



Low Slope Roofing Systems
The University of Wisconsin Madison
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Built-up and polymer-modified bitumen
membrane roof systems

presented by

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Definitions

built-up roof (BUR): A continuous, semi-flexible roof membrane consisting of multiple plies of saturated felts, coated felts, fabrics or mats assembled in place with alternate layers of bitumen and surfaced with mineral aggregate, bituminous materials, a liquid-applied coating or a granule-surfaced cap sheet.



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Definitions – cont.

polymer-modified bitumen:

- (1) A bitumen modified by including one or more polymers (e.g., atactic polypropylene, styrene butadiene styrene);
- (2) Composite sheets consisting of polymer-modified bitumen often reinforced with various types of mats or films and sometimes surfaced with films, foils or mineral granules.



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Built-up roof (BUR) membrane

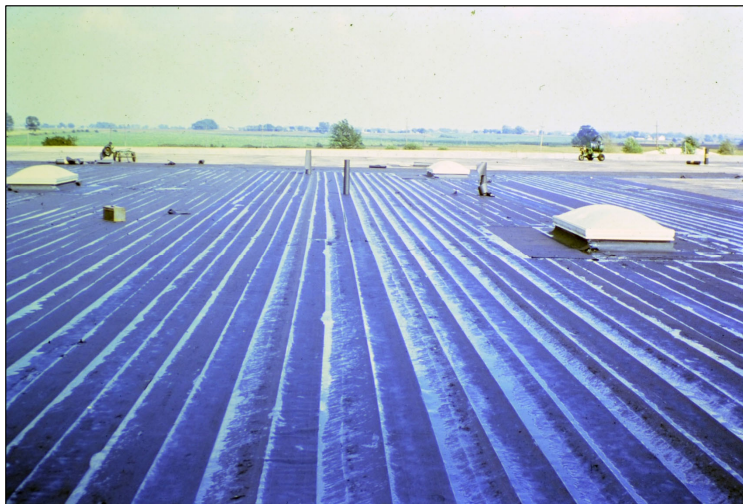


Photo credit: Structural Research, Inc.



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Polymer-modified bitumen membrane



Photo credit: Structural Research, Inc.



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Built-up roof membrane roof systems

- Components
- Terminology
- Ply configurations
- Surfacing
- Flashings
- Application
- Code compliance



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BUR components

- Ply sheet:
 - Organic: ASTM D226, Type I (No. 15) & II (No. 30)
 - Fiberglass: ASTM D2178, Type IV & VI
- Bitumen:
 - Asphalt: ASTM D312, Types, I, II, III & IV
 - SEBS-modified asphalt: ASTM D6152
 - Wax-modified asphalt: ASTM D8051
 - Coal tar: ASTM D450, Type I & II




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Designation: D312/D312M - 16a

Standard Specification for Asphalt Used in Roofing¹

This standard is issued under the final designation D312/D312M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript symbol (1) indicates an editorial change since the last revision or approval. This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope
 1.1 This specification covers four types of asphalt intended for use in built-up roof construction, construction of some

D140/D140M Practice for Sampling Asphalt Materials
 D1079 Terminology Relating to Roofing and Waterproofing
 D2042 Test Method for Solubility of Asphalt Materials in Trichloroethylene

TABLE 1 Physical Requirements of Asphalt in Roofing


Property	Type I		Type II		Type III		Type IV	
	Min	Max	Min	Max	Min	Max	Min	Max
Softening point, °C [°F]	57 [135]	66 [151]	70 [158]	80 [176]	85 [185]	96 [205]	99 [210]	107 [225]
Flash point, °C [°F]	302 [575]	...	302 [575]	...	302 [575]	...	302 [575]	...
Penetration, units:								
at 0°C [32°F]	3	...	6	...	6	...	6	...
at 25°C [77°F]	18	60	18	40	15	35	12	25
at 46°C [115°F]	90	180	...	100	...	90	...	75
Ductility at 25°C [77°F], cm	10.0	...	3.0	...	2.5	...	1.5	...
Solubility, %	99	...	99	...	99	...	99	...
EVT, °C [°F]								
At 125 cPs						221 [430]		235 [455]
At 75 cPs						243 [470]		252 [485]

D113 Test Method for Decidity of Bituminous Materials (Withdrawn 2016)
 This specification is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.03 on Surfacing and Bituminous Materials for Membrane Waterproofing and Built-up Roofing. Current edition approved Dec. 15, 2016. Published December 2016. Originally approved in 1979. Last previous edition approved in 2016 as D312/D312M - 16a. DOI: 10.1520/D312_D312M-16A.
 For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.
 The last approved version of this historical standard is referenced on www.astm.org.

purchaser and the seller. Test Method D36/D36M shall be used as the reference method.
 5.1.3 Flash Point—Test Method D92.
 5.1.4 Penetration—Test Method D510/D510M.
 5.1.5 Ductility—Test Method D113.
 5.1.6 Solubility—Test Method D2042 or D7553. In cases where a disagreement exists between the purchaser and the seller, Test Method D2042 shall be used as the reference method.
 5.1.7 EVT—Test Method D4402/D4402M.

6. Inspection
 6.1 Inspection of the material shall be agreed upon between the purchaser and the seller as part of the purchase contract.

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 Mark Graham (Mark.Graham) pursuant to License Agreement. No further reproduction authorized.



