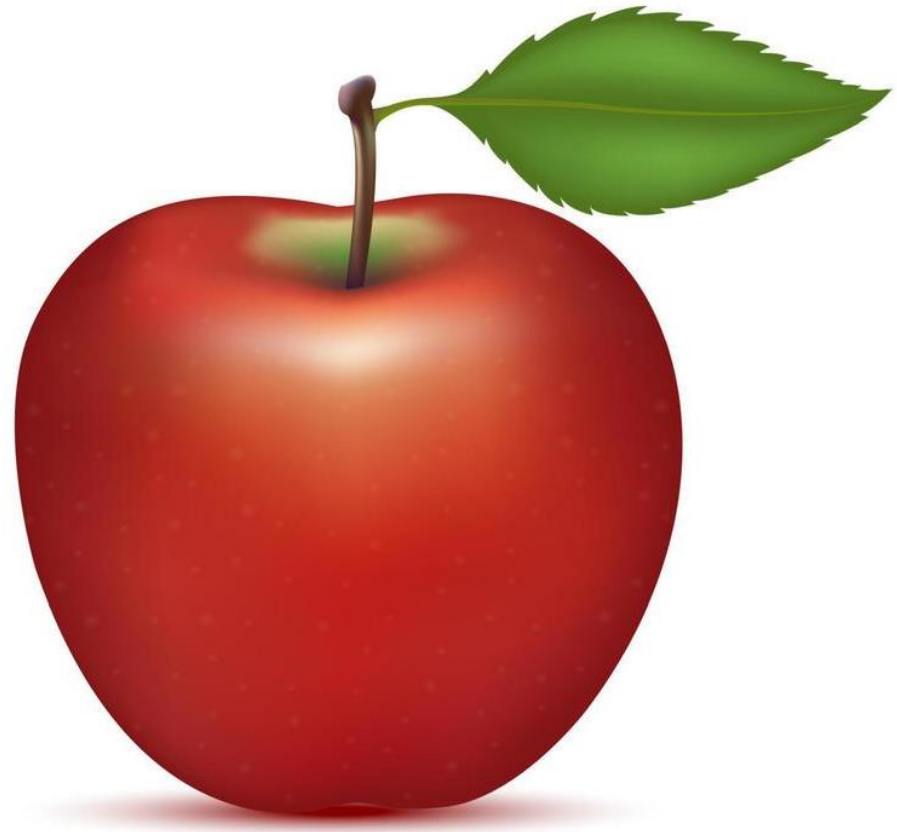
TRIPLE PANE WINDOWS

A Look Beyond U-Values

innotech
windows + doors

U-VALUES
U-VALUES
U-VALUES
U-VALUES
U-VALUES

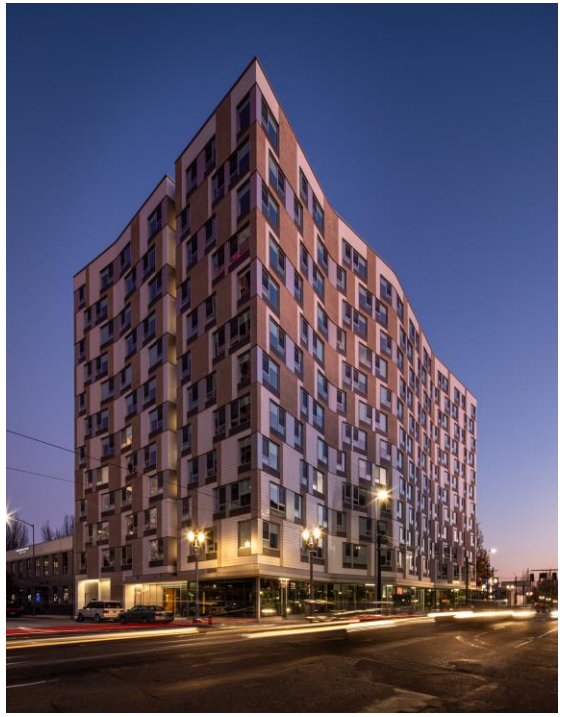
SHGC
SHGC
SHGC
SHGC
SHGC



Innotech Windows + Doors

- Established in 2001 in British Columbia Canada
- Largest exclusive manufacturer of German engineered systems designed for North American projects
- All products manufactured in Canada
- All products NFRC certified and NAFS compliant
- Recognized for superior air-water-thermal-structural performance
- Specified for Passive House, net-zero energy, LEED and other high-performance building standards

innotech
windows + doors



Completed 2024:
Parkview at Terwilliger in Portland, Oregon
Phius Certified

innotech
windows + doors

Completed 2024:
Timbre & Harmony in Vancouver, BC
PHI Certified

innotech
windows + doors

Coming Soon:
Vienna House in Vancouver, BC
Targeting PHI Certification

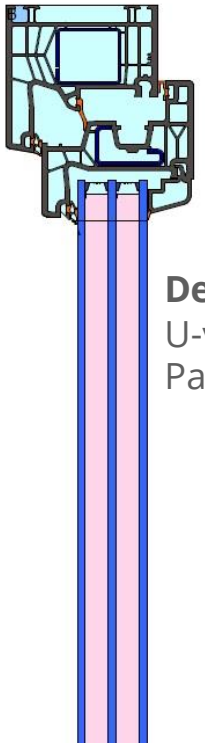
innotech
windows + doors

Coming Soon:
981 Davie in Vancouver, BC
Targeting PHI Certification

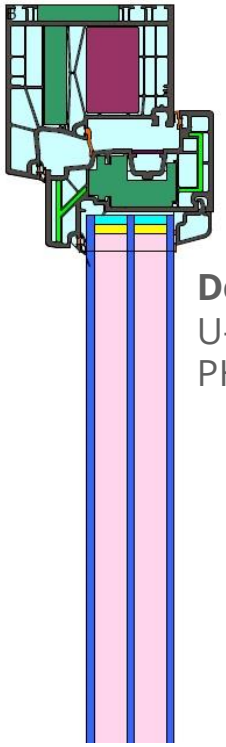
innotech
windows + doors

U-VALUES
U-VALUES
U-VALUES
U-VALUES
U-VALUES

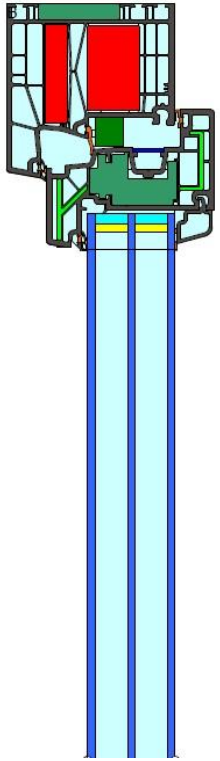
The Defender Window Series



Defender 76TS
U-value 0.90
Passive House Suitable Component



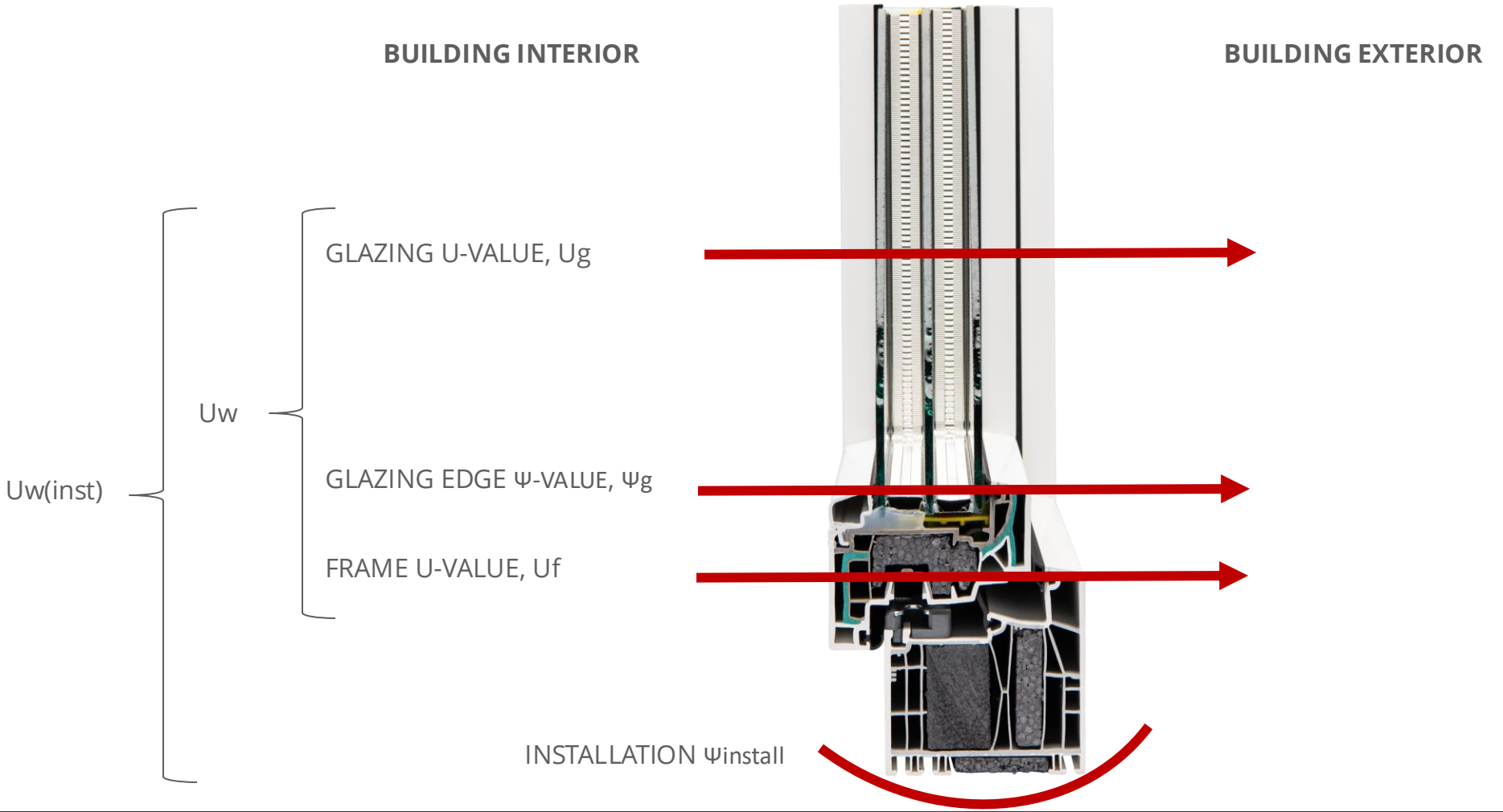
Defender 88PH+ Pro
U-value 0.746
PHI Cool Temperate Certified



Defender 88PH+ XI
U-value 0.59
PHI Cold Climate Certified

innotech
windows + doors

What is U-value?



innotech
windows + doors

How Are U-values Calculated?

