Window Installation:
Pan Flashing and Air-Sealing to Prevent Water Intrusion

Educational Overview
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Applied Building Technology Group (ABTG) is committed to using sound science and generally accepted engineering practice to develop research supporting the reliable design and installation of foam sheathing. ABTG's educational program work with respect to foam sheathing is provided through a grant by the Foam Sheathing Committee (FSC) of the American Chemistry Council.

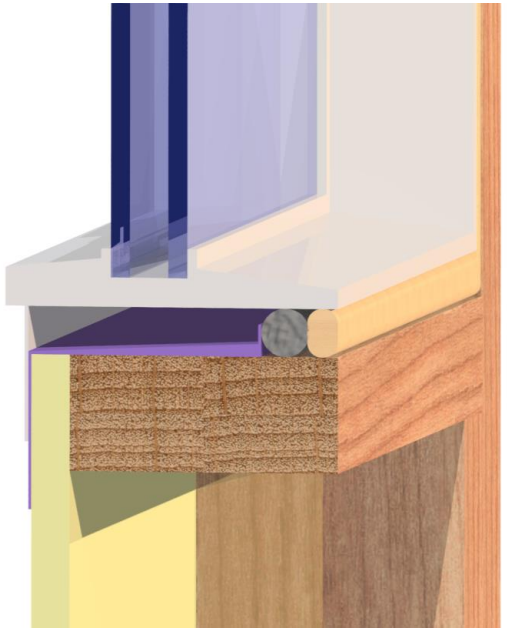
ABTG is a professional engineering firm, an approved source as defined in Chapter 2 and independent as defined in Chapter 17 of the IBC.

Foam sheathing research reports, code compliance documents, educational programs and best practices can be found at www.continuousinsulation.org.

ci Foam Plastic Applications for Better Building

Introduction

- This presentation addresses two practices with proven ability to improve water penetration resistance of fenestration product installation (windows and doors) :
  - Sill pans and flashing for rough opening drainage
  - Air-sealing of the interior side of the rough opening gap



Introduction

- These practices are important for all window types, installations, and water-resistive barrier (WRB) materials and methods.
- Why?
  - Windows leak!
  - Also, prevention of bulk water intrusion (wetting potential) is more important and effective than reliance on uncertain drying potential of a wall assembly (which can only delay, not prevent, eventual water damage or mold growth).

Window water leakage will cause damage to wood framing regardless of differences in drying potential

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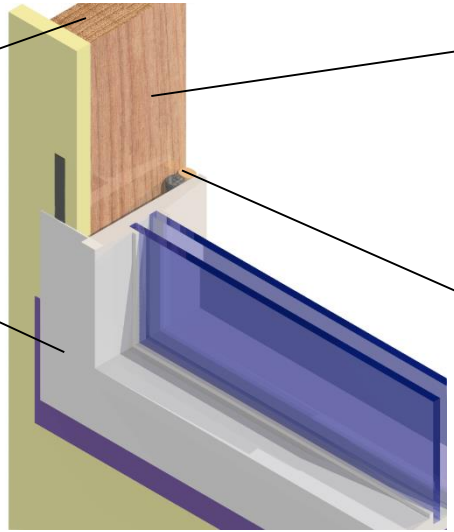
Basic Requirements

- Window installation details for any wall assembly must address multiple objectives to perform well:

Structural support and anchorage
for the window to resist wind loads

Prevention of water intrusion
at the window-wall interface by proper flashing and integration with the WRB

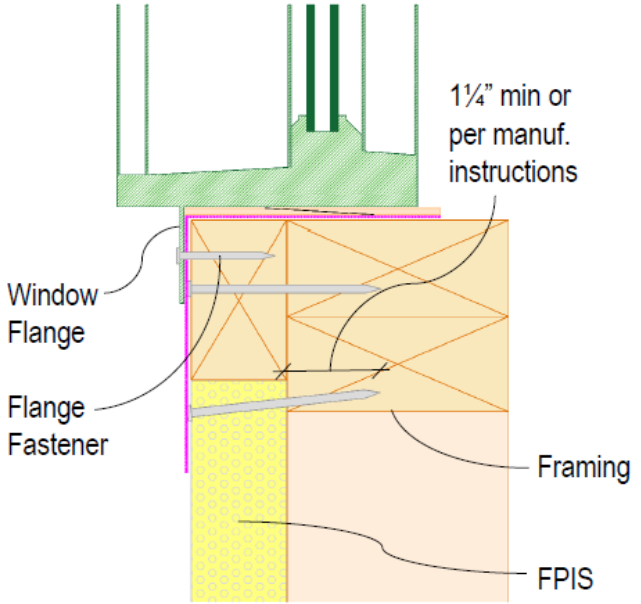


Clearances and shimming
to support the weight of the fenestration unit, ensure window operation, and allow for expansion and contraction

