

Stella PC3710 Perimeter Channel: U-Value and Condensation Analysis

STUDY OF PC3710 SHOE DETAIL

R1 - NOVEMBER 19, 2020

Analysis Notes

The thermal performance of the PC3710 Perimeter Channel has been evaluated in the following report considering three different glass configurations (outlined below). The channel geometry used was provided by Stella and assumed to be accurate to real components. CAD details for additional components such as a typical ledge support, butt joint, and fin connection were also provided by Stella for analysis. The effective u-value calculated hereafter is based on a generic layout of these components. The layout considered is outlined on page 3 of this report.

This report is prepared for research and informational purposes only. These results are only a guide to the actual system performance and should not be interpreted as exact performance. This analysis is performed at ideal steady-state conditions and does not account for any outside influences, three-dimensional interactions, or final installation of the system in the field.

Glass Make-Ups

1 1/4" glazing units:

	GL1 Configuration	GL2 Configuration	GL3 Configuration
Outer Lite	9.4mm Clear with Cardinal Glass R500 #2	9.4mm Clear with Sunguard SNX51/23 #2	9.4mm Clear with Solarban 60 #2
Space	13mm Air	13mm 90% Argon/10% Air Mix	13mm 90% Argon/10% Air Mix
Inner Lite	9.4mm Clear	9.4mm Clear with Sunguard IS20 #4	9.4mm Clear

Glazing spacers:

The glazing spacer considered in each configuration examined in this analysis is the Viracon Stainless Steel spacer. The THERM files for these elements were obtained from the Viracon Design & Education Resources website.

Modeling Assumptions

1. Models were constructed during ideal conditions.
2. Three-dimensional heat transfers are not represented.
3. Effects of surrounding conditions are not included in this analysis.
4. Non-continuous elements are not modeled.

Test Procedure

The components evaluated in this study were modeled using NFRC approved software:

- Frame and Edge Modeling: THERM 7.6
- Centre-of-Glass Modeling: WINDOW 7.6

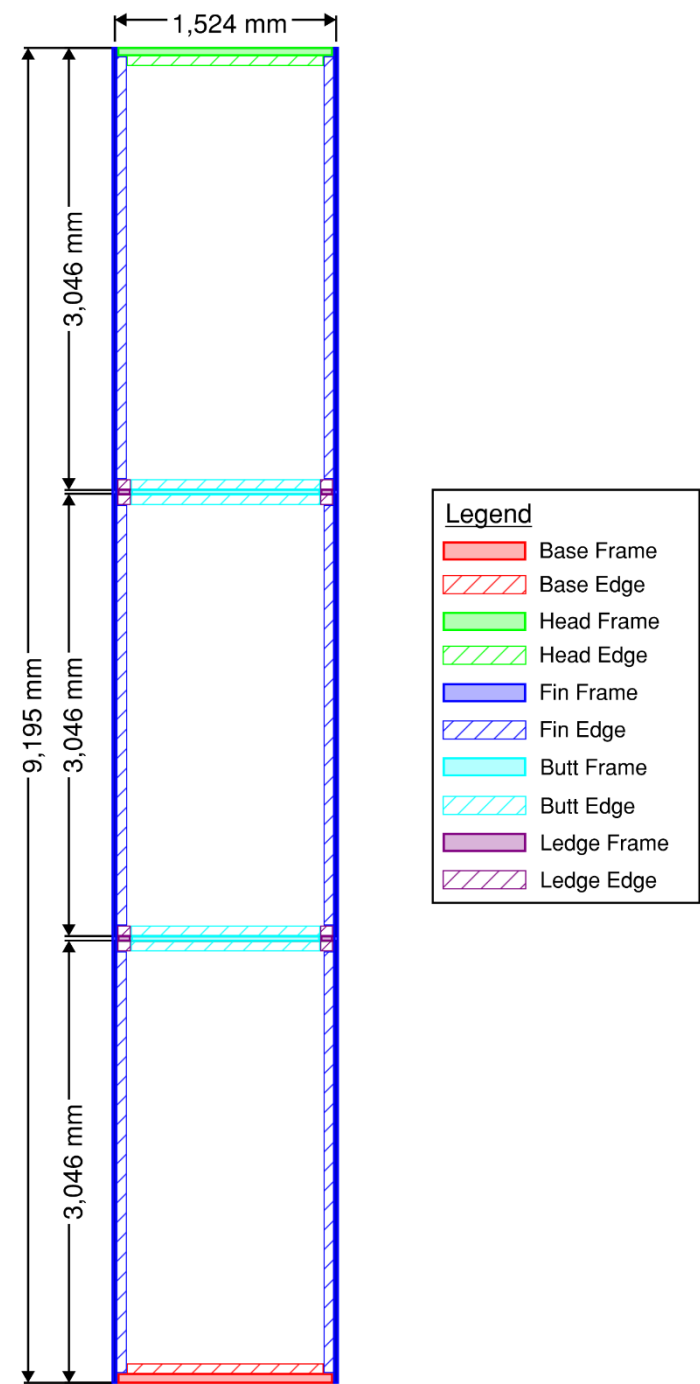
Design Guides

The perimeter channel was evaluated in accordance with the following:

- ANSI/NFRC 100-2017: Procedure for Determining Fenestration Product U-Factors
- THERM 7.6: This program calculates heat loss through frame and edge-of-glass components using finite difference analysis. The program solves for temperature and heat flow distribution through the cross-section. The temperature distribution can then be used to determine overall heat loss, total and component U-Factors, and local temperatures at points of interest.
- WINDOW 7.6: This program calculates U-Factor and center-of-glazing (COG) temperatures using a two-dimensional heat flow analysis.

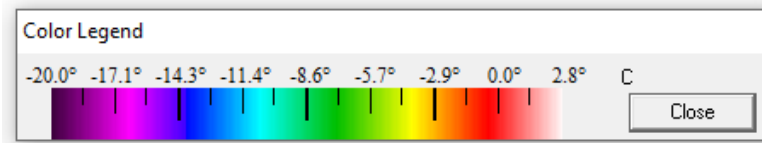
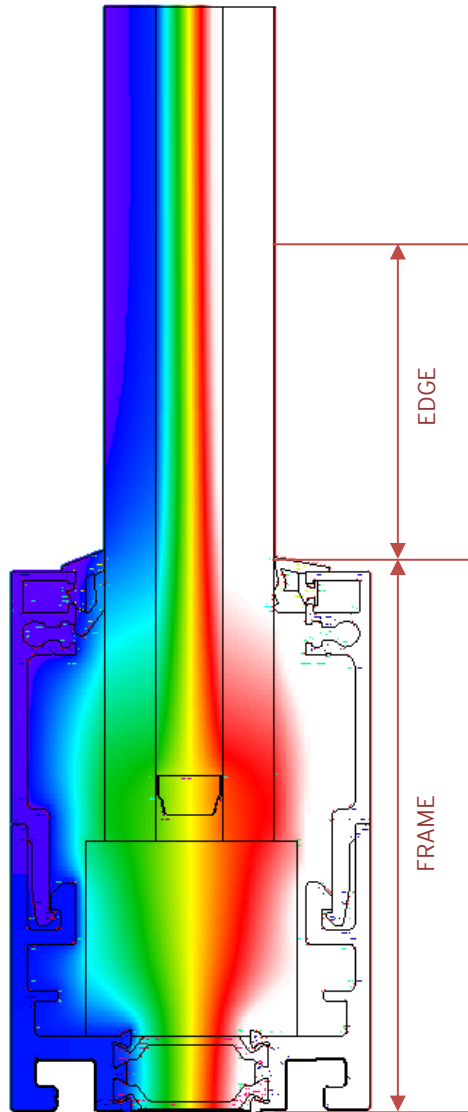
Analysis Component Geometry

