chimneys and curbs.
- F. Call for end dams at flashing terminations and identify end dams locations on the drawings.
- G. Flat seam soldered aprons/panels shall not exceed the maximum size of the SMACCNA standard.
- H. Achieve 8-inch minimum flashing heights whenever possible.

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2.11 ROOF / WALL SPECIALTIES AND ACCESSORIES

- A. Gutters and downspouts shall be copper, stainless steel, baked enamel steel or aluminum. No galvanized steel.
- B. Fascia and gravel stops shall be aluminum, copper, stainless steel, or Kynar coated steel only.

PART 3: EXECUTION

3.01 OBSERVATION OF INSTALLATION BY UNIVERSITY PERSONNEL

- A. The University shall be given 2 weeks advance notice of intent to start installation of roofing materials.
- B. Designated University personnel must be permitted to perform a pre-installation inspection of roofing materials and equipment, to be present throughout roofing installation to observe installation techniques for compliance with specifications and to participate in final inspection with manufacturer rep.
- C. Questionable installations will be brought to the attention of the A/E who shall take immediate action to correct any deficiencies in materials or installation. Failure of Cornell’s personnel to call attention to deficiencies shall not relieve the Contractor of responsibilities stipulated in the Maintenance Guarantee.
- D. Provide manufacturer’s recommended walkway pads from roof access points to and around all mechanical equipment.
- E. All roof leaks during the roof installation shall be documented and brought to the attention of the Roof Asset Manager (RAM), listing the cause and how it was repaired.
- F. Cornell University requires a broom-cleaned surface prior to final inspection and a washed down surface if necessary.

3.02 CUTTING OF TEST PANELS

- A. The University reserves the right to cut test panels from the finished roof in order to determine that minimum requirements have been met.
- B. The roofer shall repair, at his own expense, the roof where test panels were taken.

3.03 WET MATERIALS

- A. Roofing insulation that becomes wet before or after installation shall be removed and replaced. Wet materials shall not be dried and reused.

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- B. Wet membrane materials must be thoroughly evaluated to determine the effect on adhesion, lap seals or blister potential. Remove any such material if there is any possibility of failure.

3.04 LIGHTNING PROTECTION

- A. All lightning protection systems shall be designed and installed per NFPA 780 and UL 96A. All installations shall be inspected and require a UL Lightning Protection Master Label Certificate.

3.05 CLEAN UP

- A. Debris must not accumulate on roof during construction. All debris shall be completely removed at the completion of the project.

PART 4: WARRANTY

4.01 ROOFING AND FLASHING

- A. Warrantees on roofing shall include the unique identification number that correlates with the Fixed Equipment Inventory and must clearly identify the location of the warranted work.
- B. The manufacturer(s) of materials used shall furnish a written twenty five (25) year no dollar limit (NDL) warranty or greater on the complete roof installation. Submit the warranty in triplicate. The manufacturer shall include the University’s roof panel unique identifier numbers on the warranty (Provided by the Roof Asset Manager). The Warranty shall begin when the project is complete and accepted by the University.
- C. The General Contractor and the Roofing Subcontractor shall furnish a two (2) Year Maintenance Warranty on the total roofing system. The warranty shall cover, at no cost to the University, all labor and materials required to repair or replace roofing, flashings, sheet metal and copings as necessary to fully correct leaks, faulty workmanship or defective materials.

4.02 GREEN ROOF

- A. Manufacturer’s single-source written Twenty Five Year Warranty on the full green roof assembly. This should include the removal and replacement of all overburden associated with the system. Submit the warranty in triplicate.
- B. The warranty shall begin when the project is complete and accepted by the University.

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4.03 SEALANTS

- A. Provide written guarantee that the sealant manufacturer, General Contractor and sealant installer jointly guarantee to replace, at no cost to the University, any or all joints which fail to establish and maintain airtight and watertight continuous sealed joints without staining or deteriorating joint substrates within.
- B. Twenty (20) Years after acceptance for silicone building sealants.
- C. Five (5) Year Guarantee is acceptable when the Twenty (20) Year Guarantee would add additional project costs. In either case, require that adhesion pull tests be performed.
- D. Two and one half (2 ½) Years after acceptance for polyurethane sealant.

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