Air-sealing
of the rough-opening gap between the fenestration frame and wall frame

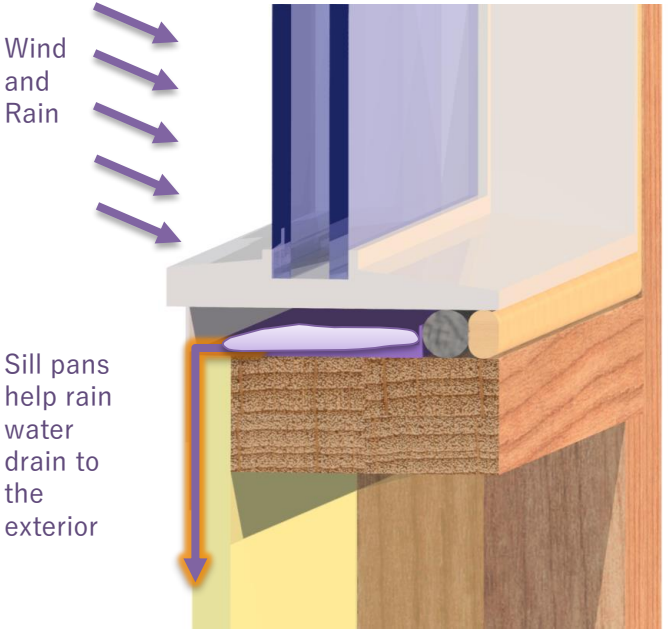
Basic Requirements

- Alternative installations, special conditions, or those conditions not addressed in window manufacturer installation instructions must rely on approved details as permitted in Section 104.11 of the IRC or IBC to achieve the above intent.



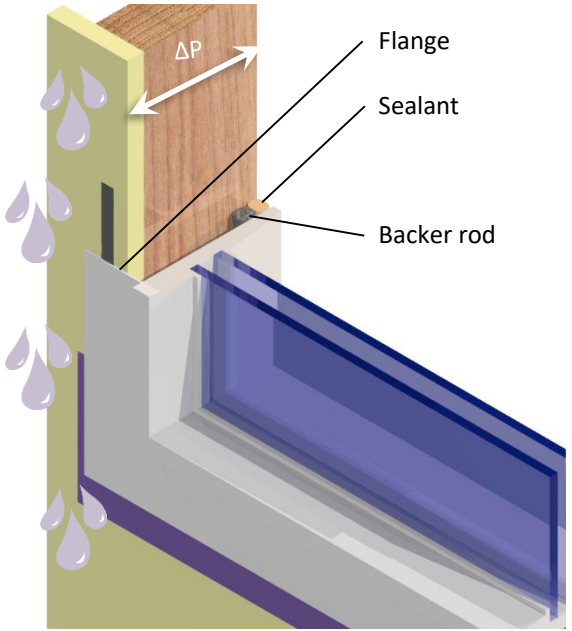
Importance of Sill Pans

- Sill pans are not required by code, but are important for multiple reasons:
  - Fenestration ratings and standards do not account for all water leakage paths
  - Inadvertent water intrusion may occur even with careful installation practices
  - Severe weather events may exceed the fenestration rating requirements
  - Durability of the fenestration unit and exterior wall coverings may degrade over time
  - Water that does inadvertently penetrate a fenestration product or interface tends to collect underneath the window sill.



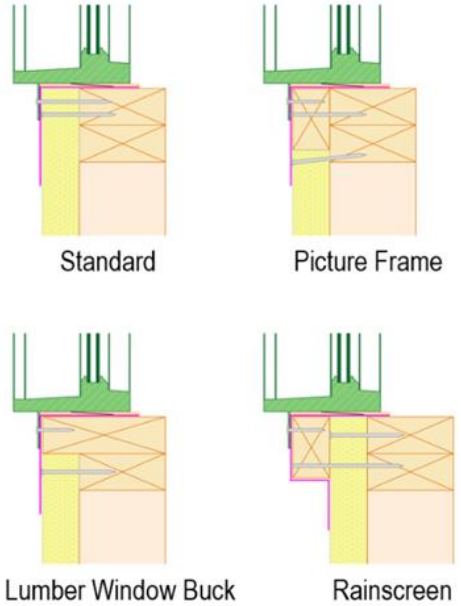
Importance of Air Sealing

- Air sealing of window installations is required by the energy code, and also improves resistance to wind-driven rain water intrusion
  - By air-sealing the interior side of the rough opening gap, the wind pressure across the exterior window-wall interface is reduced (i.e., pressure equalized)
  - This helps prevent wind pressure-driven water intrusion and improves the ability for any water collected in a properly installed sill pan to drain outward.