The components studied in this analysis have been arranged in a typical glass wall configuration comprised of one row of glass panels stacked three-high. The dimensions and layout are indicated in the enclosed schematic:



GL1 Configuration – Base Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



U-Factors

	U-factor W/m2-K	delta T C	Length mm	Rotation	
Frame	3.3886	39.0	107.742	90.0	Projected in Glass Plane
Edge	2.6823	39.0	63.5	90.0	Projected in Glass Plane

Display

☒ U-factor
☐ R-value

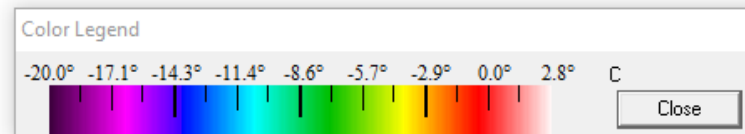
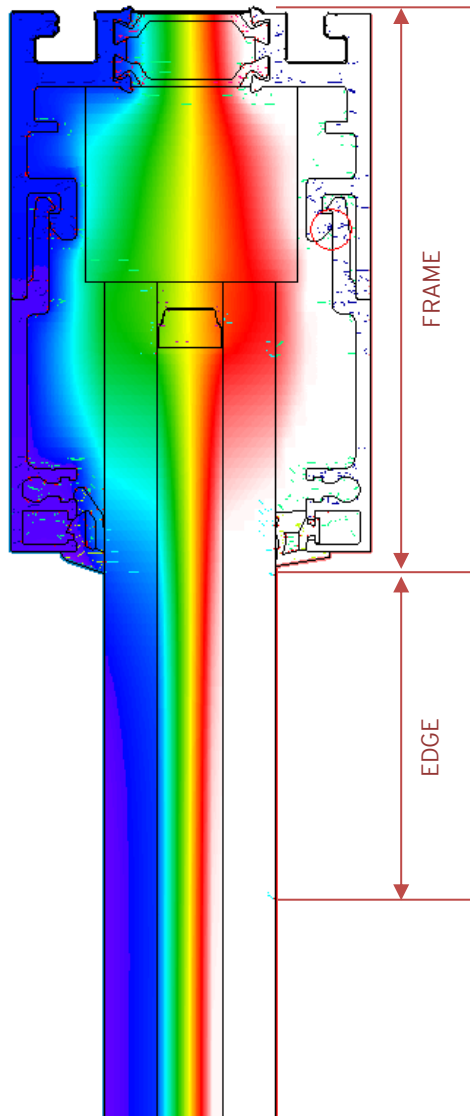
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Export

OK

GL1 Configuration – Head Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



U-Factors

	U-factor W/m ² K	delta T C	Length mm	Rotation	
Frame	3.3950	39.0	107.742	90.0	Projected in Glass Plane
Edge	2.6822	39.0	63.5	90.0	Projected in Glass Plane

Display

☒ U-factor
☐ R-value

% Error Energy Norm 5.89%

Export

OK

GL1 Configuration – Glass to Fin Detail

Exterior Temp:

-18°C/-0.4°F (NFRC 100-2010 Exterior)

Interior Temp:

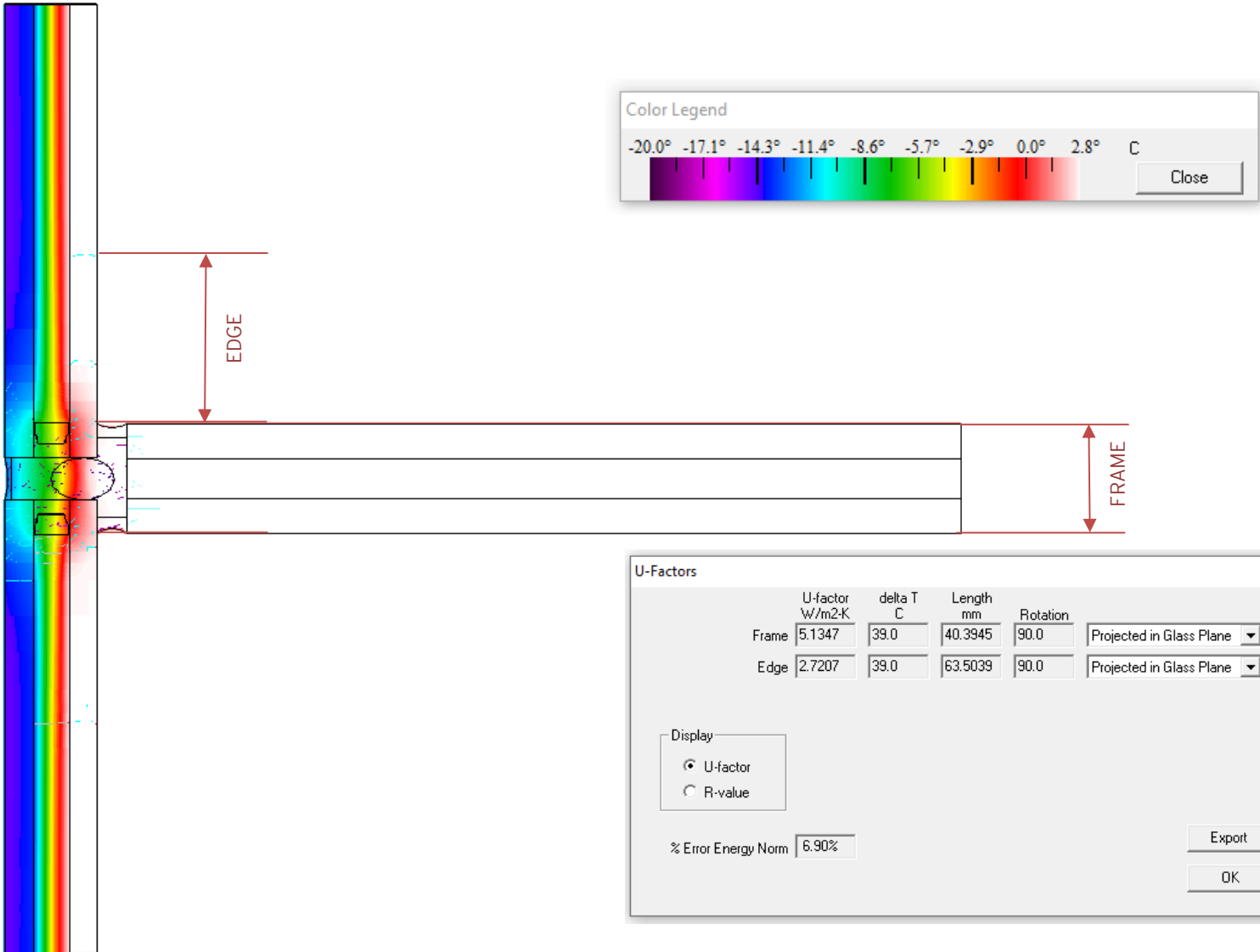
21°C/70°F (Interior Thermally Broken Frame Convection)

