The Science of Fluid-Applied Flashing Systems

Paul Grahovac, LEED AP

R-GUARD FastFlash Air and Water Barrier Technical Director. International Code Council, Air Barrier Association of America Technical, Flashing, and Whole-Building Testing Committees, National Concrete Masonry Association's Air Barrier Task Force, ASTM Committees on building performance / vapor permeability / window installation, RCI Industry Advisory Council, and the following National Institute of Building Sciences Councils: Building Enclosure Technology and Environmental Council (BETEC Building Enclosure Integration Committee) and the Council on Finance, Insurance and Real Estate, Passive House.

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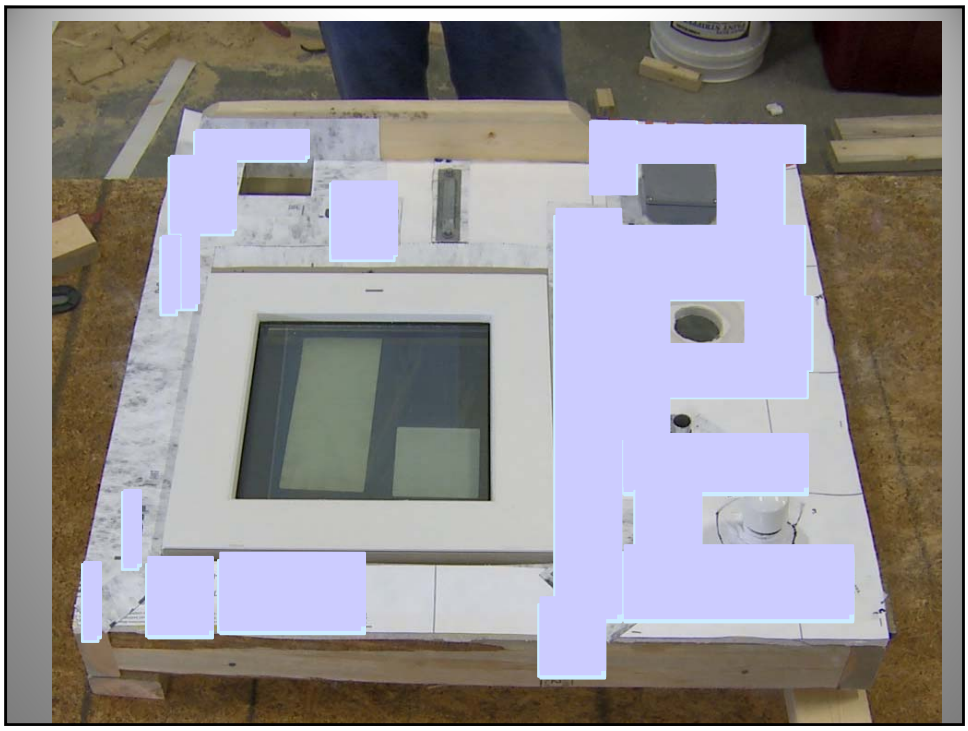
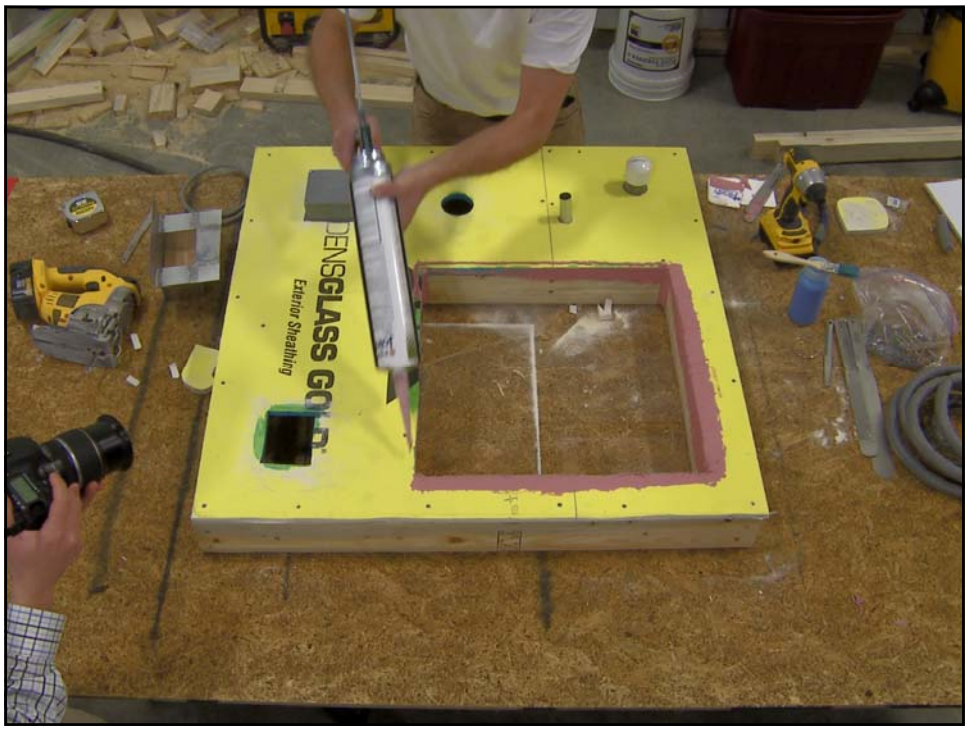
Systems Engineering

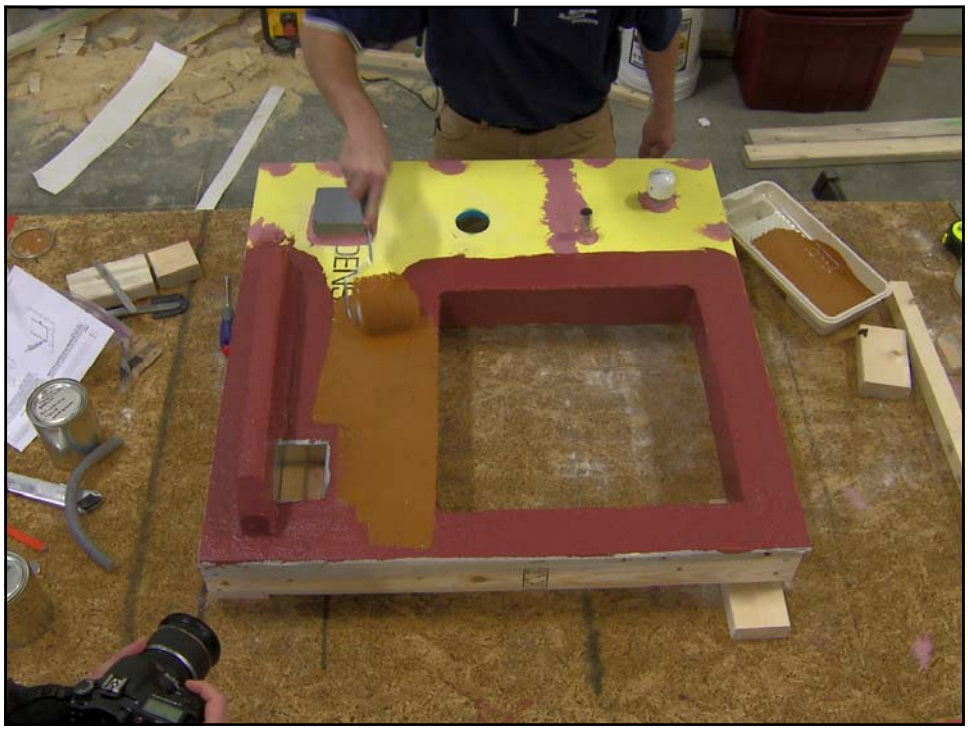
- ✓Fluid applied
- ✓**Bonds to damp surfaces**
- ✓Adheres without a primer
- ✓100% solids to avoid shrinkage
- ✓VOC Compliant – minimal odor
- ✓**Immediately waterproof – withstands rain**
- ✓Opaque when target thickness is achieved
- ✓Can be exposed for up to 6 months
- ✓Paintable / compatible
- ✓Vapor permeable
- ✓Reduces steps/saves time
- ✓Easily repaired
- ✓Self seals around fasteners




DENSGLASS GOLD
Exterior Sheathing


DENSGLASS GOLD
Exterior Sheathing


DENSGLASS
Exterior Sheathing




DEWALT

Liquid detailing membrane

Lawrence Chamber

LDVTC - Fixed Chamber - Lawrence, KS

7’ x 7’ test wall

Liquid detailing membrane

Liquid detailing membrane

Air Changes per Hour
@ 50 Pascals = 20mph wind

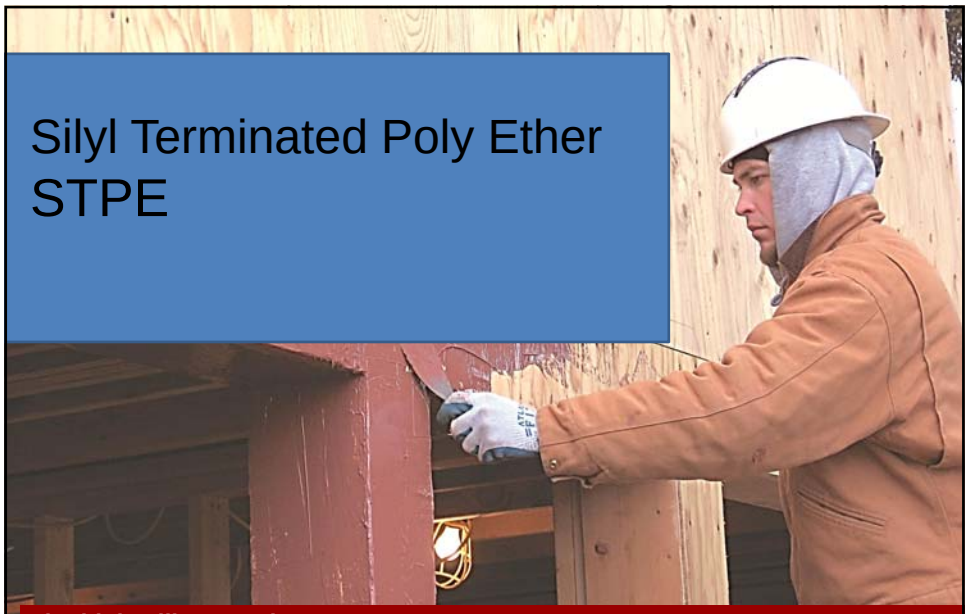
Energy Star **5** ACH
Passive House **0.6** ACH
Peel & Stick **7.01** ACH
Liquid-applied **0.17** ACH
Liquid Applied at 2,880 Pascals = 155mph wind Category V hurricane
0.53 ACH

Karuna Passive House

0.42 ACH BEFORE air sealing completed

Liquid detailing membrane

Silyl Terminated Poly Ether STPE



Liquid detailing membrane

Property	STPE	Urethane	Silicone
Environmental friendliness	10	5	9
Non-bubbling	10	6	10
Low temperature gunnability	10	8	10
Slump resistance	10	10	10
Quick cure	10	7	10
Storage stability	10	7	9
Body (tooling)	8	10	8
Weather resistance	8	6	10
Adhesion to various substrates	10	5	8
Mechanical properties	10	10	10
Heat resistance, mechanical stability	9	8	10
Non-dirt pickup	10	10	5
Stain resistance	8	8	5
Paintability with water-based paint	10	10	3
Scale: 10 – excellent; 1 – very poor	**133**	**110**	**117**

Adhesives & Sealants Council

"In addition to their high performance properties, these sealants are achieving popularity due to their formulation versatility that allows the customization of viscosity and early strength development for various applications. "

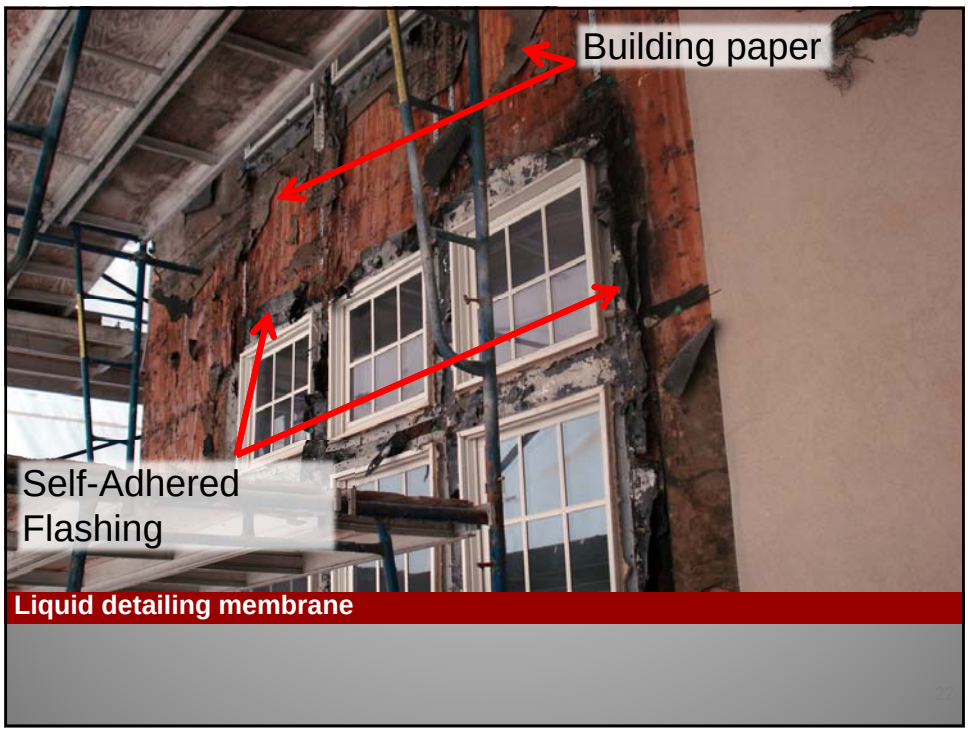
Liquid detailing membrane

Age: 3 years

Project Owner
Seattle Heights Homeowner's Association

Project Size:
$9,500,000 Exterior
$2,500,000 Interior

Liquid detailing membrane


Building paper
Self-Adhered
Flashing
Liquid detailing membrane

Liquid detailing membrane

Craig Wetmore, President of York Manufacturing (which sells both copper mesh through-wall flashing and peel-and-stick) provided the Flashings & Terminations Committee of the Air Barrier Association of America a paper in which he offered the following items in a **critique of peel-and-stick:**

1. UV damage
2. Flows at 140-180^{o}F
3. Spray foam heat causes flow and facer damage
4. Masonry cleaners harm
5. Full body weight rolling
6. Must replace sheets instead of repairing fishmouths
7. No moisture in substrate
8. No dust, fines, or dirt
9. Adhesion problems
10. Use primer, but VOC problems
11. Primer must be dry but not too dry
12. Sealant adhesion problems
13. Degrades air barriers
14. Flame and smoke
15. 10-20 year life expectancy

Writing in the Winter 2011 issue of the National Institute of Building Sciences' Journal of Building Enclosure Design, Editor and Building Enclosure Technology & Environment Council Chairman Wagdy Anis of Wiss, Janney Elstner consultants stated:

"Another significant event that took place at the Buildings XI International Conference was the U.S. Department of Energy (DOE)'s road mapping session, during which stakeholders reported their ideas about prioritizing research. BETEC reported its thoughts on this to DOE, on behalf of more than 3,000 BEC members. Ideas included:

- Evaluate the performance of some common heat air and moisture control materials.
- The durability of flashing materials ….
- Long-term adhesion of peel-and-stick membranes.
- Long-term performance of peel-and-stick membrane joints, vertical and horizontal, with and without term bars, shingled and reverse shingled."

