A XEROX BUILDERS FIELD GUIDE

Windows, Doors & Water Management

From Performance Ratings and Placement to Installation, Thresholds and Common Failures

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INTRODUCTION

The Most Interrupted Part of the Wall

Every window and door is a planned interruption in an otherwise continuous building envelope. That interruption has to keep performing four jobs at once: control heat loss, control air leakage, control water, and let the building move a little without cracking the seal around it.

> **GUIDING PRINCIPLE**
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> *Our previous guide on rainscreen systems already established that windows and doors are the single most common source of water intrusion in residential construction. This guide goes deeper into why — covering selection, placement, and installation in more detail than a single flashing sequence can capture.*

This guide covers how to select windows and doors using their actual performance ratings, how placement within the wall affects both thermal and water performance, and the installation and inspection details that determine whether an opening performs the way its rating suggests it should.

1 Understanding Window Performance Ratings

Window performance is described using a small set of standardized ratings, typically determined through NAFS (North American Fenestration Standard) testing and reported on a performance label similar to the example below.

Figure 1 — A typical window performance label and what each rating means.

GUIDING PRINCIPLE

These four numbers describe trade-offs, not a single "best" answer. A window optimized to block solar heat gain on a south-facing wall in summer is not automatically the right choice for a north-facing wall that could use the free heat in winter.

2 U-Factor and SHGC in Practice

U-factor measures the rate of heat transfer through the window — lower numbers mean less heat escapes. SHGC (Solar Heat Gain Coefficient) measures how much solar heat passes through the glazing — higher numbers mean more solar heat gain.

REF	Orientation	General SHGC Consideration
A.01	South-facing	Higher SHGC can be desirable for passive winter solar gain, if shaded appropriately in summer
A.02	North-facing	Solar gain is minimal regardless of SHGC; prioritize low U-factor

REF	Orientation	General SHGC Consideration
A.03	East / West-facing	Lower SHGC often preferred to reduce unwanted morning or afternoon heat gain

DESIGN OPTION

The right U-factor and SHGC combination depends on climate zone, orientation, shading, and the energy model for the specific project — there is no single correct rating that applies to every window on every wall of the same house.

3 Frame Materials

Frame material affects thermal performance, durability, maintenance, and cost.

REF	Frame Material	General Characteristics
B.01	Vinyl	Cost-effective, low maintenance, moderate thermal performance
B.02	Fiberglass	Strong, dimensionally stable, good thermal performance
B.03	Wood	Excellent thermal performance, higher maintenance, natural appearance
B.04	Aluminum	Durable and slim profile, requires thermal break to control heat loss
B.05	Clad (wood interior, metal exterior)	Combines interior wood appearance with lower-maintenance exterior

CODE REQUIREMENT

Aluminum-framed windows without a thermal break can create significant thermal bridging and condensation risk. Where aluminum framing is used, confirm it includes a thermal break appropriate to the climate.

4 Glazing and Spacer Systems

Double-glazed units are standard in most residential construction; triple-glazed units offer improved thermal performance and are increasingly common in high-performance and Net Zero construction. Low-E coatings reduce heat transfer while

maintaining visible light; gas fills (typically argon) between panes further reduce conductive heat transfer.

BEST PRACTICE

The spacer bar separating glazing panes is a frequently overlooked performance factor. A warm-edge spacer (typically a low-conductivity material) reduces the cold edge effect that can otherwise cause condensation and localized heat loss right at the glass perimeter, even in an otherwise well-rated window.

5 Window Placement: Innie or Outie

Where a window sits within the depth of the wall assembly is a design decision with real consequences for both thermal performance and water management — not simply an aesthetic preference.