Relative Humidity:

30%

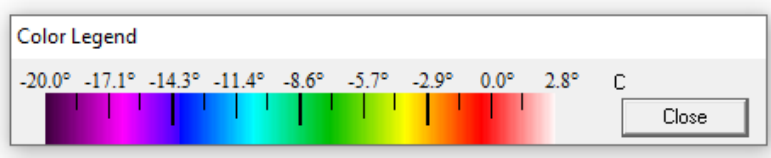
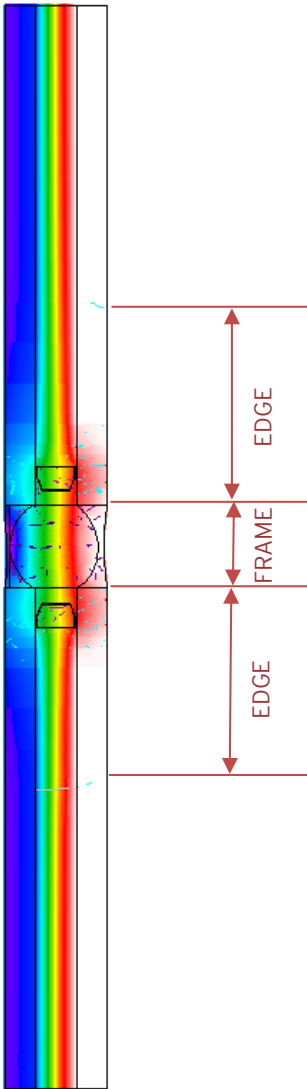
Dew Point:

2.8°C/37.1°F



GL1 Configuration – Butt Joint Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



U-Factors					
	U-factor W/m2-K	delta T C	Length mm	Rotation	
Frame	3.0785	39.0	27.0117	90.0	Projected in Glass Plane
Edge	3.1304	39.0	127	90.0	Projected in Glass Plane

Display

☒ U-factor

☐ R-value

% Error Energy Norm 6.52%

Export

OK

GL1 Configuration – Ledge Detail

Exterior Temp:

-18°C/-0.4°F (NFRC 100-2010 Exterior)

Interior Temp:

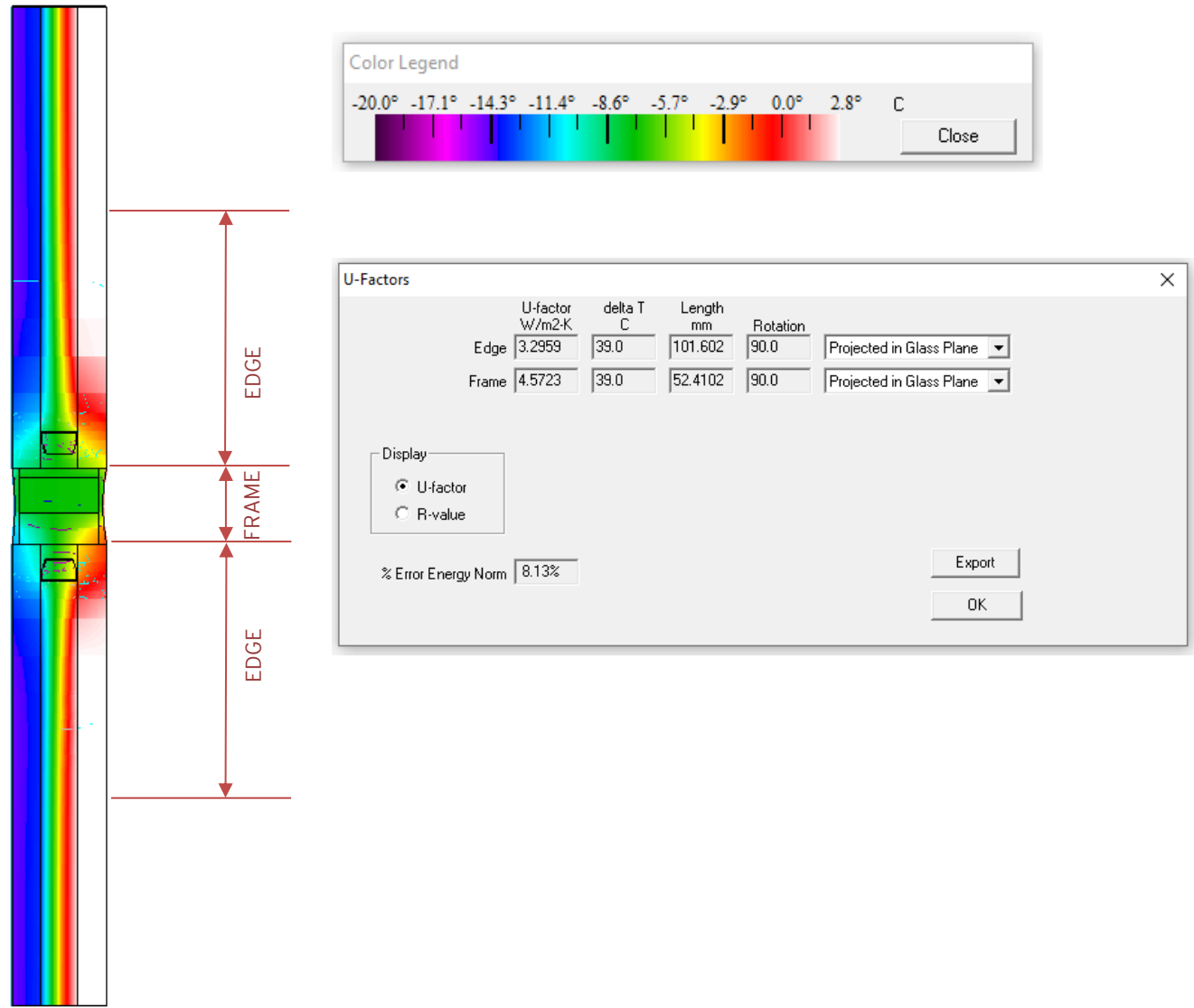
21°C/70°F (Interior Thermally Broken Frame Convection)

Relative Humidity:

