

ROOF DESIGN MANUAL

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**MISSOURI DIVISION OF
FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION**
(573) 526-6671

DESIGN GUIDELINES

07311 Shingles

07550 Modified Bituminous Roofing

07410 Manufactured Roof Panels (Metal)

07531 Single Ply Roofing

- 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 *2004 NRCA Roofing and Waterproofing Manual*. Minimize penetrations in roofs, 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. Primary slope for new roofs should be obtained through the structural system. **Minimum slope for all roofs is ¼' in 12" per IBC Code, 1507.11.1 for modified systems and 1507.12.1 for Thermoset roofs. This is a Design and Construction mandatory requirement. Specific approval must be obtained for anything less than ¼" in 12". Slope crickets at ½" in 12" minimum to maintain drainage. Taper insulation at edge flashings to avoid buildup which ponds water. Provide sumps (2' x 2') at all primary drains.**
 6. Insulation system shall be compatible with the application and warranty specified. Roofing manufacturer must approve the insulation system required for roofing warranty.
 7. Comply with ASHRAE 90.1 energy requirements with no less than an average U Value of .05 for the composite roofing system. 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.
 8. A full Labor and Material **System** Warranty (weathertightness) signed by both the installer and the manufacturer is required (see required language below).
 9. 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 *2004 NRCA Roofing and Waterproofing Manual* details and specifications unless approved by Director.
 10. **All new and re-roof projects shall be designed for UL 90 or FM 1-90 ratings and specifications shall specify a minimum wind speed warranty of 72 MPH.**
 11. No roofing or re-roofing project is to begin from November 1 through March 1, without specific approval from Manager, Project Management Unit. **Include this language in Supplementary General Conditions and allow time in schedule if necessary.**

12. 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 D&C Construction Administrator for forwarding to roof group.
- 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 UL Class 90 or Factory Mutual 1-90 wind uplift rating. 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, structural 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.
 - b. A sample modified bitumin 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 Director.
 5. **Single-Ply Membrane Systems:** The only two State accepted single-ply systems are the EPDM, 60 mil, fully adhered roof, or a 60 mil, TPO, 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 Director.

- a. Fully-adhered membranes should be a minimum of 60 mil material. A minimum 15 year warranty is required for EPDM and TPO roofs. **Splice tapes are required at all laps of EPDM membrane.** Mechanically attached or ballasted systems are not to be used.
 - b. Use a wood fiber cover board over polyisocyanurate insulation with fully adhered system. Mechanically fastened insulation is preferred.
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.**
3. Replace deteriorated flashings, counterflashings, 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. **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 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 or Modified Bitumin roofs. This warranty shall be for full replacement cost and shall be non-prorated. 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: **5 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 such as Butler's "Weathertight Gold" system warranty. Warranty shall cover all roof curbs, pipejacks, 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 **5 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.
 2. 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>, 19<YEAR>.























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

END OF SECTION-07552

07311
07410
07526
07530

ROOF SYMBOLS

ROOF LEGEND: ALL SIZES SHALL BE NOTED, EXCEPT WHEN NOT APPLICABLE. DESCRIPTION MAY BE REQUIRED.

 ATTENTION (OR REPAIR) REQUIRED	 ANTENNA, MAY VARY	O.b.s. DOWNSPOUT	 APPROX. PHOTO LOCATION & DIRECTION	 CHIMNEY	
 ROOF CORE	—EJ— EXPANSION JOINT	—AD— AREA DIVIDER	—G— GAS LINE	.25:12 EXAMPLE ROOF SLOPE	 SLOPE DIRECTION
 HOT VENT	 PONDED WATER	 CURB MOUNTED EQUIPMENT (FANS & VENTS)	—E— ELECTRICAL CONDUIT	 THROUGH WALL SCUPPER	 ROOF DRAIN
 VENT THROUGH ROOF	 TURBINE	 HATCH	 EXISTING ROOF PATCH	 O.S. OVERFLOW SCUPPER	 O.O. OVERFLOW DRAIN
 FAN	○ SOIL STACK	 RTU ROOF TOP UNIT, HVAC	 WALKWAY PADS	 LADDER	 PITCH POCKET

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 as enclosed in this manual and as listed 2004 *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 2004 *NRCA Roofing and Waterproofing Manual*?
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.