Skylights and Sloped Glazing

RCI SPRING SEMINAR
MAY 16, 2017
PRESENTED BY AL JAUGELIS

Western Canada Chapter

RDH BUILDING SCIENCE

Skylights in the North American Fenestration Standard

NAFS presents us with several skylight "product types":

WITHIN THE SCOPE OF NAFS

OUTSIDE THE SCOPE OF NAFS

→ Sloped glazing systems:

"Not intended to be tested to this Standard/Specification"

Topics covered

RDH

1. What do we mean by skylights?
2. Review of critical barriers
3. Illustrative case study

Western Canada Chapter

Skylights in the NAFS standard

1 Scope

1.1 General

This fenestration Standard/Specification applies to both operating and fixed, new construction and replacement windows, doors, SSPs, TDDs, roof windows, and unit skylights installed into exterior building envelopes.

(DP), and related performance ratings for windows, doors, SSPs, TDDs, roof windows, and unit skylights. Performance requirements are used in this Standard/Specification when possible. Prescriptive requirements are used when necessary. When products are tested to the gateway requirements, or to the gateway and optional requirements, a rating is determined and a test report may be issued. Certification procedures are not part of this Standard/Specification. This Standard/Specification applies to testing and rating products. The tested rating applies to products of identical construction, with width and/or height less than or equal to the tested size. Various systems have been developed or are proposed for determining a product energy rating based

Fenestration products not intended to be tested to this Standard/Specification include

(a) interior windows, interior accessory windows (IAWs), and interior doors;
(b) vehicular-access doors (garage doors) (see ANSI/DASMA 105, ANSI/DASMA 108, ANSI/DASMA 109, ANSI/DASMA 115, or other applicable DASMA Specifications);
(c) roof-mounted smoke and heat-relief vents;
(d) sloped glazing (other than unit skylights or roof windows) (see AAMA TIR A7);
(e) curtain walls and storefronts (see AAMA MCWM-1);
(f) folding door systems;
(g) commercial entrance systems (see AAMA SFM-1);
(h) sunrooms (see AAMA/NPEA/NSA 2100);
(i) revolving doors; and
(j) commercial steel doors rated per SDI A250.8.

What do we mean by skylights?

- → Skylights in the North American Fenestration Standard (NAFS)
- → Skylights in the code (BCBC, VBBL)
- → Skylights in ASHRAE 90.1
- → Skylights in the National Energy Code for Buildings (NECB)
- → Skylights in the BC Energy Efficiency Act

RDH BUILDING SCIENCE

Skylights in the building code (BCBC Rev. 8)

5.10.2. WINDOWS, DOORS, SKYLIGHTS AND OTHER GLAZED PRODUCTS

5.10.2.1. General

1) This Subsection applies to windows, doors and skylights, other glazed products and their components that separate

a) interior space from exterior space, or
b) environmentally dissimilar interior spaces.

2) For the purposes of this Subsection, the term "skylight" refers to unit skylights, roof windows and tubular daylighting devices.

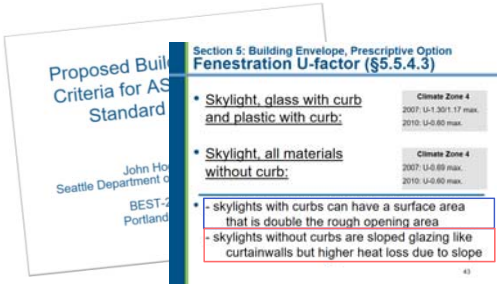
Same in VBBL, NBC, but only BCBC adds the term "other glazed products".

Skylights in ASHRAE 90.1

ASHRAE 90.1 Table 5.5 has three categories of skylight:

Fenestration	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, 0%–40% of Wall		
Nonmetal framing (all)[c]	U-2.27	
Metal framing (curtainwall/storefront)[d]	U-2.84	SHGC-0.40 all
Metal framing (entrance door)[d]	U-4.83	
Metal framing (all other)[d]	U-3.12	
Skylight with Curb, Glass, % of Roof		
0%–2.0%	U_{all}-6.64	$SHGC_{all}$-0.49
2.1%–5.0%	U_{all}-6.64	$SHGC_{all}$-0.39
Skylight with Curb, Plastic, % of Roof		
0%–2.0%	U_{all}-7.38	$SHGC_{all}$-0.65
2.1%–5.0%	U_{all}-7.38	$SHGC_{all}$-0.54
Skylight without Curb, All, % of Roof		
0%–2.0%	U_{all}-3.92	$SHGC_{all}$-0.49
2.1%–5.0%	U_{all}-3.92	$SHGC_{all}$-0.39