30%

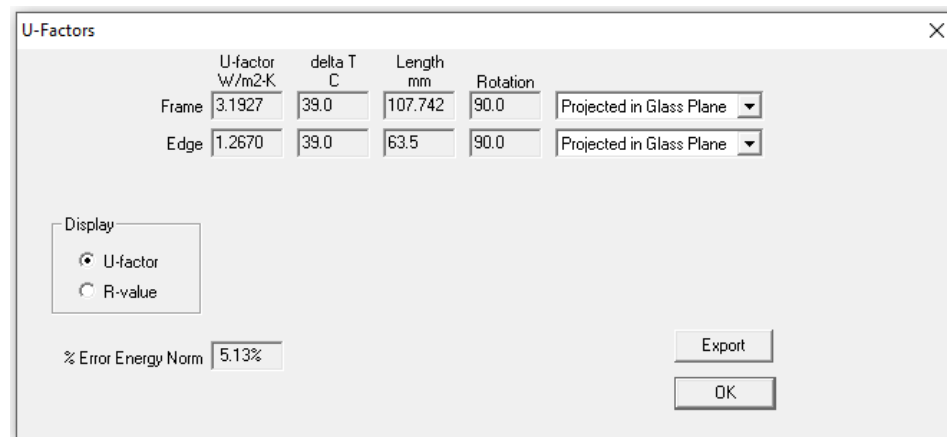
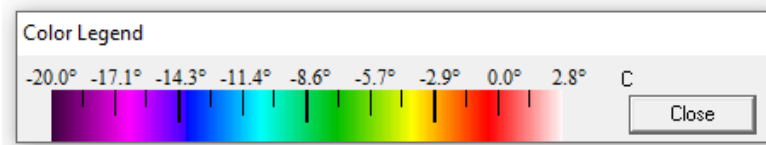
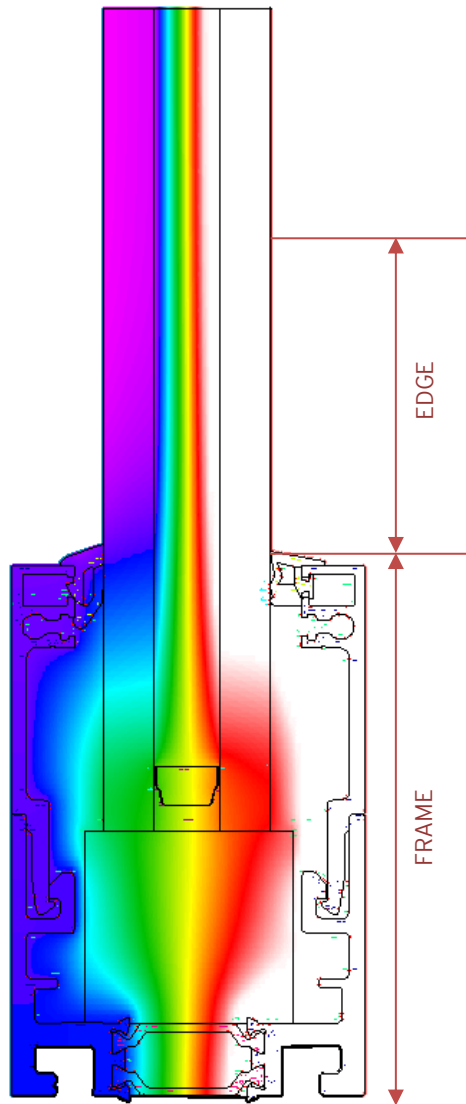
Dew Point:

2.8°C/37.1°F



GL2 Configuration – Base Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



	U-factor W/m2-K	delta T C	Length mm	Rotation	
Frame	3.1927	39.0	107.742	90.0	Projected in Glass Plane
Edge	1.2670	39.0	63.5	90.0	Projected in Glass Plane

Display

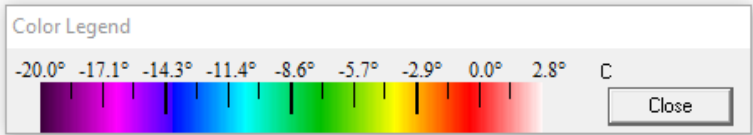
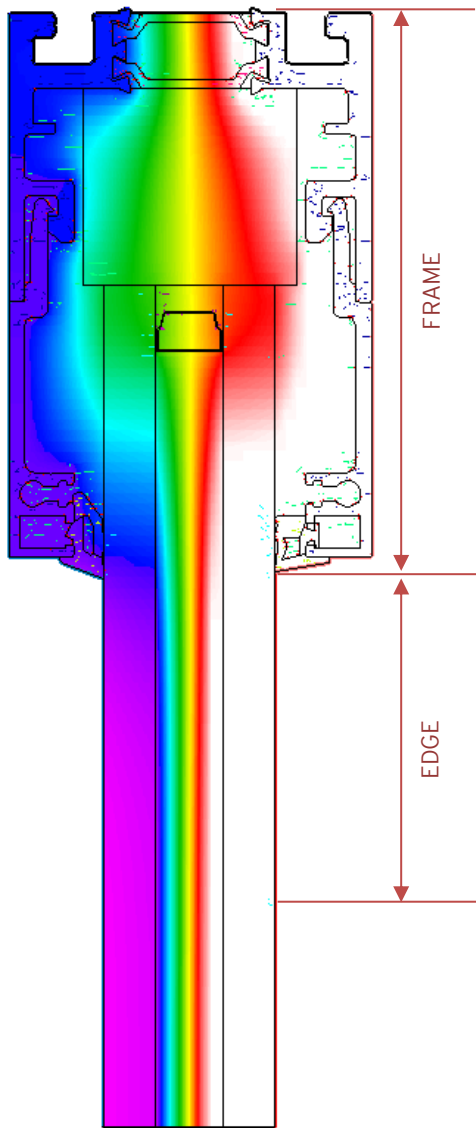
☒ U-factor
☐ R-value

% Error Energy Norm 5.13%

Export
OK

GL2 Configuration – Head Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



U-Factors

	U-factor W/m2-K	delta T C	Length mm	Rotation	
Frame	3.2449	39.0	107.742	90.0	Projected in Glass Plane
Edge	1.2612	39.0	63.4999	90.0	Projected in Glass Plane

Display

☒ U-factor
☐ R-value

% Error Energy Norm 6.84%

Export

OK

GL2 Configuration – Glass to Fin Detail

Exterior Temp:

-18°C/-0.4°F (NFRC 100-2010 Exterior)

Interior Temp:

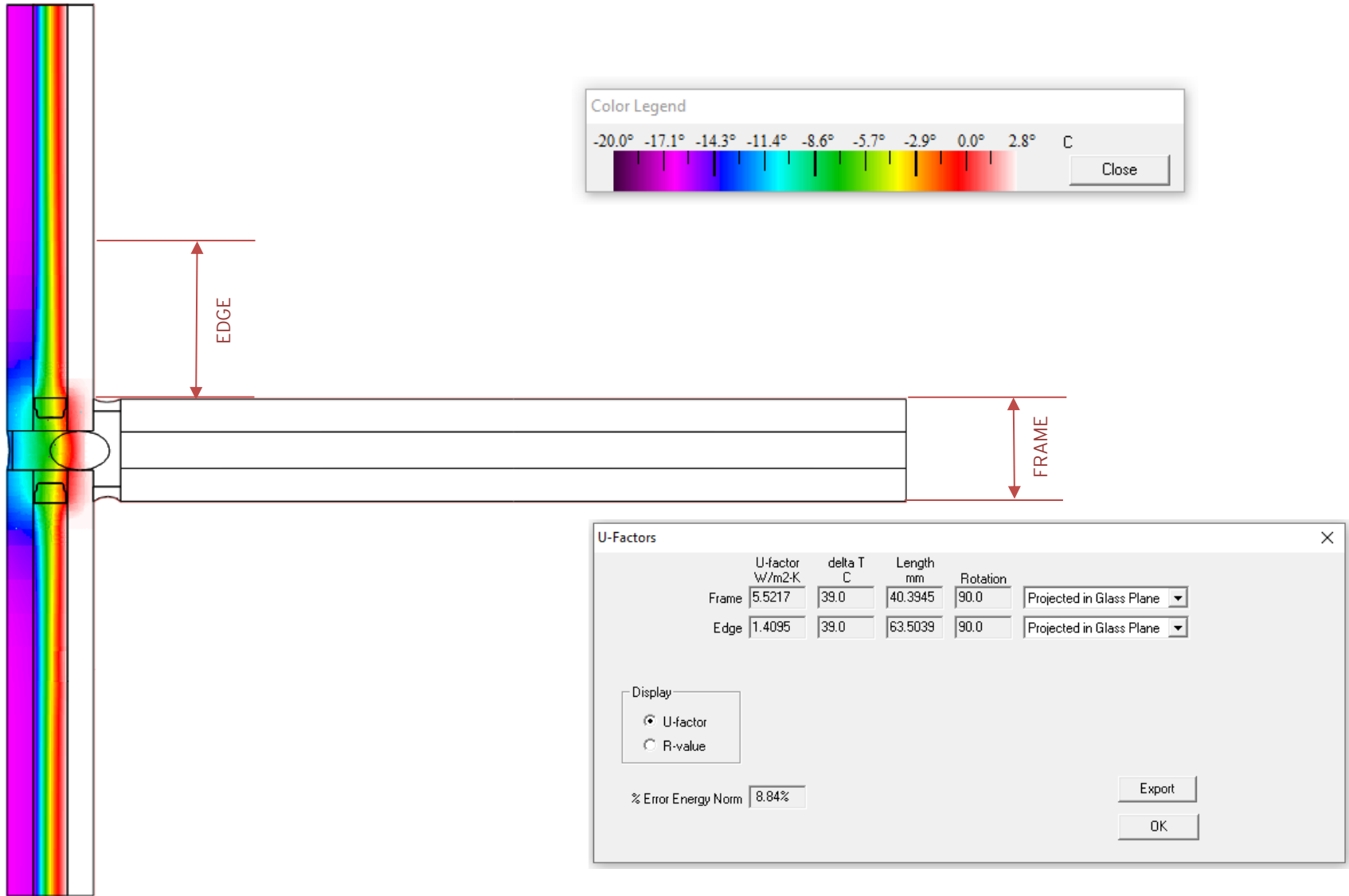
21°C/70°F (Interior Thermally Broken Frame Convection)