Applicability to Installation Variations

- Several common methods of window detailing are shown at right and described in the Window Installation Guides
- Regardless of method, effective drainage at the sill is a critical part of window performance

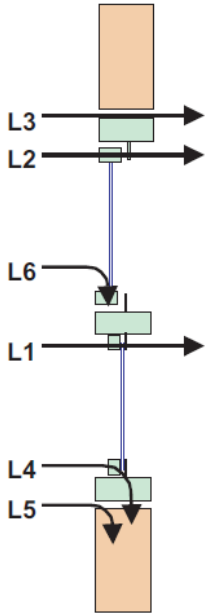


Water leakage study

- An extensive study of installed windows from 113 laboratory and 127 field tests was conducted and relevant codes, standards, and window product types also assessed.

Water leakage study

- Research identified 6 possible water leakage paths through windows and interfaces
- Paths L4 and L5 were considered to be “high risk” in relation to consequences of damage to susceptible and concealed wall materials



Leakage paths:

L1 - Through fixed unit to interior (includes through fixed portion of sash)

L2 - Around operable unit to interior

L3 - Through window-to-wall interface to interior (head, sill and jambs, also includes leakage at coupler mullions or corner posts between two adjacent window assemblies)

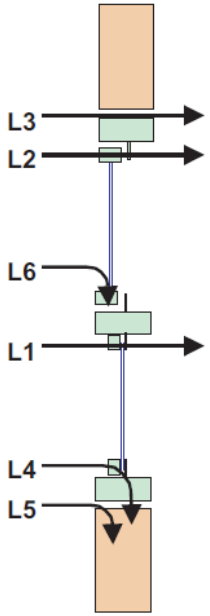
L4 - Through window assembly to adjacent wall assembly

L5 - Through window to wall interface to adjacent wall assembly (head, sill and jambs, also includes leakage at coupler mullions or corner posts between two adjacent window assemblies)

L6 - Through window assembly to concealed compartments within window assembly (includes frame sections that do not drain and spandrel cavities within window walls)

Water leakage study

- Far fewer failures observed in lab testing than field testing
- For lab tests, leakage paths L3 and L5 through interfaces are excluded and path L4 through the window unit is not always checked (same for window qualification and rating standards such as AAMA A440 referenced by US and Canadian building codes)



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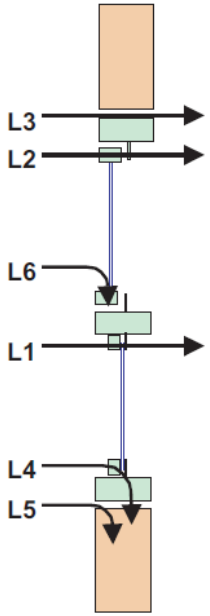
Water leakage study

- About 20% of field-tested window installations leaked through the window-wall interface
- More than 50% of window units field tested experienced water intrusion through one or more leakage paths through the window unit itself (about 15% of the cases included leakage directly through the window sill frame).



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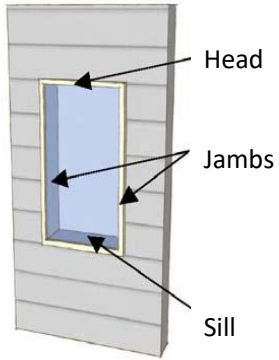
Water leakage study

- The study found that window standards, testing, and practices do not adequately address:
  - installed performance,
  - durability of water resistance,
  - climate/exposure conditions in relation to specification and test criteria,
  - guidance for many common construction materials & methods in current use, and
  - on-going quality control in fabrication/manufacture and field installation (for example there appears to be no requirement in window manufacturing or standards for periodic water resistance testing during production).
- CONCLUSION: Providing a subsill drainage path was considered more effective than attempting to achieve better quality in window manufacturing and installation

