International Roofing Expo
February 20, 2025 – San Antonio, Texas

NRCA update on roofing technical issues

Mark S. Graham
Vice President, Technical Services
National Roofing Contractors Association

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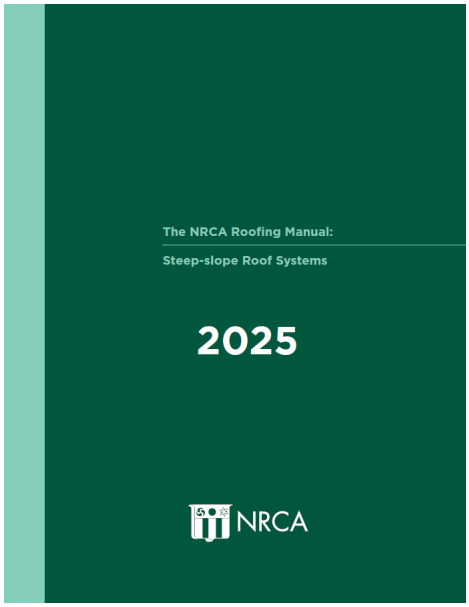

2025 NRCA Manual

Steep-slope Roof Systems

The Manual represents "best practice" guidelines

Link

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Significant revisions

The NRCA Roofing Manual: Steep-slope Roof Systems-2025

- OSB roof decks are no longer recommended
- Nailbase and vented nailbase insulation should be installed in two layers with staggered and offset joints
- Joints in vented nailbase insulation should be taped
- Updated code references to 2024 I-codes
- New appendix addressing IBHS' Fortified program

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TO VIEW, CLICK ON BOOK COVER

The NRCA Roofing Manual—2025 Set

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RESEARCH+TECH

Plywood or OSB?

Moisture-related concerns exist with wood structural panels

by Mark S. Graham

NRCA's technical services staff continues to hear from roofing contractors experiencing moisture-related dimensional stability problems with plywood and oriented strand board structural panel sheathing used with steep-slope roof systems. Following is a brief discussion of moisture mechanics, linear expansion and thickness swell testing, and NRCA's recommendations for plywood and OSB structural panel sheathing roof decks.

Moisture mechanics

Plywood and OSB sheathing, similar to all wood products, are hygroscopic, meaning they tend to absorb and release moisture from their surroundings.

When not exposed to direct wetting, structural panel sheathing's moisture content is a function of its environment's relative humidity and temperature. During construction and its service life, panels may be exposed to direct moisture. When exposed to direct wetting, structural panel sheathing's moisture content is influenced by wetting time and panel variables that affect capillarity, such as veneer species of plywood and wax additives in OSB.

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Standards for wood structural panels

International Residential Code, 2024 Edition

Plywood:

- U.S. Department of Commerce PS-1, "Structural Plywood"
- CSA Group O325, "Construction Sheathing"

Oriented-strand board (OSB):

- U.S. Department of Commerce PS-2, "Performance Standard for Wood-based Structural-use Panels"
- CSA Group O437, "Standards for OSB and Waferboard"

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Common, but not referenced in the Code

Plywood and OSB:

- APA-The Engineered Wood Association Standard PRP-108, "Performance Standards and Policies for Structural-Use Panels"

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Attachment of Wood Panels: The *International Residential Code, 2024 Edition's* Table R602.3(1)-Fastening Schedule provides minimum fastener and fastener spacing requirements for wood structural panels into roof framing shown in Figure 6.1.