Relative Humidity:

30%

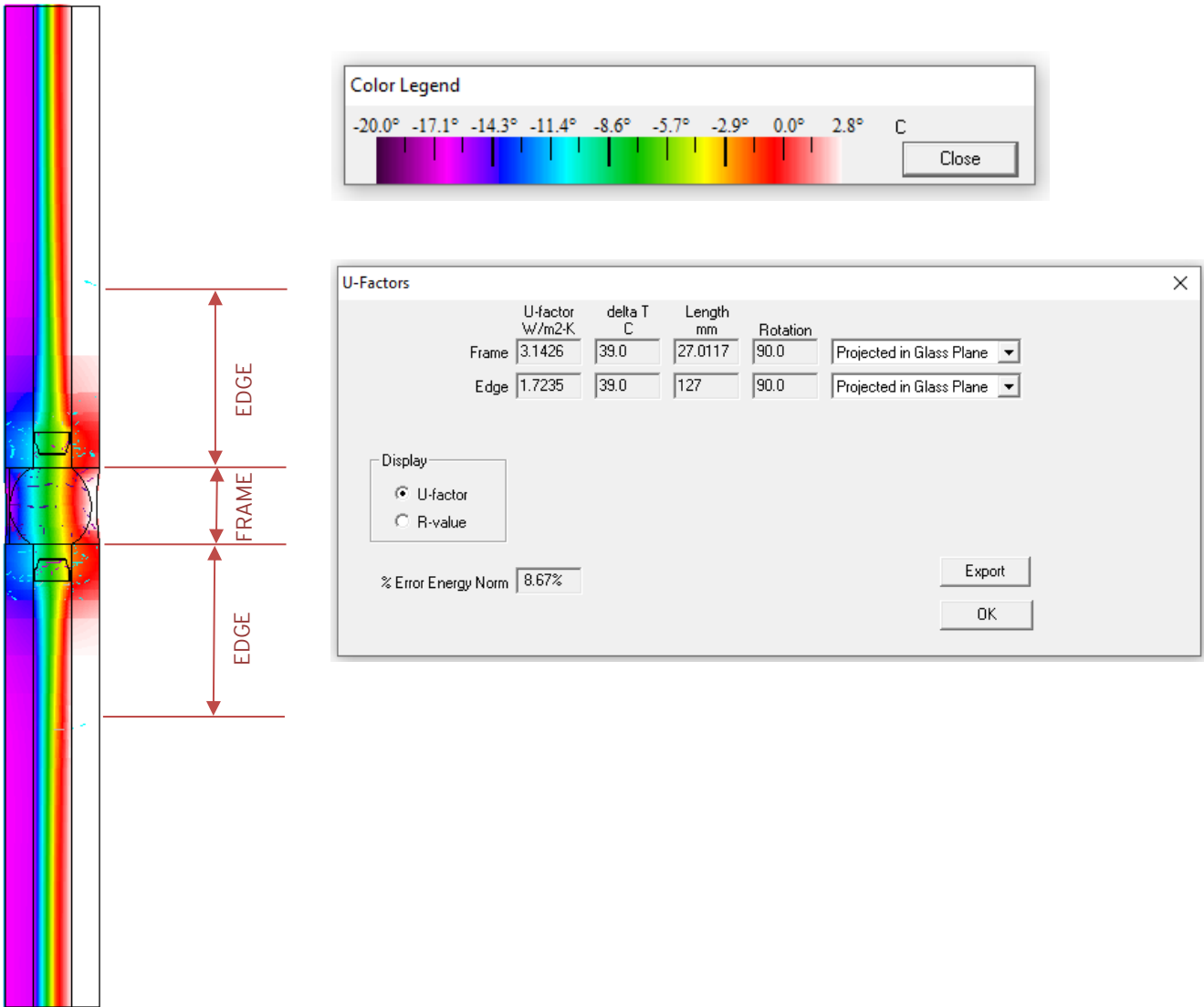
Dew Point:

2.8°C/37.1°F



GL2 Configuration – Butt Joint Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



GL2 Configuration – Ledge Detail

Exterior Temp:

-18°C/-0.4°F (NFRC 100-2010 Exterior)

Interior Temp:

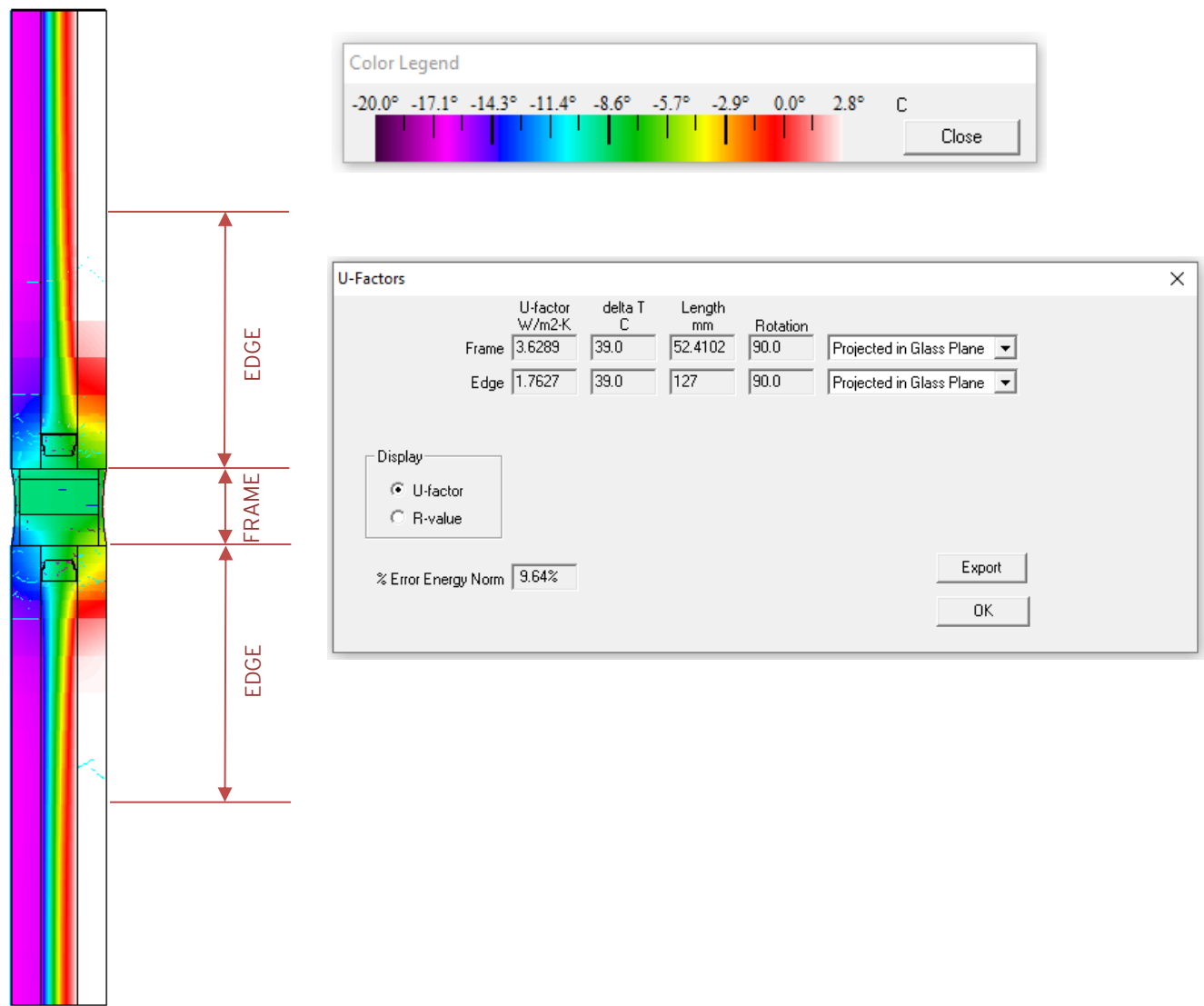
21°C/70°F (Interior Thermally Broken Frame Convection)

Relative Humidity:

30%

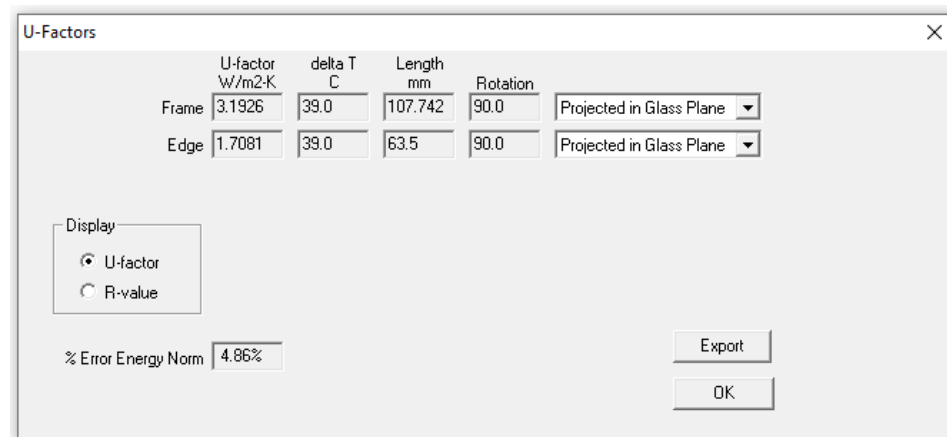
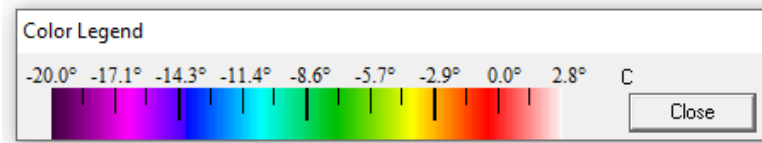
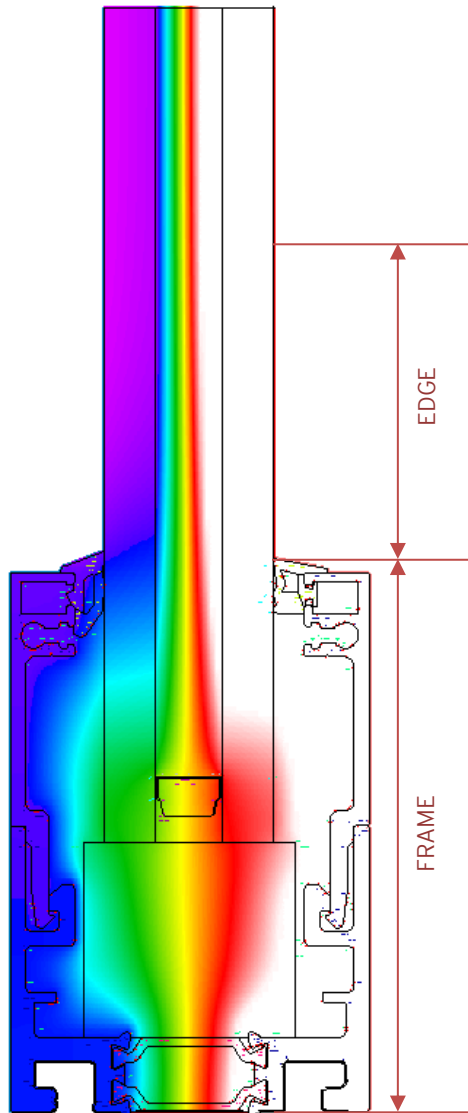
Dew Point:

2.8°C/37.1°F



GL3 Configuration – Base Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



	U-factor W/m2-K	delta T C	Length mm	Rotation	
Frame	3.1926	39.0	107.742	90.0	Projected in Glass Plane
Edge	1.7081	39.0	63.5	90.0	Projected in Glass Plane