	U-value	
	Exterior Temp.	**Interior Temp.**
NFRC 100 & 200	-18°C	21°C
ISO 10077-1, ISO 10077-2, ISO 15099	0°C	20°C
Passive House Window Certification Criteria	Frame: -10°C IGU: 20°C to -7°C (climate specific)	20°C

innotech
windows + doors

NFRC vs. ISO U-value Calculation

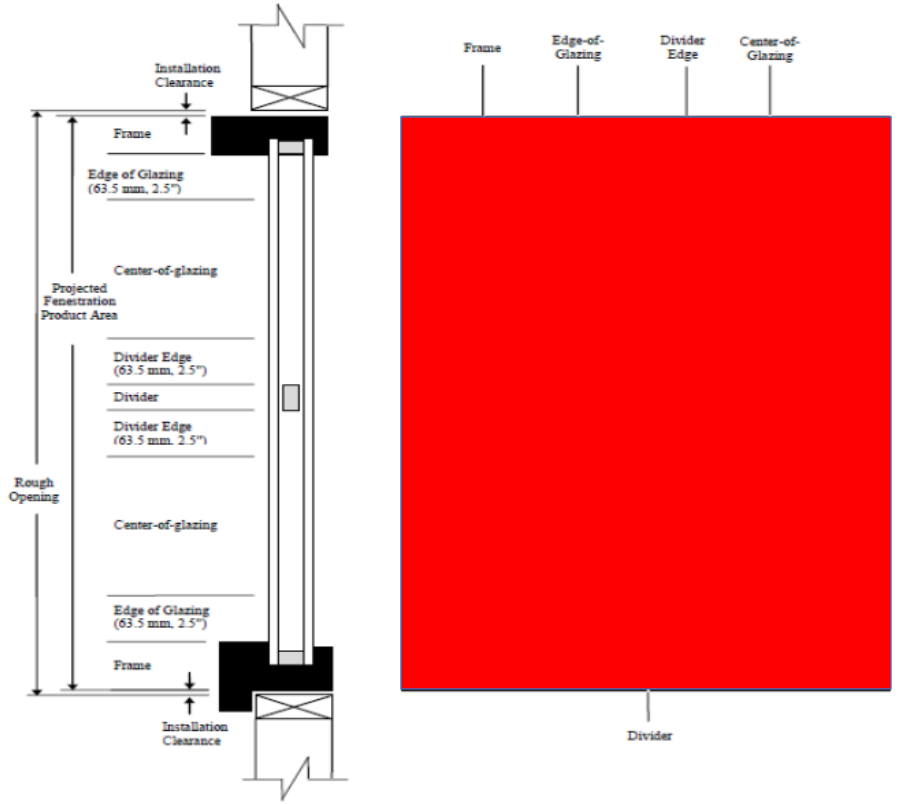
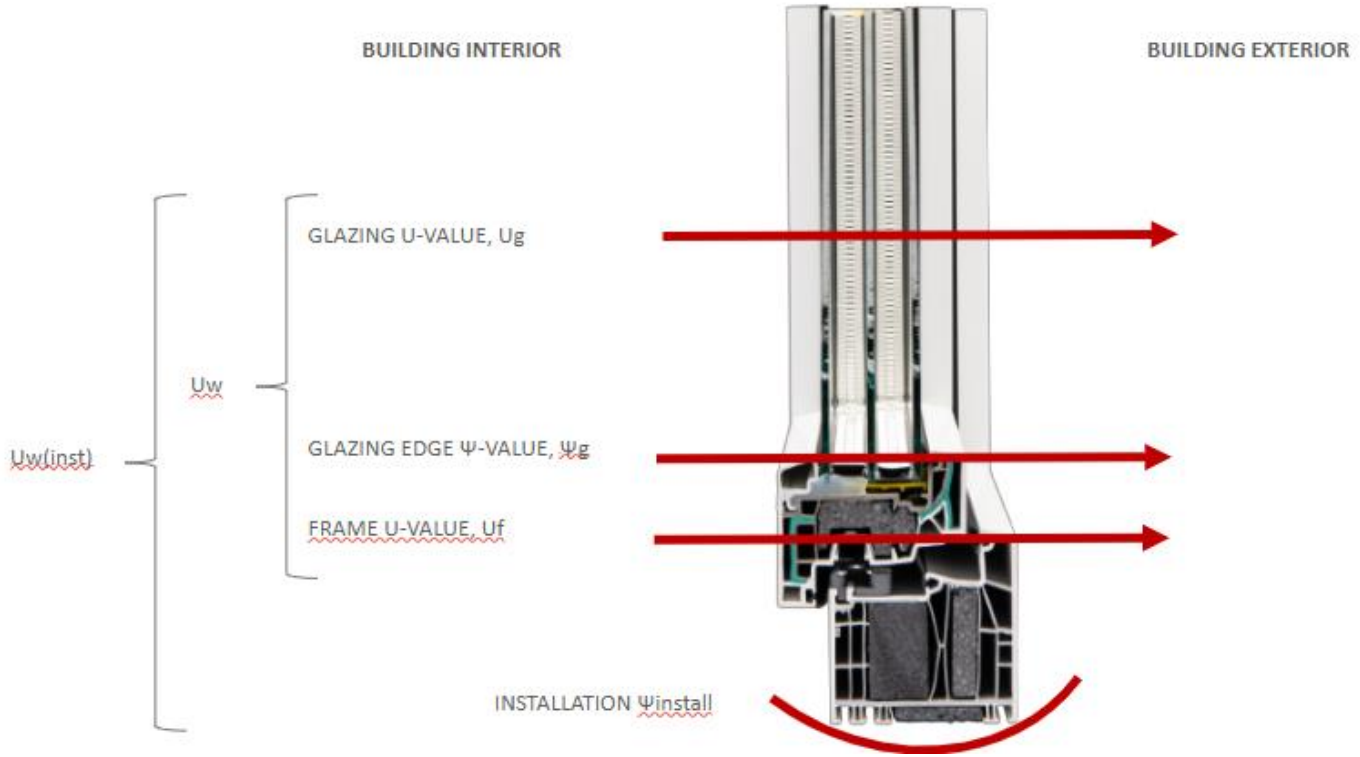


Figure 2 Window Product Diagram (NFRC, 2010)