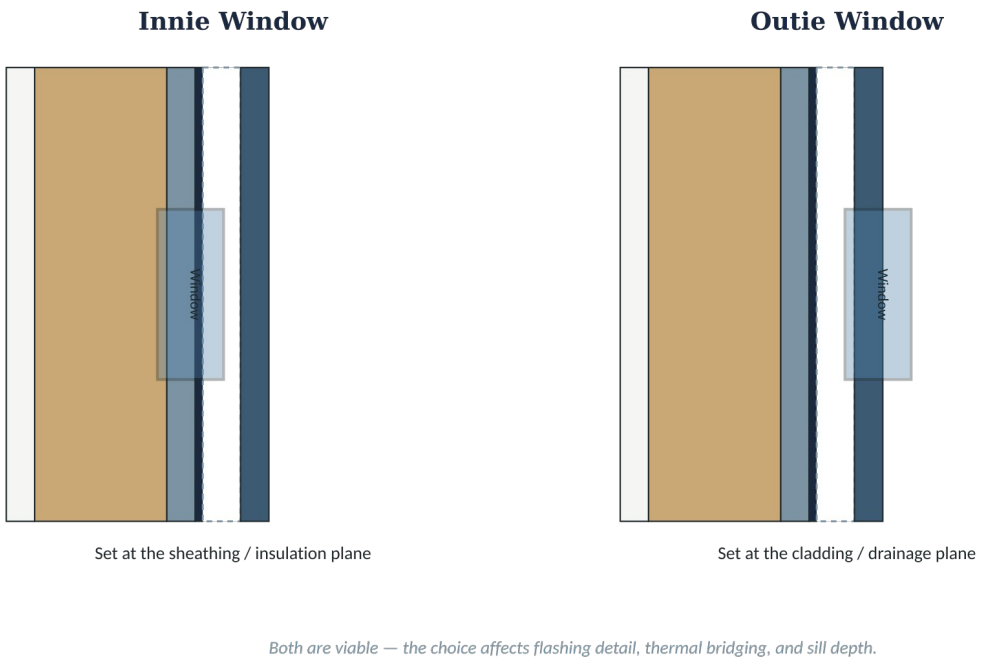

Figure 2 — Window placement at the sheathing plane (innie) versus the cladding plane (outie).

An innie window, set near the sheathing and insulation plane, can simplify continuous insulation detailing and reduce thermal bridging, but requires a well-detailed extension jamb and careful flashing integration at a greater depth. An outie window, set near the cladding plane, can simplify flashing integration with the drainage plane but may increase thermal bridging at the rough opening if not detailed carefully.

DESIGN OPTION

Neither placement is universally correct. The choice should be made deliberately, in coordination with the wall assembly design, and detailed consistently — not decided window-by-window in the field.

6 Rough Opening Preparation

The rough opening must be sized according to the window manufacturer's instructions — typically slightly larger than the window unit itself to allow for shimming, squaring, and a consistent perimeter gap for sealant or backer rod.

BUILDER'S STANDARD

I check every rough opening for square, plumb, and correct dimensions before the window arrives on site — not after. A rough opening that is out of square by the time the window shows up costs far more time to correct than it would have taken to catch during framing.

The sill of the rough opening should be sloped very slightly toward the exterior, and sheathed or built up so the sill pan flashing that goes on top of it has a consistent, gently sloped surface to drain across.

7 Sill Pan Construction

A sill pan creates a dedicated drainage surface beneath the window, catching any water that gets past the window unit itself and directing it back out to the exterior rather than into the wall.

GUIDING PRINCIPLE

A sill pan without end dams is only doing half its job. Water directed sideways along the pan, toward the jambs, needs somewhere to stop — end dams turn the pan into a proper basin rather than a flat sheet that simply redirects water into the wall at the sides instead of the bottom.

Sill pans may be formed from liquid-applied flashing membrane, factory-formed pan flashing products, or careful shop-built assemblies using flexible flashing tape — the objective in every case is a sloped, sealed, end-dammed surface that extends past both jambs.

8 Perimeter Air Sealing and Insulation

The gap between the window frame and the rough opening needs to be both air sealed and insulated — these are related but separate objectives, and the products used for each should be compatible with the window frame material.