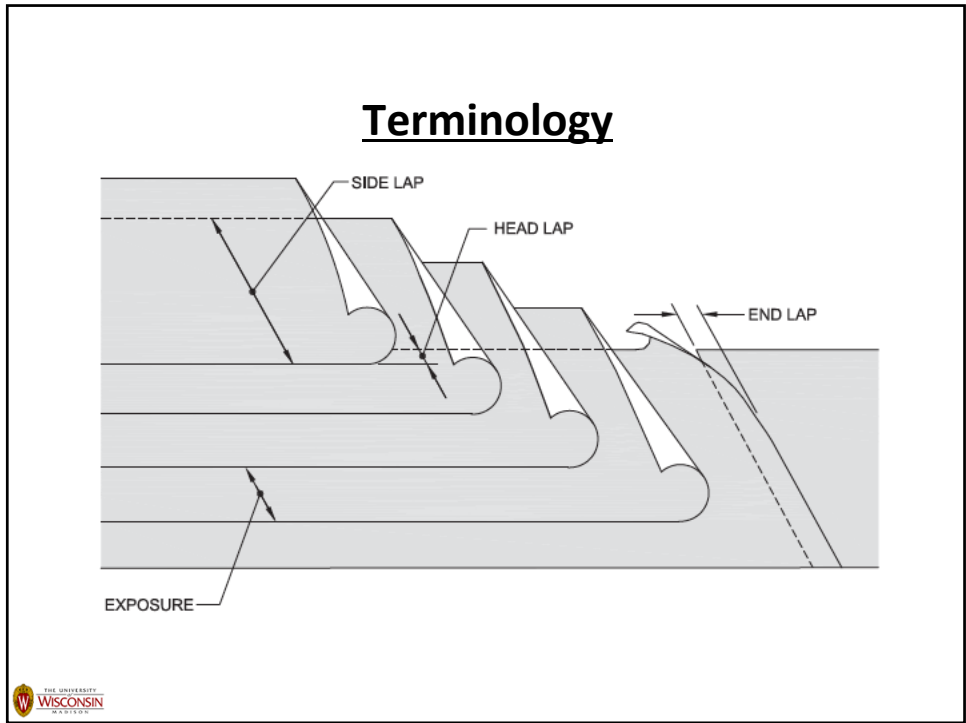
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BUR components

