



# NFRC SIMULATION REPORT

**Project Name:** Acro Aluminum Curtainwall  
**Project Number:** 1346-16639  
**Simulation Date:** May 25<sup>th</sup>, 2022  
**Report Date:** October 12, 2023  
**Revision #:** R2 – Updated Company Name on Reports

Product Model:	Name/Number	Type
	CB2000 Series Curtainwall	Curtain Wall
	CB3000 Series Curtainwall with & without the nose-pressure plate gasket	Curtain Wall

**Fenestration Product Supplier:** Acro Aluminum Inc.  
 5430 275 St,  
 Langley, BC  
 V4W 3X7  
 Attn: Brent Friesen

	Layton Consulting Employee Name	
<b>Simulation by:</b>	Ethan Officer, Thermal Modelling Analyst, Engineering Technician	
<b>Reviewed by:</b>	Taylor Wight, P.Eng., NFRC Certified Simulator	

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	Acro Aluminum Curtainwall Thermal Simulation Report			13460-16639		
	Product Models			Client:		
CB2000, CB3000 Config. 1, CB3000 Config. 2			Clearbrook Glass			
Calc. by	Simulation Date	Chk'd by	Report Date	Revision	Page:	
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	Product Models CB2000, CB3000 Config. 1, CB3000 Config. 2			Client: Clearbrook Glass	
	Calc. by EO	Simulation Date 25/05/2022	Chk'd by TW	Report Date 30/05/2022	Revision R1

## GENERAL NOTES

### Disclaimers

- This report shall not be reproduced, neither in part nor in full, without the approval of Layton Consulting Ltd.
- This report relates only to the fenestration products simulated and are based on the CAD files and information provided by the client. Layton Consulting Ltd. does not verify that all the provided information is current and accurate to what is installed.
- Ratings values included in this report are not meant to be used directly for labelling purposes. Only those options identified on a valid Certificate of Authorization (CA) by an NFRC accredited Inspection Agency (IA) are to be used for labelling purposes”.

### Simulation Notes

- Thermal simulations were conducted in full compliance with NFRC test methods (as per NFRC 100-2020<sup>[E0A0]</sup> Procedure for Determining Fenestration Product U-factors).
- The Solar Heat Gain Coefficient (SHGC) and Visible Transmittance (VT) were determined following ANSI/NFRC 200-2020<sup>[E0A0]</sup>.
- The Condensation Resistance (CR) was determined following NFRC 500-2017<sup>[E0A0]</sup>
- Glass layers are taken from the latest International Glazing Database (IGDB).
- Simulation was completed using NFRC approved software – THERM 7.7 and WINDOW 7.7.
- Thermal simulation models may require some minor modifications made by the simulator, relative to the provided drawings, to account for software limitations.
- Rounding is per NFRC 601, NFRC Unit and Measurement Policy.
- Unless otherwise stated, only continuous hardware was modelled.

## STANDARD FRAME SIZE

The standard NFRC sizes for curtainwall windows was used, the standard size is 2000 x 2000 mm (78.74 x 78.74 in). That standard size consists of half frames used around the perimeter, as well as a full vertical frame in the centre as shown in the figure below (taken from the NFRC 2017 Simulation manual Section 8.9.2).

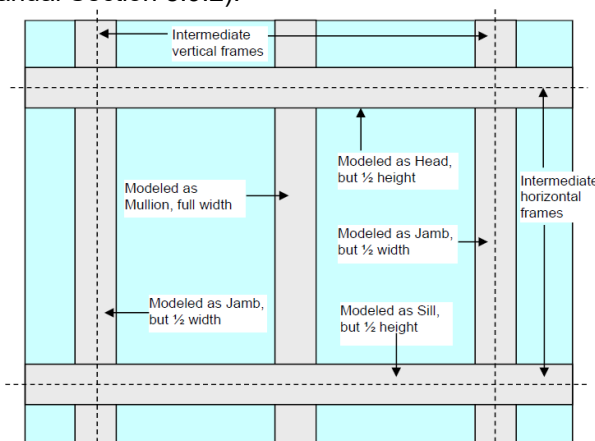



Figure 8-88. Curtain wall simulation model (represented by dotted lines) for rating, where the framing members are modeled at half their width.