Display

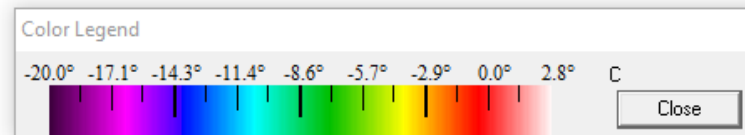
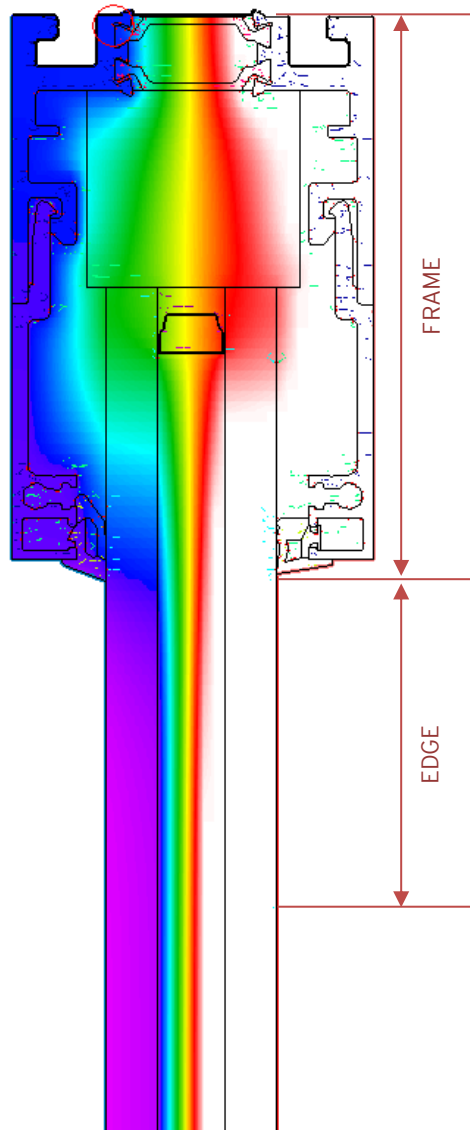
☒ U-factor
☐ R-value

% Error Energy Norm 4.86%

Export
OK

GL3 Configuration – Head Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



U-Factors					
	U-factor W/m2K	delta T C	Length mm	Rotation	
Frame	3.1995	39.0	107.742	90.0	Projected in Glass Plane
Edge	1.7089	39.0	63.4999	90.0	Projected in Glass Plane

Display

☒ U-factor
☐ R-value

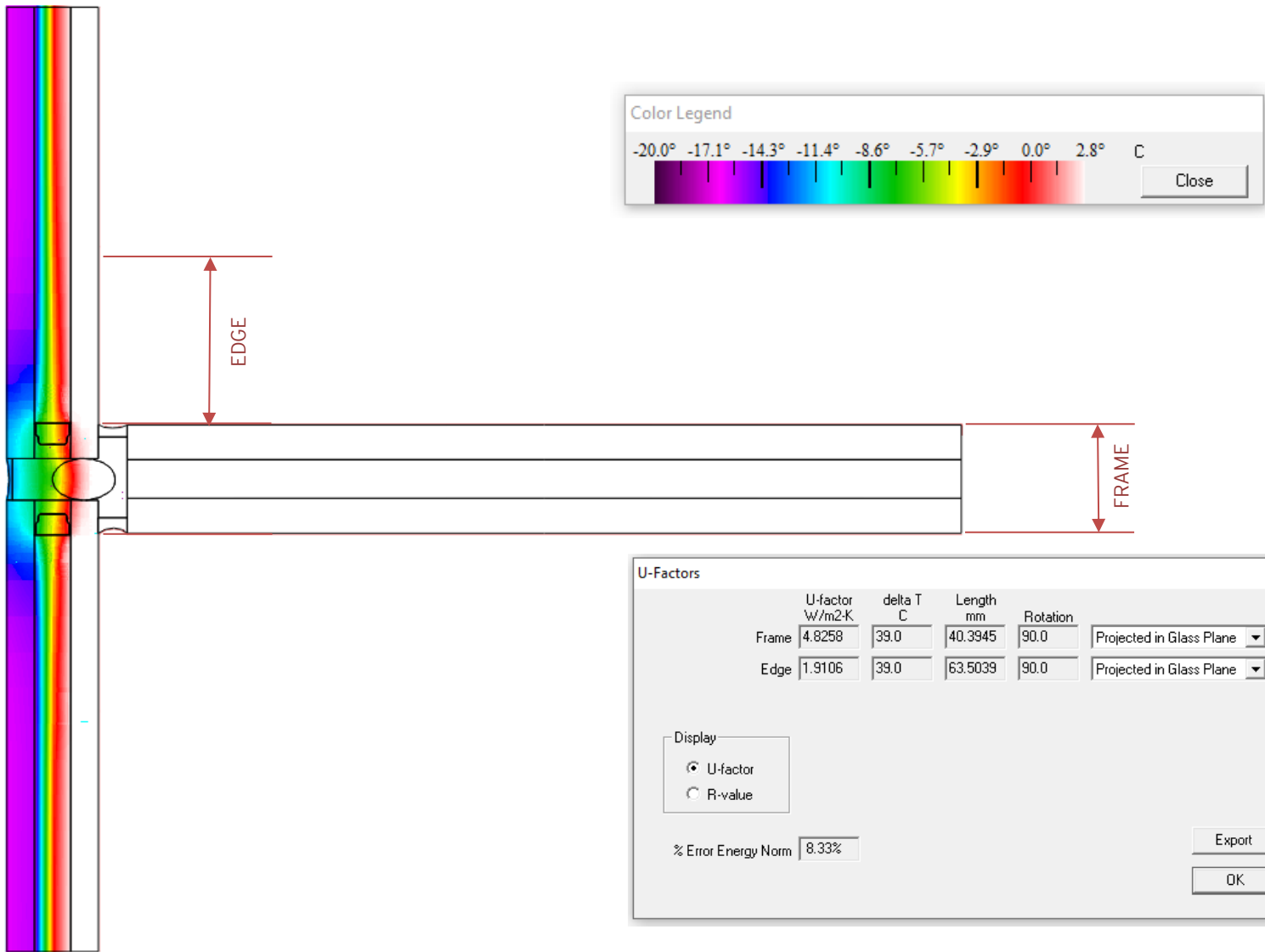
% Error Energy Norm 6.89%

Export

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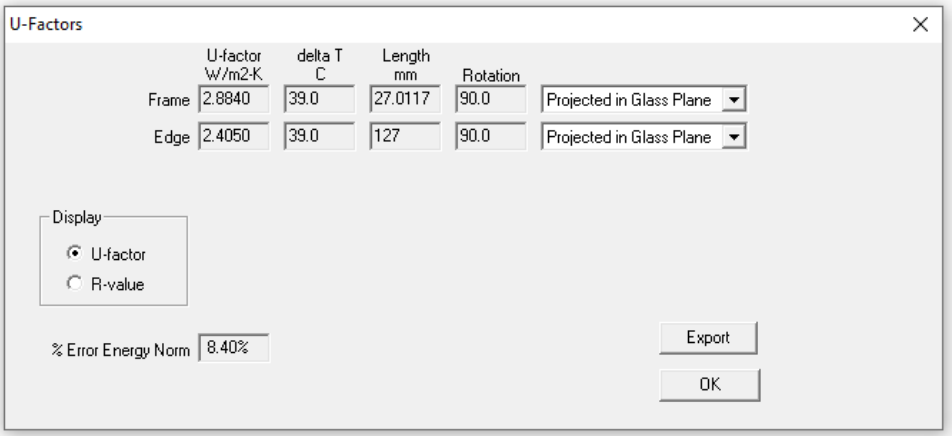
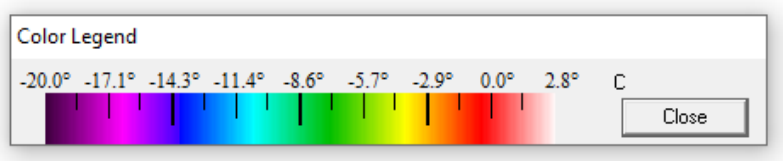
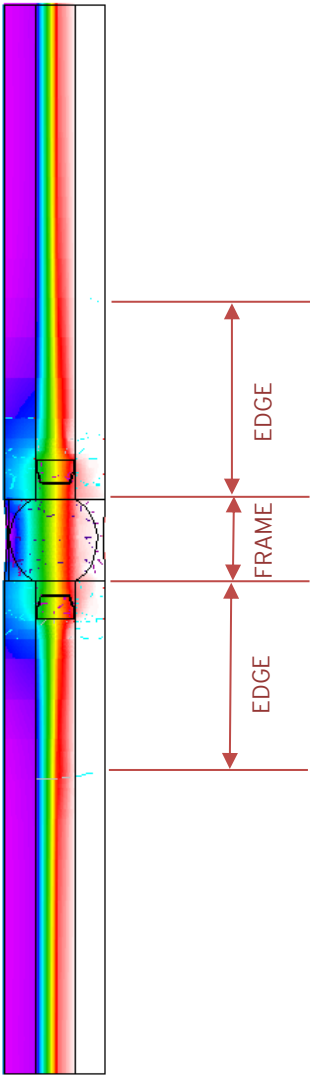
GL3 Configuration – Glass to Fin Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