BEST PRACTICE

Low-expansion spray foam is commonly used at window perimeters specifically because standard high-expansion foam can generate enough pressure to bow window frames inward, affecting operation and sometimes glazing seals. Confirm the foam product is rated for use around window and door frames before using it there. Backer rod and sealant is a common alternative or supplement at the exterior face of the perimeter gap, providing a flexible, durable air seal that can accommodate some building movement without cracking.

9 Exterior Doors

Exterior doors share most of the same water-management principles as windows, with the added complication of a threshold that sits at floor level and must manage both water and foot traffic.

Figure 3 — A door threshold and sill pan, sloped to drain to the exterior.

Like a window sill pan, the door sill pan should be sloped, end-dammed, and extend beyond the jambs. The threshold sits on top of the pan, and the door sweep at the bottom of the door slab provides the final seal against the threshold.

CODE REQUIREMENT

Accessible or barrier-free threshold requirements may limit the height of a threshold above the finished floor. Where this applies, confirm the drainage detail still functions correctly at the reduced threshold height — a lower threshold reduces the margin for error in the sill pan slope and sealing.

10 Sliding and French Doors

Large sliding and French door units present a wider threshold and often a heavier unit than a standard swing door, both of which increase the consequences of a poorly detailed sill.

> **BEST PRACTICE**
> Multi-point sill drainage — typically weep holes or channels built into the sill track — needs to be kept clear of debris and confirmed functional at handover. A blocked weep path on a sliding door sill can turn a well-designed drainage detail into a standing-water problem.

Because of their width, these units place additional structural demand on the header above them; confirm the header size accounts for the actual opening width and any additional load from a heavier glazed unit.

11 Skylights

Skylights combine window-level water management with roof-level water management, and are exposed to standing water and snow load in ways a vertical window is not.

> **CODE REQUIREMENT**
> Skylight flashing kits are typically manufacturer-specific and engineered for a particular roofing material and slope range. Confirm the flashing kit is rated for the actual roofing material and pitch before installation — substituting a generic flashing detail is a common source of skylight leaks.

Curb-mounted skylights sit on a raised curb built into the roof framing, providing additional height above the roof plane; deck-mounted skylights sit closer to the roof surface. Each has a different flashing approach, and the two are not interchangeable without redesigning the flashing detail.

12 Interior Finishing Considerations

The interior sill (stool) and apron trim are finish elements, but they interact with the window's performance — particularly around condensation management.

GUIDING PRINCIPLE

A tightly sealed interior trim detail with no ventilation path can trap moisture against a cold window frame in winter, encouraging condensation and, over time, wood rot in the sill and surrounding trim. Some manufacturers recommend a small ventilation gap for exactly this reason — check the specific product's installation instructions.

13 Condensation and Performance in Service

Interior condensation on windows is usually a symptom of a mismatch between indoor humidity, window surface temperature, and outdoor conditions — not automatically a defective window.

REF	Contributing Factor	General Effect
C.01	High indoor humidity	Raises the dew point, increasing condensation risk on any cold surface
C.02	Low window U-factor (better rated)	Warmer interior glass surface, reduced condensation risk
C.03	Cold-edge spacer (non warm-edge)	Localized cold spot at glass perimeter, increased condensation risk there
C.04	Poor ventilation	Humidity accumulates instead of being exhausted, increasing condensation risk

GUIDING PRINCIPLE

Persistent condensation on a correctly installed, correctly rated window is often a ventilation or humidity problem elsewhere in the home — not a reason to assume the window itself has failed.

14 Common Window and Door Mistakes

Most window and door failures trace back to a small set of repeated errors:

- ☐ Rough opening out of square before window arrives
- ☐ Sill pan missing end dams
- ☐ Sill pan not sloped or not extended past jambs
- ☐ Weep holes or drainage channels blocked with debris or sealant
- ☐ Skylight flashing kit mismatched to roofing material or pitch
- ☐ Interior trim sealed with no ventilation path for the frame

- ☐ High-expansion foam used at perimeter, bowing the frame
- ☐ Flashing installed out of sequence (head before sill)
- ☐ Header undersized for a wide sliding or French door opening
- ☐ Manufacturer installation instructions not followed or unavailable on site

> **GUIDING PRINCIPLE**
> *A high-performance window installed incorrectly will underperform a modest window installed correctly. The rating on the label describes the product; it does not describe the installation.*

15 Final Window and Door Inspection

Before cladding and interior finishes conceal the installation, this is the last practical opportunity to verify each opening without removing finished work.