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## PRODUCT LINE DESCRIPTION AND MATERIAL PROPERTIES

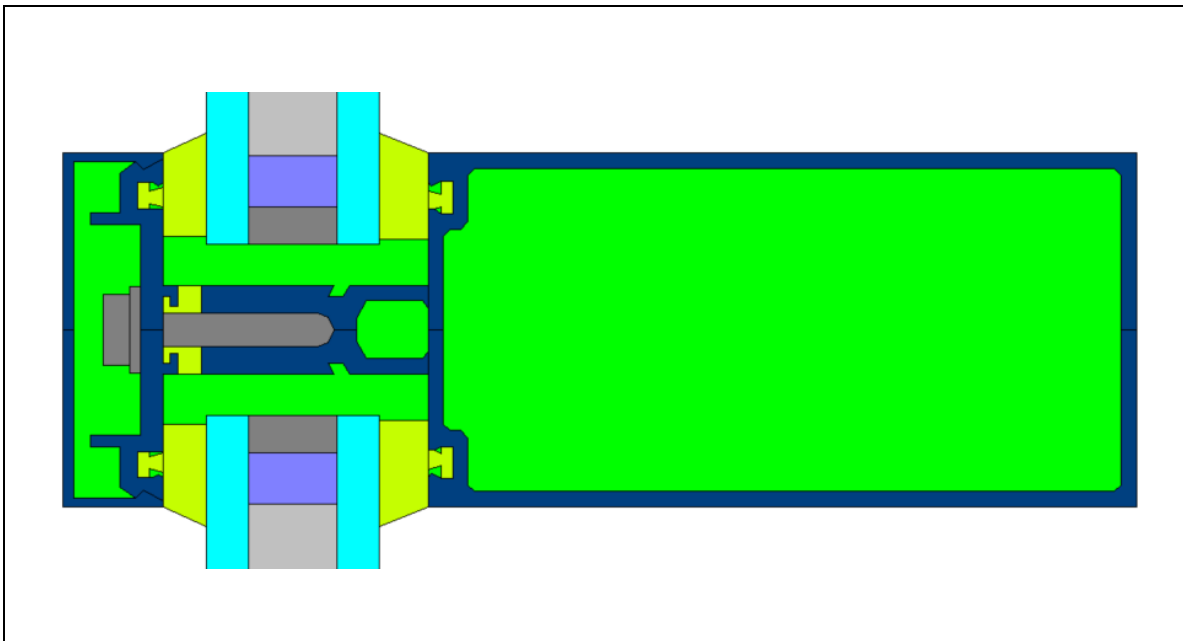
**Table 1: Frame Material Types & Properties Used for Components of the System**