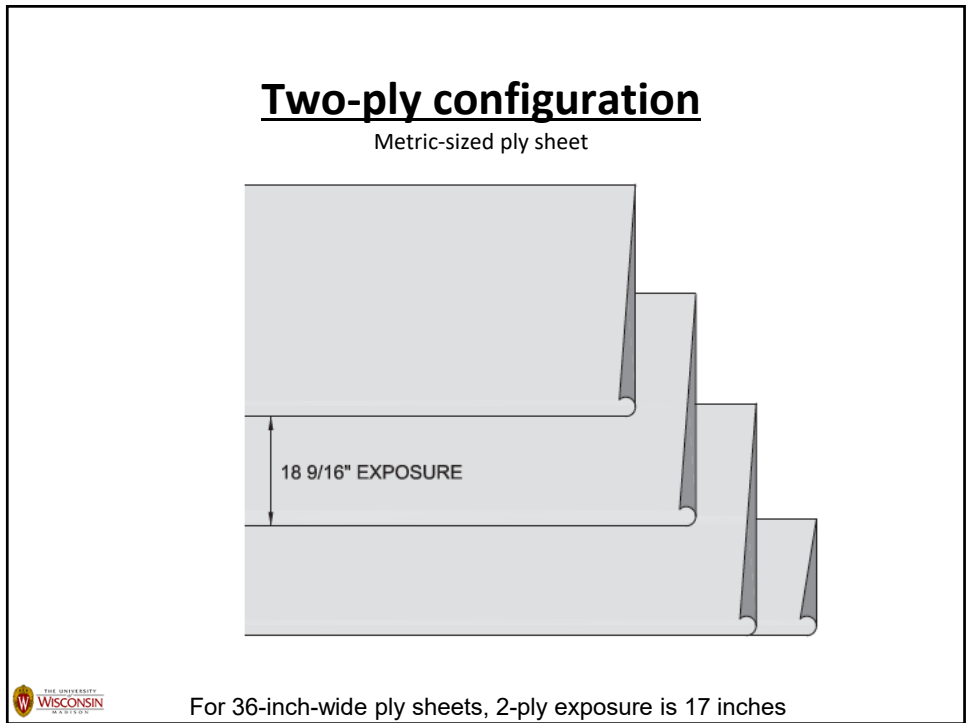




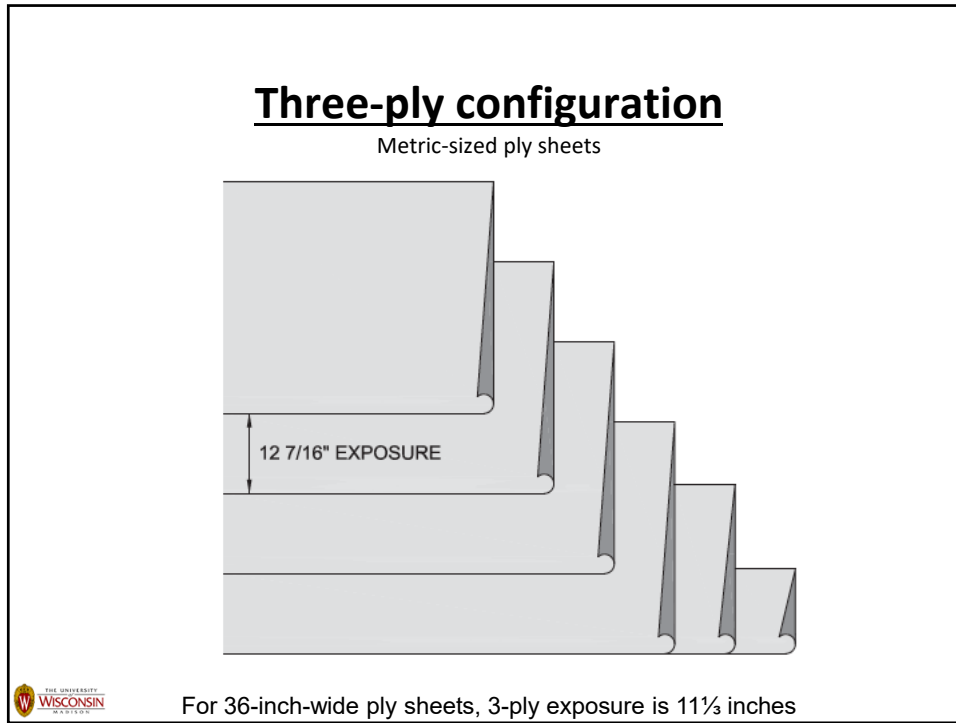

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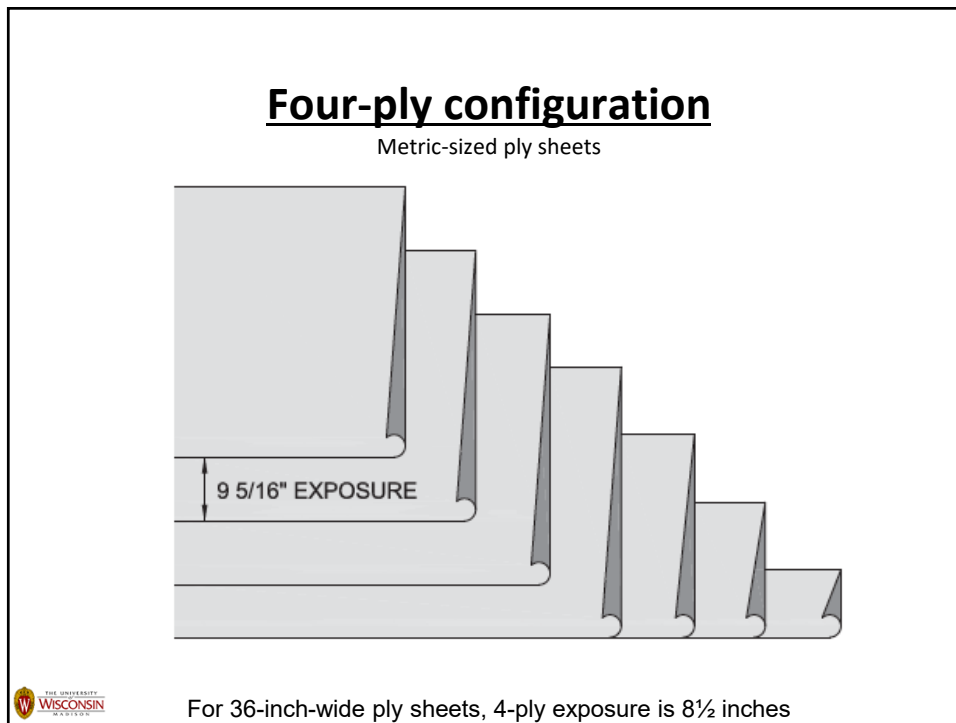
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BUR surfacings

- Flood coat and aggregate:
 - Approx. 400 lbs./sq. of aggregate in an asphalt flood coat of about 60 lbs./sq.
- Fluid-applied coatings:
 - Bituminous emulsion (black): ASTM D1227
 - Aluminum (silver): ASTM D2824
 - Acrylic (typically white): ASTM D6083
- Cap sheets:
 - Asphaltic cap sheets
 - Polymer-modified bitumen cap sheets (MB system)



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Aggregate-surfaced BUR



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Fluid-applied coating



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Cap sheet



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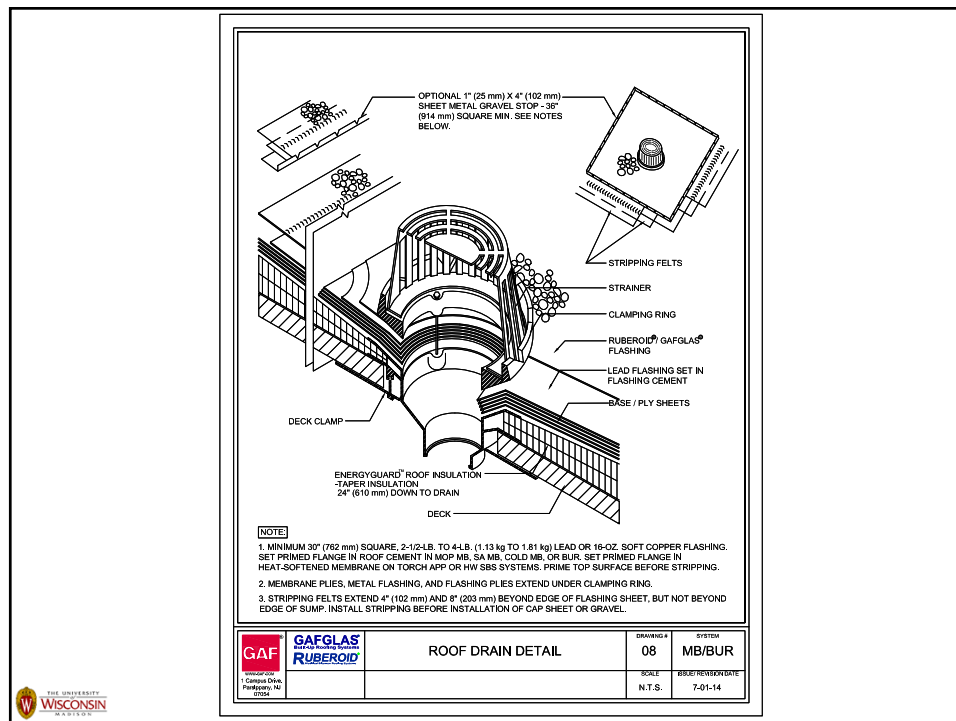
BUR flashings