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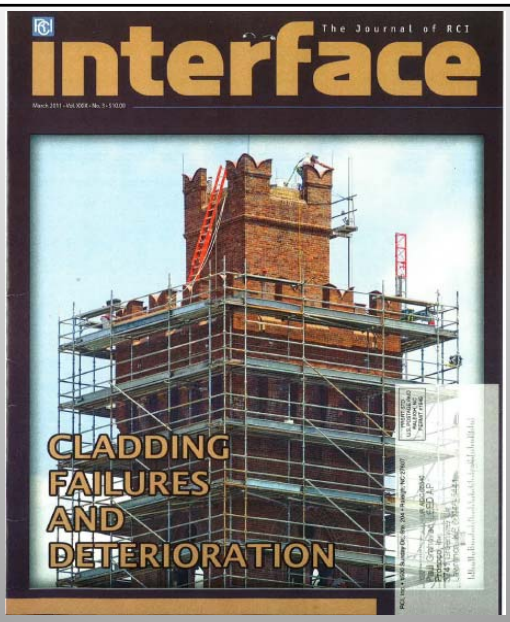
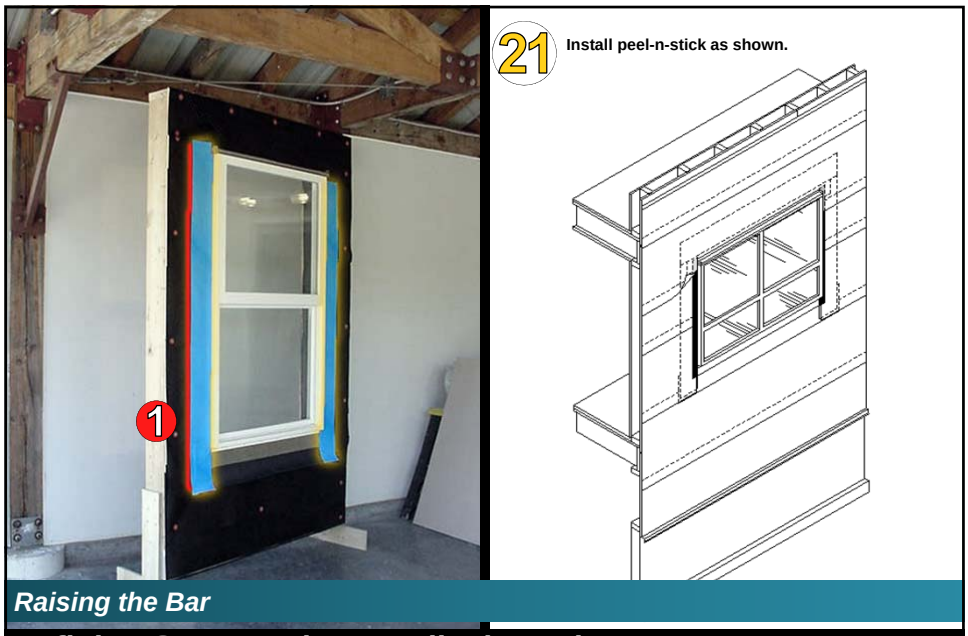



Genesis of a Waterproof Flashing System for a Damp Climate


21
Install peel-n-stick as shown.
Raising the Bar
28



Raising the Bar

Refining Construction Details through

Design Verification Testing

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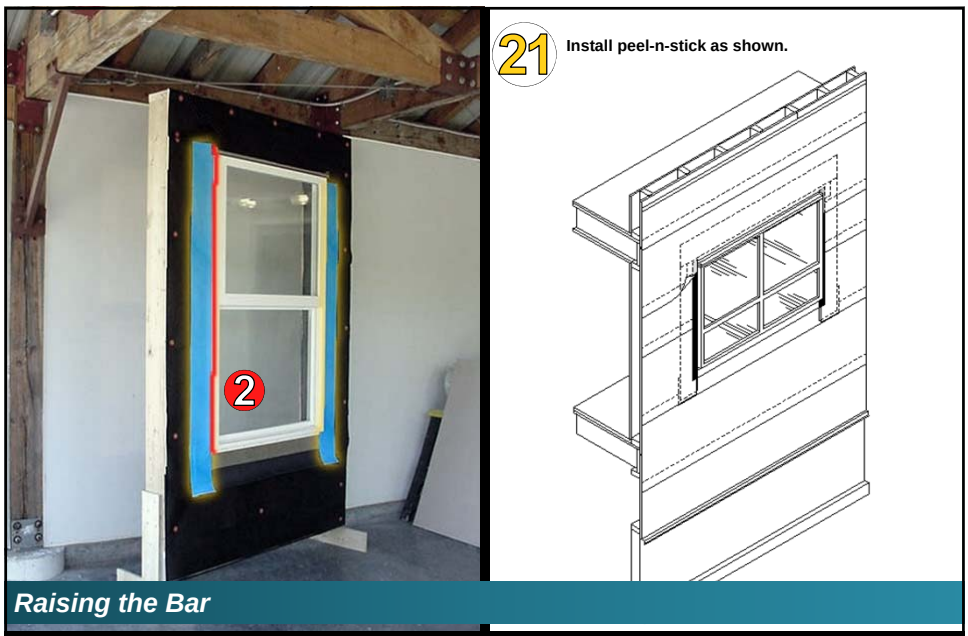

Raising the Bar

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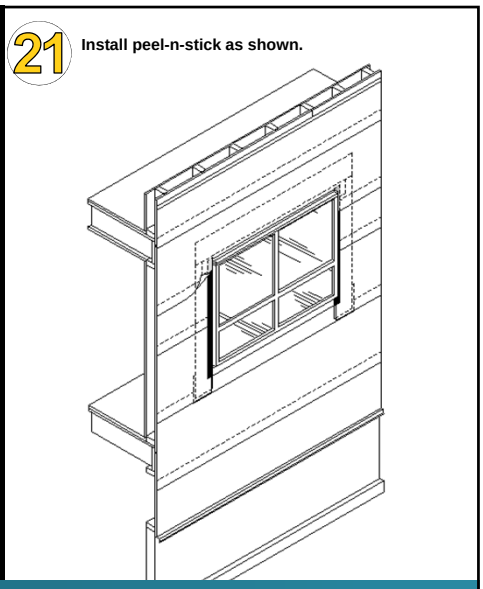

Raising the Bar

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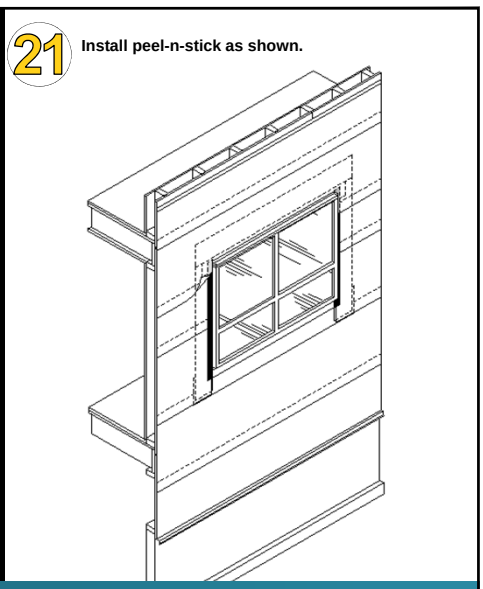

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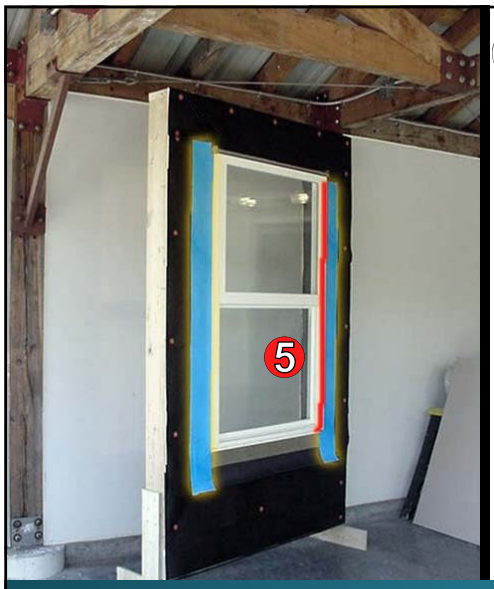

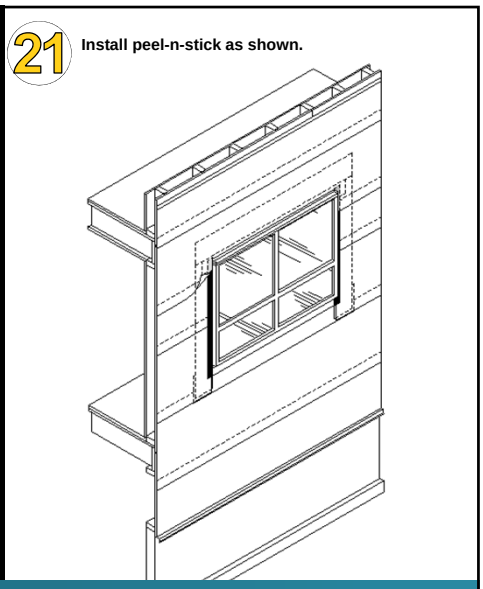

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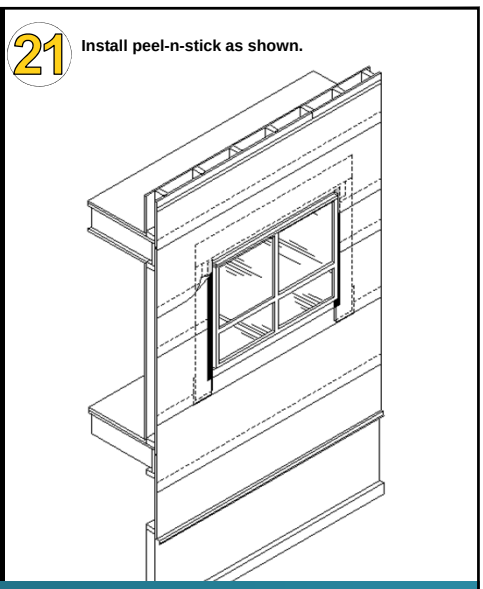

Raising the Bar

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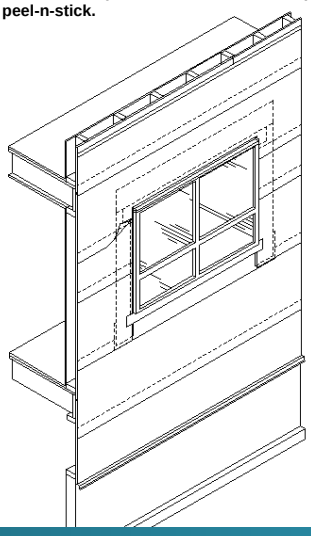
34

20 Lift second layer fifth row at window to prepare for peel-n-stick.



Raising the Bar

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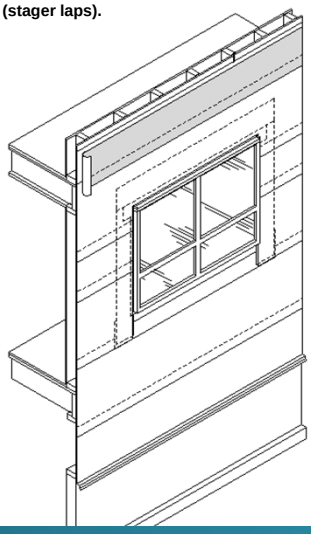
19 Building paper installation second layer sixth row (stager laps).



Raising the Bar

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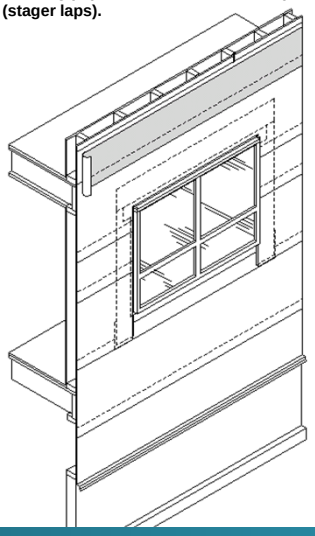
19 Building paper installation second layer sixth row (stager laps).



Raising the Bar

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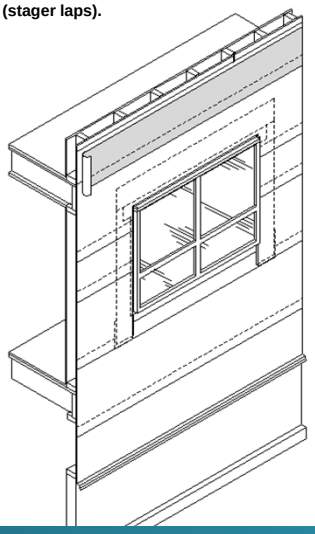

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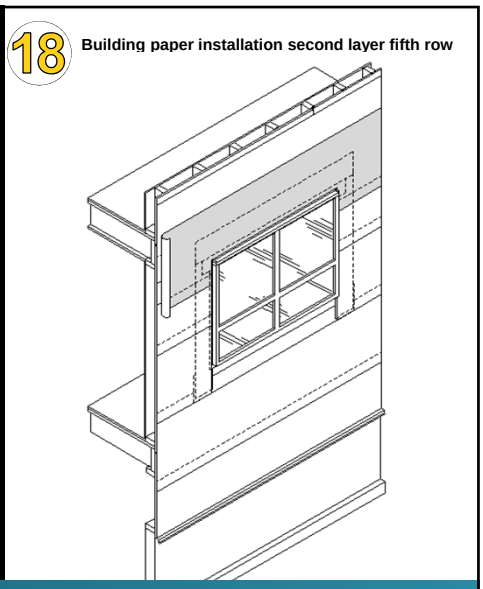

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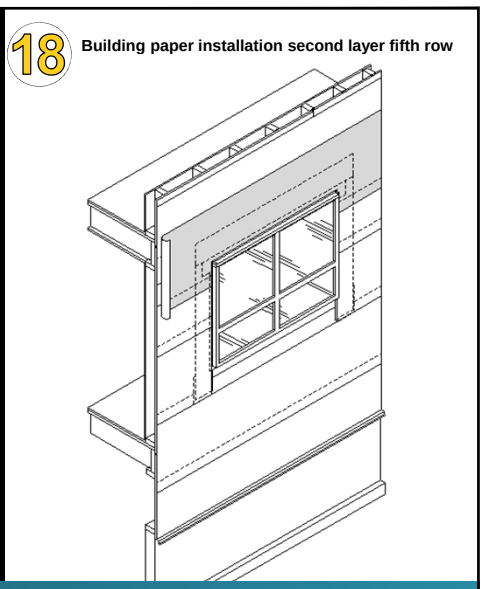

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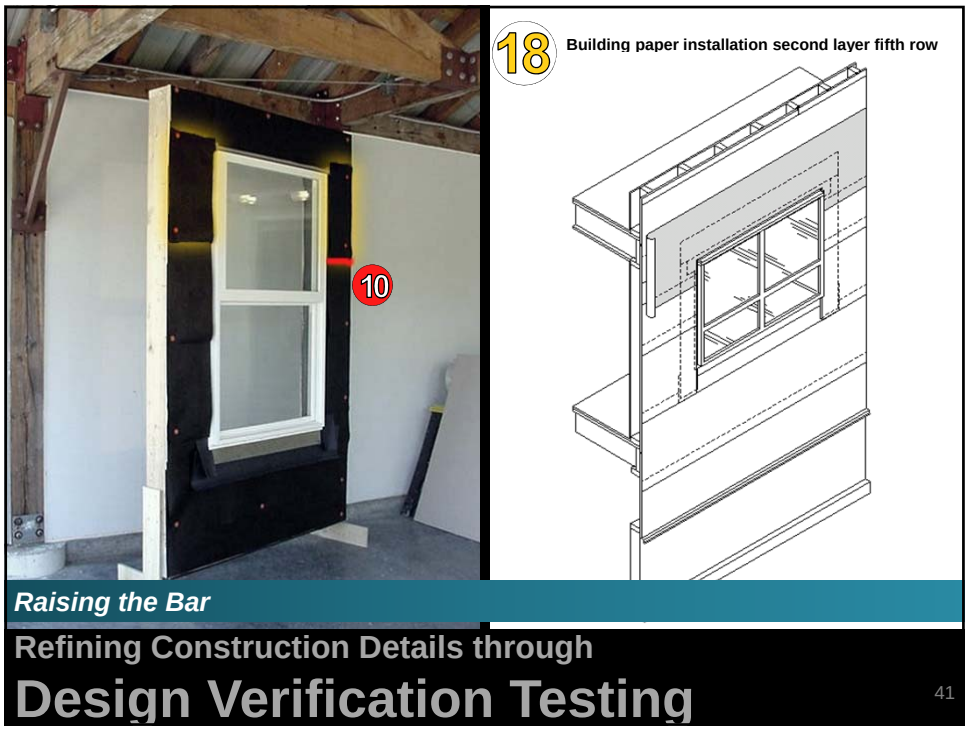
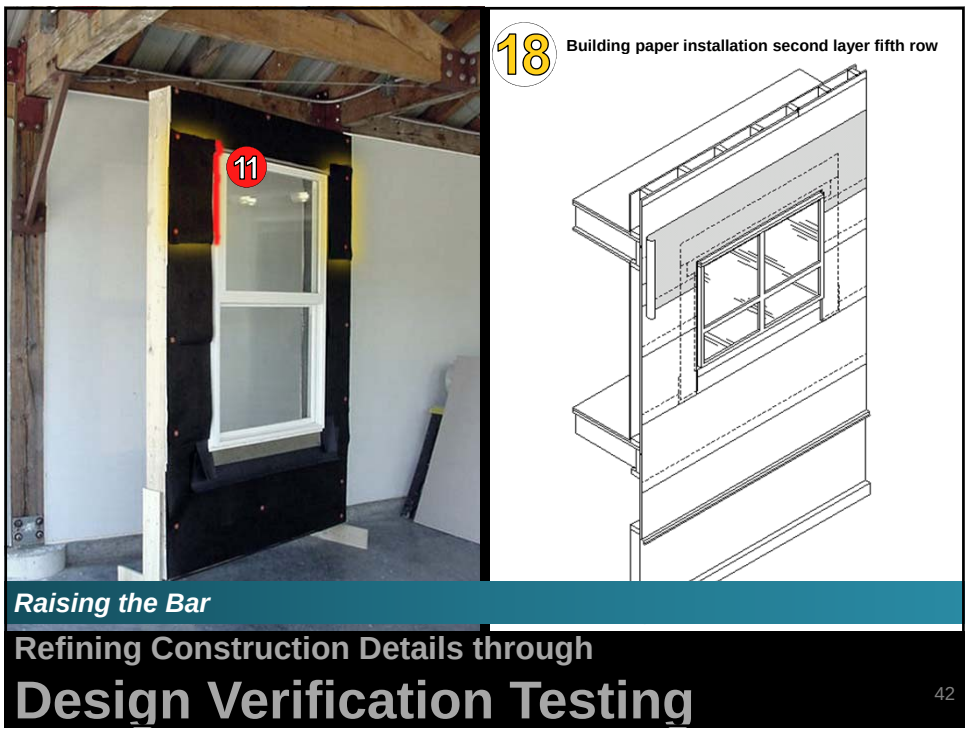