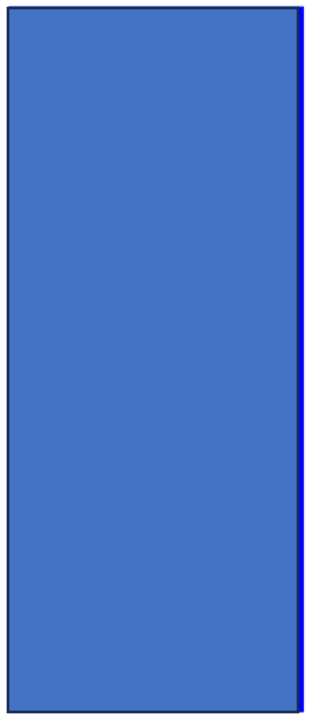
innotech windows + doors

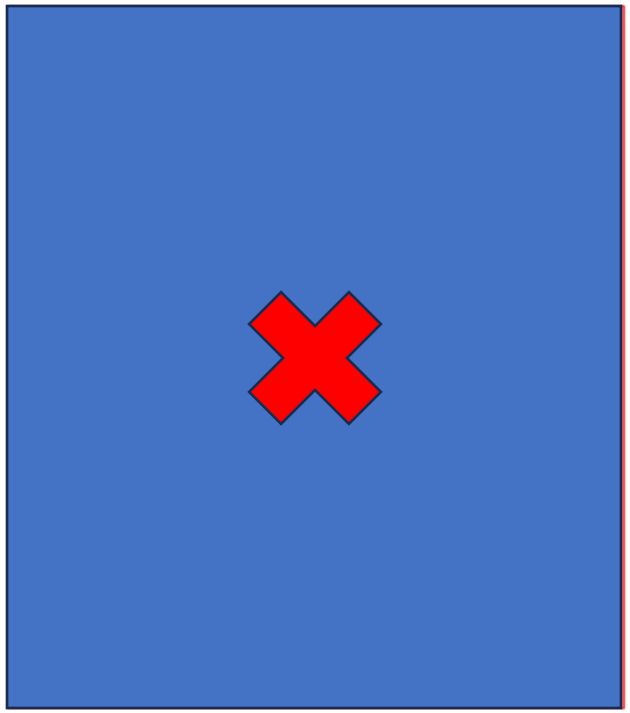
Calculating Heat Gain - Systems

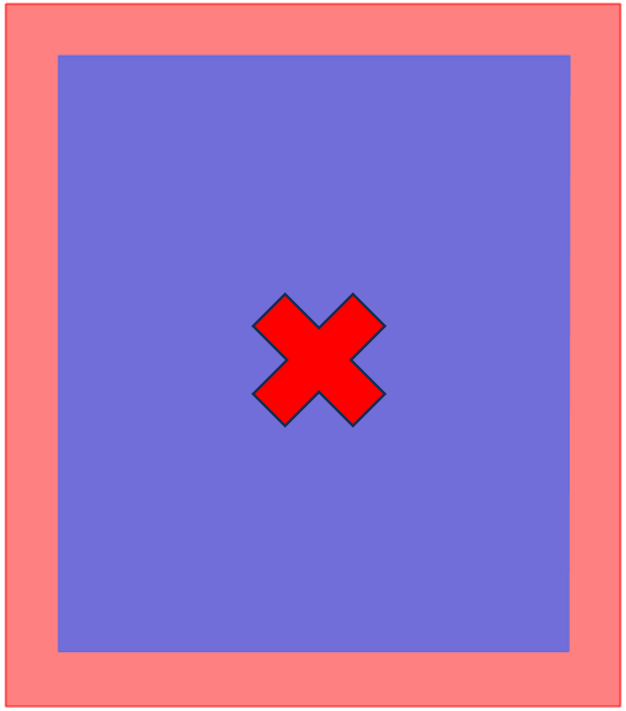
	Solar Heat Gain		
	Exterior Temp.	**Interior Temp.**	**Solar Radiation**
NFRC 100 & 200	32°C	24°C	783 W/m^2
ISO 10077-1, ISO 10077-2, ISO 15099	30°C	25°C	500 W/m^2
Passive House Window Certification Criteria	30°C	25°C	500 W/m^2

innotech
windows + doors

NFRC, ISO vs PHI Solar Heat Gain Calculation

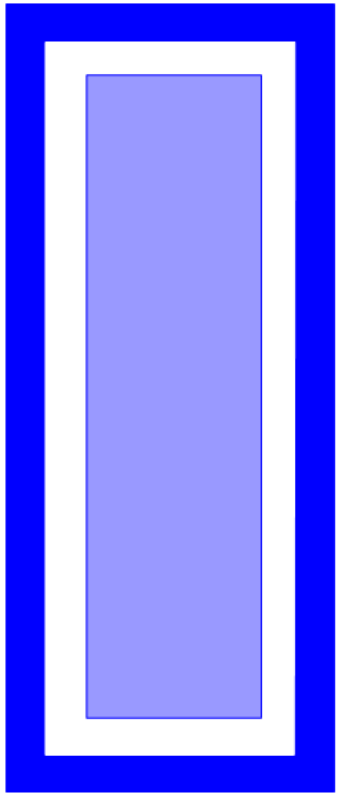




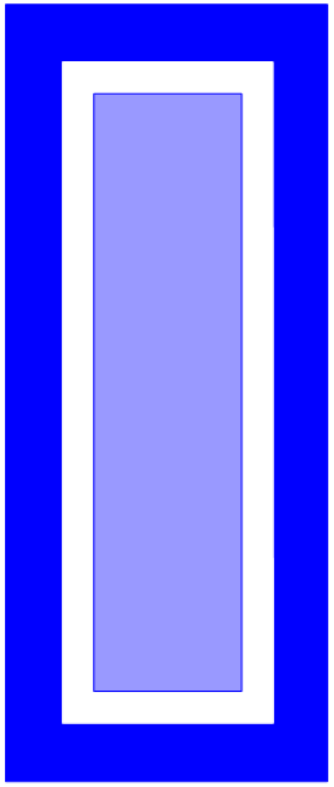


innotech
windows + doors

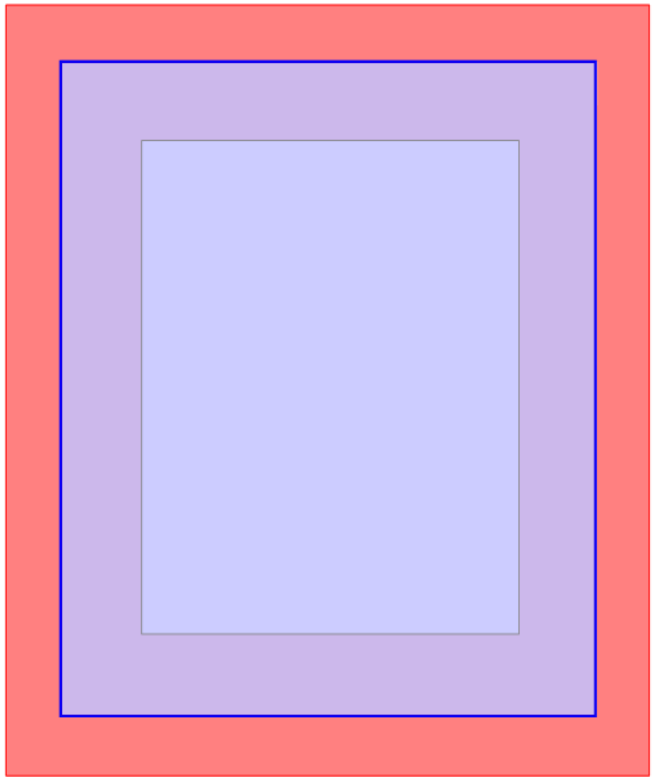
Does Size Matter for U-value & SHGC?



Window A
27% Frame
Uf=1.5
Ug=0.9
Uw=1.07
(NFRC)



Window B
46% Frame
Uf=1.25
Ug=0.90
Uw=1.07
(NFRC)



innotech
windows + doors

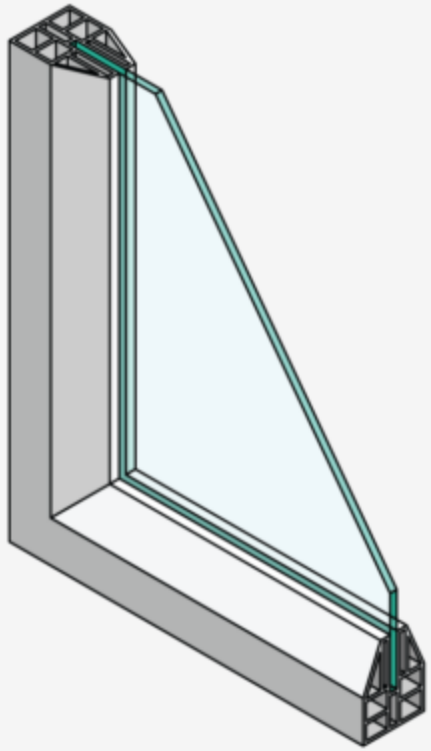
What U-value Have You Been Given?

- NFRC is intended to provide direct comparison between windows at standard size, not specific product performance for projects.

- PHI methodology is designed to provide specific heat flows for products at actual size for specific performance projects.