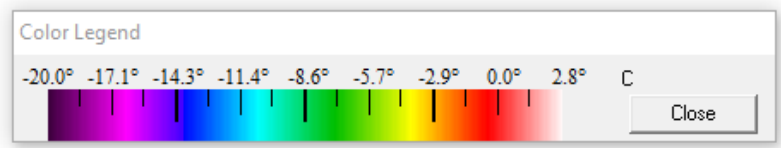
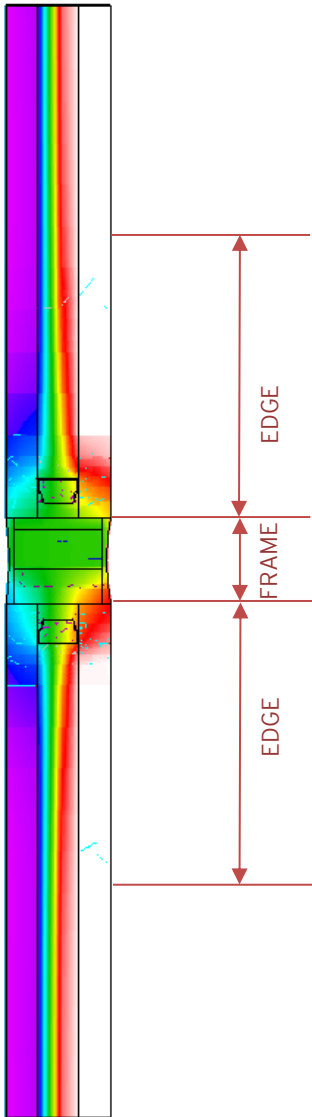
GL3 Configuration – Butt Joint Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



GL3 Configuration – Ledge Detail

Exterior Temp: -18°C/-0.4°F (NFRC 100-2010 Exterior)
Interior Temp: 21°C/70°F (Interior Thermally Broken Frame Convection)
Relative Humidity: 30%
Dew Point: 2.8°C/37.1°F



U-Factors

	U-factor W/m2-K	delta T C	Length mm	Rotation	
Frame	4.3299	39.0	52.4102	90.0	Projected in Glass Plane
Edge	2.3998	39.0	127	90.0	Projected in Glass Plane

Display

☒ U-factor
☐ R-value

% Error Energy Norm 9.79%

Export
OK

Effective U-Values by Glass Configuration

Effective U-Value Calculation for GL1 Glass Configuration

Location	Edge/Frame	u (W/m ² -K)	Width (mm)	Length (mm)	Area (mm ²)	Area (m ²)	u x Area
Base	Frame	3.389	107.7	1524.0	164134.8	0.164	0.556
Base	Edge	2.682	63.5	1397.0	88709.5	0.089	0.238
Head	Frame	3.395	107.7	1524.0	164134.8	0.164	0.557
Head	Edge	2.682	63.5	1397.0	88709.5	0.089	0.238
Fin	Frame	5.135	40.4	9195.0	371478.0	0.371	1.907
Fin	Edge	2.721	63.5	17338.0	1100963.0	1.101	2.995
Butt Joint	Frame	3.079	27.0	2641.6	71323.2	0.071	0.220
Butt Joint	Edge	3.130	127.0	2641.6	335483.2	0.335	1.050
Ledge	Frame	4.572	27.0	406.4	10972.8	0.011	0.050
Ledge	Edge	3.296	127.0	406.4	51612.8	0.052	0.170
Centre of Glass	N/A	2.631	-	-	11565658.4	11.566	30.429
				Totals	14013180.0	14.013	38.411
Effective U-Value:				2.741	W/m ² -K		

Effective U-Value Calculation for GL2 Glass Configuration

Location	Edge/Frame	u (W/m ² -K)	Width (mm)	Length (mm)	Area (mm ²)	Area (m ²)	u x Area
Base	Frame	3.193	107.7	1524.0	164134.8	0.164	0.524
Base	Edge	1.267	63.5	1397.0	88709.5	0.089	0.112
Head	Frame	3.245	107.7	1524.0	164134.8	0.164	0.533
Head	Edge	1.261	63.5	1397.0	88709.5	0.089	0.112
Fin	Frame	5.522	40.4	9195.0	371478	0.371	2.051
Fin	Edge	1.410	63.5	17338.0	1100963	1.101	1.552
Butt Joint	Frame	3.143	27	2641.6	71323.2	0.071	0.224
Butt Joint	Edge	1.724	127	2641.6	335483.2	0.335	0.578
Ledge	Frame	3.629	27.0	406.4	10972.8	0.011	0.040
Ledge	Edge	1.763	127.0	406.4	51612.8	0.052	0.091
Centre of Glass	N/A	1.121	-	-	11565658.4	11.566	12.965
				Totals	14013180.0	14.013	18.782
Effective U-Value:				1.340	W/m ² -K		

Effective U-Value Calculation for GL3 Glass Configuration

Location	Edge/Frame	u (W/m ² -K)	Width (mm)	Length (mm)	Area (mm ²)	Area (m ²)	u x Area
Base	Frame	3.193	107.7	1524.0	164134.8	0.164	0.524
Base	Edge	1.708	63.5	1397.0	88709.5	0.089	0.152
Head	Frame	3.200	107.7	1524.0	164134.8	0.164	0.525
Head	Edge	1.709	63.5	1397.0	88709.5	0.089	0.152
Fin	Frame	4.826	40.4	9195.0	371478.0	0.371	1.793
Fin	Edge	1.911	63.5	17338.0	1100963.0	1.101	2.103
Butt Joint	Frame	2.884	27.0	2641.6	71323.2	0.071	0.206
Butt Joint	Edge	2.405	127.0	2641.6	335483.2	0.335	0.807
Ledge	Frame	4.330	27.0	406.4	10972.8	0.011	0.048
Ledge	Edge	2.400	127.0	406.4	51612.8	0.052	0.124
Centre of Glass	N/A	1.376	-	-	11565658.4	11.566	15.914
				Totals	14013180.000	14.013	22.347
Effective U-Value:				1.595	W/m ² -K		