Skylights in ASHRAE 90.1



→ John Hogan is a member of the ASHRAE 90.1 standing committee

Skylights in ASHRAE 90.1

→ "Skylight with Curb" = Curb-mounted Skylight = Unit Skylight

→ "Skylight without Curb" = Sloped Glazing System

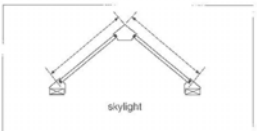
Skylights in the National Energy Code for Buildings

The 2011 NECB defines skylight this way:

> "*Skylight* means a form of *fenestration* that is inclined less than 60° from the horizontal."

The NECB does not distinguish between single lite and multiple-lite skylights

A-3.1.1.6.(2) Areas of Other Fenestration. Figure A-3.1.1.6.(2) illustrates how to measure the area of glass panes as described in Sentence 3.1.1.6.(2).



Skylights in the BC Energy Efficiency Act

→ Like the NECB, the BCEEA uses the single term "skylight" for all overhead glazing, but does not define it

Skylight terminology—the takeaway

We need to be clear about the distinctions the code makes between two categories of overhead glazing products:

→ Unit skylights: factory glazed skylight products containing a single lite of glass or plastic glazing
  → Variants include operable roof window, TDD
  → May be curb mounted or deck-mounted units with integral curbs

→ Sloped glazing: typically field glazed assemblies containing multiple lites of glass or plastic glazing

Skylight terminology—the takeaway

When discussing skylights, be sure you understand the context:

- → NAFS distinguishes between unit skylights, roof windows and TDDs, but excludes "sloped glazing systems" from its scope
- → ASHRAE 90.1 distinguishes between curb-mounted skylights and "sloped curtain wall" skylights, with different U-values for each
- → Part 5 of the code distinguishes between unit skylights and "other glazed systems", which include sloped glazing
- → In NECB and BCEEA, the term "skylights" includes sloped glazing

13

Continuity of critical barriers

- → Critical barrier continuity and integrity must be maintained throughout the enclosure
  - → At penetrations
  - → At joints between assemblies (window-wall, roof-skylight)
  - → Within assemblies of dissimilar materials (windows, doors, skylights)

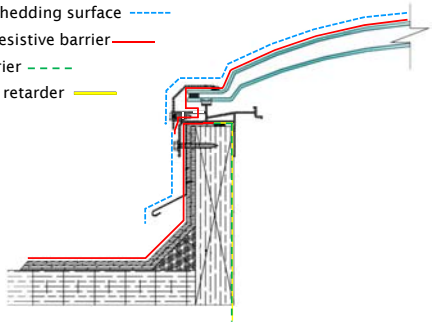
16

Review of critical barriers

RDH BUILDING SCIENCE

Critical barriers in unit skylight

- → Water shedding surface ------
- → Water resistive barrier——
- → Air barrier - - - -
- → Vapour retarder ——



17

Critical barriers

Materials and components that perform a control function within a building enclosure

- → Water shedding surface (WSS)
- → Water resistive barrier (WRB) *
- → Air barrier (AB)
- → Vapour retarder (vapour barrier, VB)

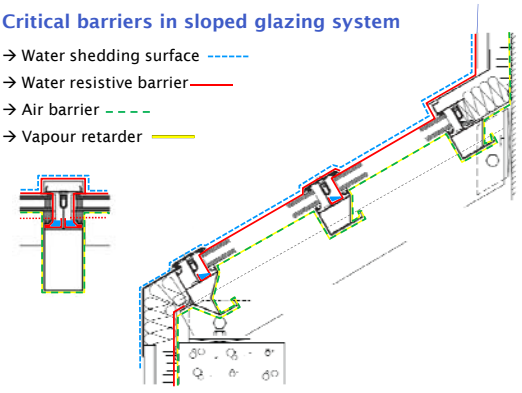
When designing or installing products such as skylights, you need to identify the critical barriers in in adjacent assemblies, and consider how to connect them to the critical barriers in the product

* Not to be confused with "weather resistive barrier" (also WRB), such as breathable sheathing membranes (Tyvek)

15

Critical barriers in sloped glazing system

- → Water shedding surface ------
- → Water resistive barrier——
- → Air barrier - - - -
- → Vapour retarder ——