Component	Color	Material	$\lambda(W/m\cdot K)$			
				CB2000	CB3000-1	CB3000-2
Spacer Type	~~~	Super Spacer TriSeal T-Spacer	0.141	X	X	X
Spacer Primary Seal		Butyl rubber, (Isobutene), Solid / Hot Melt	0.24	X	X	X
Spacer Secondary Seal (backfill)		Silicone	0.35	X	X	X
Frame / Sash		Aluminum Alloys (Anodized)	160	X	X	X
Pressure Plate (CW only)		Aluminum Alloys (Anodized)	160	X	X	X
Exterior Cladding / Beauty Cap		Aluminum Alloys (Anodized)	160	X	X	X
Thermal Break(s)		Polyamide 6.6 with 25% Glass Fiber	0.3		X	X
Curtainwall Bolt		CB2000	0.96	X		
		CB3000-1	0.95		X	
		CB3000-2	0.96			X
Glazing Gaskets		Ethylene Propylene Diene Monomer (EPDM)	0.25	X	X	X
Nose - Pressure Plate Thermal Break		Ethylene Propylene Diene Monomer (EPDM)	0.25	X	X	


~~~ See Spacer material details in next section.

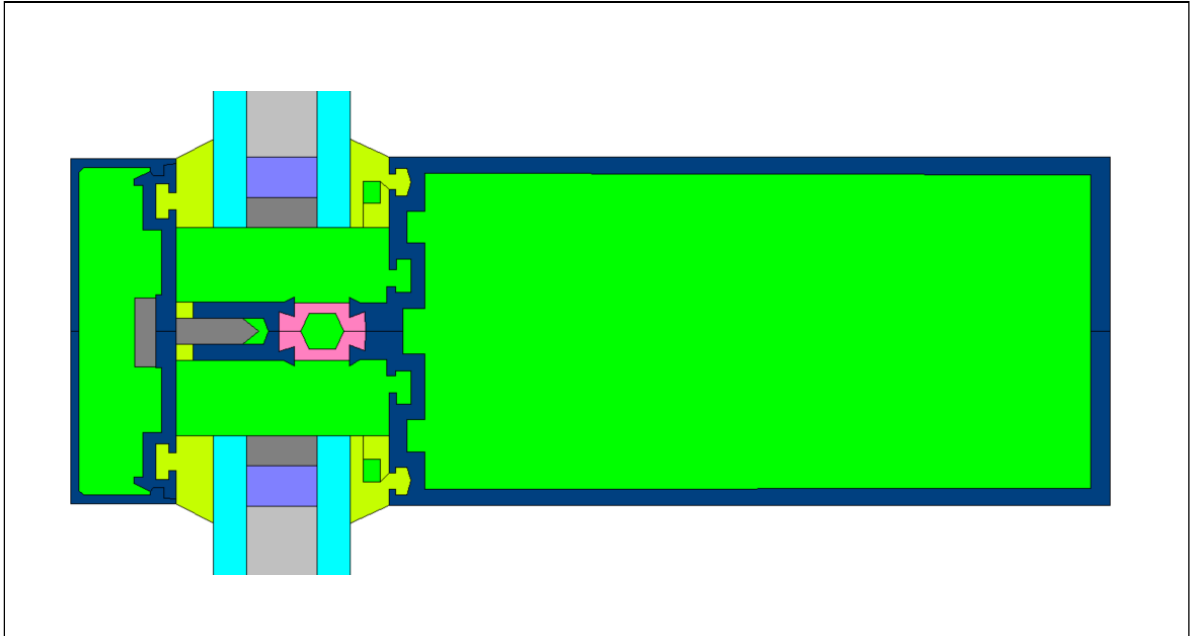
All material properties are taken from NFRC 101-2020 [E1A8], unless otherwise stated in additional footnotes.

\*Curtainwall Bolt thermal conductance calculated using standard NFRC thermal bridge calculation template.

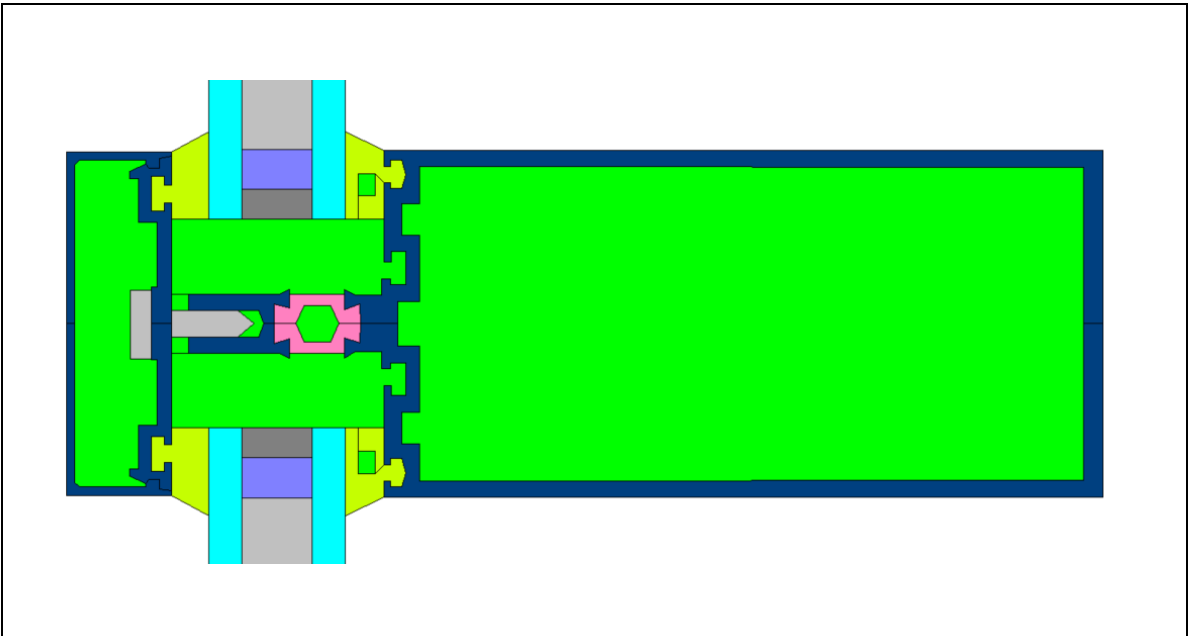


**Figure 1: Model of the CB2000 CW to Show the Materials of Components Modelled**


|                                                                                                                                                                                                                                                                                |                                                                     |                               |                |                             |                |
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|                                                                                                                                                                                                                                                                                | Product Models<br>CB2000, CB3000 Config. 1, CB3000 Config. 2        |                               |                | Client:<br>Clearbrook Glass |                |
|                                                                                                                                                                                                                                                                                | Calc. by<br>EO                                                      | Simulation Date<br>25/05/2022 | Chk'd by<br>TW | Report Date<br>30/05/2022   | Revision<br>R1 |



**Figure 2: Model of the CB3000-1 CW to Show the Materials of Components Modelled**



**Figure 3: Model of the CB3000-2 CW to Show the Materials of Components Modelled**

|                                                                                                                                                                                                                                                                            |                                                         |          |                  |             |       |
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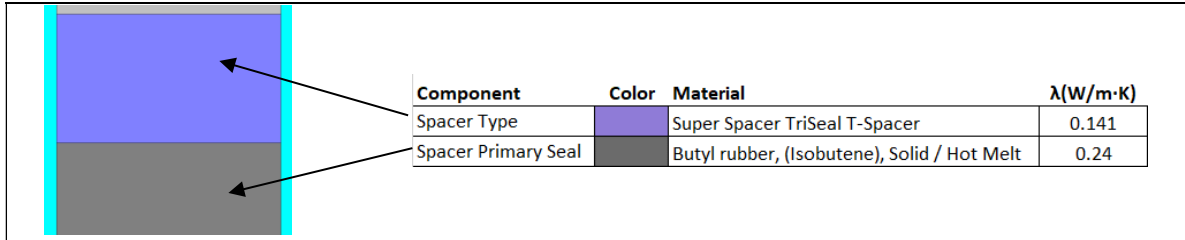


