

ARCHITECT/ENGINEER'S
ROOF DESIGN GUIDELINES

MISSOURI DIVISION OF FACILITIES MANAGEMENT,
DESIGN AND CONSTRUCTION

DESIGN GUIDELINES

- A. **GENERAL INFORMATION:** The following information is intended to help avoid common roof problems and to help determine which type of roof to select in a new construction or re-roofing project. This information is based on previous Division experience, and current trends in the roofing industry.
1. No asbestos containing materials shall be allowed. Specifically caution about use of asbestos mastics and primers that are still available today.
 2. All design details shall be consistent with the *Current NRCA Roofing and Waterproofing Manual*. Minimize penetrations in roofs, remove any non-used vents, ducts, skylights, space penetrations no closer than 24 inches apart, extend flashings a minimum of 12 inches above any overflow or drain, use factory made penetrations if possible, do not use galvanized material for flashings. Use a termination bar and counter-flashing at parapet walls, or if the parapet is short or not watertight, extend membrane over the top of the wall and attach to front face behind cap. Corner caps and allowance for expansion and contraction in metal flashings is required. Umbrellas or hoods over all pipe flashings for equipment and over pitch pockets are required. Conduit and small pipe penetrations must be made through the side of metal flashings with proper sealants or with specifically designed conduit flashings.
 3. Provide walkways to all rooftop equipment. Avoid interior gutter installations. Use two-piece, cast iron, interior drains. Use pipe or tubes for equipment stands. Place all equipment a minimum of 24 inches above roof deck for future re-roofing.
 4. For Single-Ply systems or Modified Bitumen roofs, interior roof drains and parapet walls with scuppers, are preferable. Avoid the use of gravel guards. If structural system is flat, locate drains at mid points between columns.
 5. Insulation system shall be compatible with the application and warranty specified. Roofing manufacturer must approve the insulation system required for roofing warranty.
 6. Comply with ASHRAE 90.1 energy requirements. A vapor barrier below the primary insulation is required over shower houses, swimming pools, boiler rooms, or any other area subject to high humidity conditions. A worksheet to locate critical temperatures should be utilized for vapor barrier review.
 7. A full Labor and Material System Warranty (weather tightness) signed by both the installer and the manufacturer is required (see required language below).
 8. Roof details must provide minimum flashing heights required for curbs, walls, parapets, etc. Determine if non-tapered insulation will require raising units, parapets, etc. Sheet metal, flashings, roof composite construction, parapets, terminations, expansion joints, and penetrations shall be designed according to the *Current NRCA Roofing and Waterproofing Manual* details and specifications unless approved by Director.
 9. All new and re-roof projects shall be designed for FM 1A-90 ratings or greater depending on the required design criteria such as building height and wind zone.
 10. No roofing or re-roofing project is to begin from November 1 through March 1, without specific approval from Deputy Director. Include this language in Supplementary General Conditions and allow time in schedule if necessary.
 11. Designer shall complete "Roofing Description Form" and submit with Final design documents. Specifications shall require roof contractor to provide a 12 inch by 12 inch sample of roof membrane (single-ply or modified-bitumen) from actual material used in project, along with a copy of the manufacturer's roof warranty to FMDC Construction Administrator for forwarding to roof group.
 12. Designer shall investigate and recommend vapor retarder requirements for both new and reroof assemblies. A dew-point analysis shall support his recommendation.
 13. The designer shall provide core sampling data for roof demolition requirements which shall include all components and thickness of existing roof assembly. This may coincided with the required hazardous material sapling for all reroof projects.

A minimum of 2 samples for any distinct roof area (level) is required. Visible (photograph) confirmation of decking material is required.

- B. **PRODUCTS - NEW CONSTRUCTION:** The type of roof to be used in new construction varies greatly with the type of construction and the intended use. The following are some examples of types and uses.