Definition

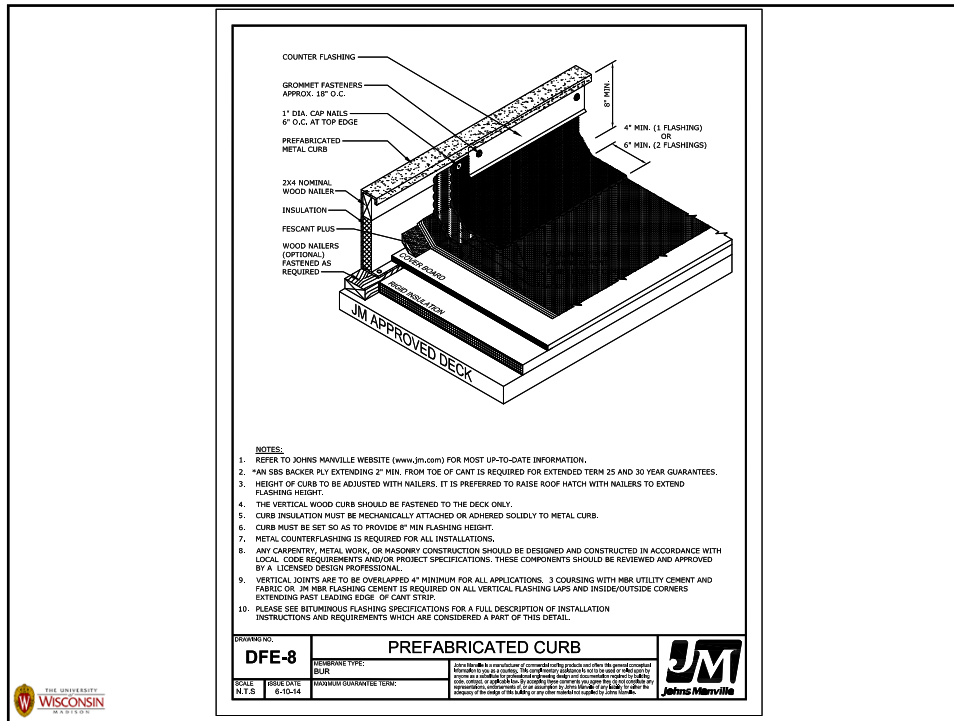
flashing: Components used to weatherproof or seal roof system edges at perimeters, penetrations, walls, expansion joints, valleys, drains, and other places where the roof covering is interrupted or terminated. For example, membrane base flashing covers the edge of the field membrane, and cap flashings or counterflashings shield the upper edges of the base flashing.