Figure 4: Spacer Material Details

### Insulated Glazing Unit (IGU) Details:

**GL1:** Generic Clear Glass / 12.7mm Air (10%) - Argon (90%) Mix / Generic Clear Glass (Total Thickness = 24.1mm)

**GL2a:** Solarban® 60 on Clear 6mm (Surface #2,  $\epsilon = 0.035$ ) / 12.7mm Air (10%) - Argon (90%) Mix / Generic Clear Glass (Total Thickness = 24.1mm)

**GL2b:** LoE<sup>3</sup> 366 on 6mm Clear (Surface #2,  $\epsilon = 0.02$ ) / 12.7mm Air (10%) - Argon (90%) Mix / Generic Clear Glass (Total Thickness = 24.1mm)


**GL2c:** LoE<sup>2</sup> 270 on 6mm Clear (Surface #2,  $\epsilon = 0.035$ ) / 12.7mm Air (10%) - Argon (90%) Mix / Generic Clear Glass (Total Thickness = 24.1mm)

**GL3:** Solarban® 60 on Clear 6mm (Surface #2,  $\epsilon = 0.035$ ) / 12.7mm Air (10%) - Argon (90%) Mix / Energy Advantage? Low-E (Surface #4,  $\epsilon = 0.157$ ) (Total Thickness = 24mm)

## RESULTS

**Table 2: Thermal Modelling Result**

| Product Name | Glazing Type | Low-E Coating | Center of Glass U-Factor (W/m <sup>2</sup> ·K) | Overall U-Factor (W/m <sup>2</sup> ·K) | Overall U-Factor (Btu/h·ft <sup>2</sup> ·°F) | SHGC | VT   |
|--------------|--------------|---------------|------------------------------------------------|----------------------------------------|----------------------------------------------|------|------|
| CW2000       | GL1          | None          | 2.54                                           | <b>3.23</b>                            | <b>0.57</b>                                  | 0.66 | 0.72 |
| CW2000       | GL2a         | SB60          | 1.39                                           | <b>2.25</b>                            | <b>0.40</b>                                  | 0.37 | 0.64 |
| CW2000       | GL2b         | 366           | 1.35                                           | <b>2.22</b>                            | <b>0.39</b>                                  | 0.26 | 0.57 |
| CW2000       | GL2c         | 270           | 1.39                                           | <b>2.25</b>                            | <b>0.40</b>                                  | 0.34 | 0.62 |
| CW2000       | GL3          | SB60 + EnAdv  | 1.13                                           | <b>2.02</b>                            | <b>0.36</b>                                  | 0.35 | 0.60 |
| CW3000-1     | GL1          | None          | 2.54                                           | <b>2.81</b>                            | <b>0.49</b>                                  | 0.64 | 0.71 |
| CW3000-1     | GL2a         | SB60          | 1.39                                           | <b>1.82</b>                            | <b>0.32</b>                                  | 0.36 | 0.63 |
| CW3000-1     | GL2b         | 366           | 1.35                                           | <b>1.79</b>                            | <b>0.32</b>                                  | 0.26 | 0.56 |
| CW3000-1     | GL2c         | 270           | 1.39                                           | <b>1.82</b>                            | <b>0.32</b>                                  | 0.33 | 0.60 |
| CW3000-1     | GL3          | SB60 + EnAdv  | 1.13                                           | <b>1.59</b>                            | <b>0.28</b>                                  | 0.39 | 0.59 |