10
18
Building paper installation second layer fifth row
Raising the Bar
Refining Construction Details through
Design Verification Testing
41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Building paper installation second layer fifth row
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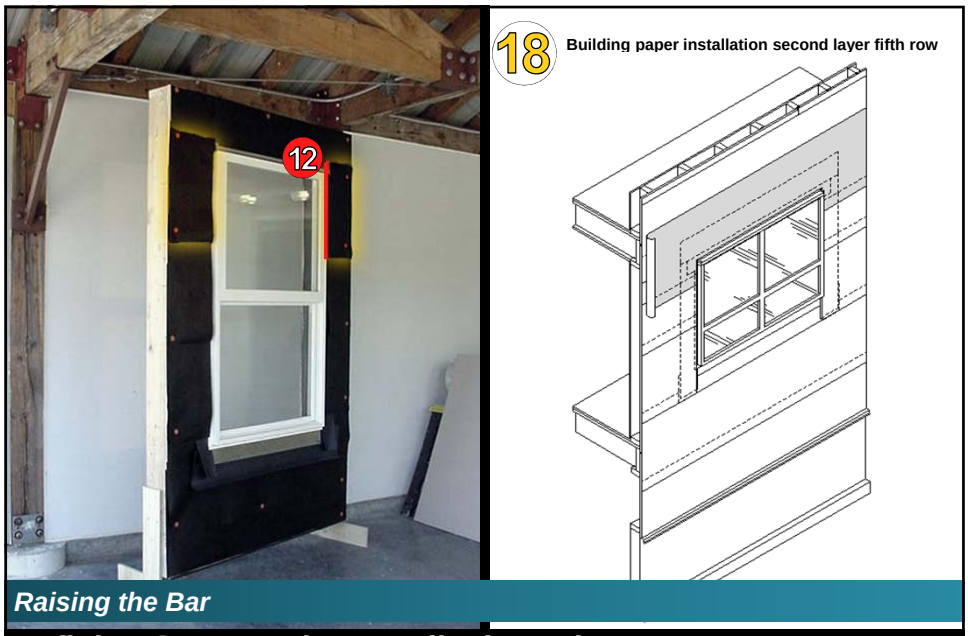

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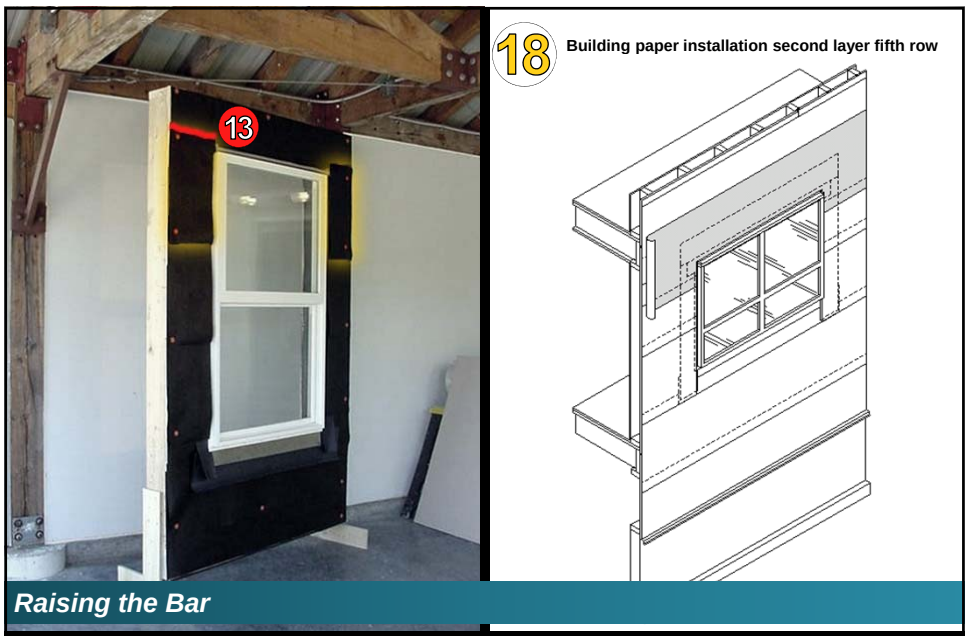

Raising the Bar

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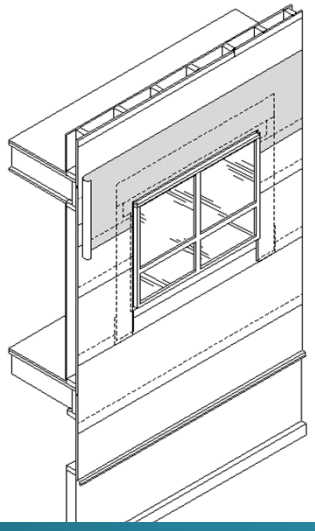
18 Building paper installation second layer fifth row



Raising the Bar

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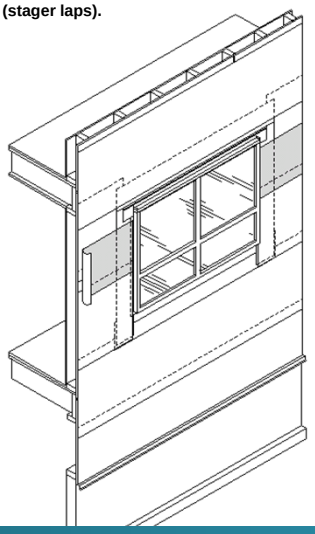
17 Building paper installation second layer fourth row (stager laps).



Raising the Bar

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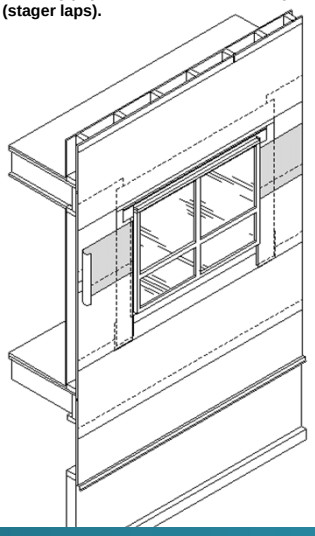
17 Building paper installation second layer fourth row (stager laps).



Raising the Bar

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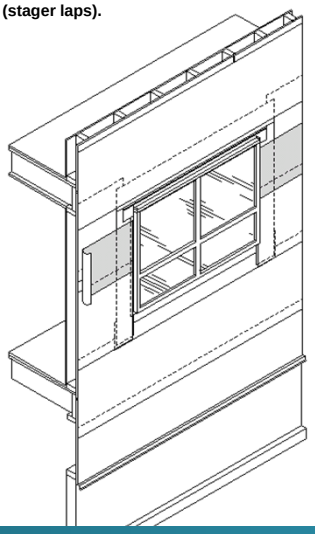
17 Building paper installation second layer fourth row (stager laps).



Raising the Bar

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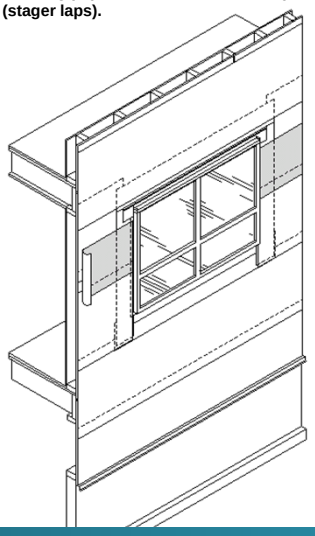
17 Building paper installation second layer fourth row (stager laps).



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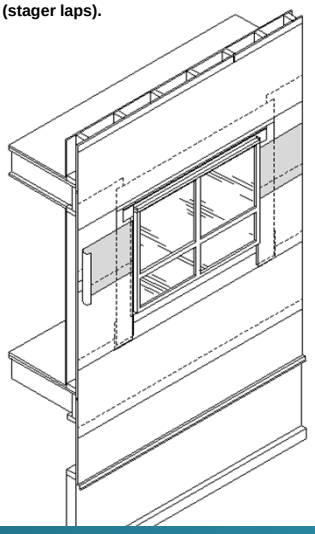

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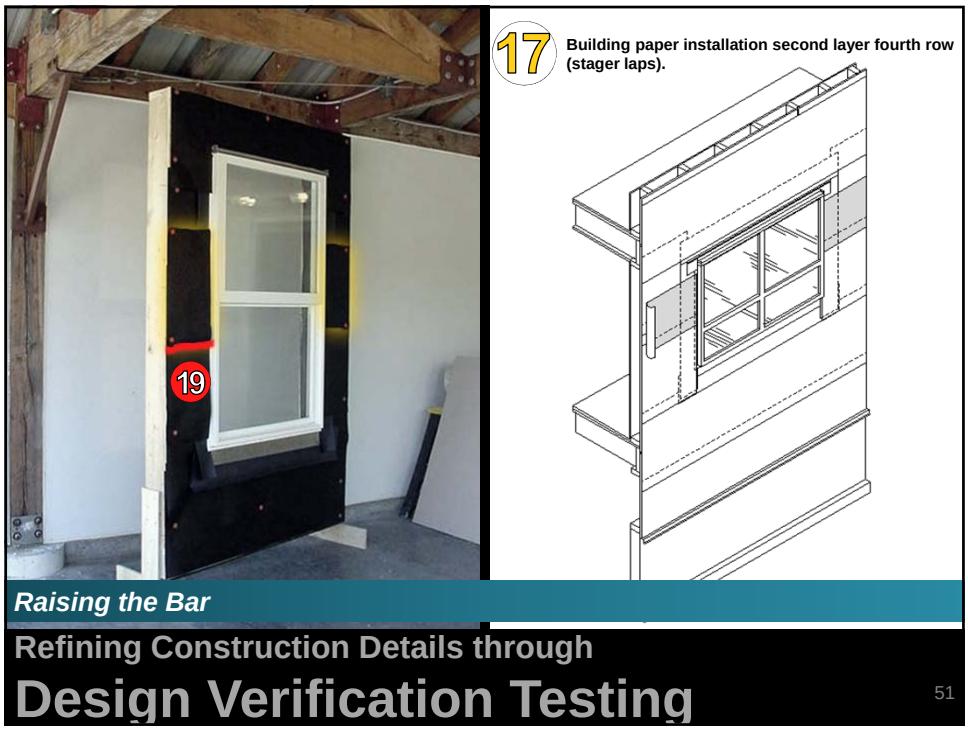
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Building paper installation second layer fourth row (stager laps).
Raising the Bar
Refining Construction Details through
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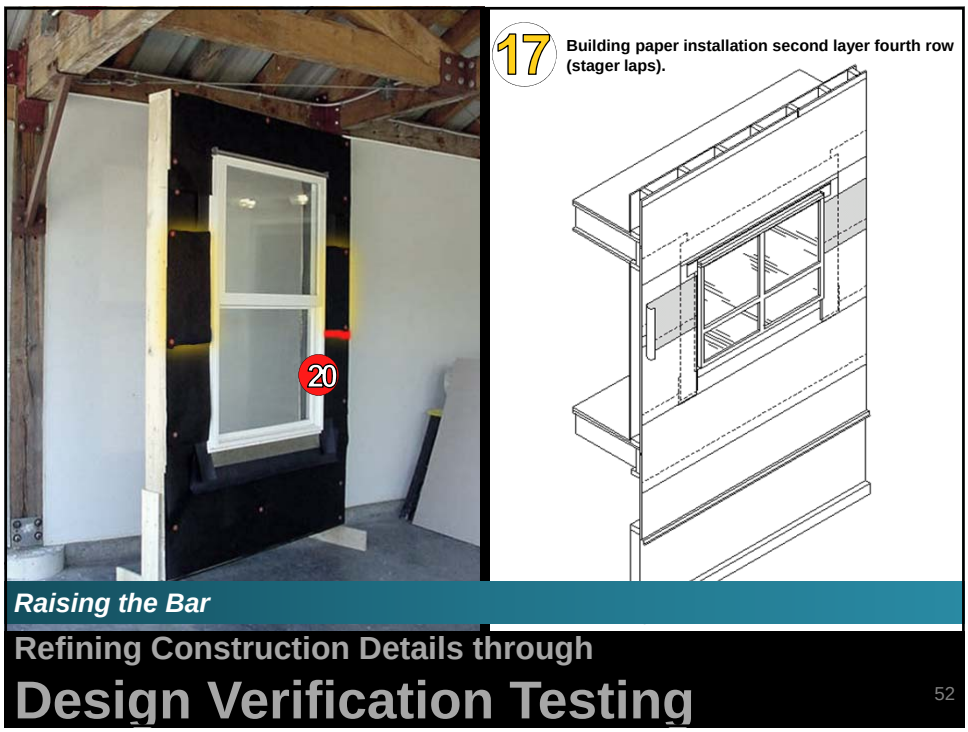
51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Building paper installation second layer fourth row (stager laps).
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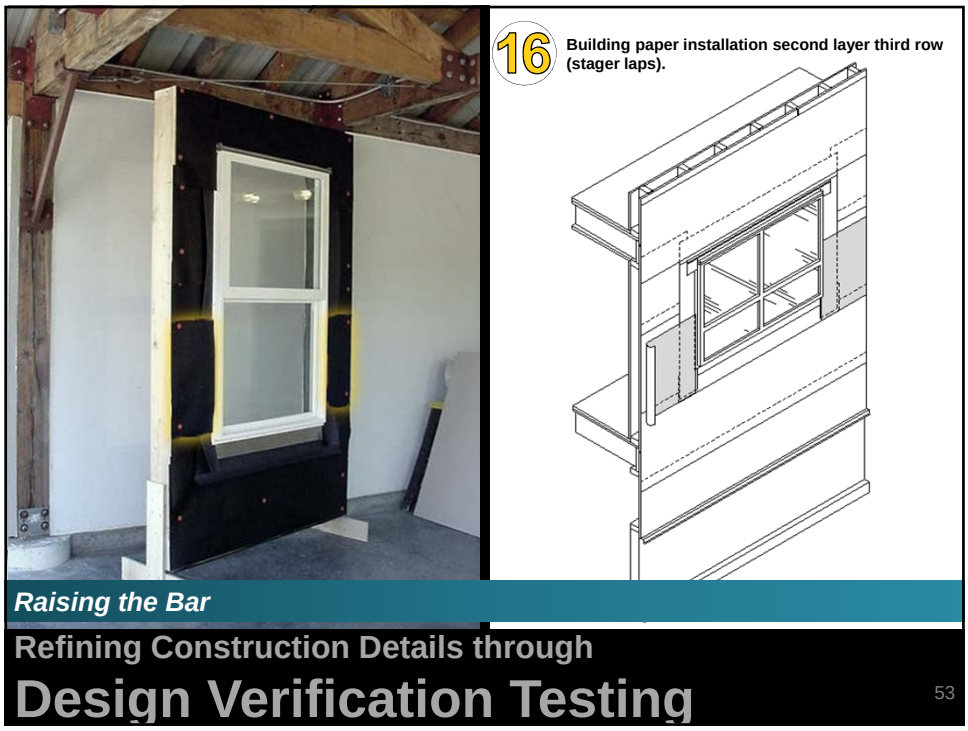

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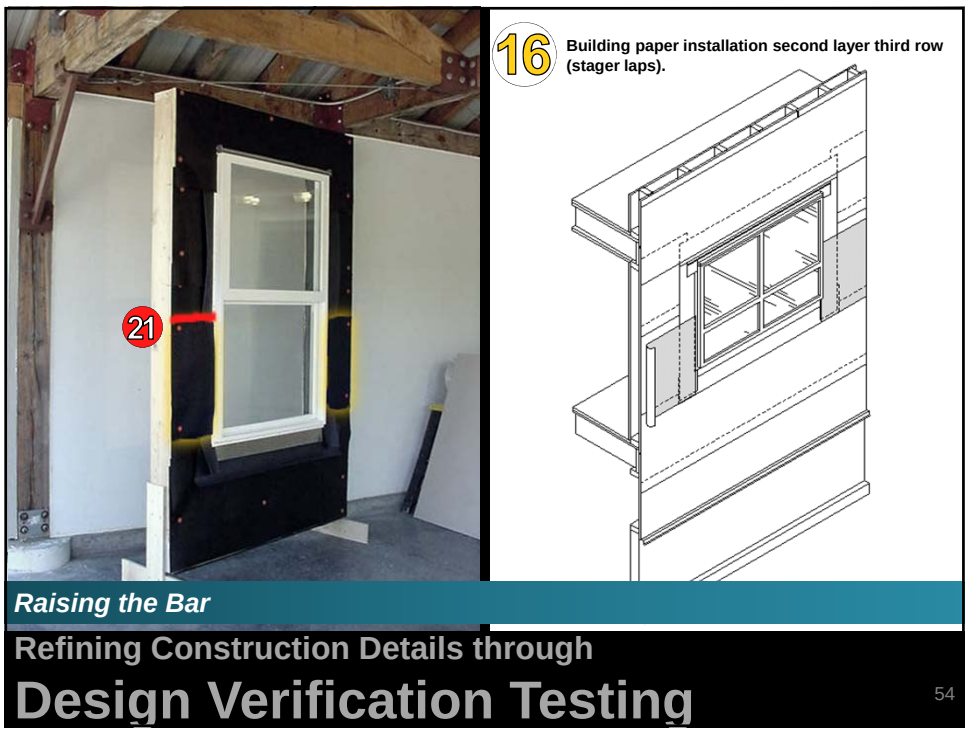

Raising the Bar

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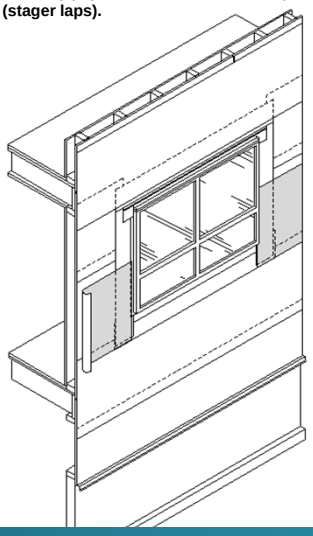
16 Building paper installation second layer third row (stager laps).