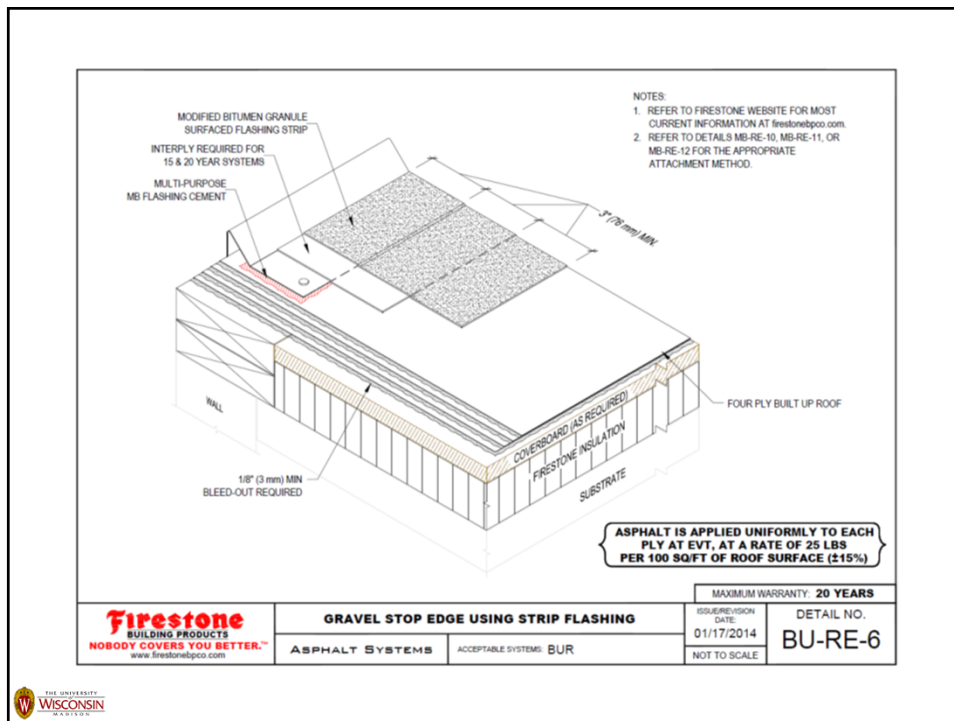
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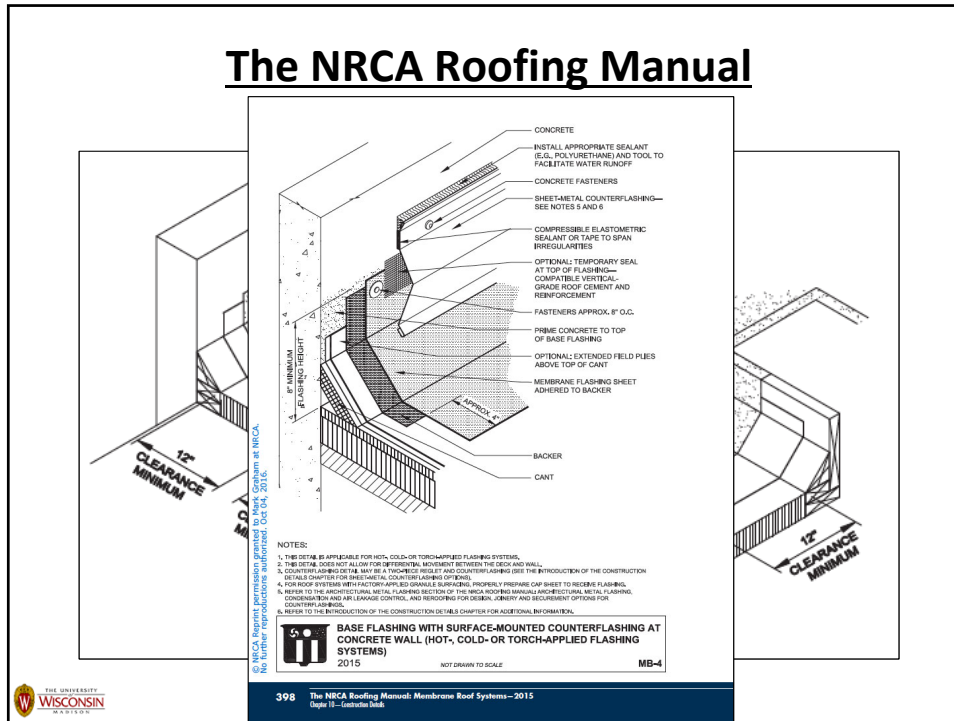
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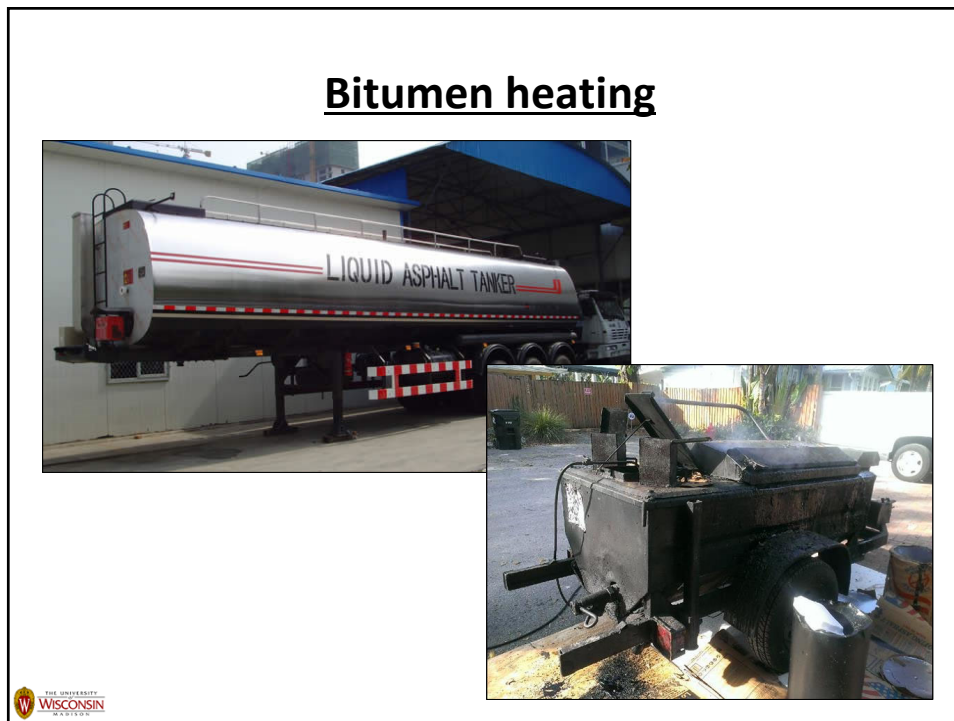
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Rooftop bitumen handling



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Mop application



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Mechanical felt-layer application



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Flood coat and aggregate application



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Building code compliance

International Building Code, 2018 Edition


TABLE 1507.10.2
BUILT-UP ROOFING MATERIAL STANDARDS

MATERIAL STANDARD	STANDARD
Acrylic coatings used in roofing	ASTM D 6083
Aggregate surfacing	ASTM D 1863
Asphalt adhesive used in roofing	ASTM D 3747
Asphalt cements used in roofing	ASTM D 3019; D 2822; D 4586
Asphalt-coated glass fiber base sheet	ASTM D 4601
Asphalt coatings used in roofing	ASTM D 1227; D 2823; D 2824; D 4479
Asphalt glass felt	ASTM D 2178
Asphalt primer used in roofing	ASTM D 41
Asphalt-saturated and asphalt-coated organic felt base sheet	ASTM D 2626
Asphalt-saturated organic felt (perforated)	ASTM D 226
Asphalt used in roofing	ASTM D 312
Coal-tar cements used in roofing	ASTM D 4022; D 5643
Coal-tar saturated organic felt	ASTM D 227
Coal-tar pitch used in roofing	ASTM D 450; Type I or II
Coal-tar primer used in roofing, dampproofing and waterproofing	ASTM D 43
Glass mat, coal tar	ASTM D 4990
Glass mat, venting type	ASTM D 4897
Mineral-surfaced inorganic cap sheet	ASTM D 3909
Thermoplastic fabrics used in roofing	ASTM D 5665, D 5726

1507.10 Built-up roofs. The installation of built-up roofs shall comply with the provisions of this section.

1507.10.1 Slope. Built-up roofs shall have a design slope of not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) for drainage, except for coal-tar built-up roofs that shall have a design slope of not less than one-eighth unit vertical in 12 units horizontal (1-percent slope).