| CW3000-2     | GL1          | None          | 2.54                                           | <b>2.80</b>                            | <b>0.49</b>                                  | 0.64 | 0.71 |
| CW3000-2     | GL2          | SB60          | 1.39                                           | <b>1.82</b>                            | <b>0.32</b>                                  | 0.36 | 0.63 |
| CW3000-2     | GL3          | SB60 + EnAdv  | 1.13                                           | <b>1.58</b>                            | <b>0.28</b>                                  | 0.34 | 0.59 |

|                                                                                                                                                                                                                                                                    |                                                                |          |                         |                    |       |  |
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|                                                                                                                                                                                                                                                                    | Product Models                                                 |          |                         | Client:            |       |  |
| <p>CB2000, CB3000 Config. 1, CB3000 Config. 2</p>                                                                                                                                                                                                                  |                                                                |          | <p>Clearbrook Glass</p> |                    |       |  |
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| EO                                                                                                                                                                                                                                                                 | 25/05/2022                                                     | TW       | 30/05/2022              | R1                 | 7     |  |

**APPENDIX**



Figure 5: NFRAC Certification of Laboratory and Simulator-in-Responsible-Charge – Taylor Wight



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| Product Models<br>CB2000, CB3000 Config. 1, CB3000 Config. 2        |                               |                |                           | Client:<br>Clearbrook Glass |            |
| Calc. by<br>EO                                                      | Simulation Date<br>25/05/2022 | Chk'd by<br>TW | Report Date<br>30/05/2022 | Revision<br>R1              | Page:<br>8 |

| IGU Name: GL1                 |      |                             |       |      |       |       |       |            |
|-------------------------------|------|-----------------------------|-------|------|-------|-------|-------|------------|