Item	Description of building elements	Number and type of fasteners	Spacing of fasteners	
			Edges (inches)	Intermediate supports (inches)
Wood structural panels, roof sheathing to framing and particle board wall sheathing to framing				
31	3/8- to ½-inch-thick	6d common or deformed nail (2" x 0.113" x 0.281" head)	6	6
		8d common nail (2½" x 0.131" x 0.281" head), or RSRS-01 nail (2⅜" x 0.113" x 0.281" head)	6	6
32	19/32- to ¾-inch thick	8d common nail (2½" x 0.131" x 0.281" head), or RSRS-01 nail (2⅜" x 0.113" x 0.281" head)	6	6
33	7/8- to 1¼-inch thick	10d common nail (3" x 0.148" x 0.281" head), or 2½" x 0.131" x 0.281" head deformed nail	6	12

Figure 6-1. Roof sheathing-specific excerpt from International Residential Code, 2024 Edition's Table R602.3(1)-Fastening Schedule

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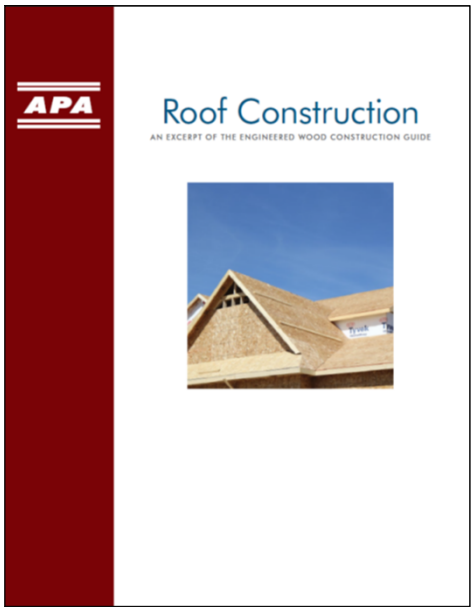

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APA Form E30, "Roof Construction"
--Roofing-specific excerpts from APA's *Engineered Wood Construction Guide* (102 pages)

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Considerations

Lumber, plywood and OSB roof decks

- Be extra cautious of plywood and OSB roof decks
- Limit your deck acceptance responsibilities
- Consider more proactive plywood and OSB deck replacement
- Consider pull tests for plywood and OSB roof decks when using mechanically-attached membrane systems

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RESEARCH + TECH

Know the options

Proper specification is essential for nail-base insulation

by Mark S. Graham

In roof assembly configurations with nailable roof coverings, such as asphalt shingles and metal panels, factory-fabricated, nail-base insulation is becoming more common as a component of insulation entirely above the roof deck. Because nail-base insulation serves multiple functions, including being a roof covering substrate and thermal insulation layer, proper design and specification are essential for roof assembly performance.

The basics

Nail-base insulation is composed of a layer of rigid board insulation factory-adhered or laminated to a layer of structural wood panel sheathing, such as plywood or oriented strand board.

The U.S. product standard for nail-base insulation is ASTM C1289, "Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board," Type V. It provides requirements for a polyisocyanurate insulation foam core

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Nailbase insulation considerations

- Double layer design and application
- Taped joints can control vapor leaks/underlayment wrinkling at board joints
- Pressure-tested and FRT nailbase are not good ideas for nailbase

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"Fully" adhered

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TECH TODAY

The fully adhered misnomer

Terminology can create unrealistic expectations within the roofing industry

by Mark S. Graham

The term "fully adhered" is used by some manufacturers and specifiers to identify adhered single-ply membrane roof system configurations or refer to the adhesion of rigid board insulation to underlying substrates. But this terminology can create application and performance expectations that are unrealistic and likely cannot be achieved.

NRCA recommends the term "fully adhered" be avoided

Definitions

When considering the term "fully adhered," it is important to realize it is not specifically defined by the U.S. roofing industry.

The industry's consensus-based terminology standard, ASTM D1079, "Standard Terminology Relating to Roofing and Waterproofing," does not include terms or definitions for fully adhered, adhered or adhesion.

Similarly, the glossary contained in the appendix of *The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Roofing—2014* does not contain a specific definition for the term fully adhered. The manual defines "adhere" as: "To cause two surfaces to be held together by the combined strength of the molecular forces and the mechanical interlocking achieved between adhesive and the bonded surface . . ."