Raising the Bar

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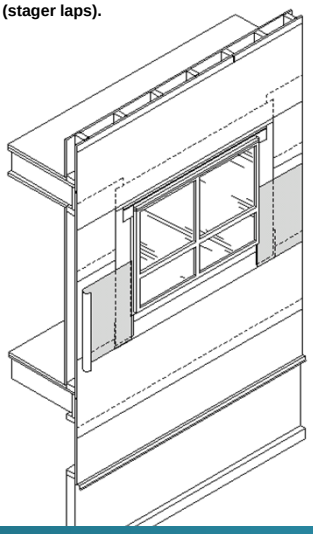
16 Building paper installation second layer third row (stager laps).



Raising the Bar

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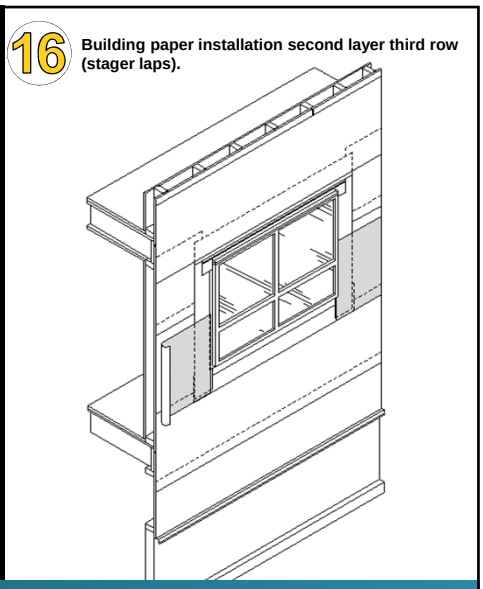

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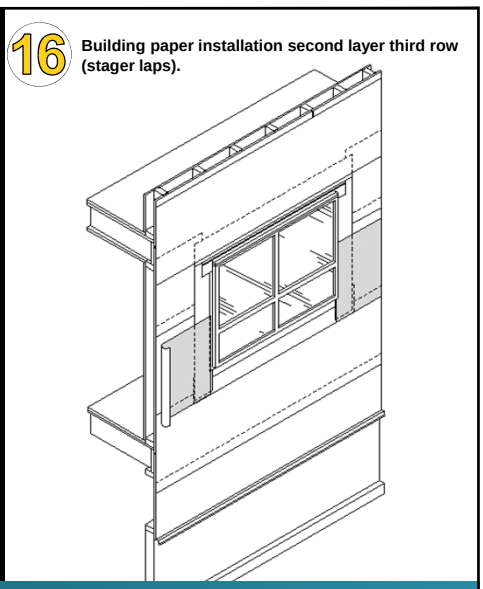

Raising the Bar

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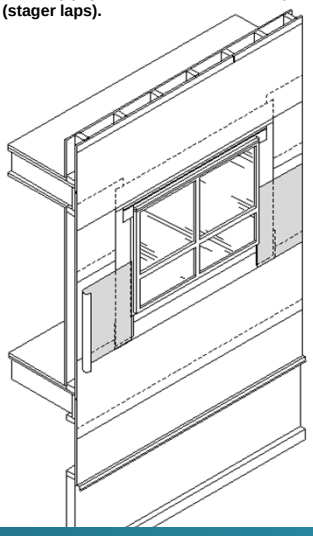
16 Building paper installation second layer third row (stager laps).



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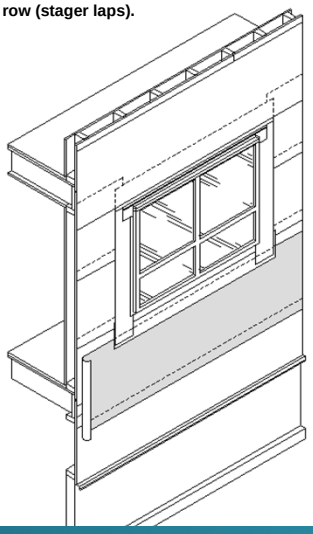
15 Building paper installation second layer second row (stager laps).



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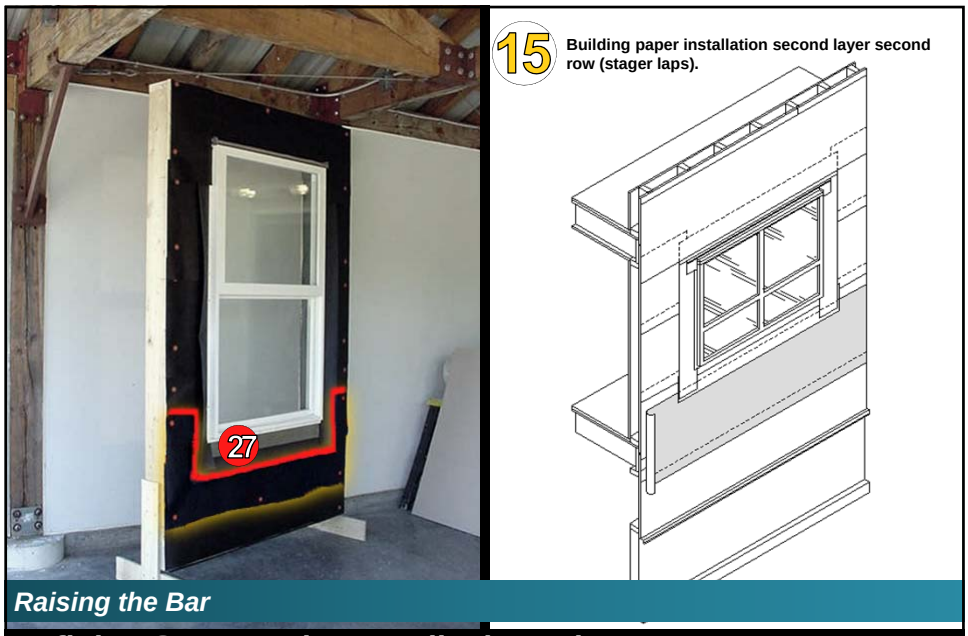

Raising the Bar

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Raising the Bar

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Design Verification Testing

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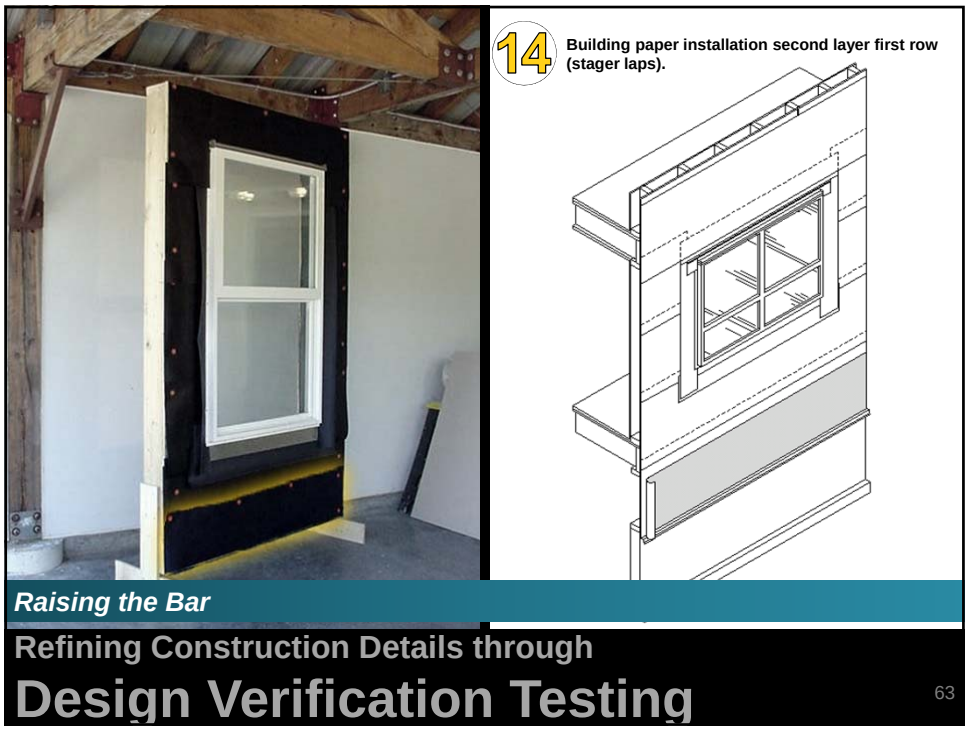
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Building paper installation second layer first row (stager laps).
Raising the Bar
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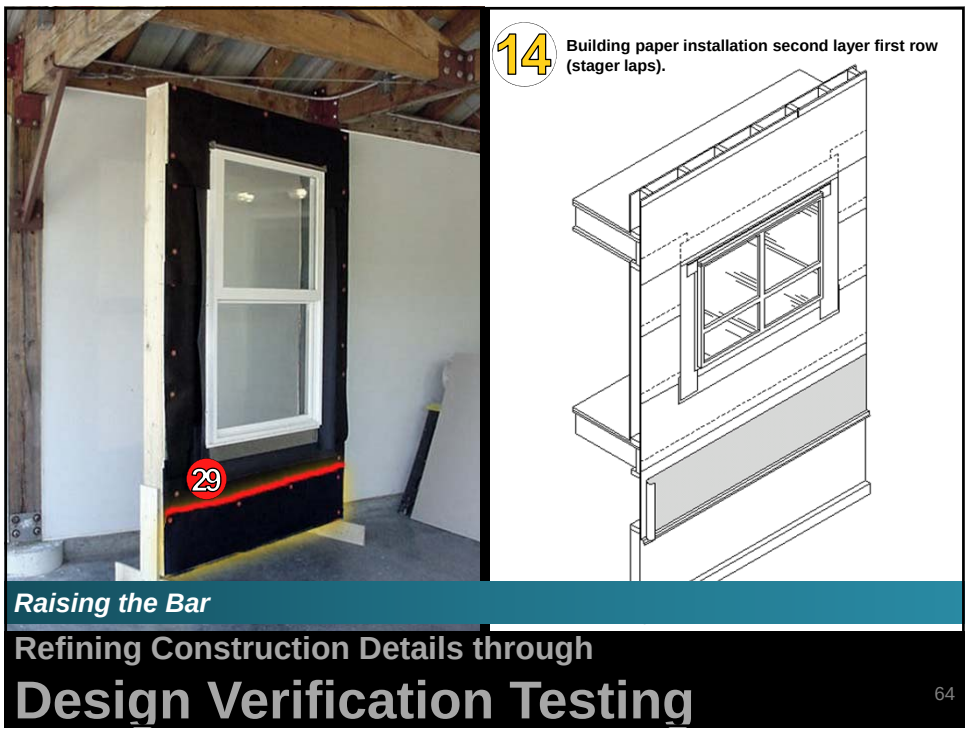
63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Building paper installation second layer first row (stager laps).
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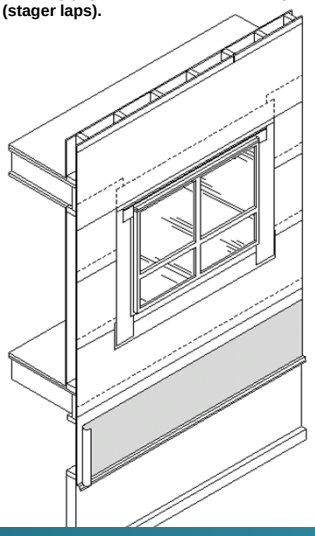
14 Building paper installation second layer first row (stager laps).



Raising the Bar

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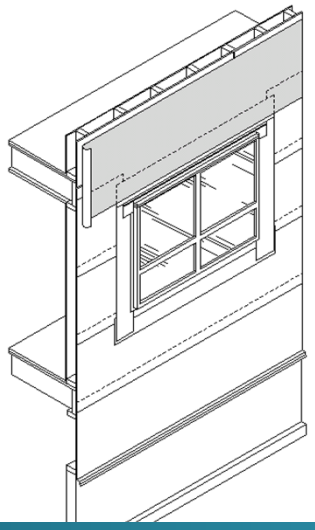
65