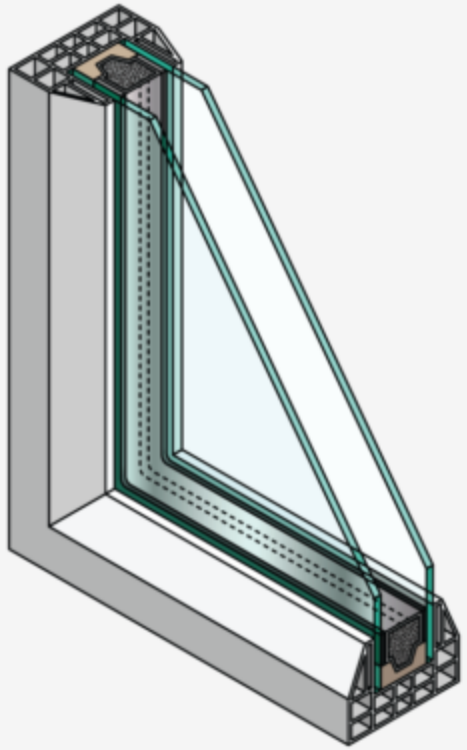
innotech
windows + doors

Single Pane



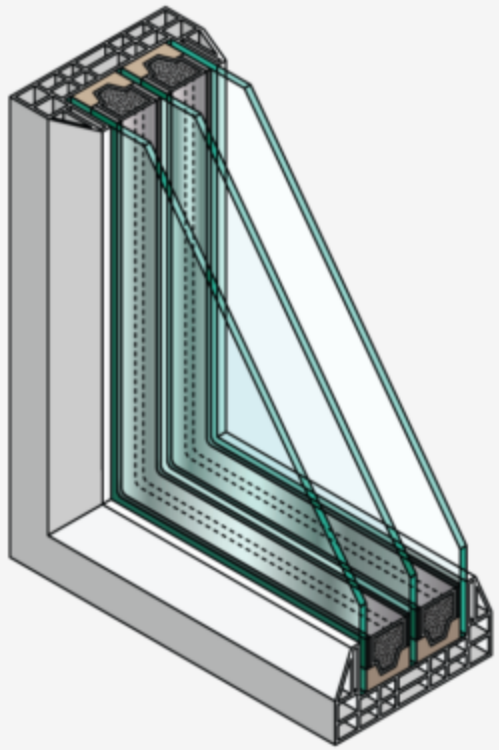
PHi Ug=5.801
g=0.858

Double Pane

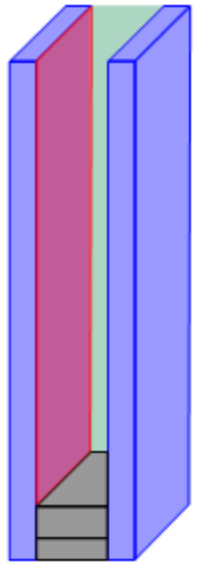


PHi Ug=1.116
g=0.394

Triple Pane

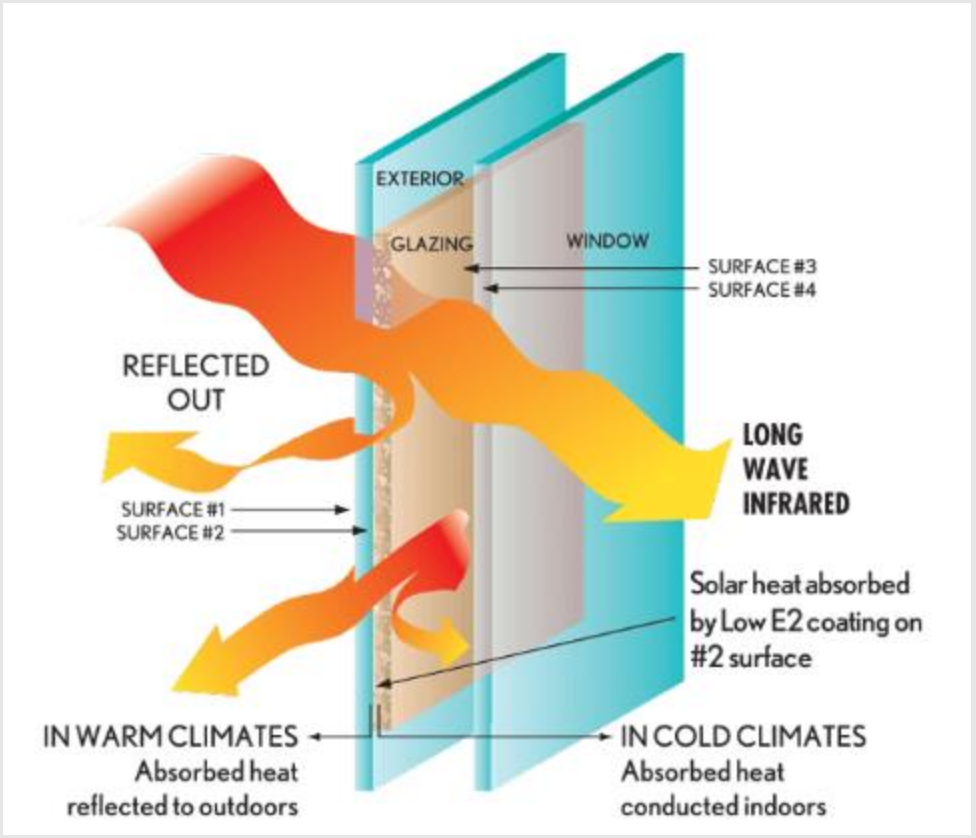


PHi Ug=0.535
g=0.339

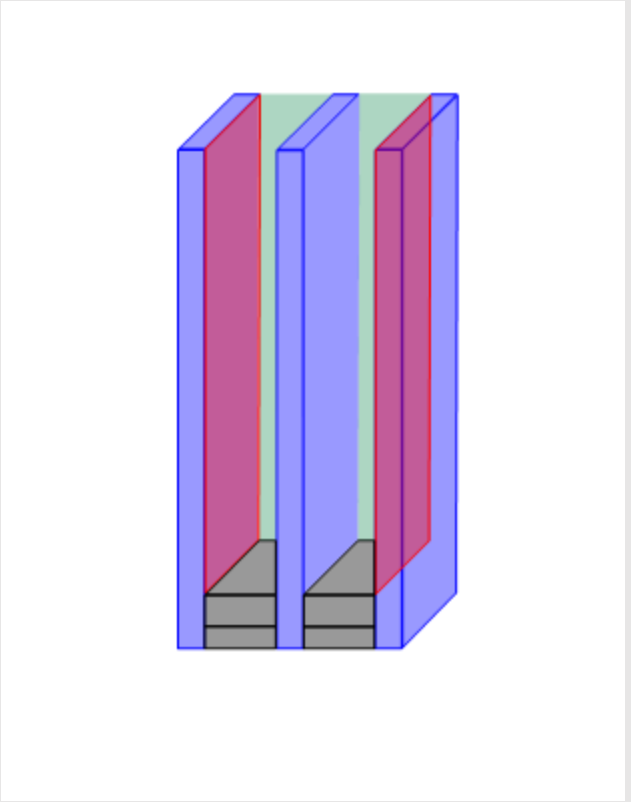


PHi Ug=1.116
g=0.394

Fill: 95% Ar
15mm cavity, 23mm O/A
1 layer LowE

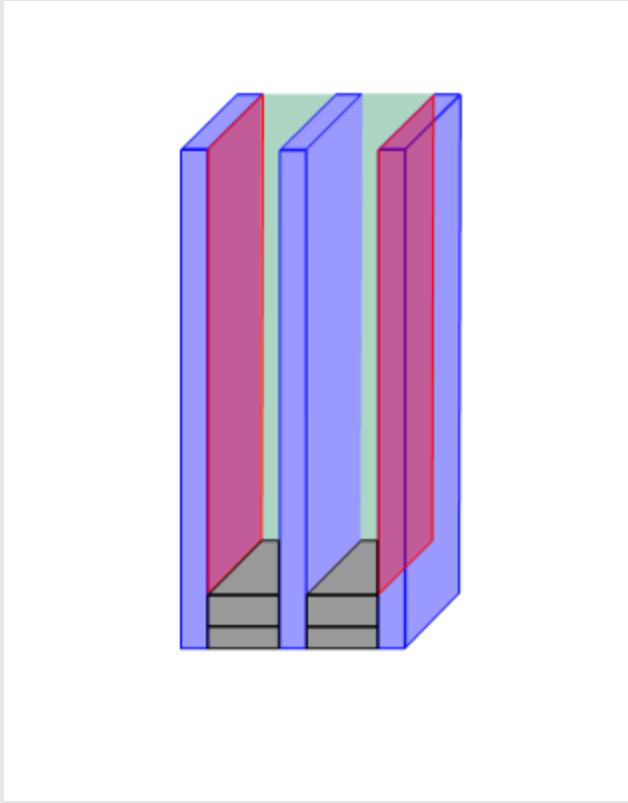


Low Emissivity Coatings (Low-E) are critical to reflecting heat back to the source in glazed units, but are <u>not</u> the sole determinant to performance.