Merriam-Webster defines adhere (and its derivatives adhered and adhering) as "to hold fast or stick by or as if by gluing, suction, grasping, or fusing." Similarly, the term "fully" is defined as "in a full manner or degree; complete."

Although not specifically defined, the implication of fully adhered is 100 percent adhesion between two surfaces or materials.

Realistic expectations

Experienced roofing industry professionals realize the expectation of complete adhesion between two surfaces such as a single-ply membrane and underlying rigid board insulation is unrealistic and likely cannot be achieved in field applications.

Taken at its most literal sense, complete adhesion between a single-ply membrane and a rigid board insulation substrate is impossible because there will not be membrane adhesion at the insulation boards' joints.

Also, thickness variability in insulation boards and its effect on adhesion needs to be considered. For example, the U.S. product standard for polyisocyanurate insulation, ASTM C1289, "Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board," permits a board thickness tolerance of ±⅛-inch and crushing and depressions up to ⅛ of an inch in depth on up to 10 percent of a polyisocyanurate insulation board's surface area. Because reinforced single-ply membranes tend to lay relatively flat, having an adhered membrane application readily conform to and remain completely adhered to the recognized irregularities in insulation boards is unlikely.

Irregular, nonsmooth roof deck surfaces create similar situations. Because board-type insulation is relatively rigid, it generally will not readily conform to irregularities in roof deck substrates. Individual rigid boards tend to rest on the high points in a roof deck's finished surface and span the low points.

As a result, rigid board insulation seldom is completely adhered to roof deck substrates. It generally is adhered at the relative high points in the roof deck's surface and may be partially or marginally adhered and even unadhered at the relative low points. Specifying smaller insulation board sizes (4 by 4 feet instead of 4 by 8 feet) generally is suggested to minimize rigid insulation boards from spanning substrate low-point irregularities.

In practice

The concept of lacking 100 percent, complete adhesion between two adhered surfaces is not new to the roofing industry; it has long been recognized in the application of built-up roof membranes where voids between plies can occur. To address this, NRCA's *Quality Control Guidelines for the Application of Built-up Roofing* indicates interply moppings are intended to be continuous; however, voids of limited size are permitted provided overlapping voids do not occur between two or more plies. NRCA has maintained this position since the late 1970s, and it has become well-accepted by the roofing industry.

As it applies to adhering rigid board insulation in continuously applied adhesive applications, actual adhesion rates of about 60 to 90 percent are common (even less in some specific instances) in successfully performing adhered roof systems.

On this basis, NRCA recommends the term "fully adhered" be avoided and suggests the term "adhered" for field applications because it is more realistic.

MARK S. GRAHAM is NRCA's vice president of technical services.

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Polyiso. testing

R-value testing
Facer sheet adhesion (with the Chicago Roofing Contractors Association)

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<u>LTTR</u> – ASTM C1303 and ASTM C518

- A 15-year time-weighted average R-value
- The predicted R-value after 5-years (under controlled laboratory conditions)

<u>R-value</u> – ASTM C518

- R-value at the time of the test

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- LTTR and R-value is typically tested and reported at 75 F.
- NRCA tests at 75 F, but we also test at 40 F and 110 F.

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Test results

Physical properties

Manufacturer	Apparent density (lb/ft^3)	Thickness (inches)
1c	2.726	2.578
1p	2.002	2.594
2c	3.254	2.576
2p	2.024	2.585
3p	2.218	2.500
4p	2.057	2.735

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Test results

R-value

Manufacturer	R-value (75 F)
1c	14.4
1p	13.9
2c	13.6
2p	15.6
3p	13.2
4p	15.3

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More test results

R-value

Manufacturer	R-value (40 F)	R-value (75 F)	R-value (110 F)
1c	10.8	14.4	12.8
1p	8.9	13.9	12.0
2c	14.5	13.6	12.1
2p	15.4	15.6	13.4
3p	12.6	13.2	11.6
4p	16.9	15.3	13.1