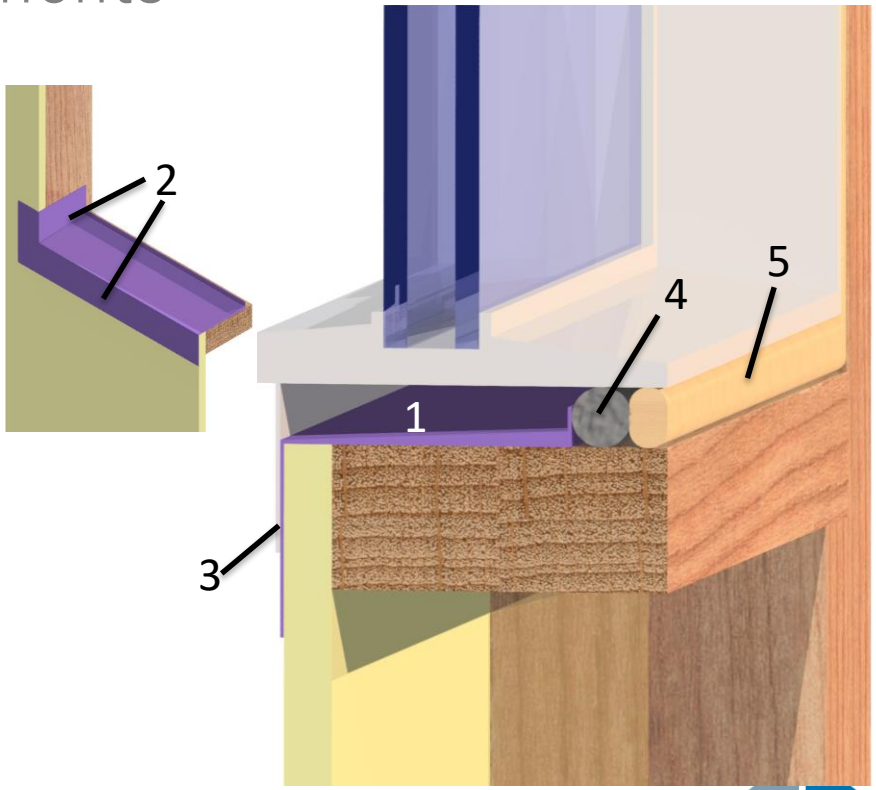
Water leakage study

- Based on the prior findings, over 25 variations of wall-window interface details were tested to determine the most effective methods for managing rainwater infiltration



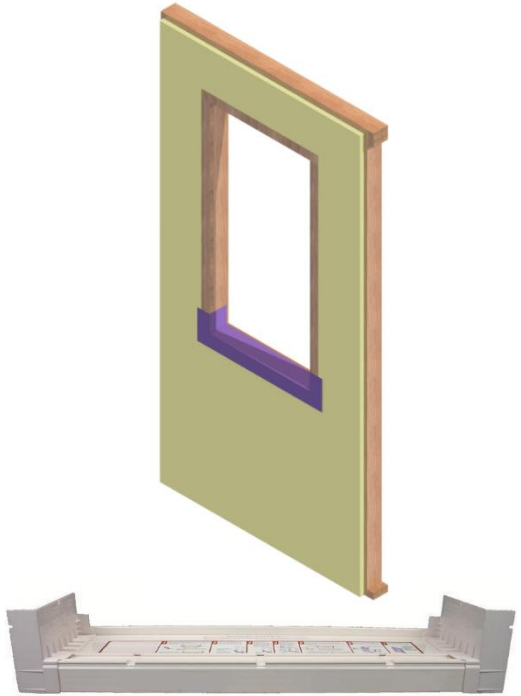
Installation Details & Components

1. Sill flashing membrane wrapping up the jambs and over the sheathing WRB or membrane WRB at the sill
2. Proper lapping of flashing layers and the WRB
3. Small (1/16”-1/8”) drainage gap behind the window flange
4. Backer rod
5. Insulation/sealant to the interior side of the sill leaving the drainage path unobstructed.



Recommendations

- Pan flashing (sill drainage) should be provided in all except “no exposure” conditions (e.g., not exposed to wind-driven rain)
- The sloped sill pan, while preferred, may only be necessary in moderate to high exposures



Suggested Resources

- Window Installation - ContinuousInsulation.org
- “Water Penetration Resistance of Windows – Study of Manufacturing, Building Design, Installation, and Maintenance Factors”, RDH Building Engineering Limited, Vancouver, BC, Canada (study sponsored by Canada Mortgage and Housing Corporation, Homeowner Protection Office, and British Columbia Housing Management Commission) (http://rdh.com/wp-content/uploads/2014/07/Water-Penetration-Resistance-of-Windows-Study.pdf), December 31, 2002.
- “Results of Assessing the Effectiveness of Wall-Window Interface Details to Manage Rainwater”, 11th Canadian Conference on Building Science and Technology, 2007 (http://www.nbec.net/documents/RESULTSONASSESSINGTHEEFFECTIVENESSOFWALL-WINDOWINTERFACEDETAILSTOMANAGERAINWATER-M.A.LACASSE.pdf)

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Suggested Resources

- “Window Sill Details for Effective Drainage of Water”, 2011 (http://www.nrc-cnrc.gc.ca/ctu-sc/ctu_sc_n76)
- “Window Installation Details for Effective Sealing Practice”, 2013 (http://www.nrc-cnrc.gc.ca/ctu-sc/ctu_sc_n80)
- “Water Penetration Resistance of Windows – Study of Manufacturing, Building Design, Installation and Maintenance Factors”, CMHC-SCHL Canada, Research Highlight Technical Series 03-124, November 2003 (https://www.cmhc-schl.gc.ca/odpub/pdf/63367.pdf)
- “Water Penetration Resistance of Windows – Study of Codes, Standards, Testing and Certification”, CHMC-SCHL Canada, Research Highlights Technical Series 03-125 (https://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/03-125-e.htm)

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