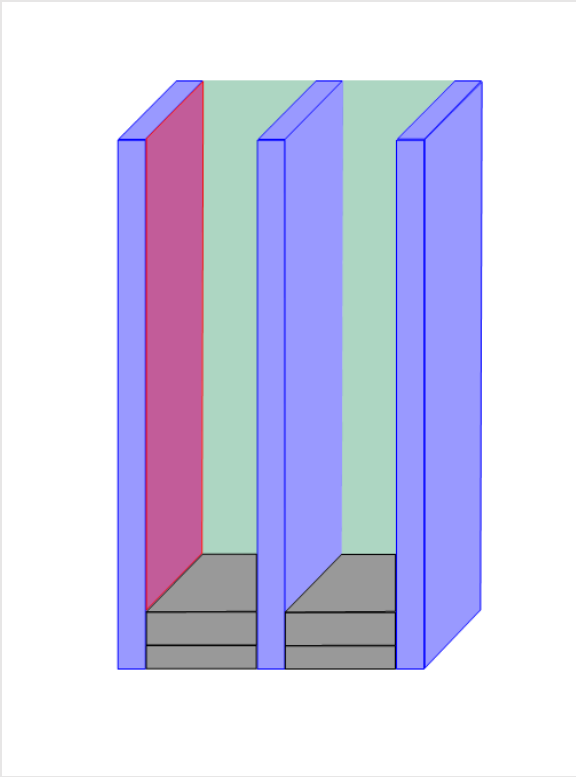
PHi Ug=1.565
g=0.369

Fill: 95% Ar
5.7mm cavities, 23mm O/A
1 layer LowE



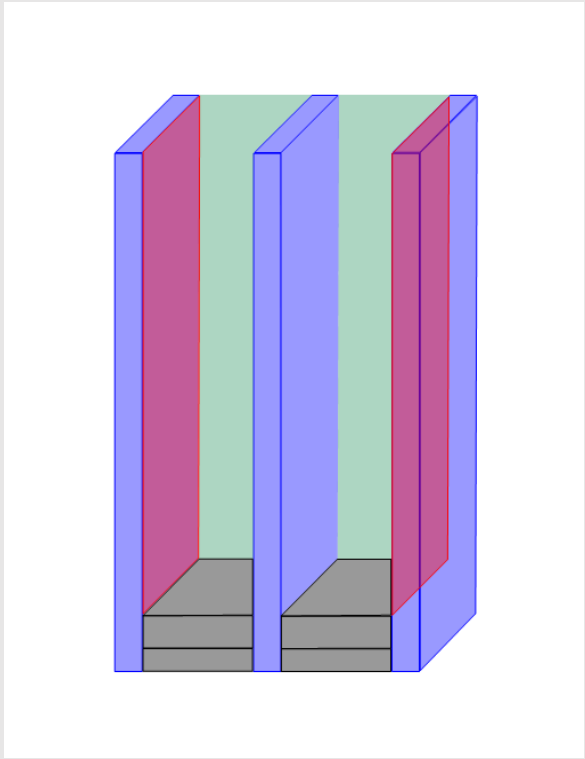
PHi Ug=1.267
g=0.358

Fill: 95% Ar
5.7mm cavities, 23mm O/A
2 layers LowE



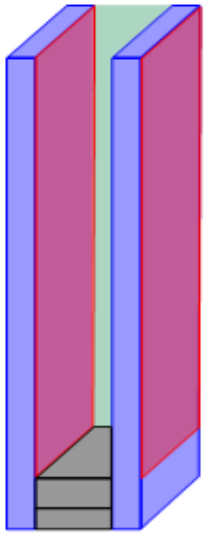
PHi Ug=0.890
g=0.363

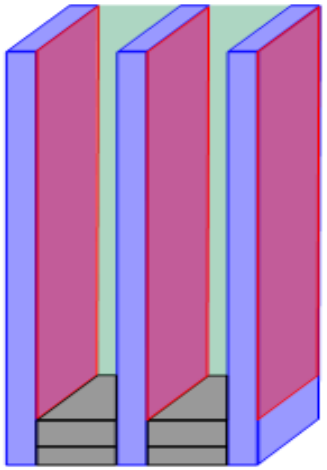
Fill: 95% Ar
18mm cavities, 48mm O/A
1 layer LowE

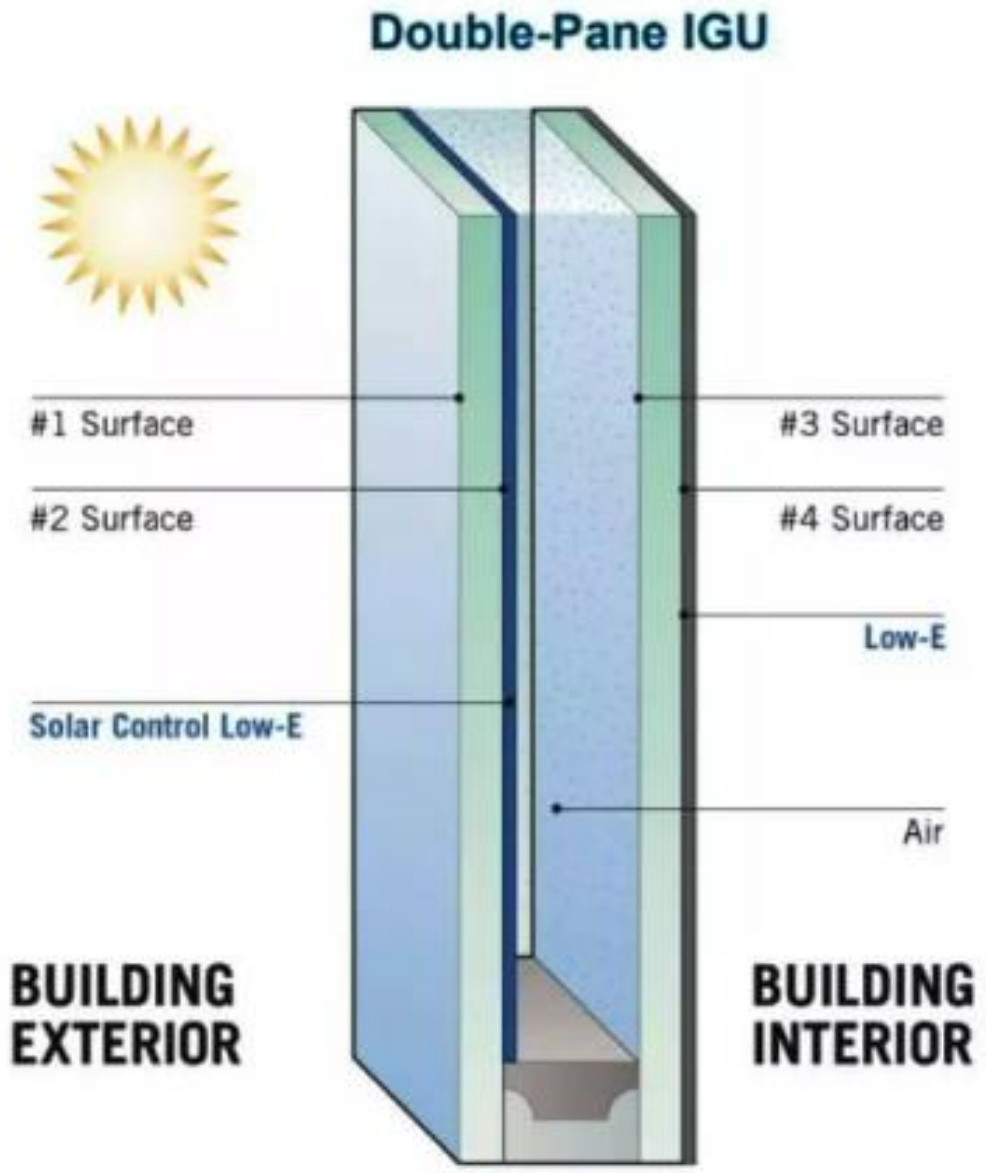


PHi Ug=0.570
g=0.353

Fill: 95% Ar
18mm cavities, 48mm O/A
2 layers LowE






Double-Pane IGU
#1 Surface
#2 Surface
Solar Control Low-E
#3 Surface
#4 Surface
Low-E
Air
BUILDING EXTERIOR
BUILDING INTERIOR

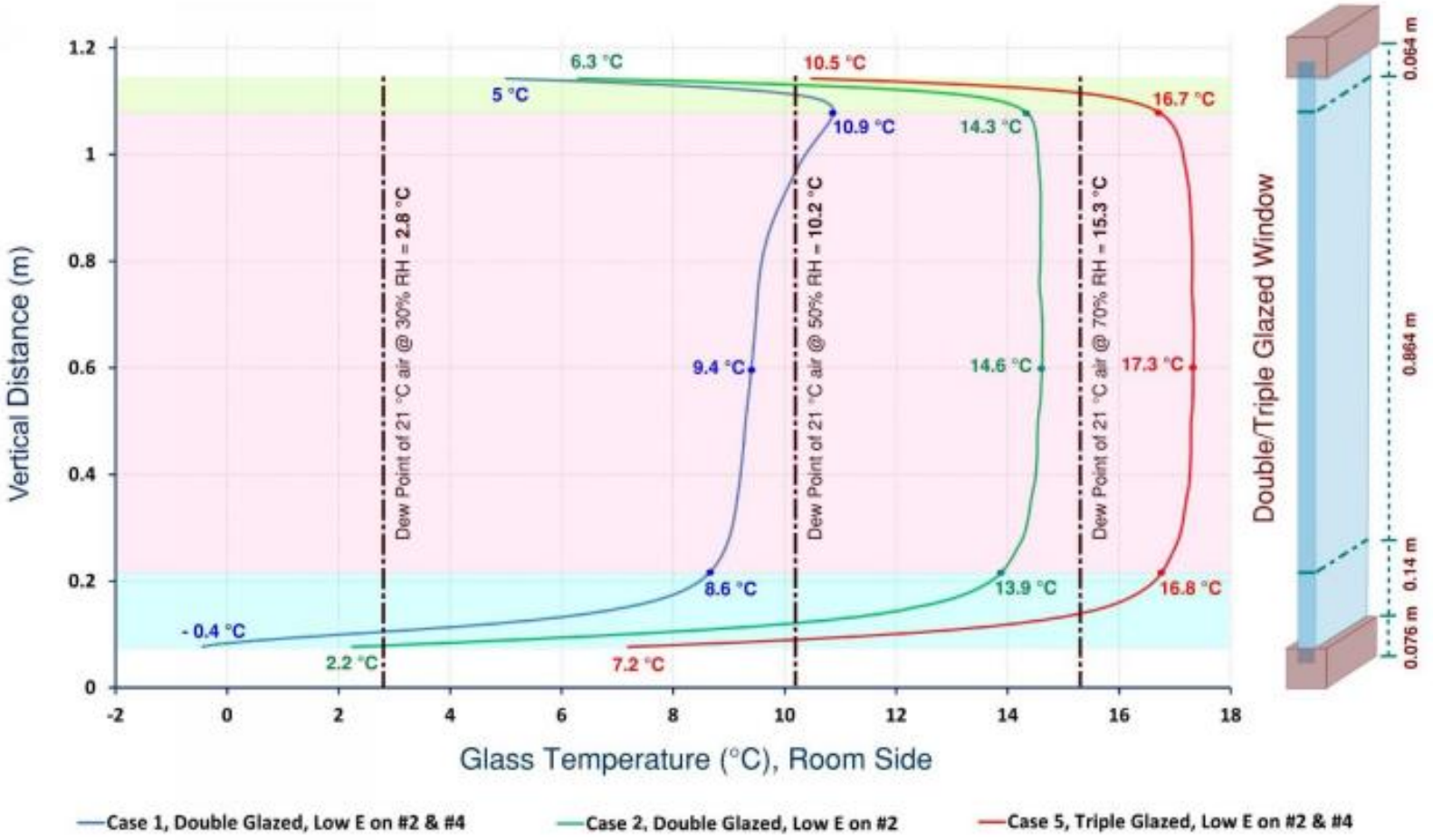


Figure D Surface temperature of the most inner pane of glass (surface #4 for double-glazed and surface #6 for triple-glazed) when subject to 21 °C (70 °F) indoor temperature and -18 °C (-0.4 °F) outdoor temperature. The results are for windows inside the concrete wall (Cases 1, 2 & 5 – Figure B).