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Preliminary conclusions

- Tested R-values vary
- Some tested R-values are already lower than LTTR
- Some samples are exhibiting different characteristics

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Preliminary recommendations

- Specify, purchase and sell polyisocyanurate insulation (and all insulation products) based on their thicknesses, not its R-values

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Polyiso facer sheet adhesion

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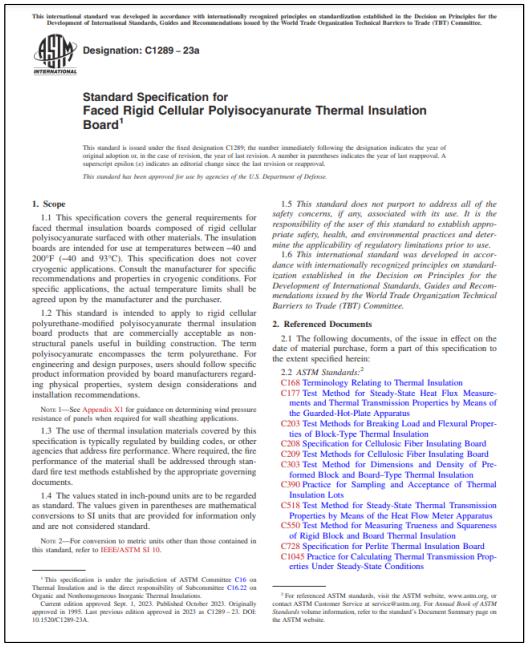

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: C1289 – 23a

Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board[1]

This standard is issued under the fixed designation C1289; 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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers the general requirements for faced thermal insulation boards composed of rigid cellular polyisocyanurate surfaced with other materials. The insulation boards are intended for use at temperatures between −40 and 200°F (−40 and 93°C). This specification does not cover cryogenic applications. Consult the manufacturer for specific recommendations and properties in cryogenic conditions. For specific applications, the actual temperature limits shall be agreed upon by the manufacturer and the purchaser.

1.2 This standard is intended to apply to rigid cellular polyurethane-modified polyisocyanurate thermal insulation board products that are commercially acceptable as non-structural panels useful in building construction. The term polyisocyanurate encompasses the term polyurethane. For engineering and design purposes, users should follow specific product information provided by board manufacturers regarding physical properties, system design considerations and installation recommendations.

NOTE 1—See Appendix X1 for guidance on determining wind pressure resistance of panels when required for wall sheathing applications.

1.3 The use of thermal insulation materials covered by this specification is typically regulated by building codes, or other agencies that address fire performance. Where required, the fire performance of the material shall be addressed through standard fire test methods established by the appropriate governing documents.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

NOTE 2—For conversion to metric units other than those contained in this standard, refer to IEEE/ASTM SI 10.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 The following documents, of the issue in effect on the date of material purchase, form a part of this specification to the extent specified herein:

2.2 *ASTM Standards:*[2]

C168 Terminology Relating to Thermal Insulation
C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
C203 Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
C208 Specification for Cellulosic Fiber Insulating Board
C209 Test Methods for Cellulosic Fiber Insulating Board
C303 Test Method for Dimensions and Density of Preformed Block and Board–Type Thermal Insulation
C390 Practice for Sampling and Acceptance of Thermal Insulation Lots
C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
C550 Test Method for Measuring Trueness and Squareness of Rigid Block and Board Thermal Insulation
C728 Specification for Perlite Thermal Insulation Board
C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions

[1] This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.22 on Organic and Nonhomogeneous Inorganic Thermal Insulations.

Current edition approved Sept. 1, 2023. Published October 2023. Originally approved in 1995. Last previous edition approved in 2023 as C1289 – 23. DOI: 10.1520/C1289-23A.

[2] 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.