|                               | ID   | Name                        | Thick | Surf | Tsol  | Tvis  | E     | Source     |
| Glass 1                       | 103  | CLEAR_6.DAT                 | 5.7   |      | 0.771 | 0.884 |       | IGDB v11.4 |
| Gap 1                         | 9    | Air (10%) - Argon (90%) Mix | 12.7  |      |       |       |       |            |
| Glass 2                       | 103  | CLEAR_6.DAT                 | 5.7   |      | 0.771 | 0.884 |       | IGDB v11.4 |
| Overall thickness (mm): 24.13 |      |                             |       |      |       |       |       |            |
| IGU Name: GL2a                |      |                             |       |      |       |       |       |            |
|                               | ID   | Name                        | Thick | Surf | Tsol  | Tvis  | E     | Source     |
| Glass 1                       | 5284 | SB60 Clear_6.VTA            | 5.7   | 2    | 0.396 | 0.791 | 0.035 | IGDB v58.0 |
| Gap 1                         | 9    | Air (10%) - Argon (90%) Mix | 12.7  |      |       |       |       |            |
| Glass 2                       | 103  | CLEAR_6.DAT                 | 5.7   |      | 0.771 | 0.884 |       | IGDB v11.4 |
| Overall thickness (mm): 24.08 |      |                             |       |      |       |       |       |            |
| IGU Name: GL2b                |      |                             |       |      |       |       |       |            |
|                               | ID   | Name                        | Thick | Surf | Tsol  | Tvis  | E     | Source     |
| Glass 1                       | 2157 | LoE366-6.CIG                | 5.7   | 2    | 0.269 | 0.703 | 0.020 | IGDB v69.0 |
| Gap 1                         | 9    | Air (10%) - Argon (90%) Mix | 12.7  |      |       |       |       |            |
| Glass 2                       | 103  | CLEAR_6.DAT                 | 5.7   |      | 0.771 | 0.884 |       | IGDB v11.4 |
| Overall thickness (mm): 24.12 |      |                             |       |      |       |       |       |            |
| IGU Name: GL2c                |      |                             |       |      |       |       |       |            |
|                               | ID   | Name                        | Thick | Surf | Tsol  | Tvis  | E     | Source     |
| Glass 1                       | 2029 | LoE270-6.CIG                | 5.7   | 2    | 0.362 | 0.755 | 0.035 | IGDB v69.0 |
| Gap 1                         | 9    | Air (10%) - Argon (90%) Mix | 12.7  |      |       |       |       |            |
| Glass 2                       | 103  | CLEAR_6.DAT                 | 5.7   |      | 0.771 | 0.884 |       | IGDB v11.4 |
| Overall thickness (mm): 24.12 |      |                             |       |      |       |       |       |            |
| IGU Name: GL3                 |      |                             |       |      |       |       |       |            |
|                               | ID   | Name                        | Thick | Surf | Tsol  | Tvis  | E     | Source     |
| Glass 1                       | 5284 | SB60 Clear_6.VTA            | 5.7   | 2    | 0.396 | 0.791 | 0.035 | IGDB v58.0 |