13 Building paper installation first layer fifth row.

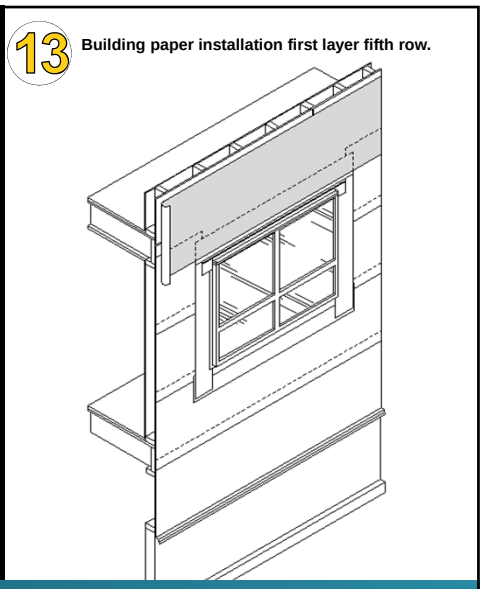


Raising the Bar

Refining Construction Details through

Design Verification Testing

66

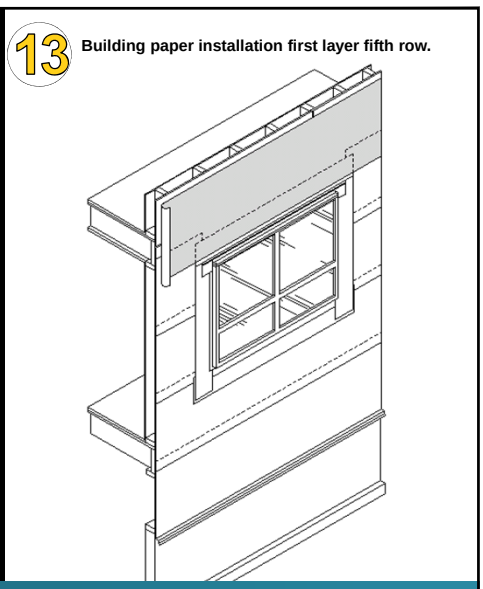


Raising the Bar

Refining Construction Details through

Design Verification Testing

67

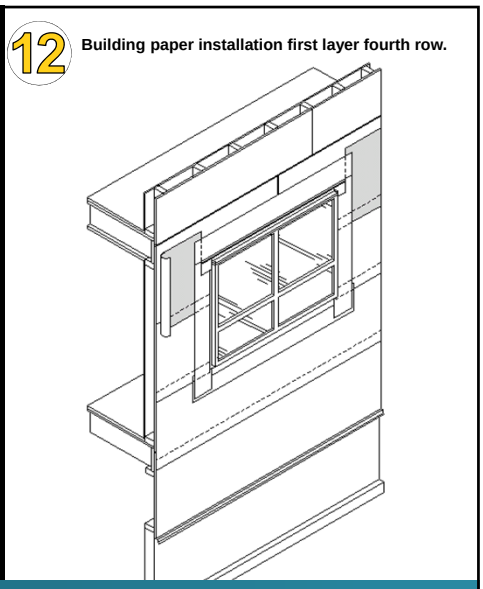


Raising the Bar

Refining Construction Details through

Design Verification Testing

68

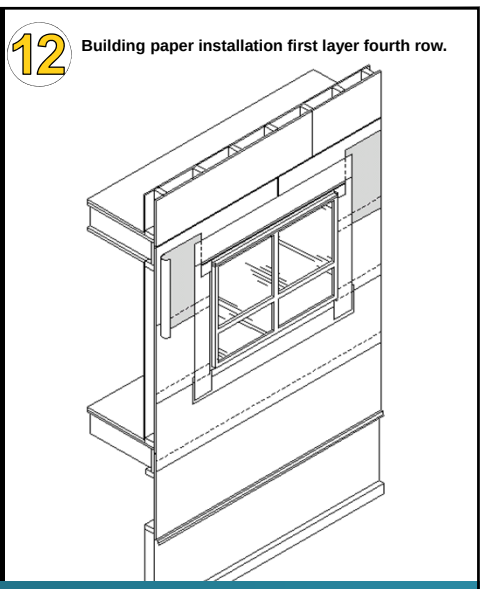


Raising the Bar

Refining Construction Details through

Design Verification Testing

69

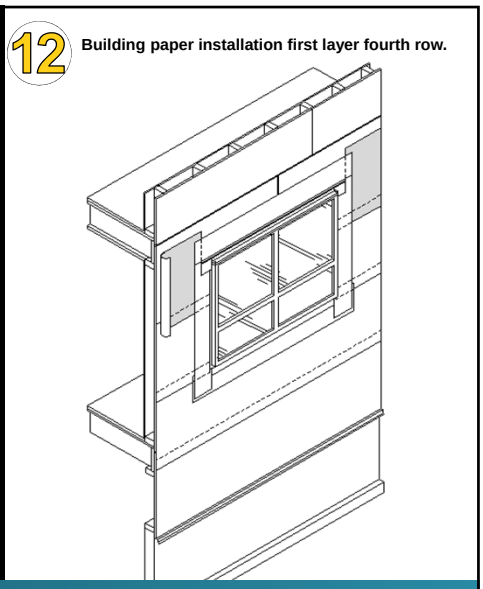


Raising the Bar

Refining Construction Details through

Design Verification Testing

70

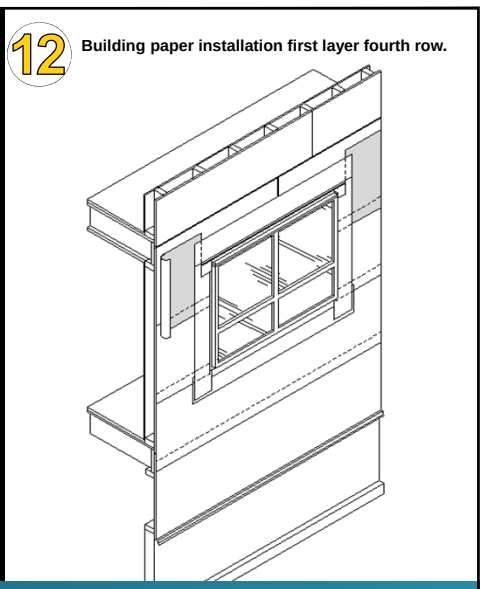


Raising the Bar

Refining Construction Details through

Design Verification Testing

71

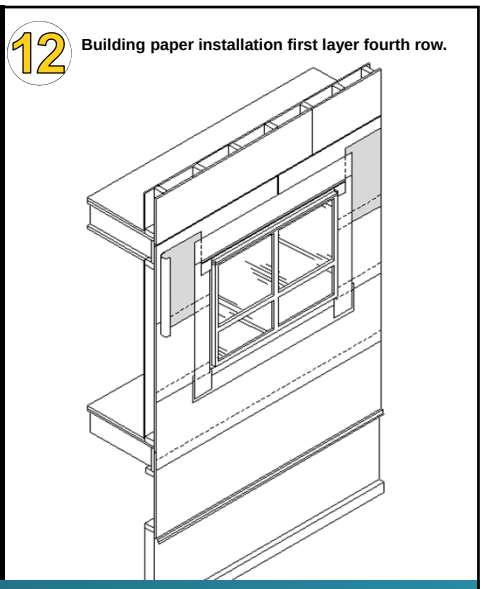


Raising the Bar

Refining Construction Details through

Design Verification Testing

72

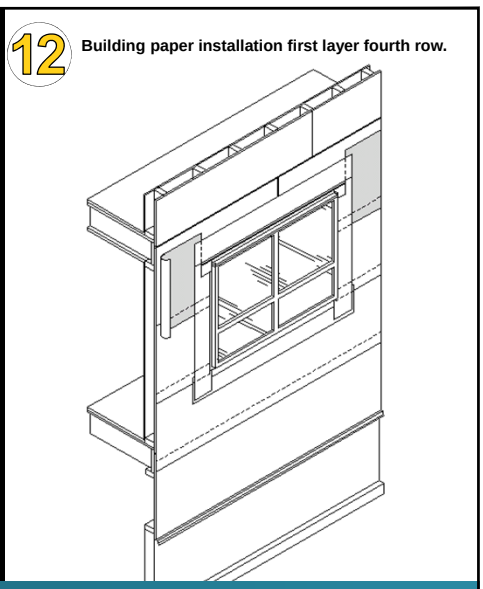


Raising the Bar

Refining Construction Details through

Design Verification Testing

73



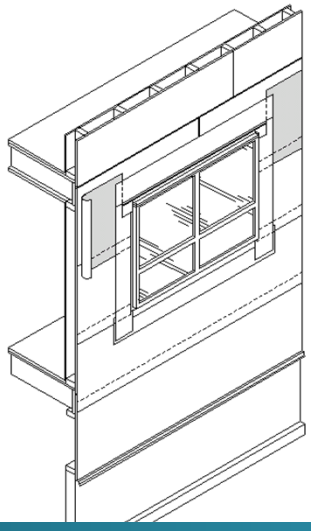
Raising the Bar

Refining Construction Details through

Design Verification Testing

74

12 Building paper installation first layer fourth row.



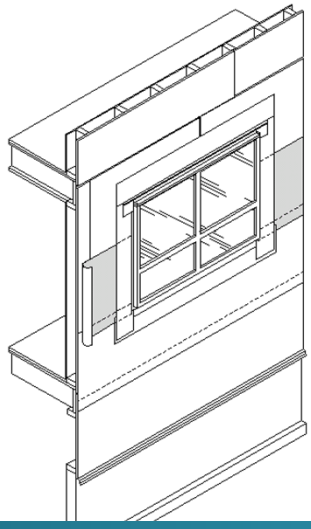
Raising the Bar

Refining Construction Details through

Design Verification Testing

75

11 Building paper installation first layer third row.

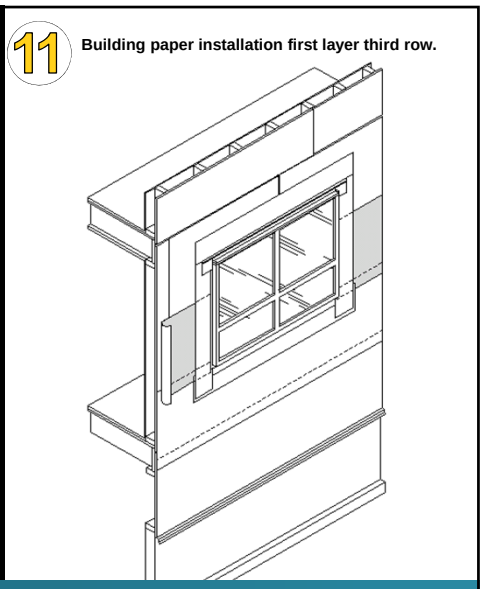


Raising the Bar

Refining Construction Details through

Design Verification Testing

76

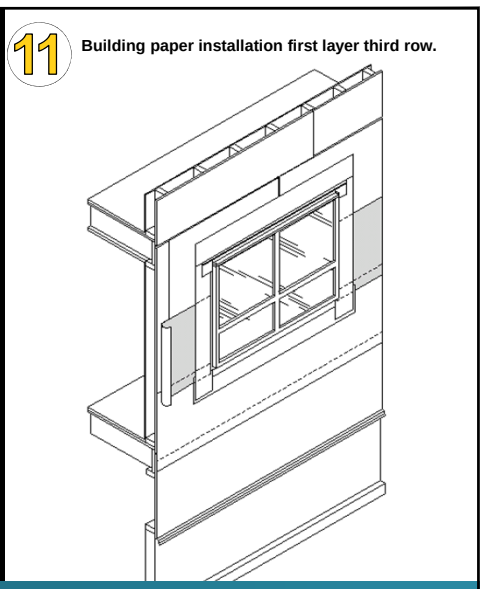


Raising the Bar

Refining Construction Details through

Design Verification Testing

77

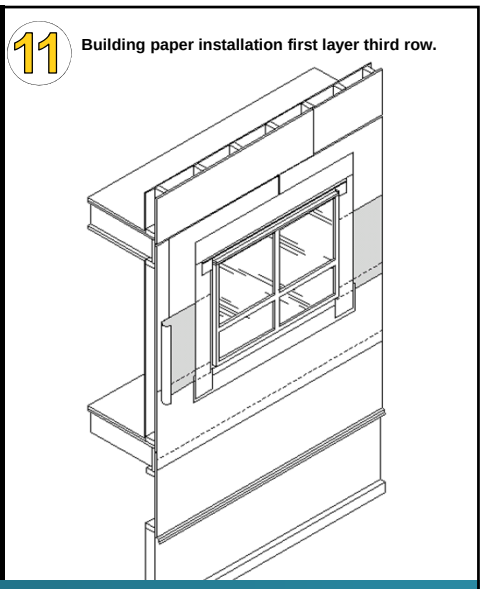


Raising the Bar

Refining Construction Details through

Design Verification Testing

78

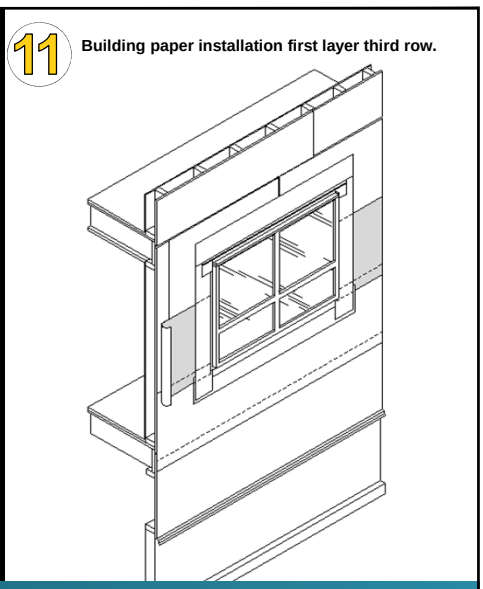


Raising the Bar

Refining Construction Details through

Design Verification Testing

79

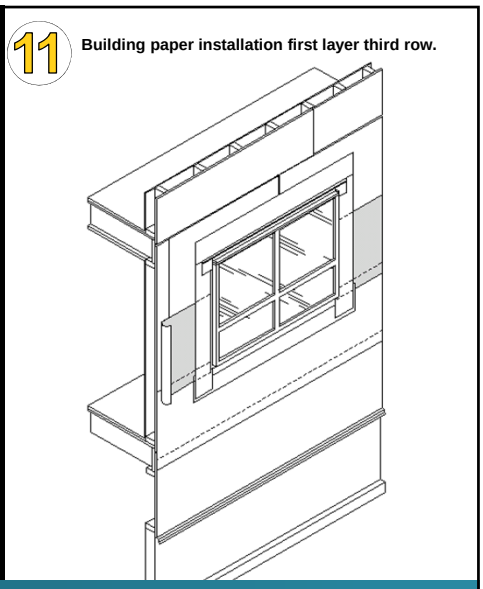


Raising the Bar

Refining Construction Details through

Design Verification Testing

80

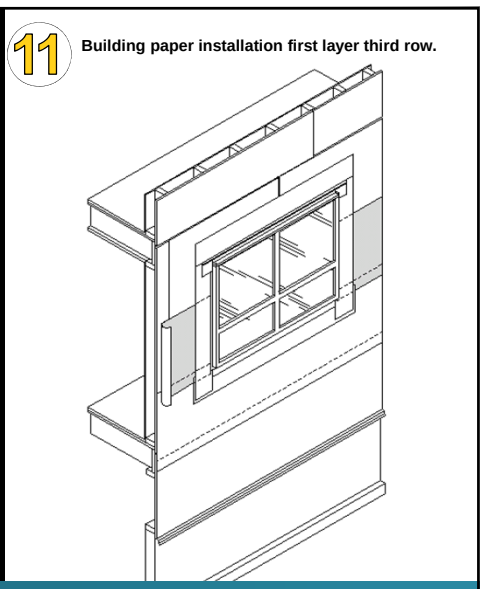


Raising the Bar

Refining Construction Details through

Design Verification Testing

81

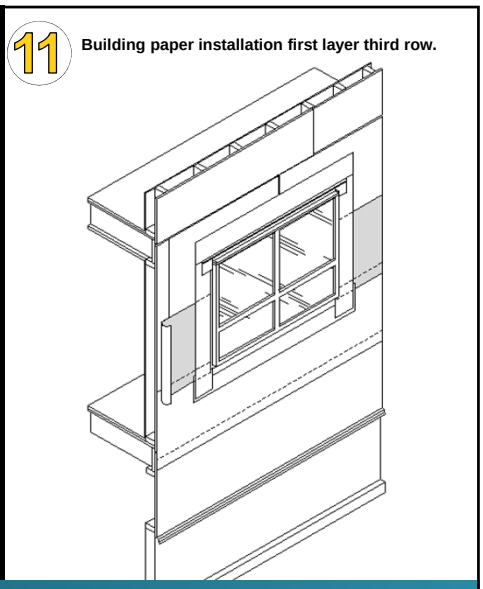


Raising the Bar

Refining Construction Details through

Design Verification Testing

82

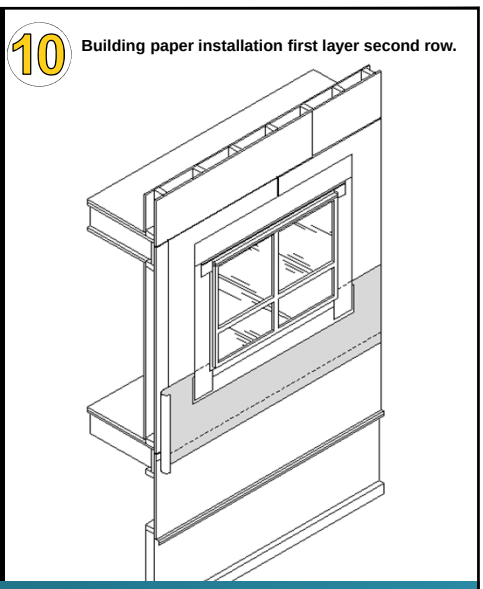


Raising the Bar

Refining Construction Details through

Design Verification Testing

83

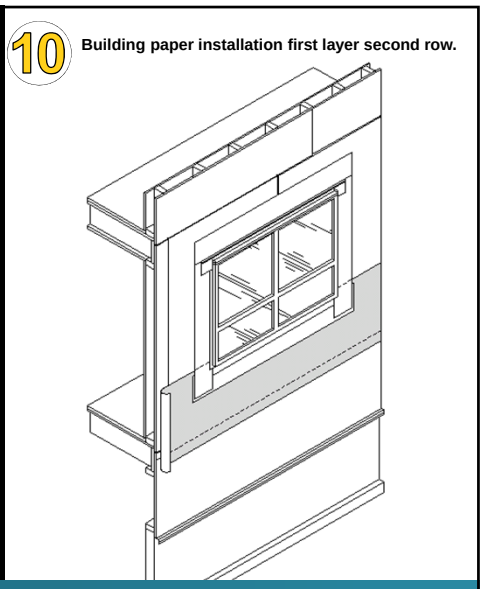


Raising the Bar

Refining Construction Details through

Design Verification Testing

84

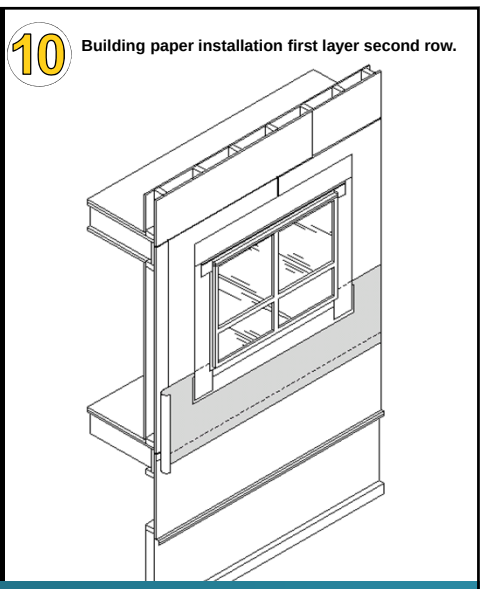


Raising the Bar

Refining Construction Details through

Design Verification Testing

85

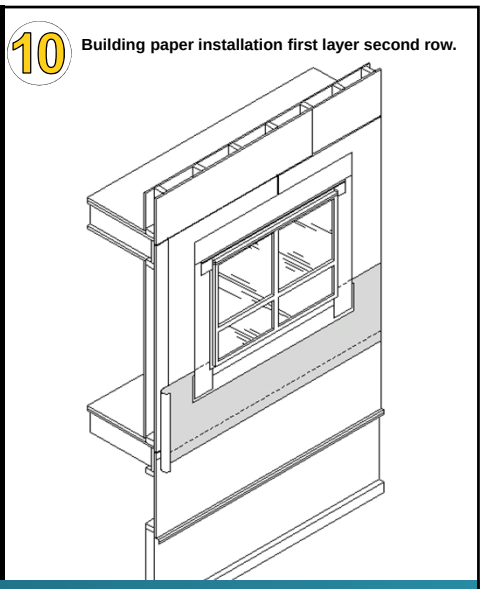


Raising the Bar

Refining Construction Details through

Design Verification Testing

86

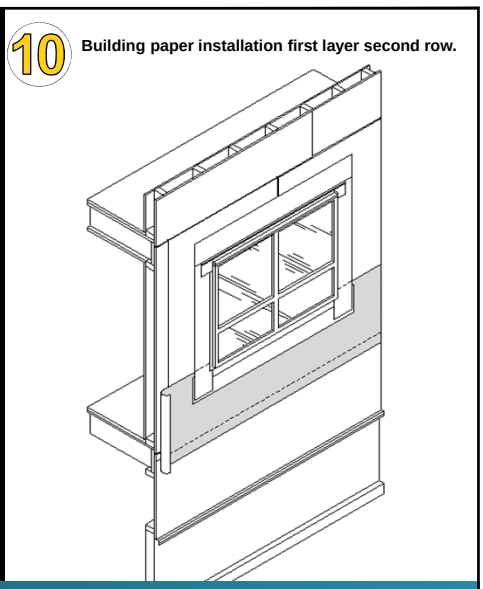


Raising the Bar

Refining Construction Details through

Design Verification Testing

87

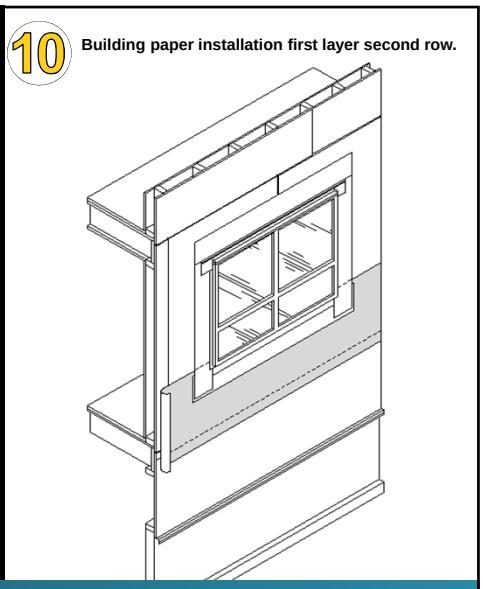


Raising the Bar

Refining Construction Details through

Design Verification Testing

88

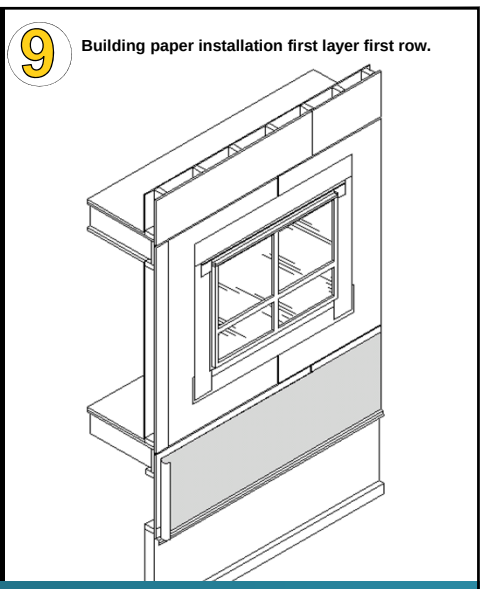


Raising the Bar

Refining Construction Details through

Design Verification Testing

89

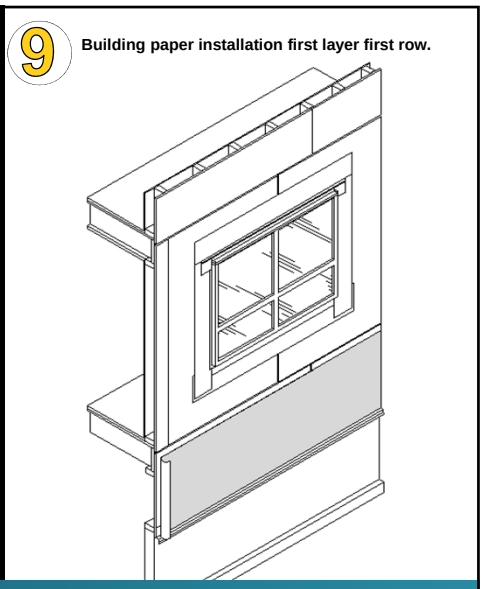


Raising the Bar

Refining Construction Details through

Design Verification Testing

90