ASTM C1289-23a

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11.6 *Tensile Strength Perpendicular to Board Surface*—Tensile strength perpendicular to the major board surfaces of the faced board product shall be tested in accordance with Test Method C209, Tensile Strength Perpendicular to Surface, or Test Method D1623 (Type C), utilizing a 250°F (121°C) hot melt adhesive system for sample preparation. Molten adhesive shall be uniformly applied over each faced sample surface and allowed to cool in 73°F (23°C) laboratory air for 24 h before testing.

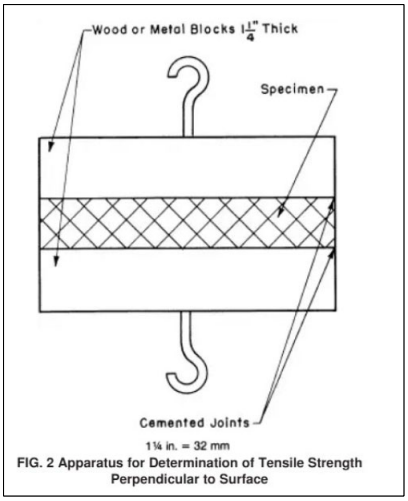

FIG. 2 Apparatus for Determination of Tensile Strength Perpendicular to Surface

Tensile strength, psf (kPa), min Perpendicular to board surface	500 (24)	500 (24)	500 (24)	500 (24)	500 (24)	2000 (95)

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Test results

ASTM C209 tensile strength

Manufacturer	Tensile strength Average (psf)	Standard deviation (psf)
1c	1,888	556
1p	2,041	909
2c	1,874	730
2p	1,301	409
3p	1,029	495
4p	1,185	327

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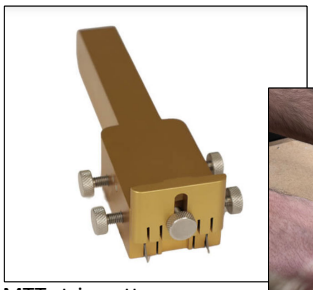
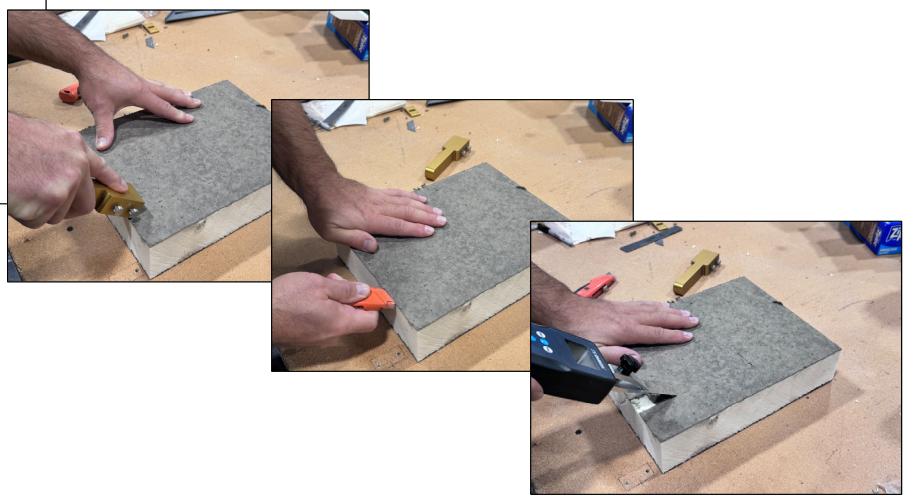
Peel test

Internally-developed evaluation method
No ASTM standard



MTT strip cutter



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Test results

Manufacturer	Peel strength Average (psi)	Standard deviation (psi)
1c	2.78 MD 3.03 XMD	0.62 MD 0.44 XMD
1p	2.52 MD 2.89 XMD	0.78 MD 0.94 XMD
2c	2.30 MD 2.30 XMD	0.31 MD 0.28 XMD
2p	2.52 MD 2.36 XMD	0.61 MD 0.53 XMD
3p	2.83 MD 2.97 XMD	0.59 MD 0.57 XMD
4p	2.61 MD 2.19 XMD	0.56 MD 0.76 XMD
Average	2.59 MD 2.62 XMD	