Illustrative case study

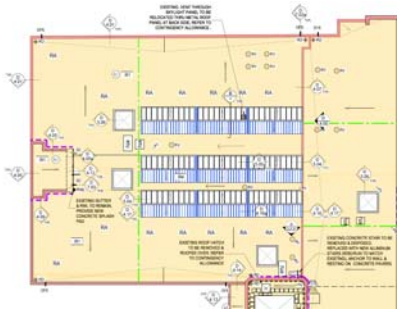
- Leonard S. Klinck Building, UBC
- Roof and skylight replacement

RDH BUILDING SCIENCE

Klinck Building aerial view

20

Klinck Building roof plan



21

Klinck Building—existing sloped glazing

22

Klinck Building—existing sloped glazing

23

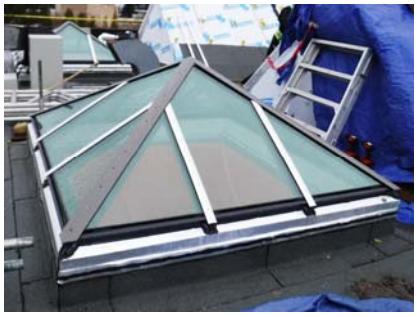
Klinck Building—new sloped glazing

24

Klinck Building—existing pyramid skylights

25

Klinck Building—new pyramid skylights



26

Klinck Building renewals

Scope: Renew roof, replace skylights

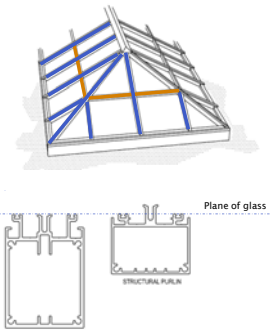
- → Roof and "skylight without curb" insulation levels to ASHRAE 90.1 prescriptive requirements
- → Sloped glazing system: Spectrum Skyworks "tubular rafter pressure plate system"
  - → Spectrum system designed with "open gutter" infiltrating water management
  - → Purlin-rafter connection modified to achieve "closed gutter" drainage from purlins to rafters
  - → "Closed gutter" drainage pressure-equalized to exterior

27

Sloped glazing framing terminology

Sloped glazing systems typically have two types of framing member:

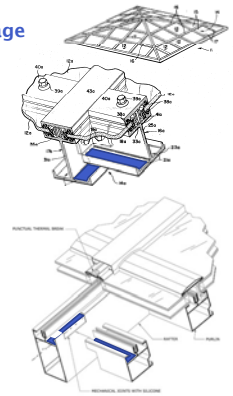
- → Rafters span the opening structurally and drain infiltrating water to the exterior
- → Purlins span between rafters and drain infiltrating water to the rafters
- → Purlins and rafters typically have different cross section profiles



28

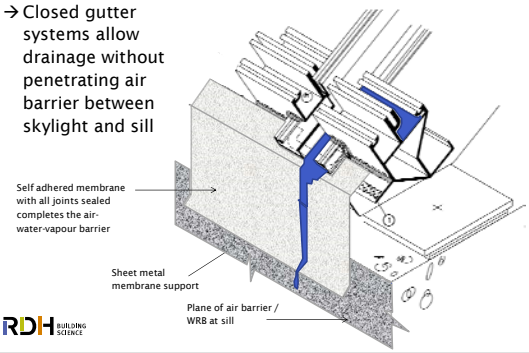
Sloped glazing system drainage

- → Sloped glazing systems differ in how they manage infiltrating water:
- → Open gutter systems collect infiltrating water into gutters mounted along the sides of the rafter and purlin members
- → Closed gutter systems collect infiltrating water into internal gutters, separated from the interior environment by air and water barrier seals



Closed gutter system drainage at sill

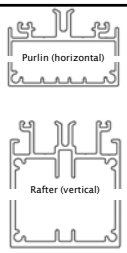
- → Closed gutter systems allow drainage without penetrating air barrier between skylight and sill



Klinck purlin-rafter drainage

A closed gutter drainage method was desirable for critical barrier continuity both within the system and with adjacent assemblies

→ Original design: open gutter framing system



RDH BUILDING SCIENCE

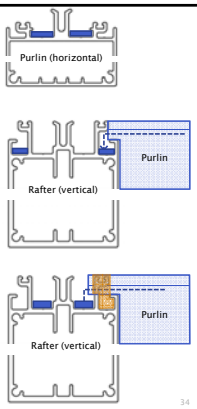
31

Klinck purlin-rafter drainage

A closed gutter drainage method was desirable for critical barrier continuity both within the system and with adjacent assemblies

→ Original design: open gutter framing system

→ Modified fabrication method can convert the product to function as a closed gutter system