1507.10.2 Material standards. Built-up roof covering materials shall comply with the standards in Table 1507.10.2 or UL 55A.



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Polymer-modified bitumen sheet membrane roof systems

- Components
- Application methods
- Membrane configurations
- Surfacing
- Flashings
- Code compliance



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MB sheet composition

- Bitumen:
 - Atactic polypropylene (APP)
 - Styrene butadiene styrene (SBS)
- Reinforcement:
 - Fiberglass mats
 - Polyester mats
 - Combination mats
- Sheet surfacing:
 - Smooth (unsurfaced)
 - Mineral granules
 - Foil



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ASTM product standards

APP base sheet:

- ASTM D6509 – fiberglass

APP cap sheets:

- ASTM D6222 – polyester
- ASTM D6223 – polyester and fiberglass combo

Note: Each cap sheet also has Type I and II, and Grade G and S classifications



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ASTM product standards – cont.

SBS base and cap sheets:

- ASTM D6162 – polyester and fiberglass combo.
- ASTM D6163 – fiberglass
- ASTM D6164 – polyester

Note: Each of the above cap sheets have Type I, II & III, and Grade G and S classifications

SBS cap sheet:

- ASTM D6298 – foil surface

Note: The above cap sheet has Type I & II classifications



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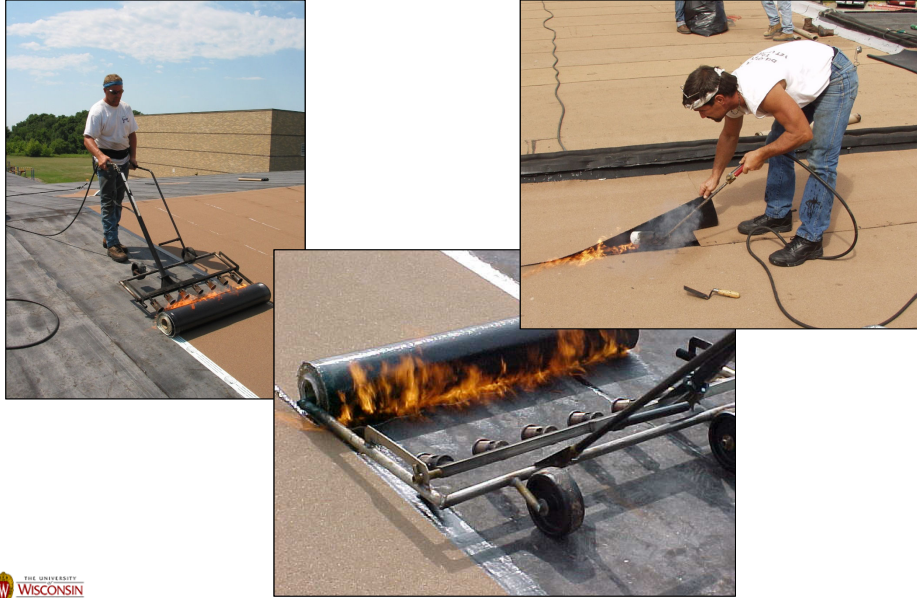
MB sheet application methods

- Torch application
- Mop application
- Cold-adhesive application
- Self-adhering application



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Torch-applied application



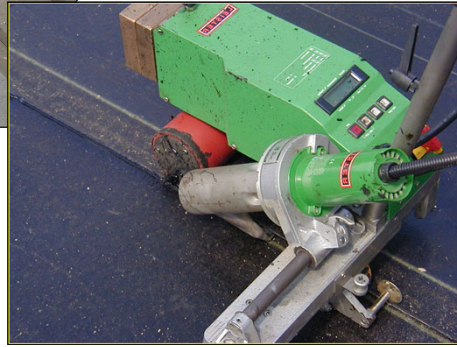
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Mop application