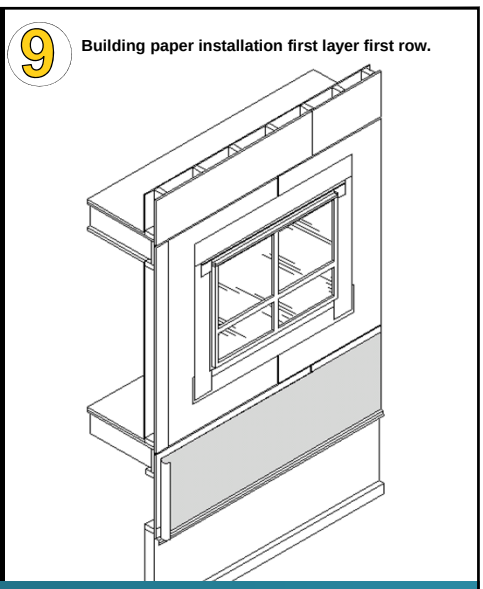


Raising the Bar

Refining Construction Details through

Design Verification Testing

91



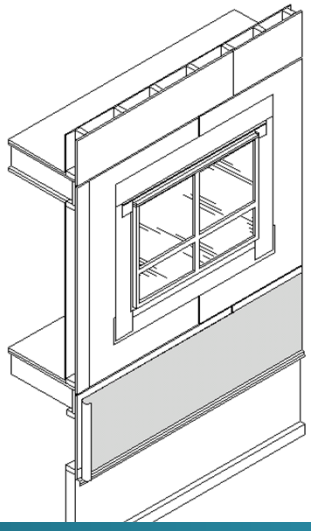
Raising the Bar

Refining Construction Details through

Design Verification Testing

92

9 Building paper installation first layer first row.



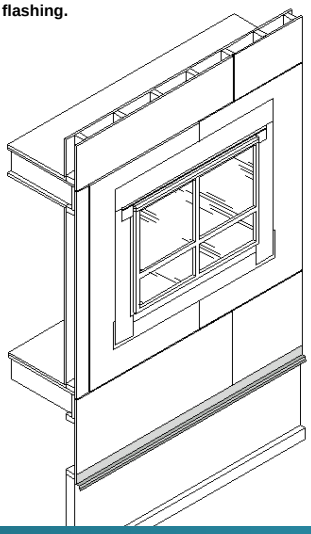
Raising the Bar

Refining Construction Details through

Design Verification Testing

93

8 Begin building installation paper with drip edge flashing.

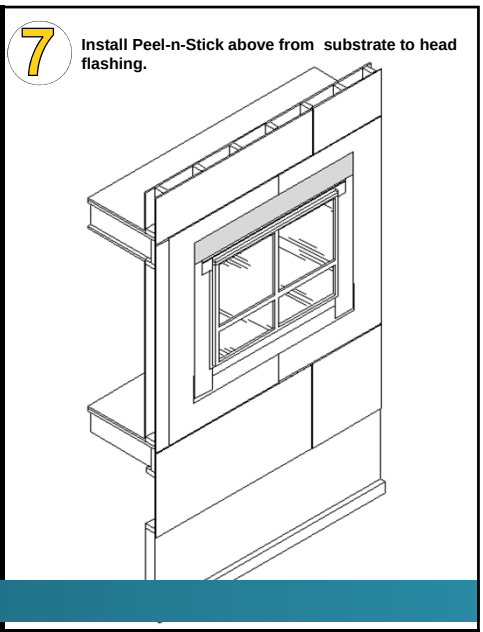


Raising the Bar

Refining Construction Details through

Design Verification Testing

94

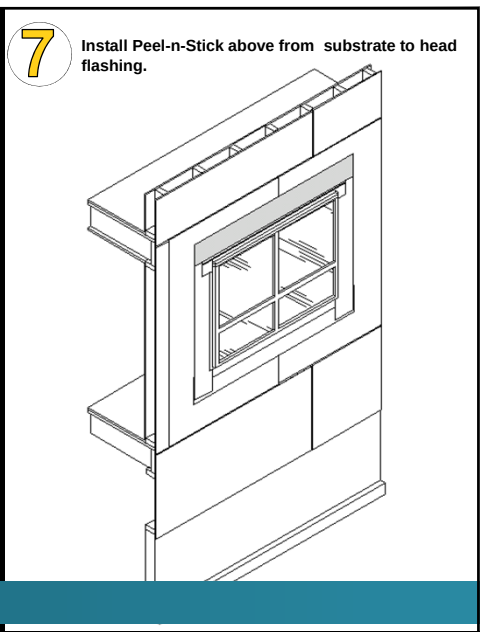


Raising the Bar

Refining Construction Details through

Design Verification Testing

95

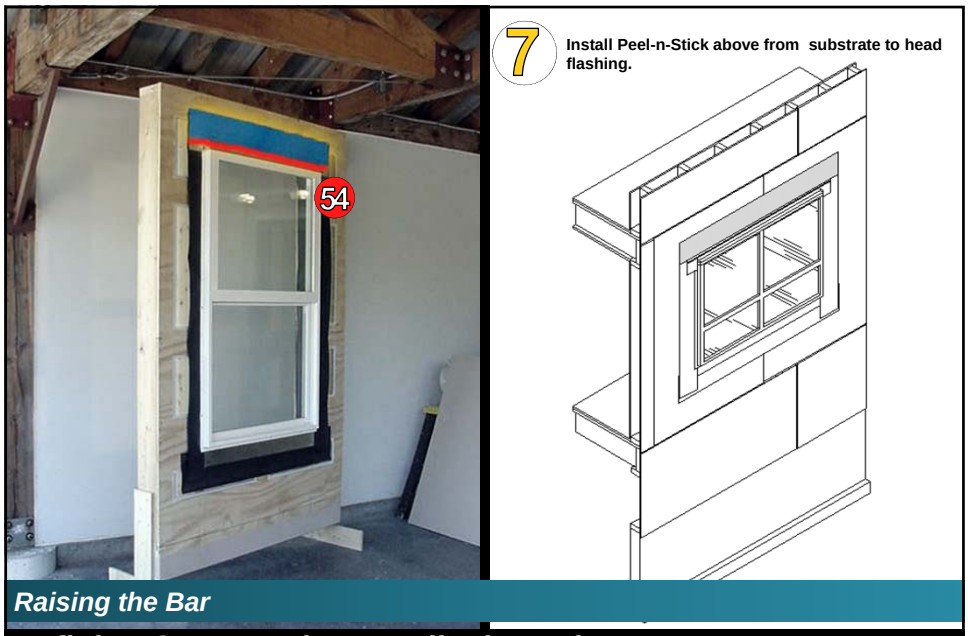


Raising the Bar

Refining Construction Details through

Design Verification Testing

96

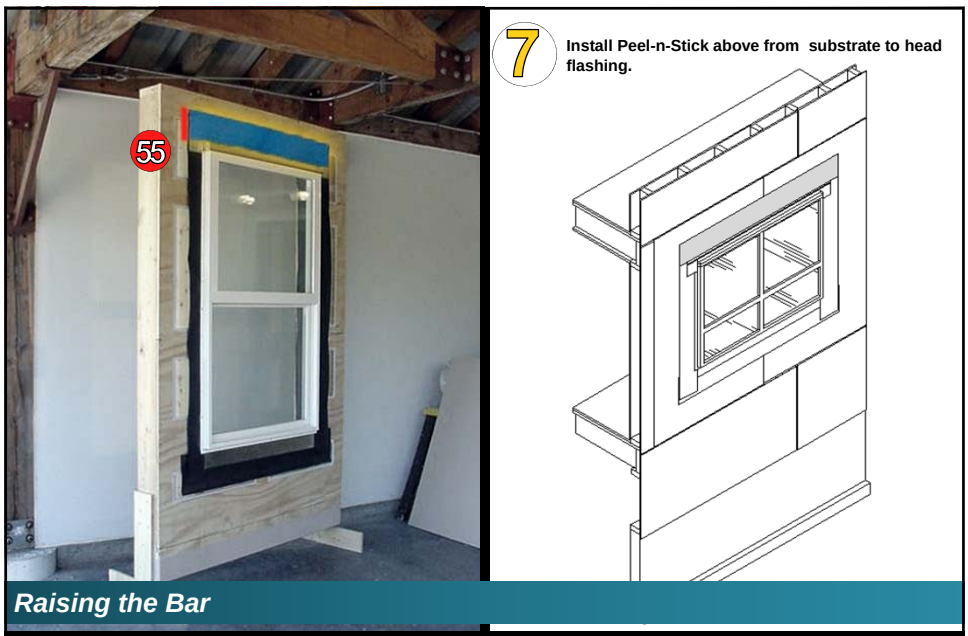


Raising the Bar

Refining Construction Details through

Design Verification Testing

97



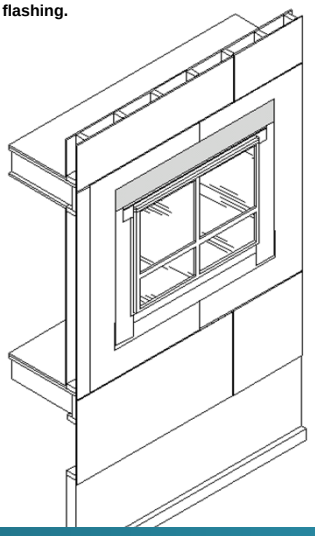
Raising the Bar

Refining Construction Details through

Design Verification Testing

98

7 Install Peel-n-Stick above from substrate to head flashing.



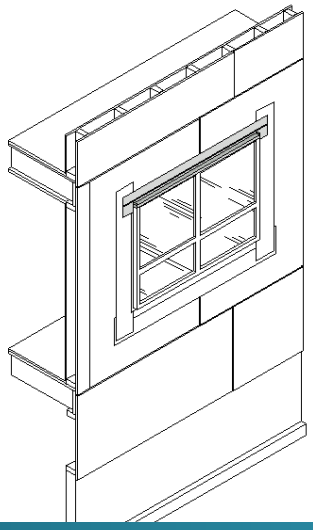
Raising the Bar

Refining Construction Details through

Design Verification Testing

99

6 Install sheet metal head flashing.

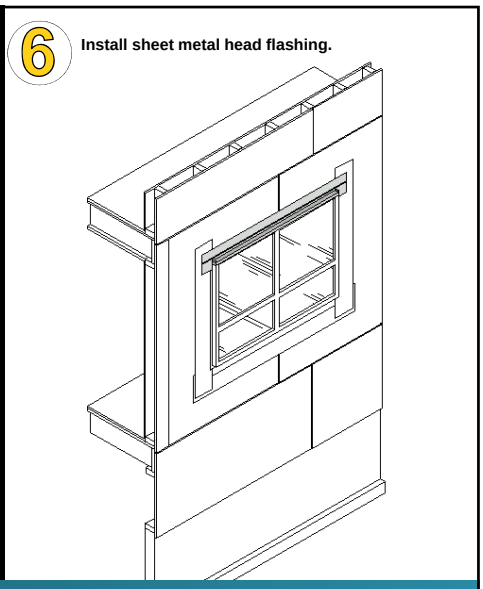


Raising the Bar

Refining Construction Details through

Design Verification Testing

100

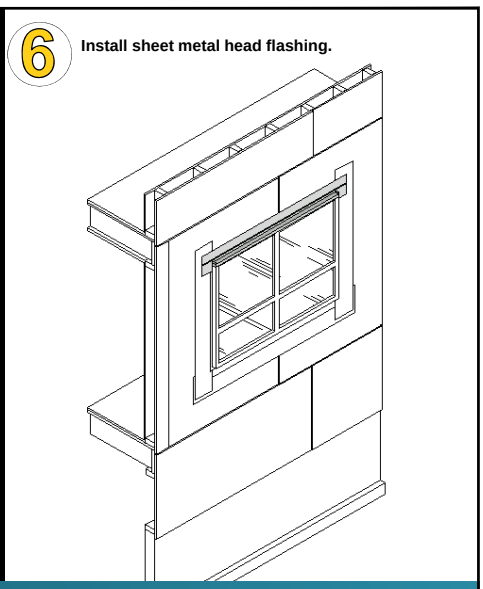


Raising the Bar

Refining Construction Details through

Design Verification Testing

101



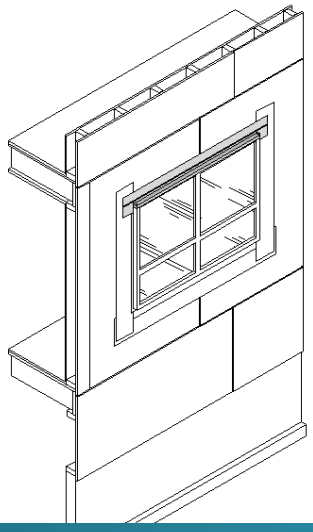
Raising the Bar

Refining Construction Details through

Design Verification Testing

102

6 Install sheet metal head flashing.



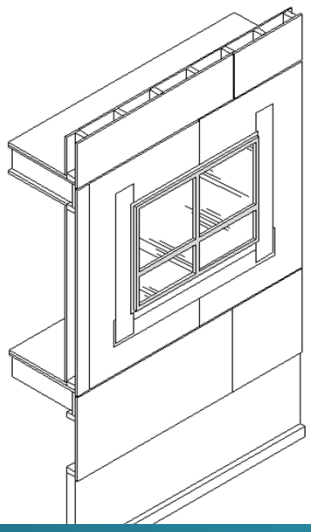
Raising the Bar

Refining Construction Details through

Design Verification Testing

103

5 Install window.

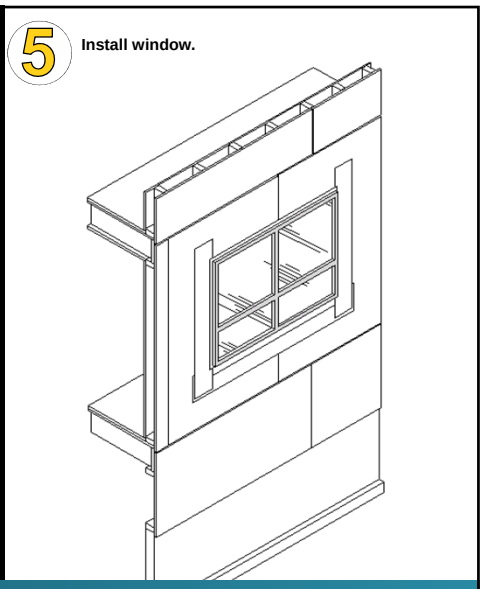


Raising the Bar

Refining Construction Details through

Design Verification Testing

104

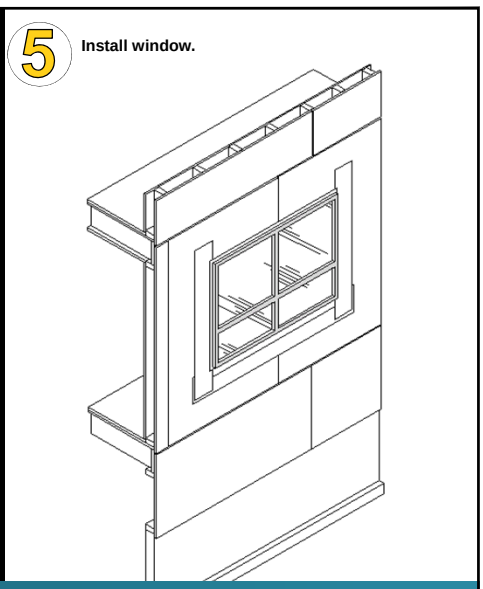


Raising the Bar

Refining Construction Details through

Design Verification Testing

105

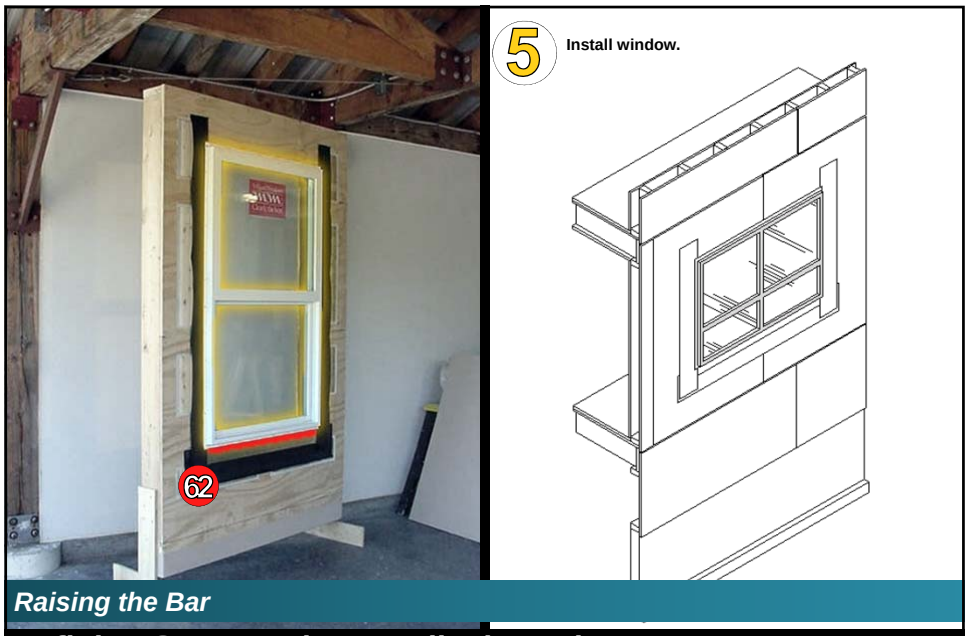


Raising the Bar

Refining Construction Details through

Design Verification Testing

106

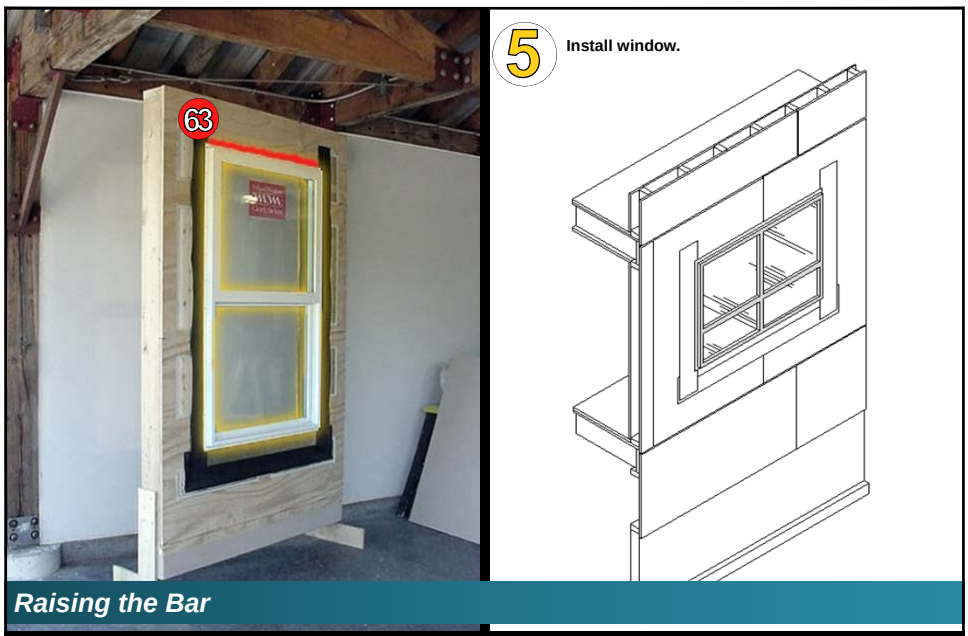


Raising the Bar

Refining Construction Details through

Design Verification Testing

107



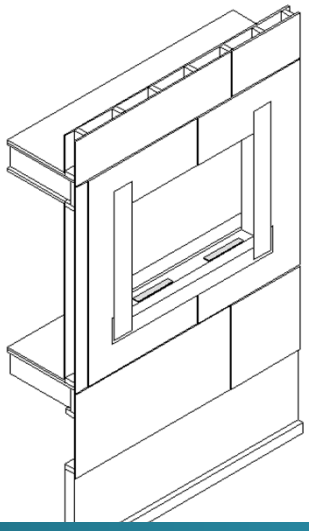
Raising the Bar

Refining Construction Details through

Design Verification Testing

108

4 Install shims.



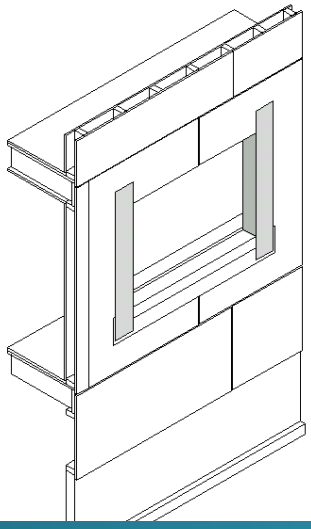
Raising the Bar

Refining Construction Details through

Design Verification Testing

109

3 Install sheet membrane into window opening.

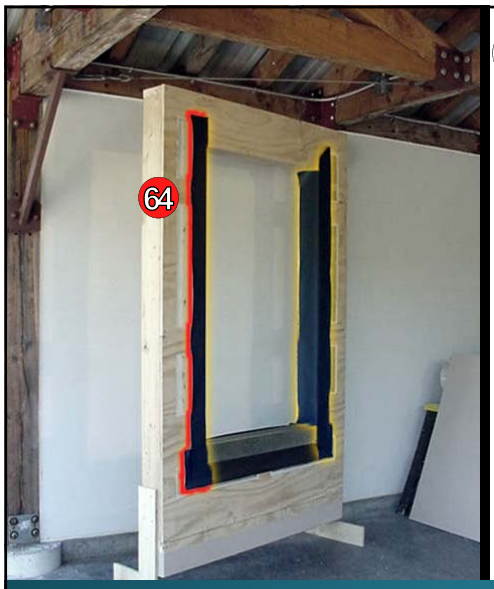


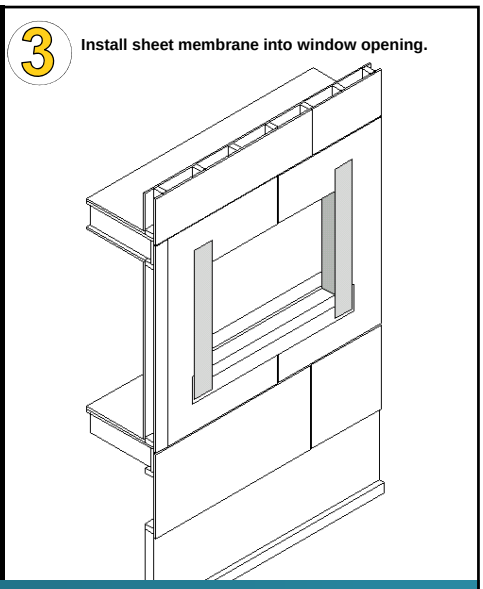
Raising the Bar

Refining Construction Details through

Design Verification Testing

110



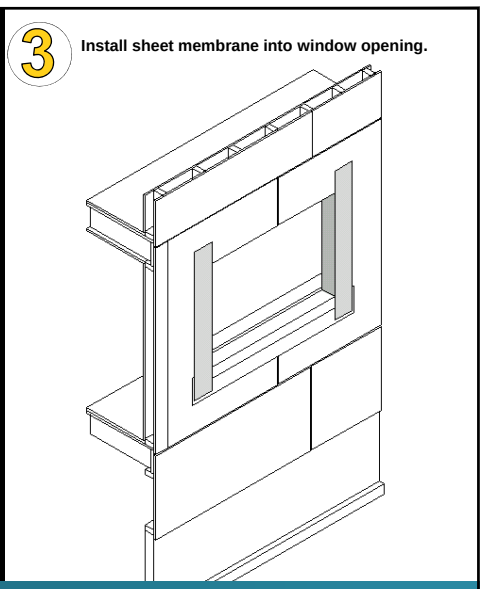


Raising the Bar

Refining Construction Details through

Design Verification Testing

111

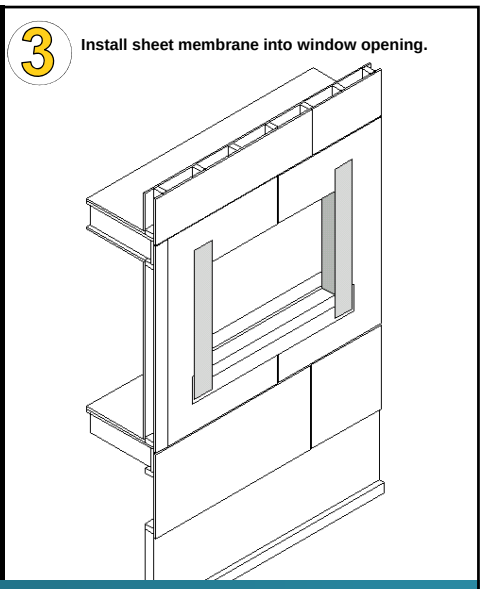


Raising the Bar

Refining Construction Details through

Design Verification Testing

112

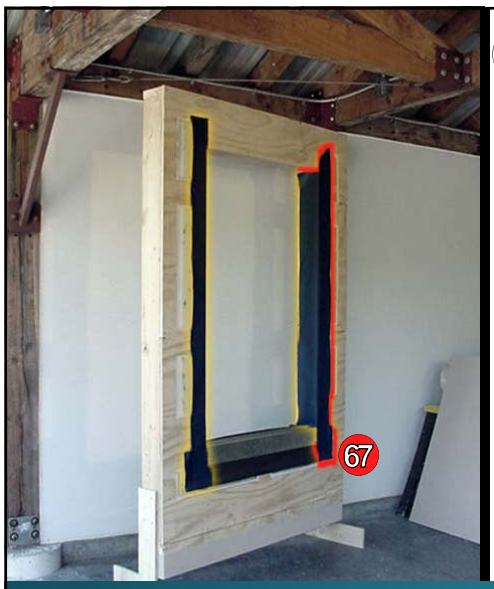


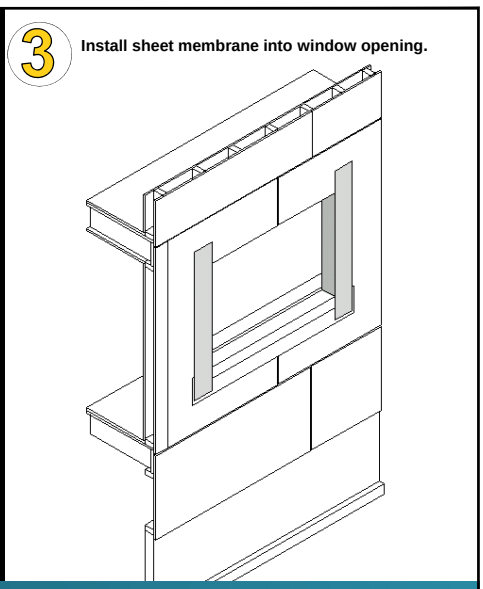
Raising the Bar

Refining Construction Details through

Design Verification Testing

113