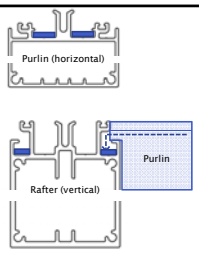
RDH BUILDING SCIENCE

34

Klinck purlin-rafter drainage

A closed gutter drainage method was desirable for critical barrier continuity both within the system and with adjacent assemblies

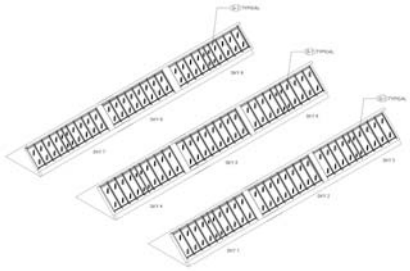
→ Original design: open gutter framing system



RDH BUILDING SCIENCE

32

Single span sloped glazing assemblies



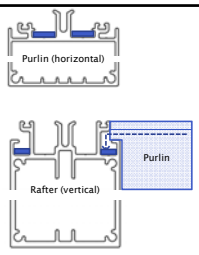
35

Klinck purlin-rafter drainage

A closed gutter drainage method was desirable for critical barrier continuity both within the system and with adjacent assemblies

→ Original design: open gutter framing system

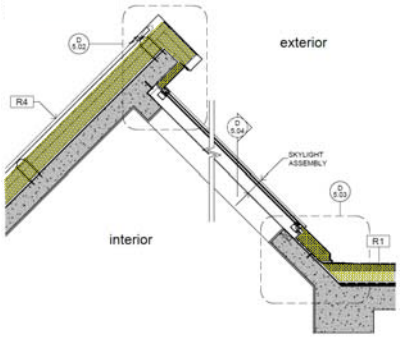
→ Modified fabrication method can convert the product to function as a closed gutter system