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Cold-adhesive application

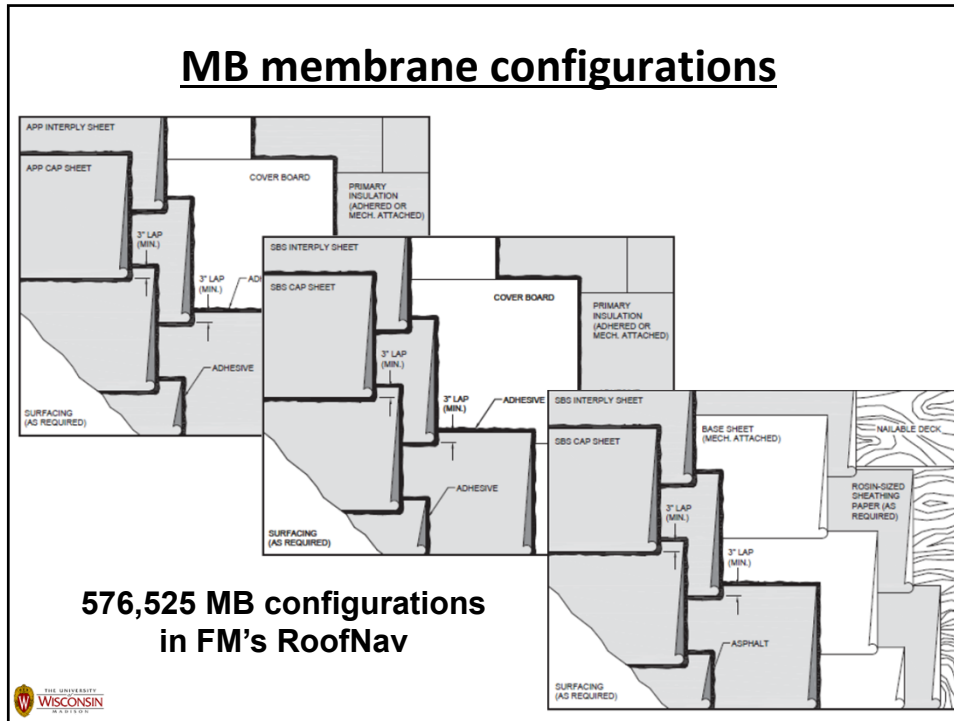


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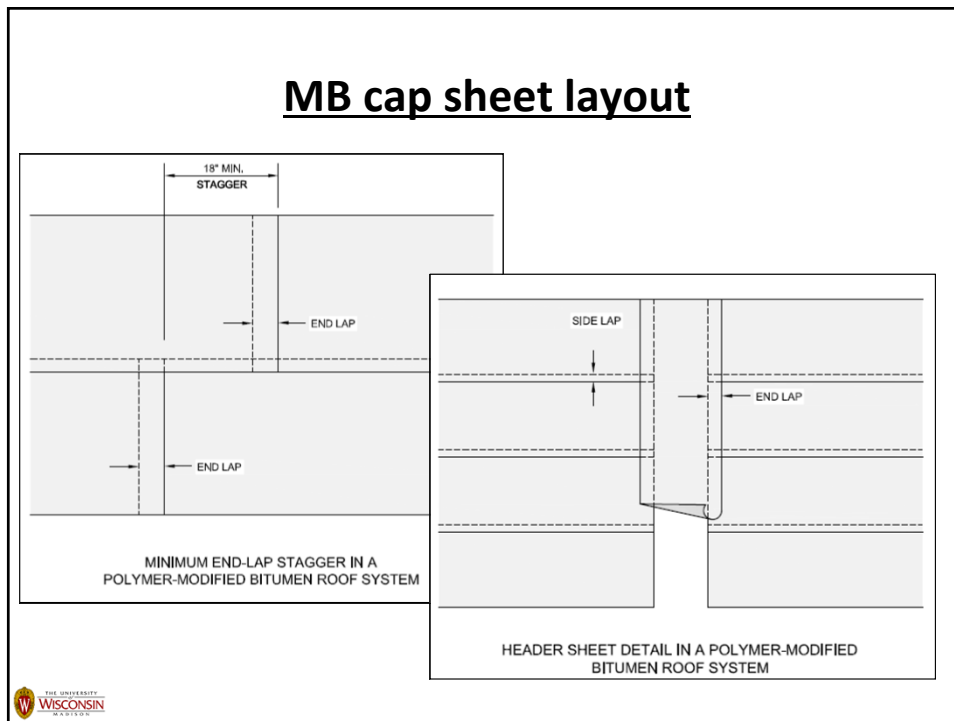
Self-adhering application



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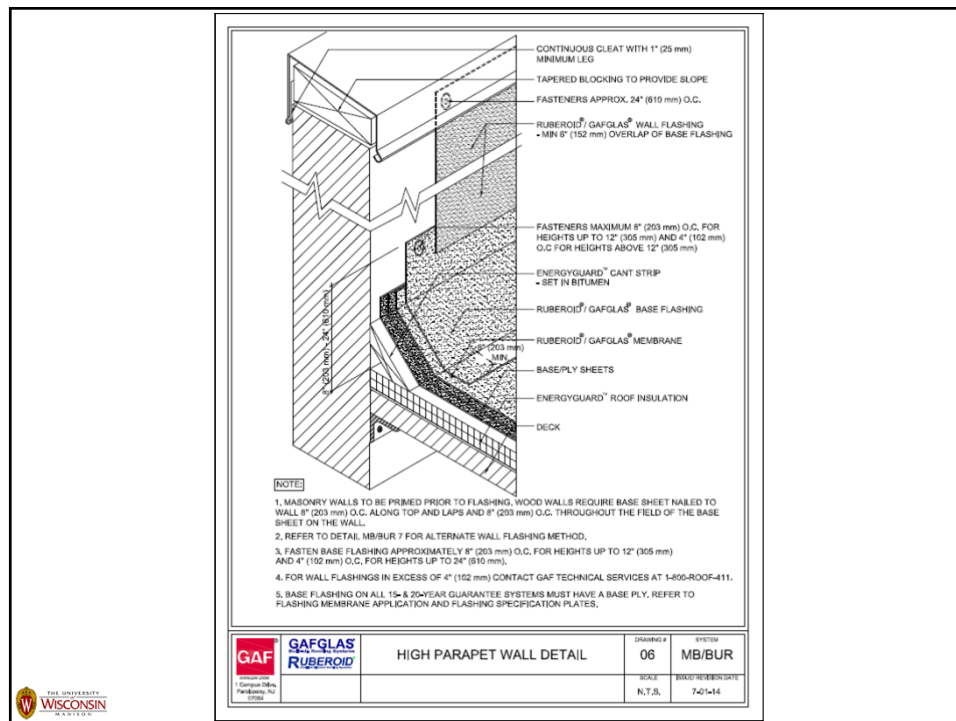
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MB surfacings