- ☐ Rough opening was square and correctly sized
- ☐ Sill pan installed, sloped, and end-dammed
- ☐ Flashing sequence followed sill, then jambs, then head
- ☐ Perimeter sealed and insulated with compatible products
- ☐ Frame not bowed or distorted by perimeter foam
- ☐ Window or door operates smoothly with no binding
- ☐ Weep holes and drainage channels clear and functional
- ☐ Skylight flashing kit matched to roofing material and pitch
- ☐ Header sized correctly for wide or heavy units
- ☐ Manufacturer installation instructions followed and retained
- ☐ Photographs taken of flashing and sill pan details

16 The Most Important Lessons to Remember

If a homeowner or builder remembers only a few principles from this guide, they should be these:

1. **Performance ratings describe trade-offs**
   Not a single "best" answer for every wall of the same house.
2. **The right frame and glazing depend on the whole project**
   Climate, orientation, and budget all factor in.
3. **Placement in the wall is a decision, not a habit**
   Innie or outie, made deliberately and detailed consistently.

4. **A sill pan without end dams is half a sill pan**
   Water needs somewhere to stop, not just something to run across.

5. **High-expansion foam can bow a frame**
   Use products rated for window and door perimeters specifically.

6. **Sliding doors need clear weep paths**
   A blocked drainage channel undoes a well-designed sill.

7. **Skylight flashing kits are not interchangeable**
   Match the kit to the actual roofing material and pitch.

8. **Condensation is often a humidity problem, not a window defect**
   Look at the whole house before blaming the glass.

9. **A rated window installed poorly underperforms a modest window installed well**
   The label describes the product, not the installation.

CLOSING

Conclusion

A window or door is a manufactured product with a tested performance rating, installed by hand, into an opening built by hand, in a wall assembled by hand. The rating on the label is only ever as good as the weakest of those three human steps.

Select openings deliberately, based on their actual ratings and the project's real requirements. Prepare the rough opening correctly. Build the sill pan properly, with end dams, before anything else goes in. Follow the flashing sequence. Verify it all before it disappears behind cladding and trim.

> **GUIDING PRINCIPLE**
>
> *Nearly every serious window or door failure traces back to one of a handful of well-understood mistakes. None of them are difficult to avoid — they simply require doing the sequence correctly, every time, on every opening.*

IMPORTANT NOTICE

Please Read Before Using This Guide

This guide is an educational resource. It does not replace, and must not be treated as a substitute for:

- The current British Columbia Building Code, National Building Code of Canada, or any other applicable code in force at the time of construction.
- Municipal or regional-district bylaws, permit conditions, and inspection requirements.
- Site-specific structural and building envelope design and engineering prepared by a licensed professional.
- Manufacturer installation instructions for any specific window, door, skylight, flashing, or sealant product.
- The professional and legal judgment of building envelope consultants, architects, engineers, and other registered professionals engaged on a specific project.

The technical values, ratings and examples in this guide are general construction information. Actual requirements and performance vary according to climate zone, exposure, product selection, manufacturer specifications and project-specific engineering.

Where a conflict exists, the applicable building code, envelope design drawings, manufacturer's installation instructions and qualified professionals take precedence over this guide.

> **GUIDING PRINCIPLE**
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> *This guide reflects the author's own field research, training, and construction experience. It has not yet been reviewed by an independent building envelope consultant or legal professional. Readers must verify every technical statement against the current, authentic codes, standards, and manufacturer instructions applicable to their project before relying on it.*

Research and drafting assistance for this guide was provided using AI-based research and writing tools (Claude, by Anthropic), under the direction, technical judgment and final authorship of Mandeep S.
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