ASHRAE C080 by Hamid Heidarali

innotech windows + doors

Warning: You Might Overheat

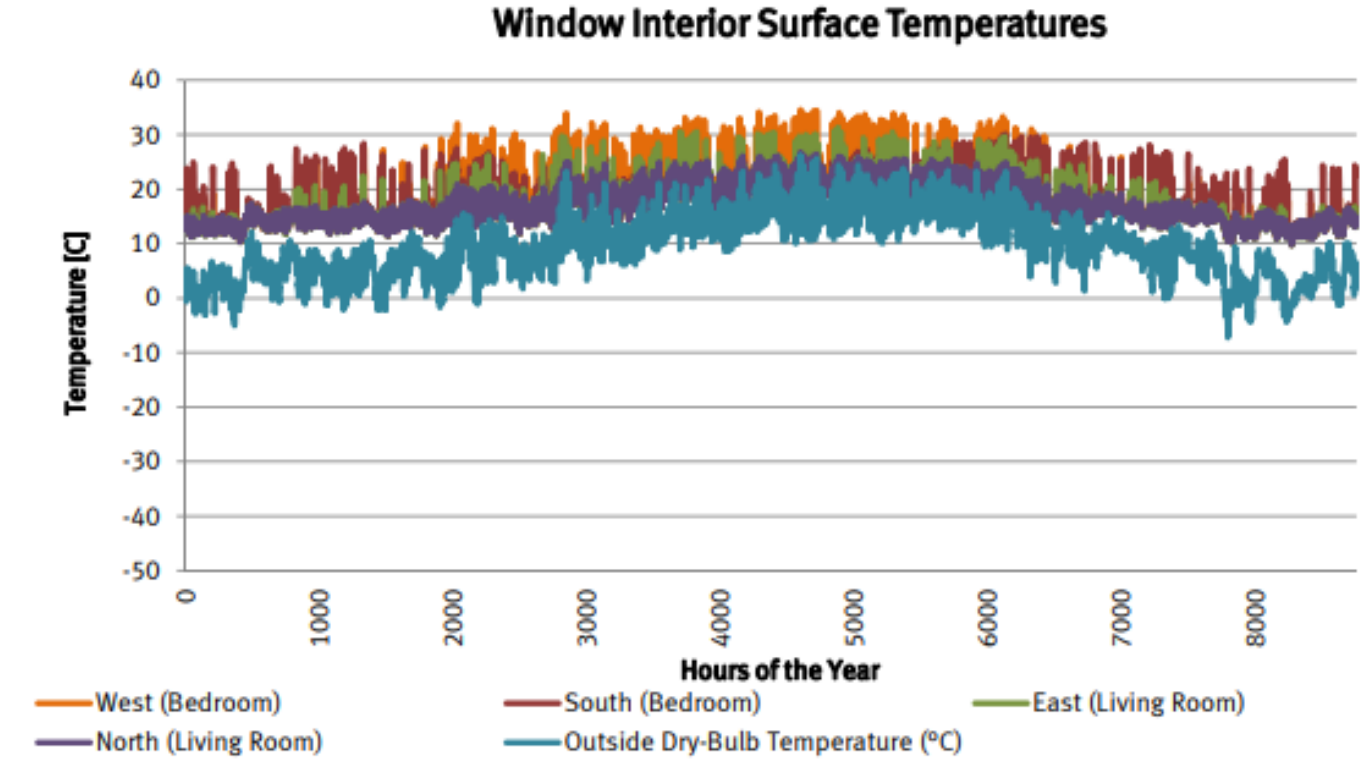
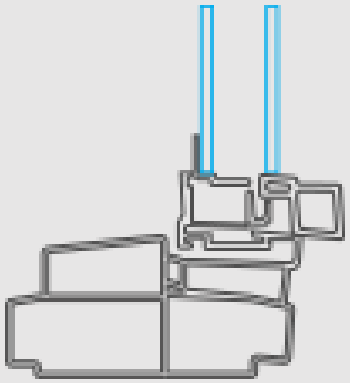
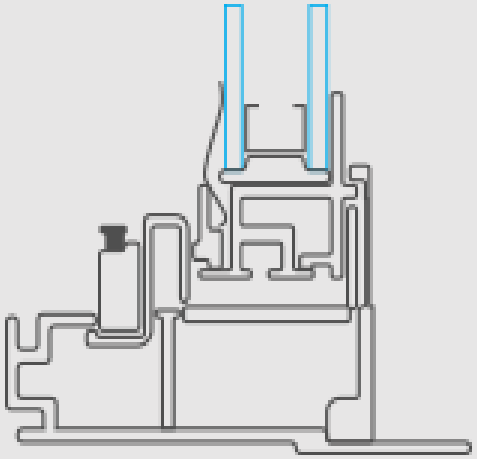


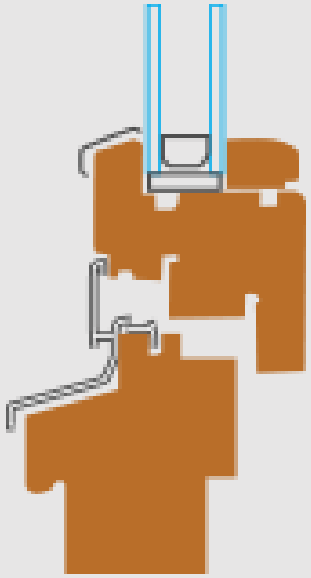
Fig. 9.4.5 D1 Vancouver, Window surface temperatures

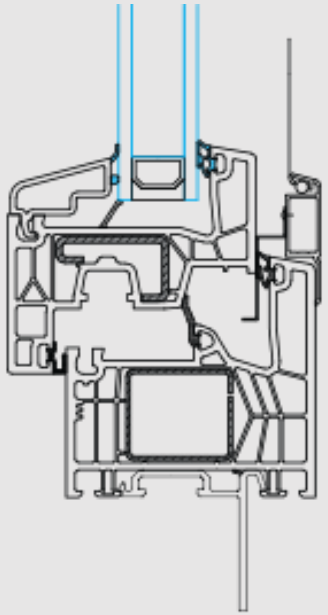
Source: https://www.bchousing.org/publications/Window-Energy-Rating.pdf

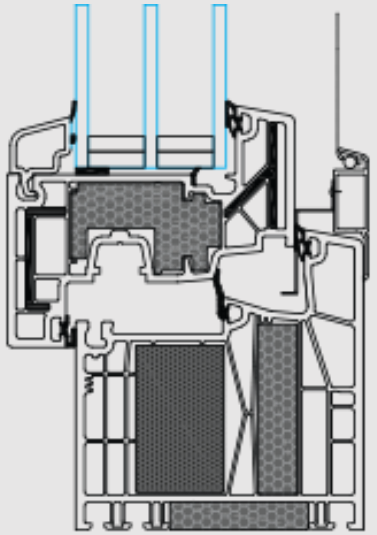
innotech windows + doors







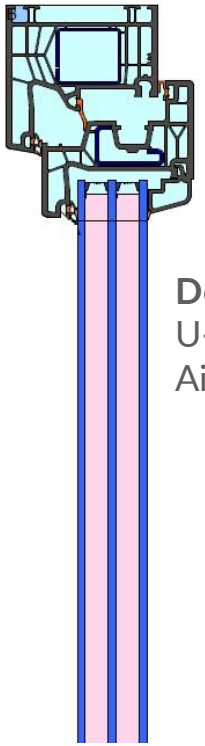




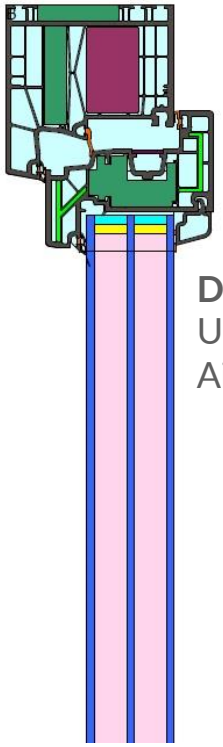
AIRTIGHTNESS
DURABILITY
EMBODIED CARBON
AFFORDABILITY
WATER RESISTANCE
COMFORT CRITERIA
Uinstalled
HYGIENE CRITERIA
STRUCTURE

AIRTIGHTNESS
DURABILITY
EMBODIED CARBON
AFFORDABILITY
WATER RESISTANCE
COMFORT CRITERIA
Uinstalled
HYGIENE CRITERIA
STRUCTURE