RDH BUILDING SCIENCE

33

Single span sloped glazing cross-section



36

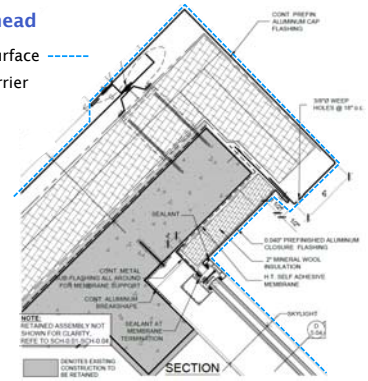
Sloped glazing head

→ Water shedding surface ------

→ Water resistive barrier

→ Air barrier

→ Vapour retarder



Sloped glazing head

40

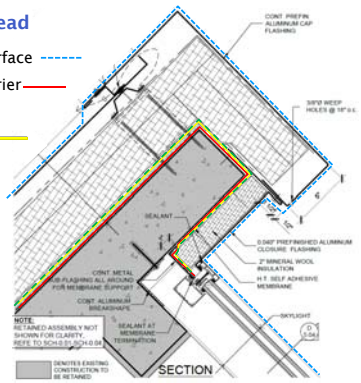
Sloped glazing head

→ Water shedding surface ------

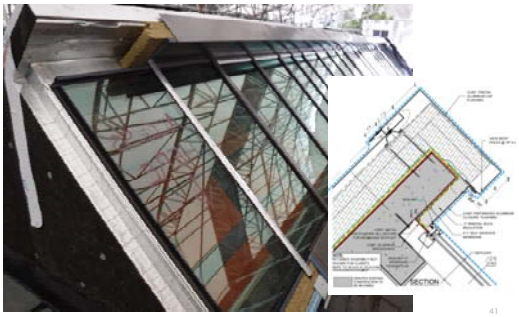
→ Water resistive barrier——

→ Air barrier - - - -

→ Vapour retarder ——

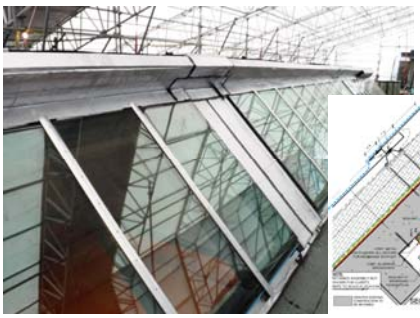


Sloped glazing head



41

Sloped glazing head



39

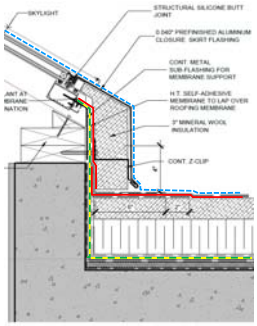
Pyramid sloped glazing sill

→ Water shedding surface ------

→ Water resistive barrier——

→ Air barrier - - - -

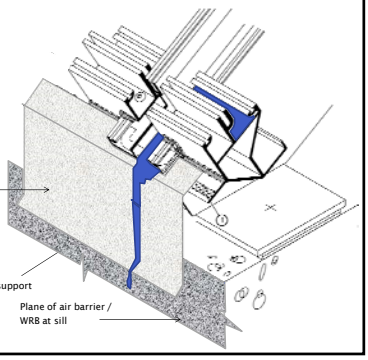
→ Vapour retarder ——



42

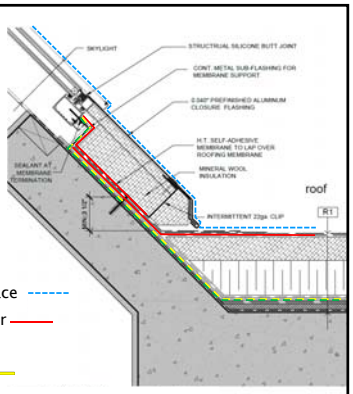
Sloped glazing system drainage at sill

→ Closed gutter systems allow drainage without penetrating air barrier between skylight and sill



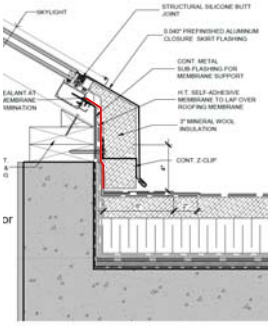
RDH BUILDING SCIENCE

Sloped glazing sill



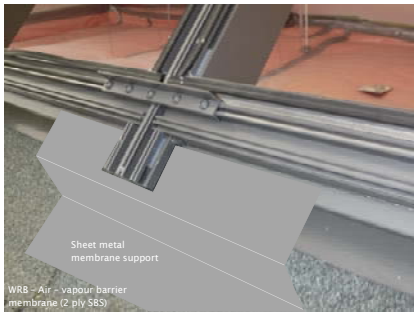
→ Water shedding surface
→ Water resistive barrier
→ Air barrier
→ Vapour retarder

Pyramid sloped glazing sill



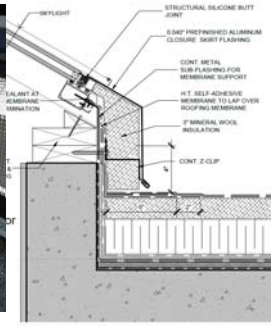
44

Sloped glazing sill



47

Pyramid sloped glazing sill



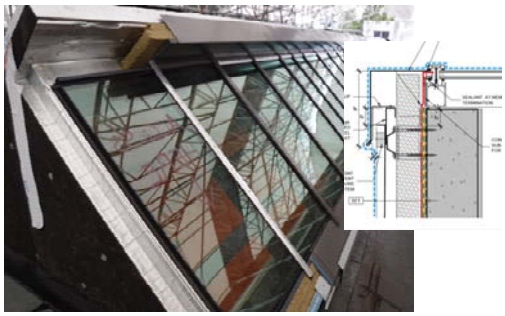
Sloped glazing sill

48

Sloped glazing sill

49

Sloped glazing jamb



52

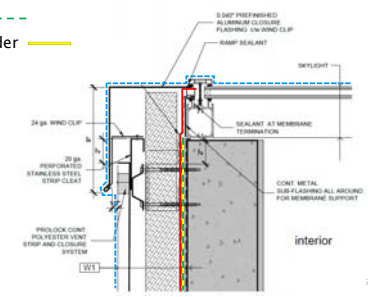
Sloped glazing jamb

→ Water shedding surface ------

→ Water resistive barrier ——

→ Air barrier - - - -

→ Vapour retarder ——



50

Sloped glazing jamb

53

Sloped glazing jamb

51

Concluding thoughts

RDH BUILDING SCIENCE

Concluding thoughts

- → Pay attention to "skylight" terminology: the code and ASHRAE 90.1 have different requirements for unit skylights and sloped glazing
  - → The NAFS standard applies only to unit skylights, roof windows, and TDDs
- → Think in terms of critical barriers when designing, reviewing shop drawings, installing, and reviewing installations
  - → Critical barriers are functional constructs, not materials.
  - → Some materials can perform multiple functions, and continuity of barriers must be analyzed across all materials used to construct them

55