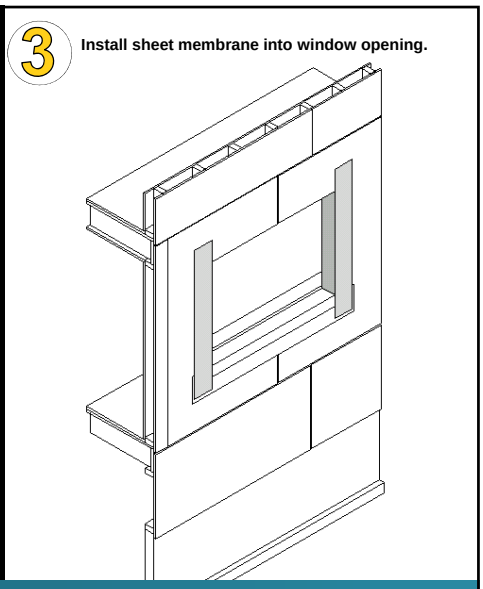


Raising the Bar

Refining Construction Details through

Design Verification Testing

114

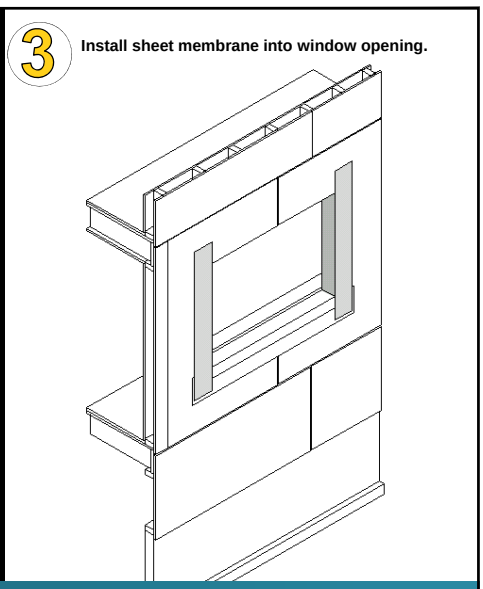


Raising the Bar

Refining Construction Details through

Design Verification Testing

115

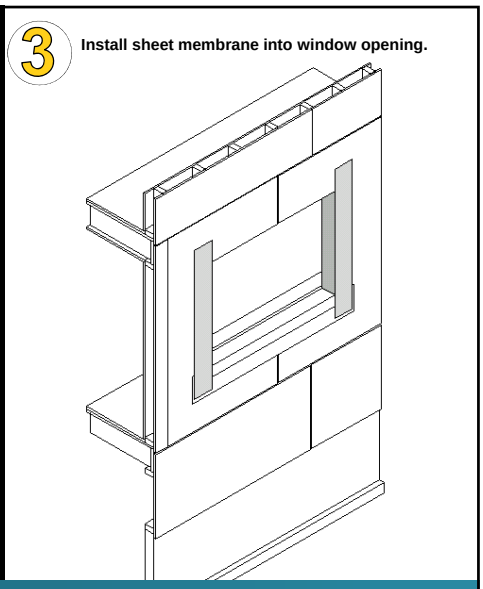


Raising the Bar

Refining Construction Details through

Design Verification Testing

116

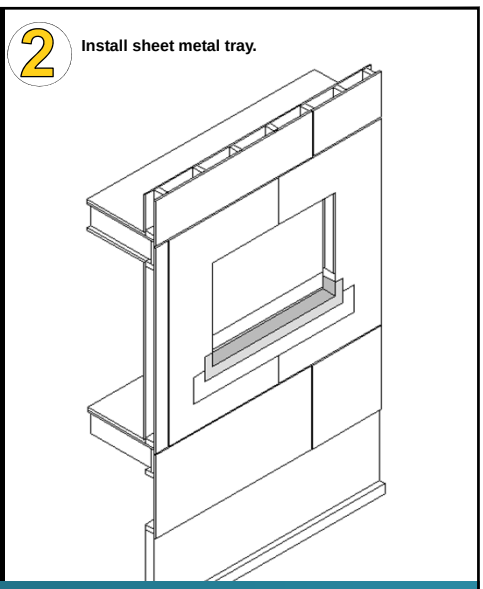


Raising the Bar

Refining Construction Details through

Design Verification Testing

117

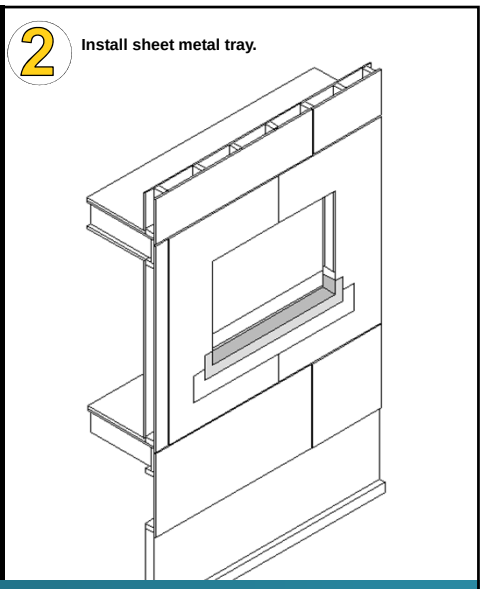


Raising the Bar

Refining Construction Details through

Design Verification Testing

118

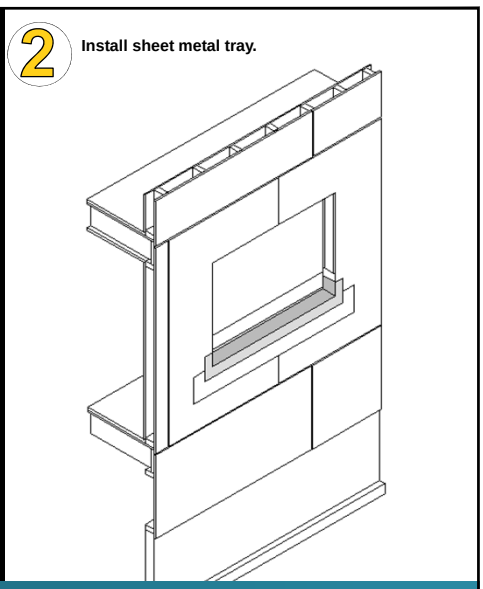


Raising the Bar

Refining Construction Details through

Design Verification Testing

119

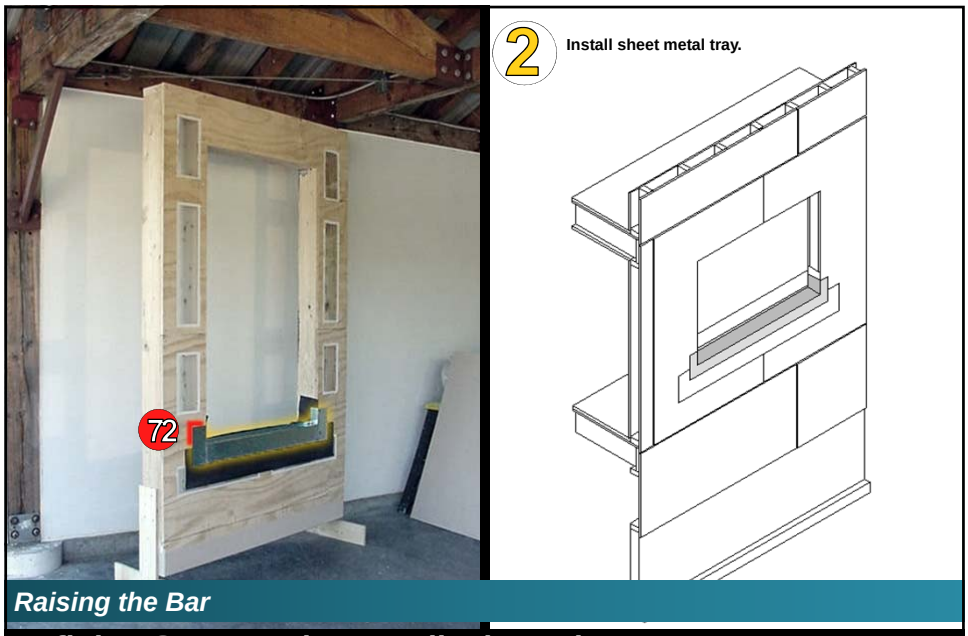


Raising the Bar

Refining Construction Details through

Design Verification Testing

120

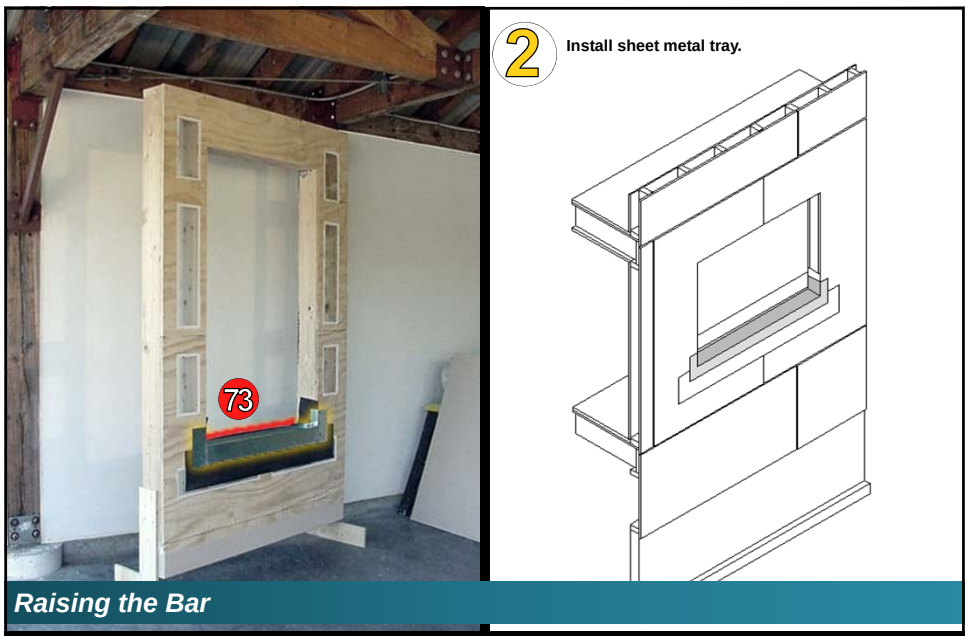


Raising the Bar

Refining Construction Details through

Design Verification Testing

121

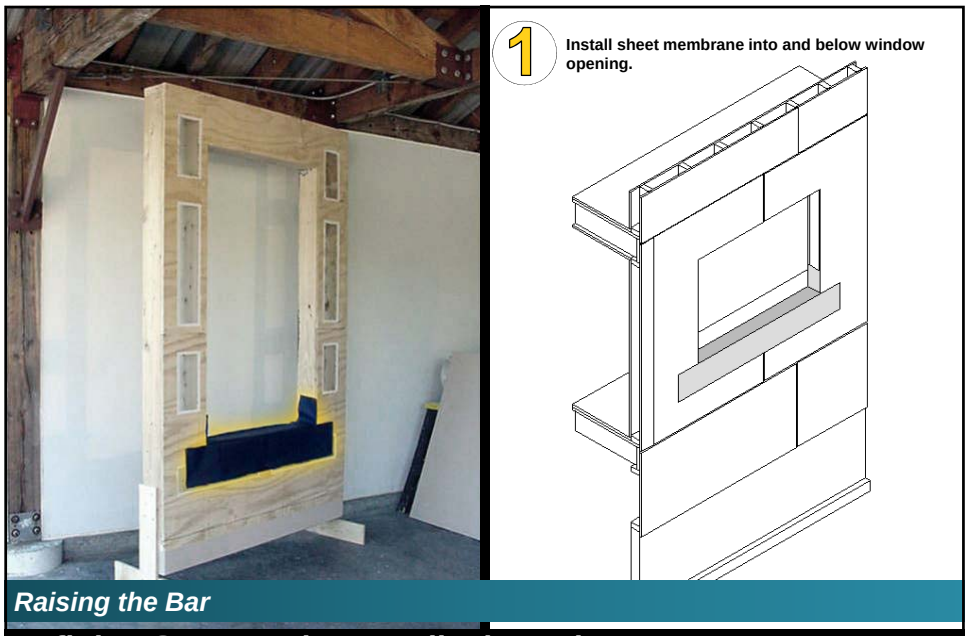


Raising the Bar

Refining Construction Details through

Design Verification Testing

122

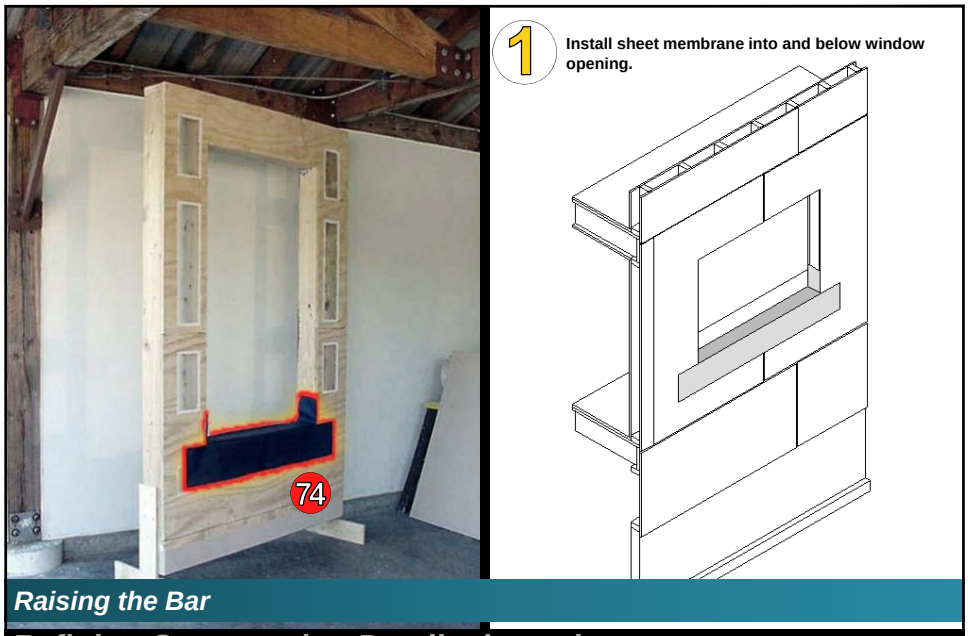


Raising the Bar

Refining Construction Details through

Design Verification Testing

123

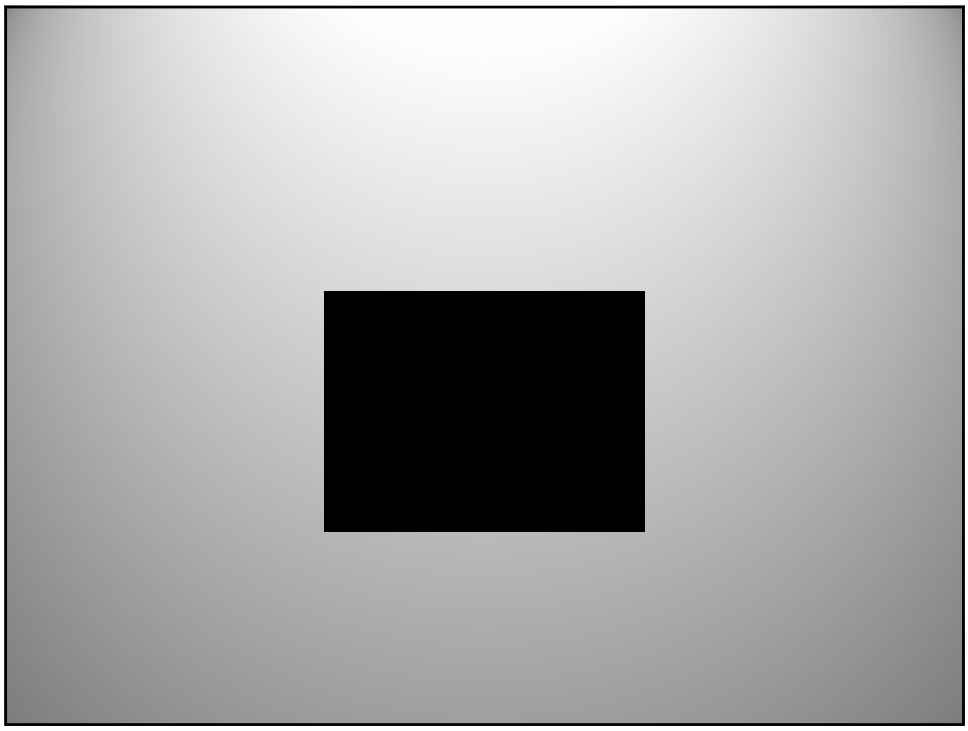


Raising the Bar

Refining Construction Details through

Design Verification Testing

124



ICC-ES AC 212 WRB Coatings

TEST	TEST METHOD	CRITERIA
Tensile Bond	ASTM C 297/E 2134 ICC ES (AC 212)*/ASTM E 2570	Minimum 104 kPa (15 psi)
Freeze-thaw	ASTM E 2485/ICC-ES Proc. ICC ES (AC 212)*/ASTM E 2570	No deleterious effects after 10 cycles
Water Resistance	ASTM D 2247 ICC ES (AC 212)*/ASTM E 2570	No deleterious effects after 14 days exposure
Water Vapor Transmission	ASTM E 96 Proc. B ICC ES (AC 212)*/ASTM E 2570	Vapor Permeable
Air Leakage	ASTM E 283	No Criteria
Structural Performance	ASTM E 1233 Proc. A ICC ES (AC 212)*/ASTM E 2570	Minimum 10 positive cycles at 1/240 deflection; No cracking in field, at joints or interface with flashing
Racking	ASTM E 72 ICC ES (AC 212)*/ASTM E 2570	No cracking in field, at joints or interface with flashing at net deflection of 3.2 mm (1/8 inch)
Restrained Environmental	ICC-ES Procedure ICC ES (AC 212)*/ASTM E 2570	5 cycles; No cracking in field, at joints or interface with flashing
Water Penetration	ASTM E331 ICC ES (AC 212)*/ASTM E 2570	No water penetration beyond the inner-most plane of the wall after 15 minutes at 137 Pa (2.86 psf)
Weathering UV Exposure Acceleratred Aging Hydrostatic Pressure Test	 ICC ES Proc. ICC ES (AC212)*/ASTM E 2570 AATCC 127 ICC ES (AC212)*/ASTM E 2570	 UV - 210 hours of exposure Aging - 25 cycles of drying and soaking 21.6" water column for 5 hours
Surface Burning Characteristics	ASTM E 84	Flame Spread < 25 Smoke Developed < 450

* AC 212– Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers Over Exterior Sheathing

4.1.5.2 Liquid Applied Membranes

All testing shall be conducted with the applied liquid material within the minimum / maximum range. The specific thickness of the material which was used when conducting the following tests shall be recorded on the test report and shall be the site installed thickness.

The manufacturer shall submit the following additional test reports.

Product Property	Test Standard	Test Standard Title	Unit	Requirement	
				Min	Max