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Preliminary conclusions

- Our peel test method seems viable
  - More refinement of the test method may be needed
- Peel values are only about 10% of tensile values
- Peel values seem low
- More testing is planned:
  - More polyiso. specimens (production lots, plants)
  - Board top vs. board bottom
  - Impact of knit lines
  - Other faced insulation boards

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Recent and common technical inquires

Requests of NRCA for technical assistance

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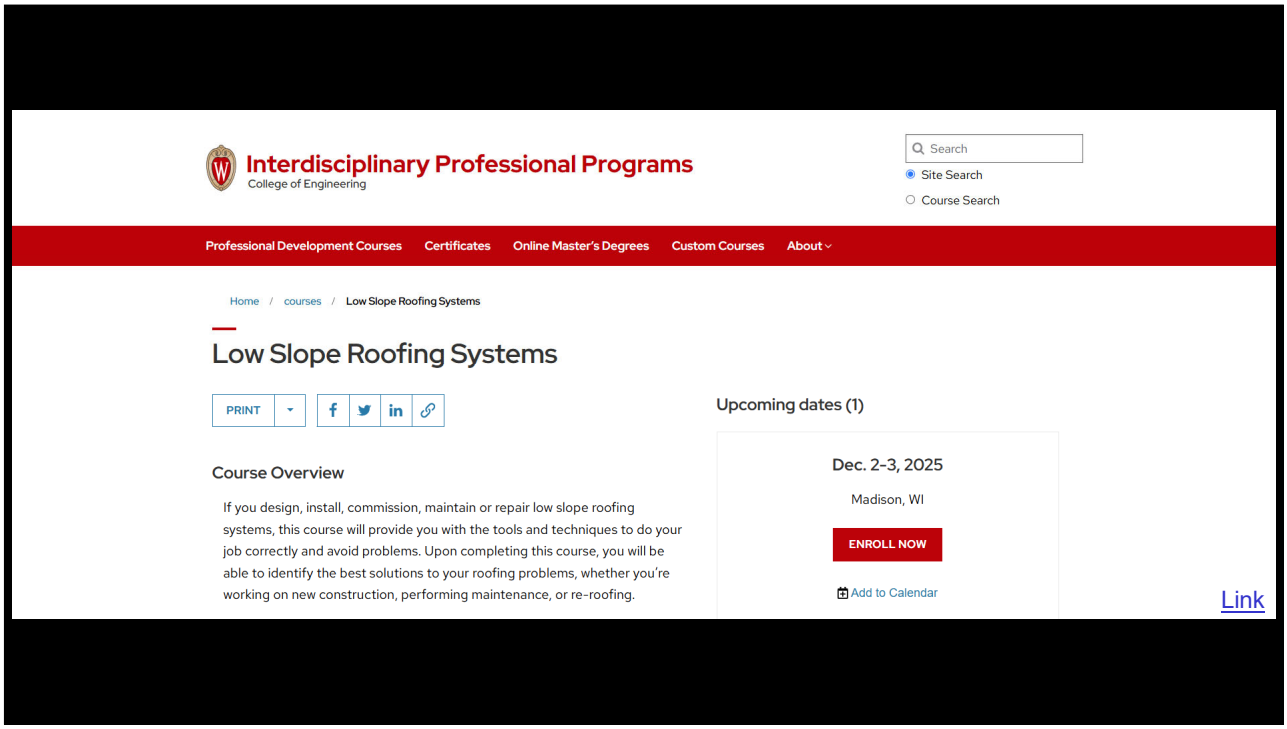
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Course Overview
If you design, install, commission, maintain or repair low slope roofing systems, this course will provide you with the tools and techniques to do your job correctly and avoid problems. Upon completing this course, you will be able to identify the best solutions to your roofing problems, whether you're working on new construction, performing maintenance, or re-roofing.