1. Shingle Roof: Used primarily on wood frame construction, requires plywood and felt back-up.
 - a. Shingles should be 30 year, Class A Fire Resistance, asphalt type. Shingles should be seal-tab architectural type. Roof slopes of 4:12 or greater are required.
2. Metal Systems: All metal roofing systems shall carry a minimum of a 20 year System warranty. This warranty shall include all flashings, curbs, pipe flashings, and penetrations. All metal roofs must have a Factory Mutual 1A-90. Metal roofs will be Structural Standing Seam or Architectural systems. Machine seaming with a factory sealant in sidelaps is required of all Structural and Architectural roofs. No on-site panel fabrication is allowed.
 - a. Structural standing seam roofs are preferred. A variation of the structural standing seam panels can be found in the composite roofs that consist of an inside metal deck, a vapor barrier, rigid thermal insulation and the standing seam roof material. Standing Seam roofs shall be a double-lock, roll-formed seam at least 2 1/2" high. Minimum thickness shall be 24 gauge. Minimum slope should be 1/2 inch in 12 inches. All clips shall be concealed, and allow for expansion and contraction. All accessories shall be pre-manufactured and approved as part of roofing system. Curbs for roof penetrations shall be designed and built using manufacturer's approved details for the roofing system. Standard finish for low-profile applications shall be ALZN or galvalume. Painted finishes for high profile roofs shall have 20 year paint finish warranty.
 - b. Flat, architectural standing seam metal roofing systems may be used on roofs with slopes of 2 inches in 12 inches or greater only. Some of these systems need some type of deck for support, or will work over an existing deck, as well as a base felt for additional moisture protection. Many of these systems are attached with fixed cleats that do not allow for expansion or contraction. Limit panel lengths to 40 feet or less. Require the panel to be machine seamed with side lap sealant. The roof system must be attached to the substrate and vapor barrier approved by the manufacturer. Avoid vented ridge conditions if at all possible. The Division has had serious problems with vented ridge caps. Use fans and soffit vents if necessary. If the roof is to be installed with a vented air space, it must be demonstrated that the allowable roof systems (minimum of three) have a tested vented system.
3. Modified Bitumen: Modified Bitumen roofs should be installed with a minimum of 1/4 inch in 12 inch slope.
 - a. Modified Bitumen roofs shall be designed for a 20 year roof warranty. In most applications, we shall only request a 15 year warranty in the bidding documents. All MBS systems shall be specified to have a modified base sheet or a venting, modified base sheet; a minimum of two plies; plus a granular cap sheet. SBS Modified Bitumen systems should be used. An APP fully adhered, cold applied adhesive may also be used, no torching allowed.
 - b. A sample modified bitumen specification is included with this manual. Edit and use this specification unless specific approval is given to vary from

the enclosed specification.

4. **Built-up Roof:** Built-up roofing is not an approved roof system. The use of a built-up roof system shall be approved by the Deputy Director.
5. **Single-Ply Membrane Systems:** The State accepted single-ply systems are the EPDM, 60 mil, fully adhered roof, PVC, 60 mil reinforced, fully adhered roof or a TPO, 60 mil, fully adhered roof. Single-Ply roofs should be installed with a minimum of 1/4 inch in 12 inch slope. Use of any other system requires the approval of the Deputy Director.
 - a. Fully-adhered membranes should be a minimum of 60 mil material. A minimum 15 year warranty is required for EPDM, PVC and TPO roofs. The selected system shall be designed so that if the State desires to purchase a 20 year system warranty as an alternative to the 15 year system warranty it may do so without change to the design criteria.
 - b. A high density polyisocyanurate cover board is recommended for all single-ply systems.
6. **Other Systems:** Other roof systems such as slate, roofing tile, etc. may be used in special circumstances as approved by the Division and the Agency.

C. **RE-ROOF APPLICATIONS:** All of the above roof systems may have an application for re-roofing. The following items should be considered in any re-roofing application:

1. Do not re-roof a flat roof with another flat roof. Use tapered, polyisocyanurate insulation, metal slope build-up, or other appropriate system to obtain minimum slopes for new construction. Add additional roof drains or scuppers if necessary to avoid insulation thicknesses over 12 inches, if possible. Remove any unused or unneeded roof structure or penetrations.
2. Unless otherwise approved by the Division, do not re-roof over an existing roof. Re-roofing over an existing roof could cause serious problems with trapped moisture in the existing roof. It could also be a violation of Code. A complete tear-off is required unless approved by the Division and the Agency.
3. Replace deteriorated flashings, counter flashings, gutters, downspouts, etc. with material warranted for the same duration or greater as the roof warranty.
4. Add insulation to roof system per ASHRAE 90.1 but no less than a U Value of .05. Provide calculations with design submittal or review documents.
5. Consider the addition of a roof hatch and ladder for access to roof if none exists.
6. Drains, curbs, and equipment shall be raised or lowered to proper levels. Steep slopes to drains are not allowed.