Air Permeance	ASTM E 2178-03	Standard Test Method for Air Permeance of Building Materials	L/(s·m²) at a pressure difference of 75 Pa	-	0.02 L/(s·m²) (0.004 cfm/ft²at a pressure difference of 1.56 lbf/ft²)
Water Resistance	AATCC 127 - 03	Water Resistance: Hydrostatic Pressure Test for 5 h	cm	55	
Fastener Sealability	ASTM D 1970-01	Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection - Section 7.9 Nail Sealability	-	Pass or specify sealing detail around fasteners	-
Pull Adhesion	ASTM D 4541-05	Modified Version of Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete using Portable Pull-Off Adhesion Testers– Specify substrates and surface preparation for glass fiber faced gypsum sheathing and concrete block. Declare failure mode.	kPa	110 or report force at substrate failure	-
Crack Bridging	ES-AC 212 OR	Acceptance Criteria for Water-Restive Coatings used as Water-Restive Barriers over Exterior Sheeting	-	Pass	-
	ASTM C 1305	Standard Test Method for Crack Bridging Ability of Liquid Applied Waterproofing Membrane– Report thickness and joint treatment (158° for 2 weeks)	-	Pass	
Water Vapor Permeance (at applied thickness)	ASTM E 96-00e1	Standard Test Methods for Water Vapor Transmission of Materials (*Water and Desiccant Method*)	Ng/(Pa·s·m²)	Declare	

LABORATORY REPORT

AMT Laboratories • 3741 Greenway Circle • Lawrence, Kansas 66046 • (785) 830-7308

FOR: Jack Sykes
cc: Paul Grahovac
Tom Stalnaker
Brian Koenings

SUBJECT: Heat Resistance of R-GUARD Products
Lawrence, KS
Adverse Effects Evaluation

DATE: April 3, 2012
PROJECT: 1112-01 AE

Heat Tested to 300 F

Box-O-Water

Full since 2006

Box-O-Water

Full for 13 months

Edge Water
Miramar Beach, Florida

Pinnacle Point
Panama City Beach, Florida

Carillon Point
Panama City Beach, Florida

Red Fish Village
Grayton Beach, Florida

Smiling Fish
Santa Rosa Beach, Florida

Perdido Key
Alabama

Two City Plaza
Baton Rouge,LA

Grand Dunes
Miramar Beach, Florida

Lake Chelan Resort
Eastern Washington

STPE liquid pan and rough opening flashing

- Becoming commonly specified
- Recognized in Architectural Record
- Entering ASTM process

Liquid detailing membrane

"Five years from now, what will we look back on as an important development in building envelope construction?"

The answer: "The replacement of peel-and-stick flashing membranes with fluid-applied flashing products."

Liquid detailing membrane

This from panel member Alex Lukachko of a leading waterproofing and air-barrier consulting company **(Joe Lstiburek's** Building Science Corporation)

responding to an audience question at the

National Institute of Building Sciences, Building Enclosure Technology and Environment Council (BETEC), December, 2011 building envelope symposium in Washington, DC.

Liquid detailing membrane

The Science of Fluid-Applied Flashing Systems

Paul Grahovac, LEED AP

R-GUARD FastFlash Air and Water Barrier Technical Director. International Code Council, Air Barrier Association of America Technical, Flashing, and Whole-Building Testing Committees, National Concrete Masonry Association's Air Barrier Task Force, ASTM Committees on building performance / vapor permeability / window installation, RCI Industry Advisory Council, and the following National Institute of Building Sciences Councils: Building Enclosure Technology and Environmental Council (BETEC Building Enclosure Integration Committee) and the Council on Finance, Insurance and Real Estate, Passive House.

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