| Gap 1                         | 9    | Air (10%) - Argon (90%) Mix | 12.7  |      |       |       |       |            |
| Glass 2                       | 9924 | LOW-E_6.LOF                 | 5.6   | 4    | 0.662 | 0.819 | 0.157 | IGDB v11.4 |
| Overall thickness (mm): 24    |      |                             |       |      |       |       |       |            |

| ID | Name | # of Layers | Mode | Tilt | Environmental Conditions | Overall Thickness | Uval   | SHGC  | Tvis  | Tdw-ISO |
|----|------|-------------|------|------|--------------------------|-------------------|--------|-------|-------|---------|
|    |      |             |      |      |                          | mm                | W/m2-K |       |       |         |
| 1  | GL1  | 2           | #    | 90   | NFRC 100-2010            | 24.70             | 2.543  | 0.705 | 0.786 | 0.690   |
| 2  | GL2a | 2           | #    | 90   | NFRC 100-2010            | 24.70             | 1.388  | 0.387 | 0.702 | 0.530   |
| 3  | GL3  | 2           | #    | 90   | NFRC 100-2010            | 24.70             | 1.128  | 0.368 | 0.651 | 0.476   |
| 4  | GL2b | 2           | #    | 90   | NFRC 100-2010            | 24.70             | 1.354  | 0.271 | 0.624 | 0.411   |
| 5  | GL2c | 2           | #    | 90   | NFRC 100-2010            | 24.70             | 1.389  | 0.356 | 0.671 | 0.490   |

**Center of Glazing Results**

**Figure 6: Additional IGU Details**





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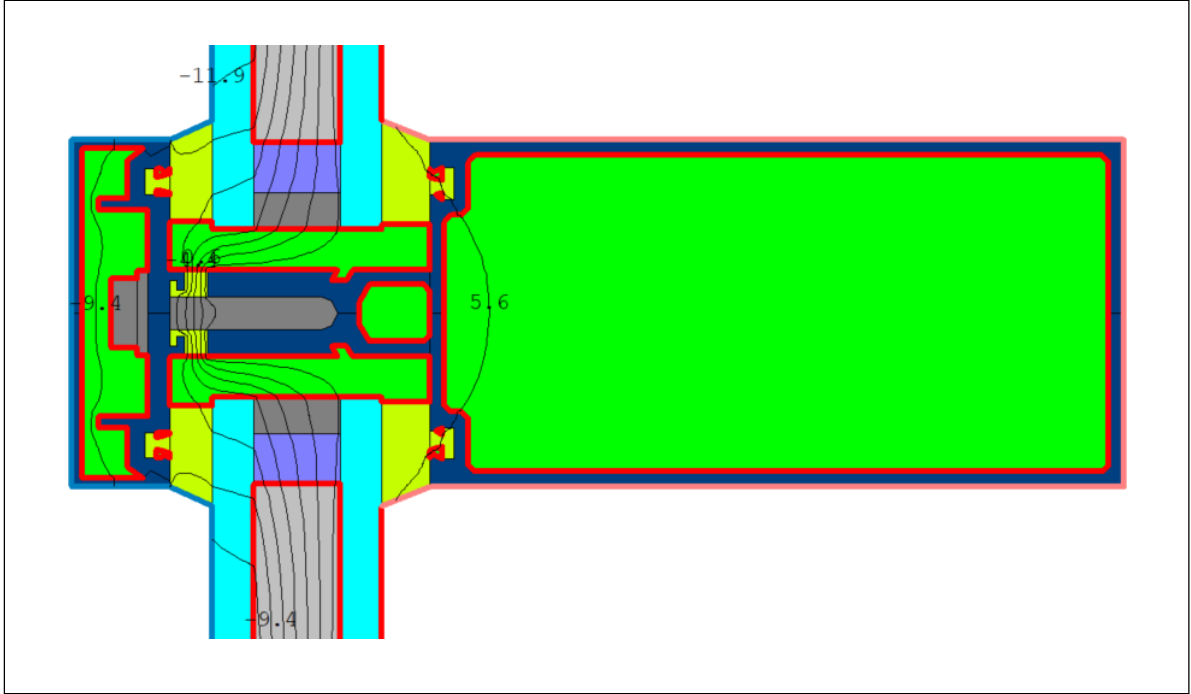


Figure 7: Thermal Modelling Result – CW2000, Exemplified with glass GL1

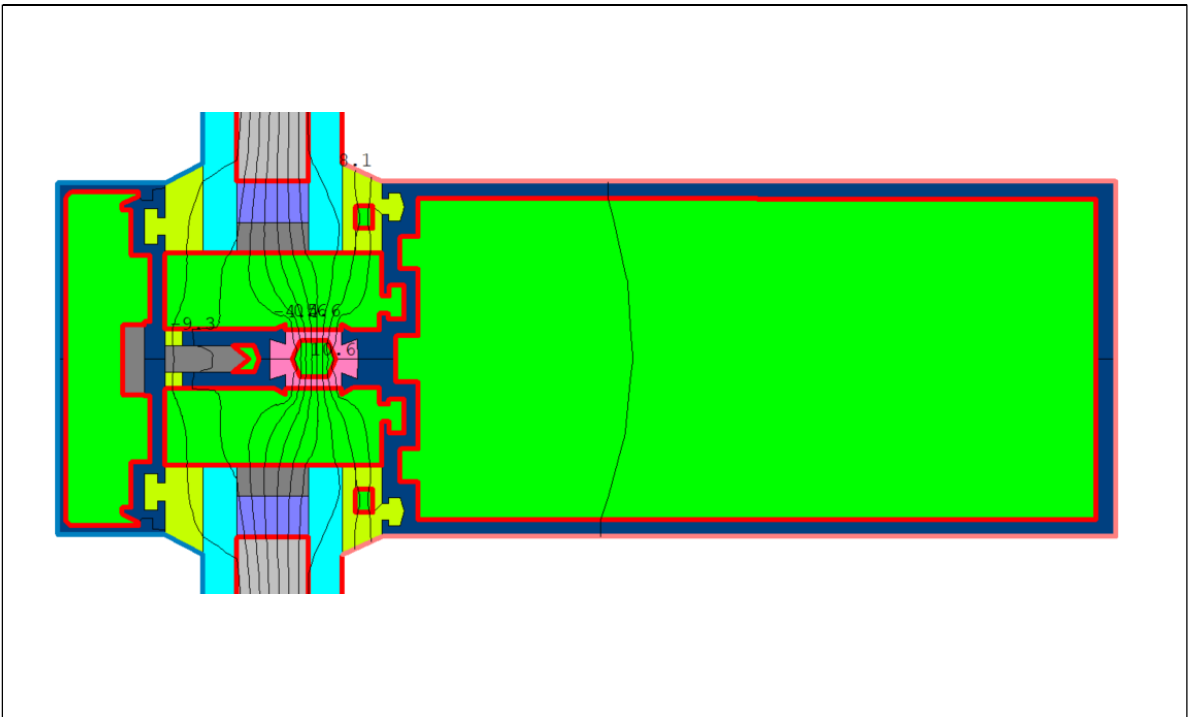



Figure 8: Thermal Modelling Result – CW3000-1, Exemplified with glass GL1

|                                                                                                                                                                                                                                                                                   |                                                                     |                               |                |                             |                |
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|                                                                                                                                                                                                                                                                                   | Product Models<br>CB2000, CB3000 Config. 1, CB3000 Config. 2        |                               |                | Client:<br>Clearbrook Glass |                |
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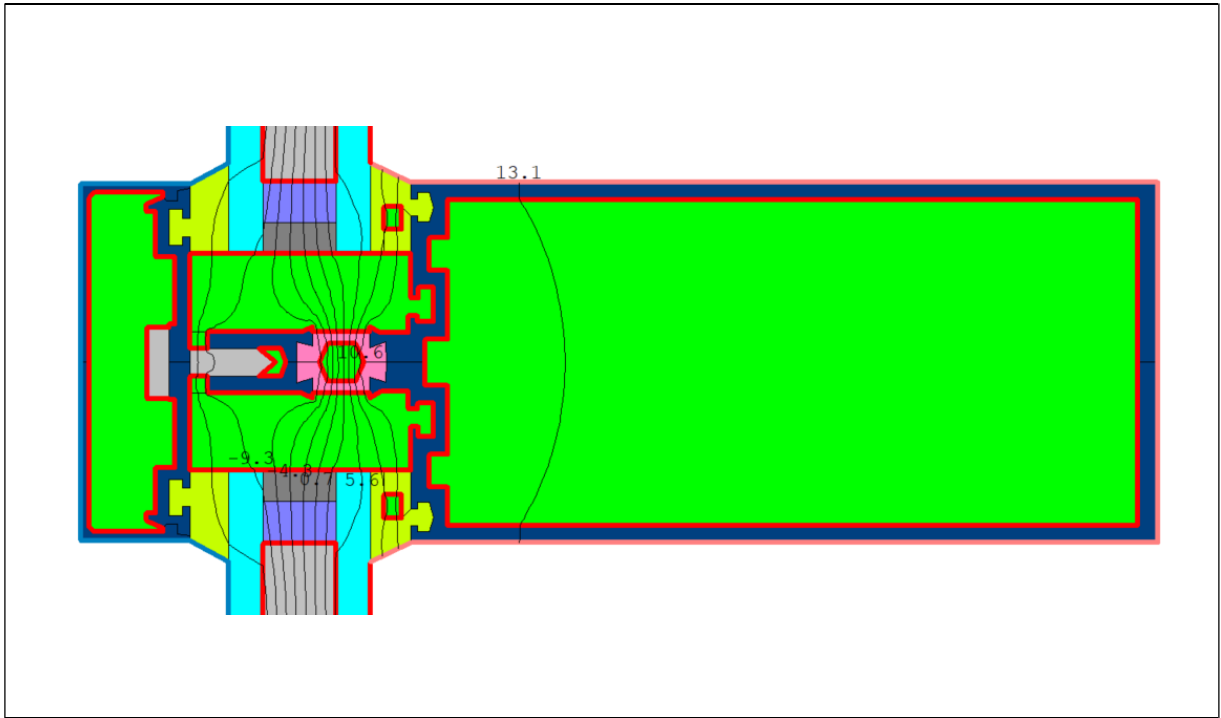


Figure 9: Thermal Modelling Result – CW3000-2, Exemplified with glass GL1

Table 3: SHGC/VT 0 & 1 Values, & Centre of Glazing (COG) Values

| Frame Type    | SHGC0      | SHGC1      | SHGCc      | Total SHGC | VT0        | VT1        | VTc        | Total VT   |
|---------------|------------|------------|------------|------------|------------|------------|------------|------------|
| CB2000 GL1    | 0.01441820 | 0.93119000 | 0.70311600 | 0.65901512 | 0.00000000 | 0.91677180 | 0.78610400 | 0.72067798 |