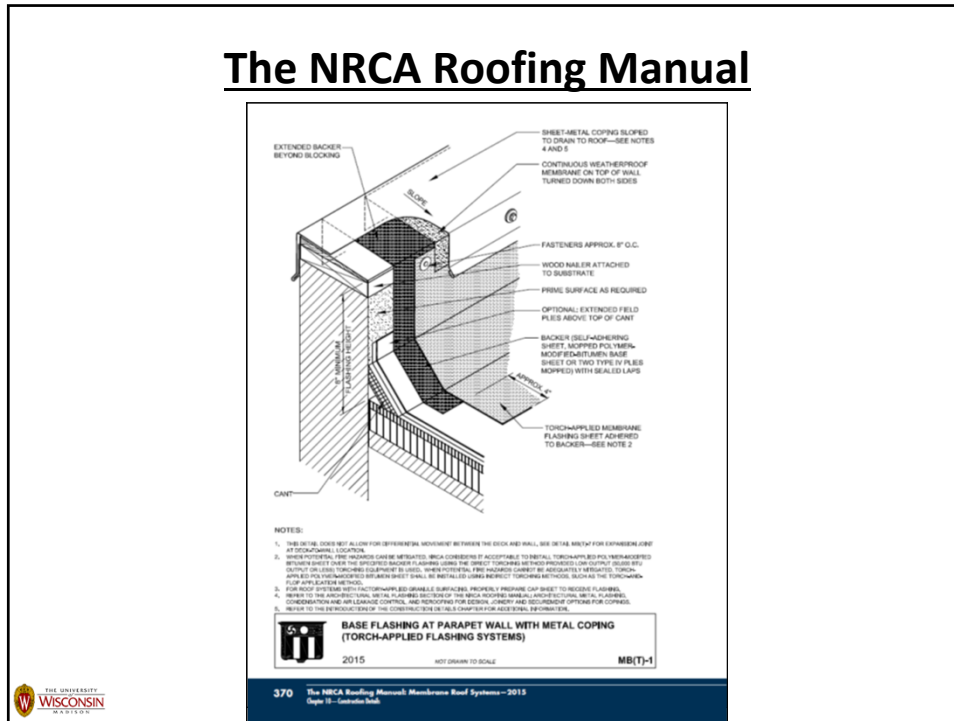
- Unsurfaced (smooth or granule-surfaced sheet)
- Fluid-applied coatings:
 - Bituminous emulsion (black): ASTM D1227
 - Aluminum (silver): ASTM D2824
 - Acrylic (typically white): ASTM D6083
- Flood coat and aggregate:
 - Approx. 400 lbs./sq. of aggregate in an asphalt flood coat of about 60 lbs./sq.



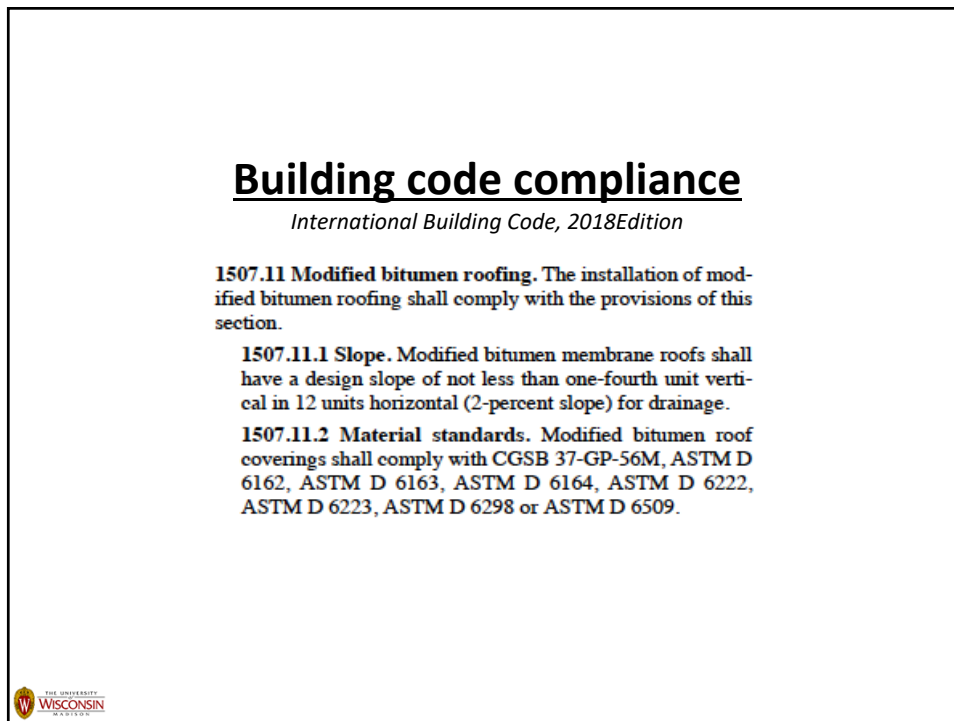
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Additional topics

- Quality control and assurance
- Test cuts and field testing
- Metal flashings
 - Design guides
 - ANSI/SPRI ES-1



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Quality Control and Quality-assurance Guidelines for the Application of Membrane Roof Systems



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