Upcoming dates (1)
Dec. 2-3, 2025
Madison, WI
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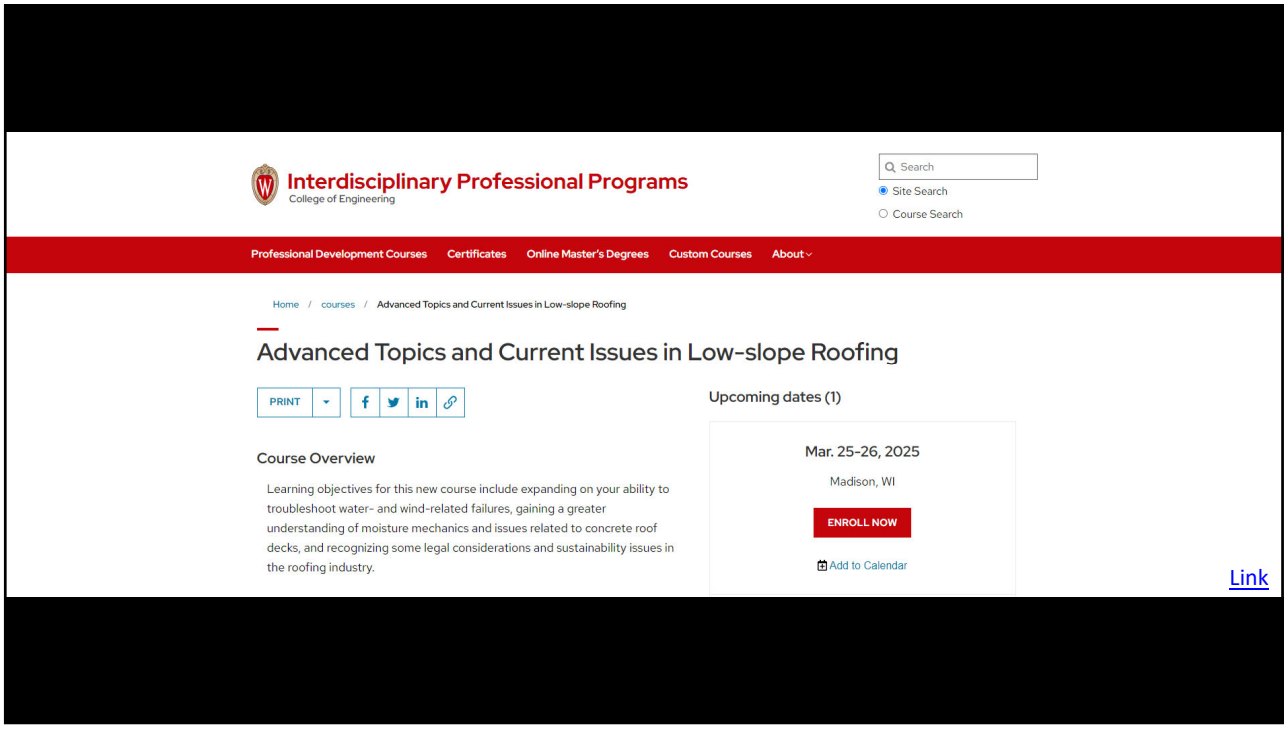
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Advanced Topics and Current Issues in Low-slope Roofing
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Course Overview
Learning objectives for this new course include expanding on your ability to troubleshoot water- and wind-related failures, gaining a greater understanding of moisture mechanics and issues related to concrete roof decks, and recognizing some legal considerations and sustainability issues in the roofing industry.
Upcoming dates (1)
Mar. 25-26, 2025
Madison, WI
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We're moving! NRCA's new office address as of April 1, 2025…

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