D. **FIELD QUALITY CONTROL:** Arrange for a final roof system inspection through the roofing system manufacturer's technical personnel in order to inspect the roof system upon completion. Repair or remove and replace components of membrane roofing system where inspections indicates that they do not comply with specified requirements. Defective or non-confirming conditions defined as follows, unless more stringent criteria required by roofing system manufacturer:

1. **Blister, Bubble, Capillaries or Voids:** A spongy raised portion of roofing membrane resulting from improper surface preparation, pressure of entrapped air, entrapped water vapor, inadequate adhesive, adhesive bonding failure, improper attachment method, or resulting from climatic installation conditions. Such conditions shall not exceed Four (4) inches in individual diameter, multiple occurrences be spaced less than Forty Eight (48) inches on center, or multiple

occurrences exceeding Sixteen (16) square inches within One Hundred Forty Four (144) square feet of surface area.

2. Fishmouth: Opening or void in lapped edge or seam.
3. Punctures or Holes: Condition compromising system watertight effectiveness.
4. Seam or Joint Separation: Unbonded edge condition where probing tool penetrates lapped area under firm pressure.
5. Slope, Drainage, or Ponding (Standing Water): Criteria for judging proper slope for drainage is no ponding water on roof surface Forty-Eight (48) hours after precipitation event during conditions conducive to drying.
6. Wrinkles or Distortions: Surface condition that impede the proper flow of water drainage. Insulation and/or Cover Board Joints: Butt joints exceeding 1/4" wide or uneven surfaces exceeding 1/4" vertical measured in transition plane.
7. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements

E. **WARRANTIES:** The state of Missouri is prohibited from entering into binding arbitration. No warranty shall be accepted with any arbitration clause.

1. Low Profile Modified Bitumen, TPO, PVC and EPDM Roofs: The following language is required for all low profile roof warranties.
 - a. The roofing manufacturer shall provide written confirmation, submitted with shop drawings, that: "All roofing components exclusive of the deck, contained in the system proposed are approved, and compatible with the warranty requirements of the roof system as specified, and that the warranty specified will be issued at completion of project if system is installed as designed.
 - b. A fifteen year SYSTEM warranty shall be provided for EPDM, TPO, PVC or Modified Bitumen roofs. In addition, all insulation, flashings and penetrations shall be included within this warranty.
 - c. Warranty shall be executed by both the system manufacturer and the roofing contractor.
 - d. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering roofing insulation, fasteners, vapor retarders, membrane roofing, base flashing, penetrations, curbs, accessories, etc., if any, for the following warranty period: 2 years from date of Substantial Completion. (See attached format)
 - e. Special Warranty Language: The liability of the Surety under the installer warranty provisions of this contract is limited to correcting defective workmanship and materials for a period of two years from the Substantial Completion date of the project. Any warranty beyond this two years is an agreement between the Owner and the Contractor and falls outside the performance bond obligation.
2. Metal Structural and Architectural Systems: All metal roofing systems shall carry a minimum of a 20 year system warranty. Warranty shall cover all roof curbs, pipe jacks, roof transitions and any other roof penetrations. Painted panels and their finishes shall carry a 20 year material, Extended-Life Endorsement if it is not a part of the SYSTEM warranty. Warranty shall be executed by both the system

manufacturer and the roofing contractor. Specifications shall require roofing contractor to guarantee complete installation and any area of work not covered by roof system warranty for 2 years.

Also specify that: Roofing installer must be a certified installer by the roof manufacturer, with the certified installer on the job while the roof is being installed. Roof installer must have 5 years minimum experience installing metal roofs.

ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <NAME> of <ADDRESS>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
1. Owner:
 2. Address:
 3. Building Name/Type:
 4. Address:
 5. Area of Work:
 6. Acceptance Date:
 7. Warranty Period:
 8. Expiration Date:
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning,
 - b. peak gust wind speed exceeding 72 mph,
 - c. fire,
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition,
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work,
 - f. vapor condensation on bottom of roofing and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and

until cost and expense thereof has been paid by Owner or by another responsible party so designated.