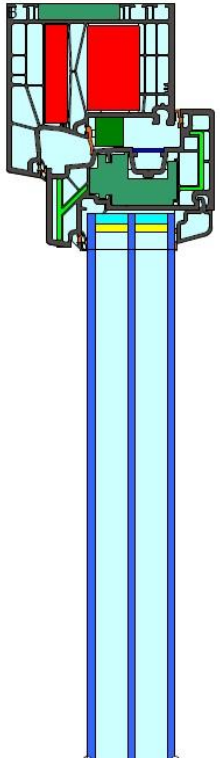
Airtightness



Defender 76TS
U-value 0.90
Airtightness 0.01 CFM/FT_2



Defender 88PH+ Pro
U-value 0.746
Airtightness 0.01 CFM/FT_2



Defender 88PH+ XI
U-value 0.59
Airtightness 0.01 CFM/FT_2

innotech
windows + doors

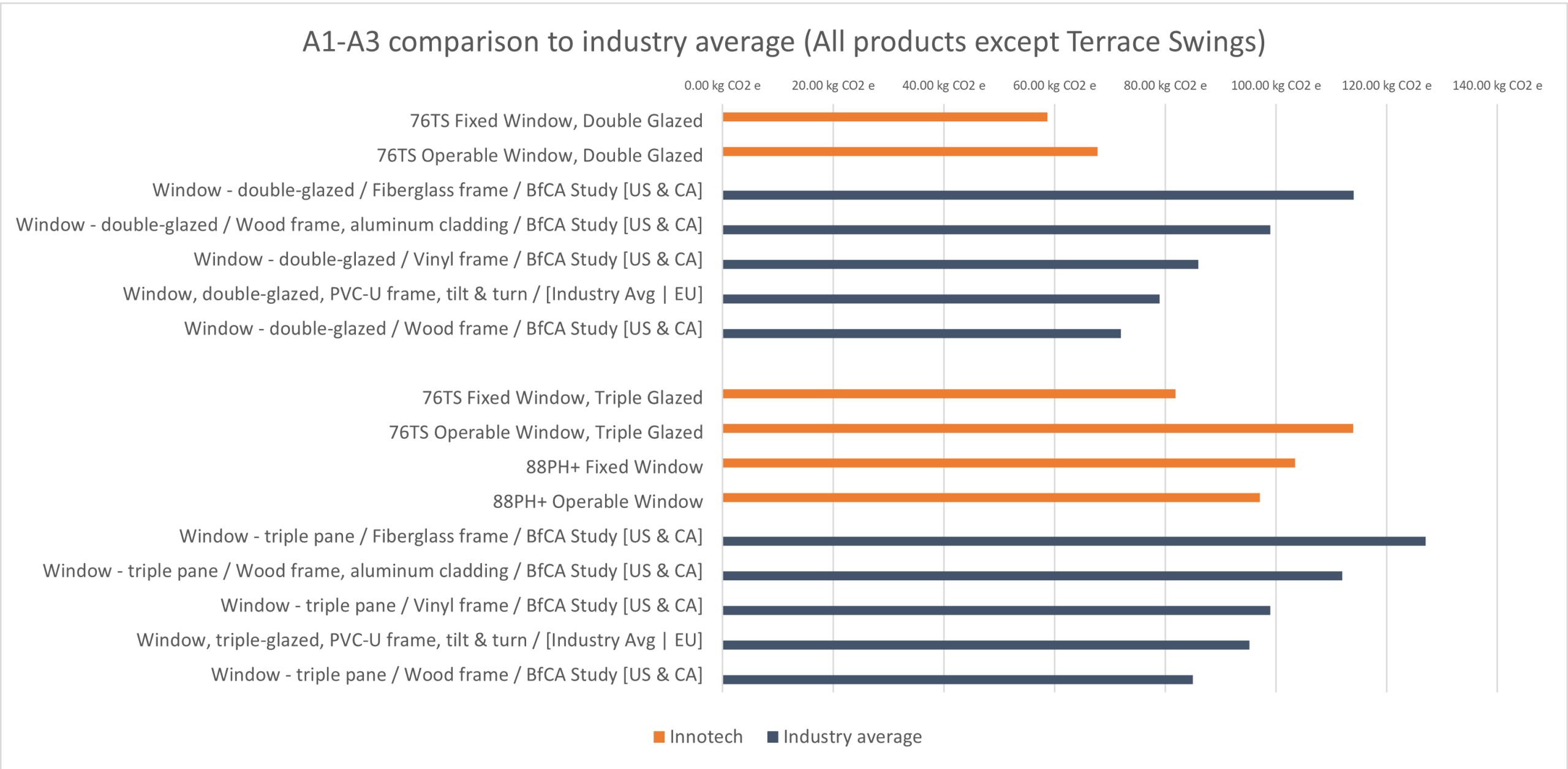
Embodied Carbon

- Triple glazing impacts embodied carbon
- Balance embodied carbon with future operational carbon

EPD®

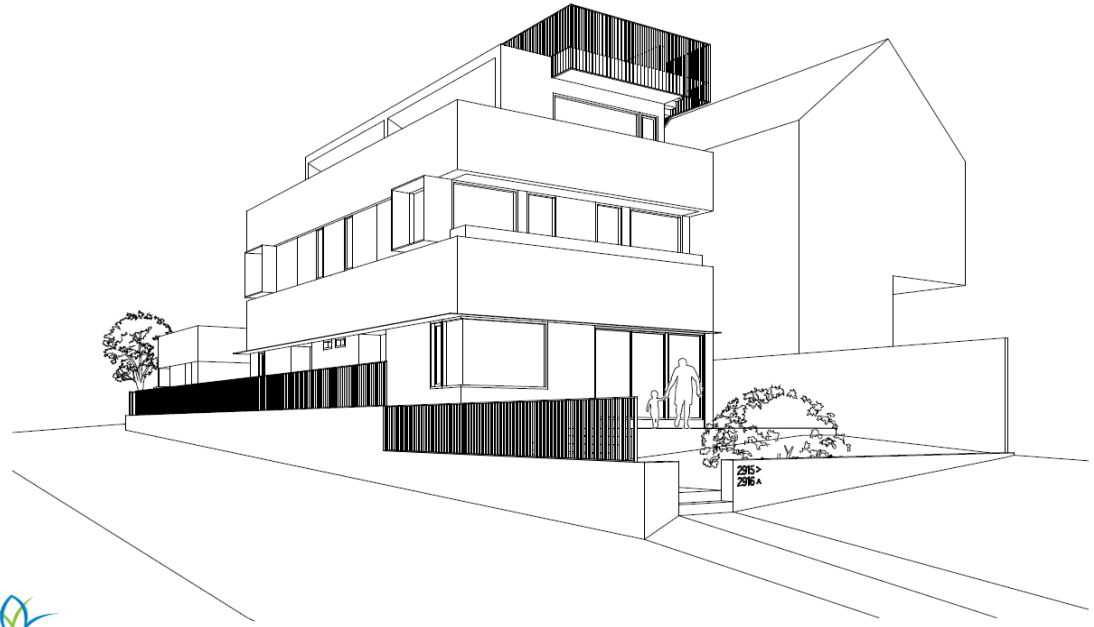
THE INTERNATIONAL EPD® SYSTEM

innotech windows + doors



Data compiled by Carbon Wise.

Affordability: Finding Balance



CITY OF VANCOUVER

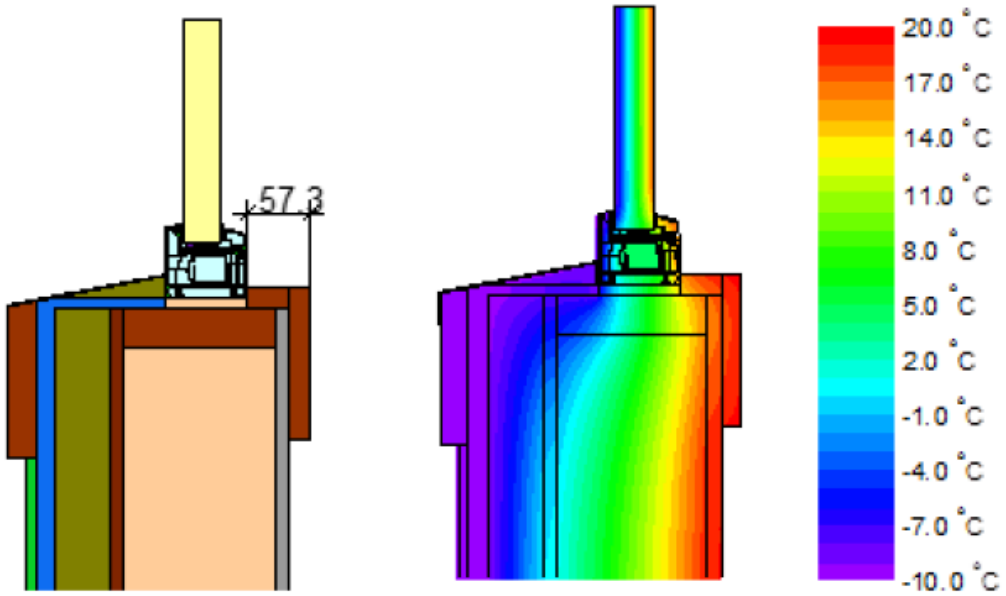
innotech windows + doors

CAN YOUR INSTALLATION IMPROVE THE OVERALL U-VALUE OF THE WINDOW?