3. The Roofing Installer is responsible for damage to work covered by this Warranty
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void, unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. The Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
6. This Warranty is recognized to be the installation warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents and to coordinate the Manufacturer's warranty, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this<DAY>day of <MONTH>, 20<YEAR>.

1. Authorized Signature:
2. Name:
3. Title:

END OF SECTION

ADDITIONAL PROJECT REQUIREMENTS

In addition to the Design Guidelines, the following is a list of items that must be included in any roof project.

1. A/E shall as a minimum, indicate on roof plans the following:
 - Basic roof lay-out showing all roof top units, drains, accessories, and penetrations. All roof edge conditions.
 - All applicable flashing conditions, including new curb details as necessary.
 - All adjoining walls or stepped roof areas.
 - Expansion joints and vapor barriers.
 - Insulation lay-out including thickness, crickets if applicable, and slope.
 - Height of new roof surface at every roof-top curb or penetration and details to raise accessory if necessary.
2. A/E shall list in the acceptable products division of the specifications each manufacturer's specific system that is an acceptable alternate system to the one proposed.
3. The *Substitution Request* form shall be included in project manual and any substitution of a roof system other than those specified must be approved at least 10 days in advance of bid date. A copy of this form is enclosed.
4. Specify that Night-Seals or Cut-Offs used shall flash all of roof system down to the deck to prevent water penetration into the new roof.
5. Project A/E shall use the standard roof symbols on all drawings and details per current *NRCA Roofing and Waterproofing Manual*.

PROJECT MANAGER/DESIGNER CHECKLIST

For

ROOF PROJECTS

- | | | | |
|----|---|--------|-------|
| 1. | Have Design Standards been reviewed and incorporated in design? | _____ | _____ |
| | | yes | no |
| 2. | Are design details consistent with, or designed from current <i>NRCA Roofing and Waterproofing Manual</i> ? | _____ | _____ |
| | | yes | no |
| 3. | Has the facility been visited and roof dimensions and accessories adequately verified? | _____ | _____ |
| | | yes | no |
| 4. | Has a vapor barrier calculation been completed? | _____ | _____ |
| | | yes | no |
| 5. | Is the roof warranty a full “system” warranty including the roof manufacturer and contractor? | _____ | _____ |
| | | yes | no |
| 6. | Has a roof core been taken to determine composition of existing roof insulation and deck? Has roof been checked for asbestos? | _____ | _____ |
| | | yes | no |
| 7. | What is minimum slope designed into project? | _____ | |
| | | in/ft. | |
| 8. | Is the new roof and insulation system in compliance with ASHRAE 90.1? | _____ | _____ |
| | | yes | no |
| 9. | What is the average “U Value” for new roof? | _____ | |

SUPPLEMENTARY OR SPECIAL CONDITIONS

1. In addition to the Pre-Construction Conference required by the State of Missouri's, General Conditions; a Pre-Installation Conference shall be held no earlier than two weeks before the start of the roof work. This Conference shall not be scheduled until all submittals have been received and approved by the project A/E.
2. The submittals shall include as a minimum the following:
 - A complete schedule of all proposed work with a phasing plan indicating sequence of removal and replacement of roof. Show phasing on a roof plan defining each day's proposed work.
 - Manufacturer's approved, but project specific, installation details of roofing and flashings, including roof slopes and insulation lay-outs, penetration details, curbs, and accessories.
 - A "systems" letter from the manufacturer agreeing "That all roofing components exclusive of the deck, contained in the system proposed are approved and compatible with the warranty requirements of the roof system as specified, and that the warranty specified will be issued at completion of project if system is installed as designed.
 - Submit sample of proposed manufacturer's roof warranty.
 - A detail showing proposed Night Seal or Cut-Off flashing to be used at end of each day's work.
3. Roofing Contractor shall notify Construction Administrator when Manufacturer's final Warranty inspection is to occur. Furnish a copy of the warranty inspection report to Construction Administrator.
4. The Contractor must provide copies of all disposal receipts for any hazardous materials removed from roof.
5. The Contractor shall not remove any more roofs during the day than they can completely replace with new roofing materials including night seal-off and flashing of perimeter and accessories.