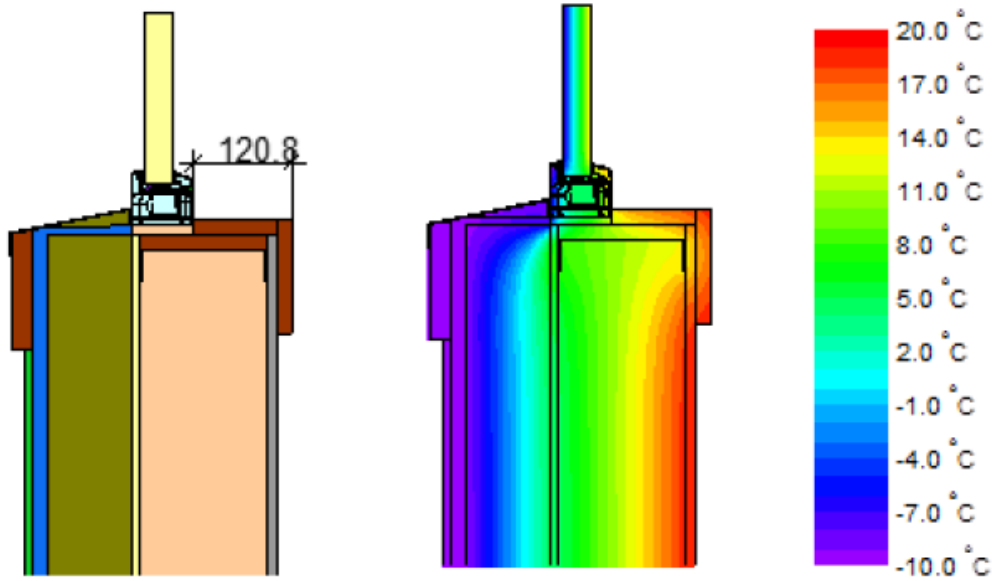
TABLE 4.1 OVERALL EFFECTIVE U-VALUE, $U_{W,installed}$			
Wall Type	**Optimal Position (non-OI/OI)**	**TS**	
		U-value (non-OI)	**U-value (with OI)**
Wall 1	Outer/Inner	1.010 (13%)	0.897 (0%)
Wall 2	Mid/Mid	1.004 (12%)	0.906 (1%)
Wall 3	Outer/Mid	0.994 (11%)	0.890 (-1%)
Wall 4	Mid/Mid	1.136 (27%)	0.969 (8%)
Wall 5	Out/Inner	1.239 (38%)	1.038 (16%)
Wall 6	Outer/Outer	1.181 (32%)	0.988 (10%)

innotech
windows + doors

Optimal Position



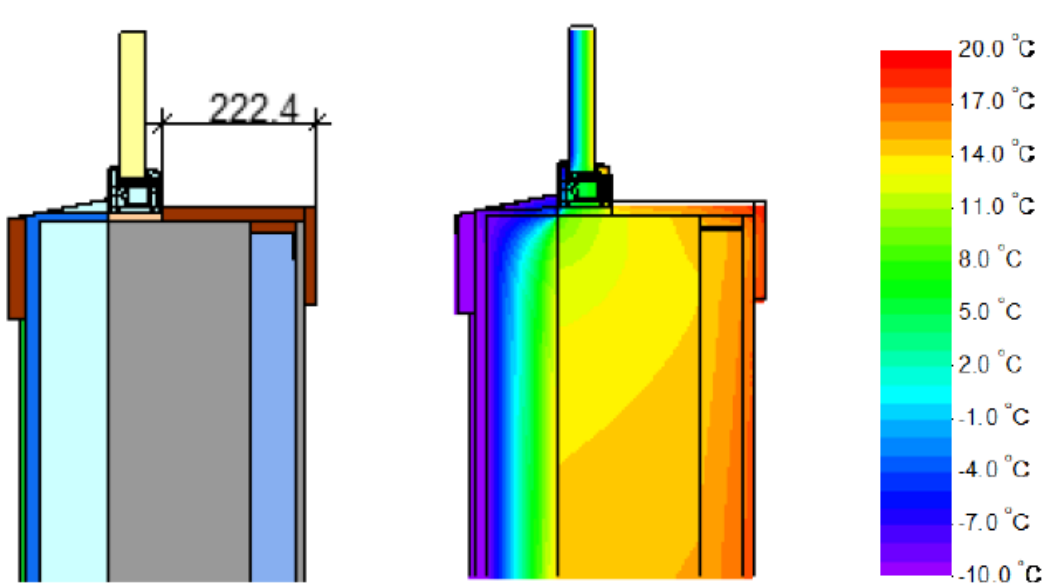
Wall 1
2x6 w/ 2" Ext. Insulation
R-22+ Effective
Uw-inst w/ OI: 0.897



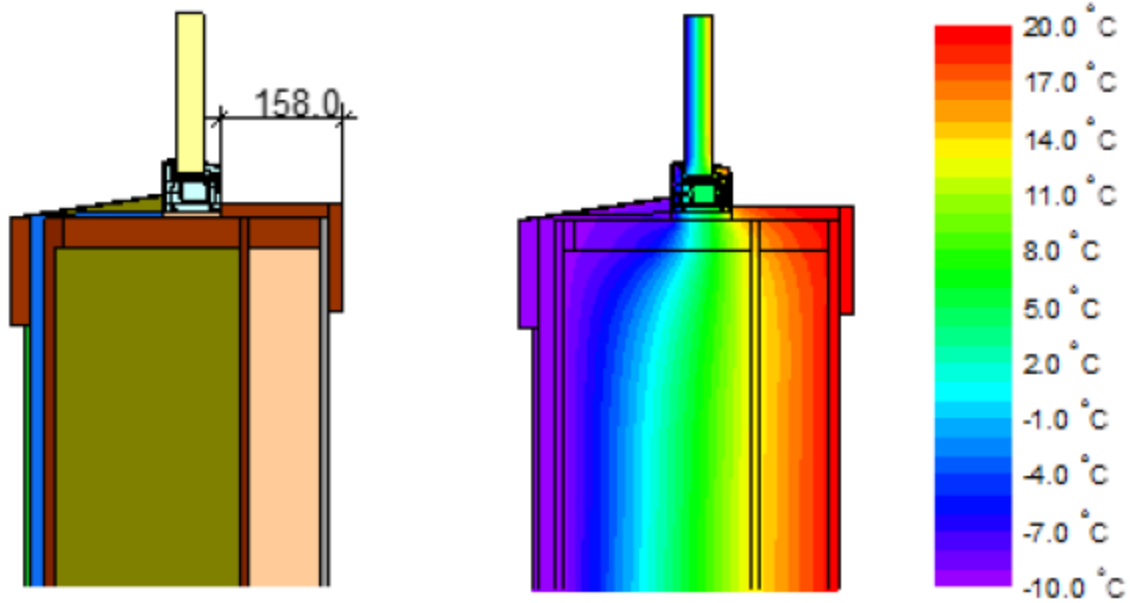
Wall 4
2x6 Steel Stud with 4” Ext. Insulation
R-20+ Effective
Uw-inst w/ OI: 0.969

innotech windows + doors

Optimal Position



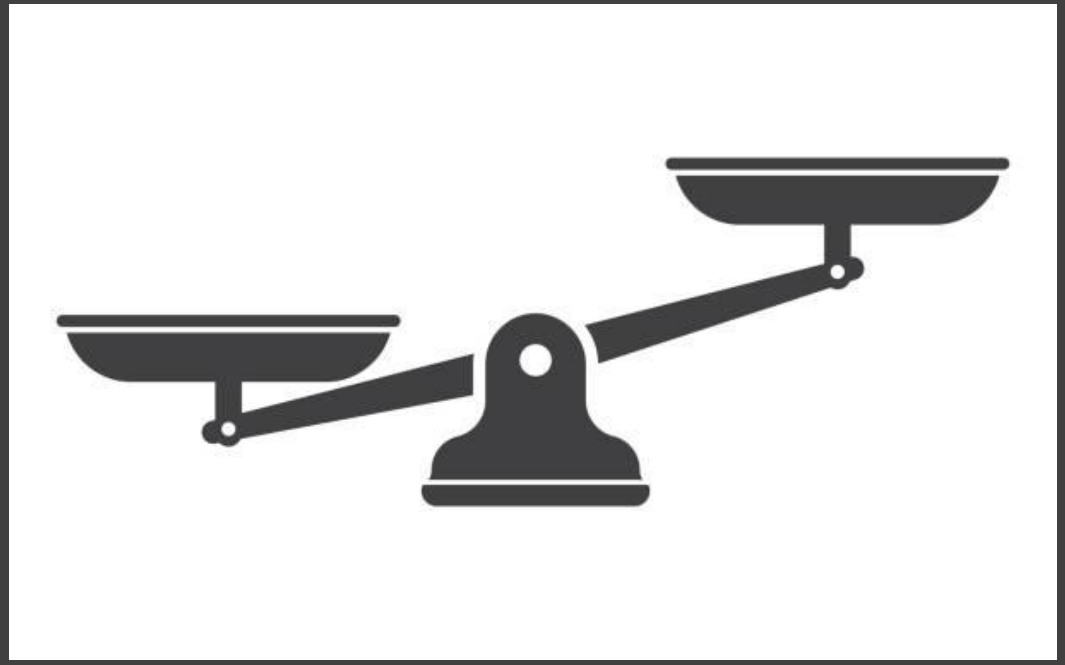
Wall 6
Ext. Insulated Concrete Wall, 8" Deep with 2.5" Steel Framing
R-20+ Effective
Uw-inst w/ OI: 0.988



Wall 2
Deep Stud/Double Stud
R-40+ Effective
Uw-inst w/ OI: 0.906

innotech
windows + doors

U-VALUE
AIRTIGHTNESS
DURABILITY
EMBODIED CARBON
AFFORDABILITY
SOLAR HEAT GAIN
WATER RESISTANCE
COMFORT CRITERIA
Uinstalled
HYGIENE CRITERIA
STRUCTURE



innotech
windows + doors

innotech-windows.com