| CB2000 GL2a   | 0.01416690 | 0.93093870 | 0.38662500 | 0.36861380 | 0.00000000 | 0.91677180 | 0.70206500 | 0.64363339 |
| CB2000 GL2b   | 0.01415370 | 0.93092540 | 0.27076400 | 0.26238247 | 0.00000000 | 0.91677180 | 0.62397600 | 0.57204360 |
| CB2000 GL2c   | 0.01417510 | 0.93094690 | 0.35562700 | 0.34020390 | 0.00000000 | 0.91677180 | 0.67056600 | 0.61475600 |
| CB2000 GL3    | 0.01477220 | 0.93154400 | 0.36610500 | 0.35040694 | 0.00000000 | 0.91677180 | 0.65100800 | 0.59682578 |
| CB3000-1 GL1  | 0.00871120 | 0.90683900 | 0.70311600 | 0.64019923 | 0.00000000 | 0.89812770 | 0.78610400 | 0.70602178 |
| CB3000-1 GL2a | 0.00820260 | 0.90633030 | 0.38662500 | 0.35544122 | 0.00000000 | 0.89812770 | 0.70206500 | 0.63054402 |
| CB3000-1 GL2b | 0.01018570 | 0.91457530 | 0.27076400 | 0.25506185 | 0.00000000 | 0.90438950 | 0.62397600 | 0.56431734 |
| CB3000-1 GL2c | 0.00820750 | 0.90633530 | 0.35562700 | 0.32760600 | 0.00000000 | 0.89812770 | 0.67056600 | 0.60225390 |
| CB3000-1 GL3  | 0.00880330 | 0.90693110 | 0.36610500 | 0.33761238 | 0.00000000 | 0.89812770 | 0.65100800 | 0.58468832 |
| CB3000-2 GL1  | 0.00854760 | 0.90667530 | 0.70311600 | 0.64003556 | 0.00000000 | 0.89812770 | 0.78610400 | 0.70602178 |
| CB3000-2 GL2  | 0.00812320 | 0.90625100 | 0.38662500 | 0.35536186 | 0.00000000 | 0.89812770 | 0.70206500 | 0.63054402 |
| CB3000-2 GL3  | 0.00866510 | 0.90679290 | 0.36610500 | 0.33747418 | 0.00000000 | 0.89812770 | 0.66510080 | 0.59734545 |



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|                                                                     |                               |                |                             |                |             |
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| Project:<br><b>Clearbrook Curtainwall Thermal Simulation Report</b> |                               |                | Project No:<br>13460-16639  |                |             |
| Product Models<br>CB2000, CB3000 Config. 1, CB3000 Config. 2        |                               |                | Client:<br>Clearbrook Glass |                |             |
| Calc. by<br>EO                                                      | Simulation Date<br>25/05/2022 | Chk'd by<br>TW | Report Date<br>30/05/2022   | Revision<br>R1 | Page:<br>11 |

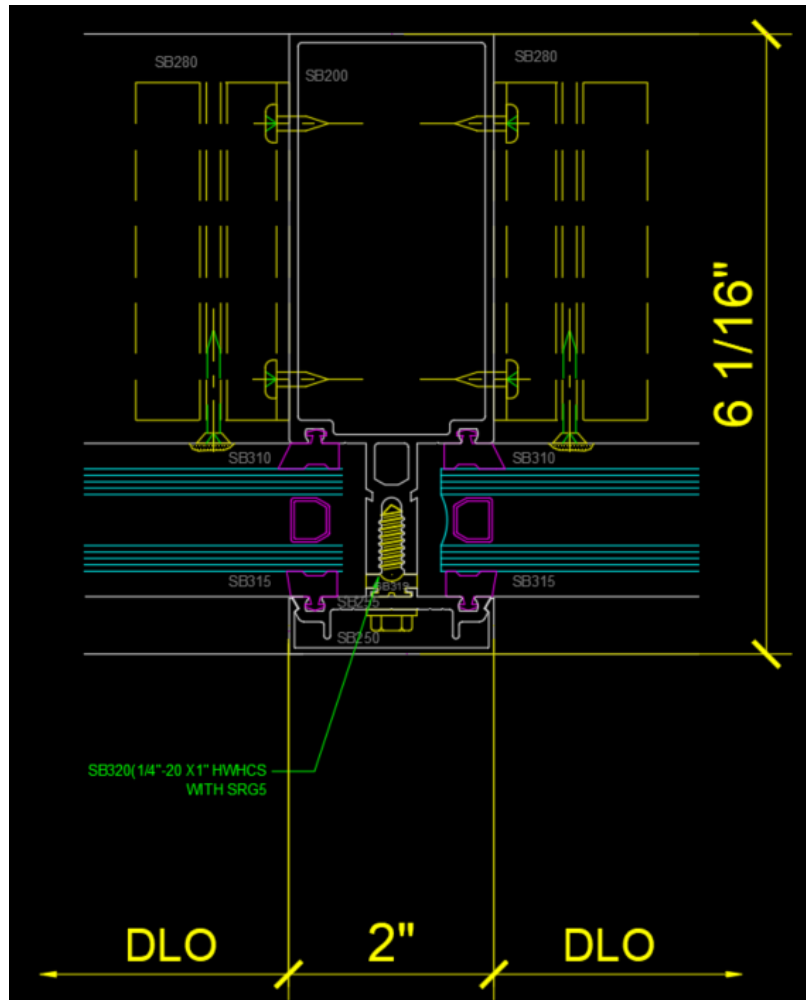


Figure 10: Individual part drawings – CB2000



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|                                                                     |                               |                |                             |                |             |
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| Project:<br><b>Clearbrook Curtainwall Thermal Simulation Report</b> |                               |                | Project No:<br>13460-16639  |                |             |
| Product Models<br>CB2000, CB3000 Config. 1, CB3000 Config. 2        |                               |                | Client:<br>Clearbrook Glass |                |             |
| Calc. by<br>EO                                                      | Simulation Date<br>25/05/2022 | Chk'd by<br>TW | Report Date<br>30/05/2022   | Revision<br>R1 | Page:<br>12 |

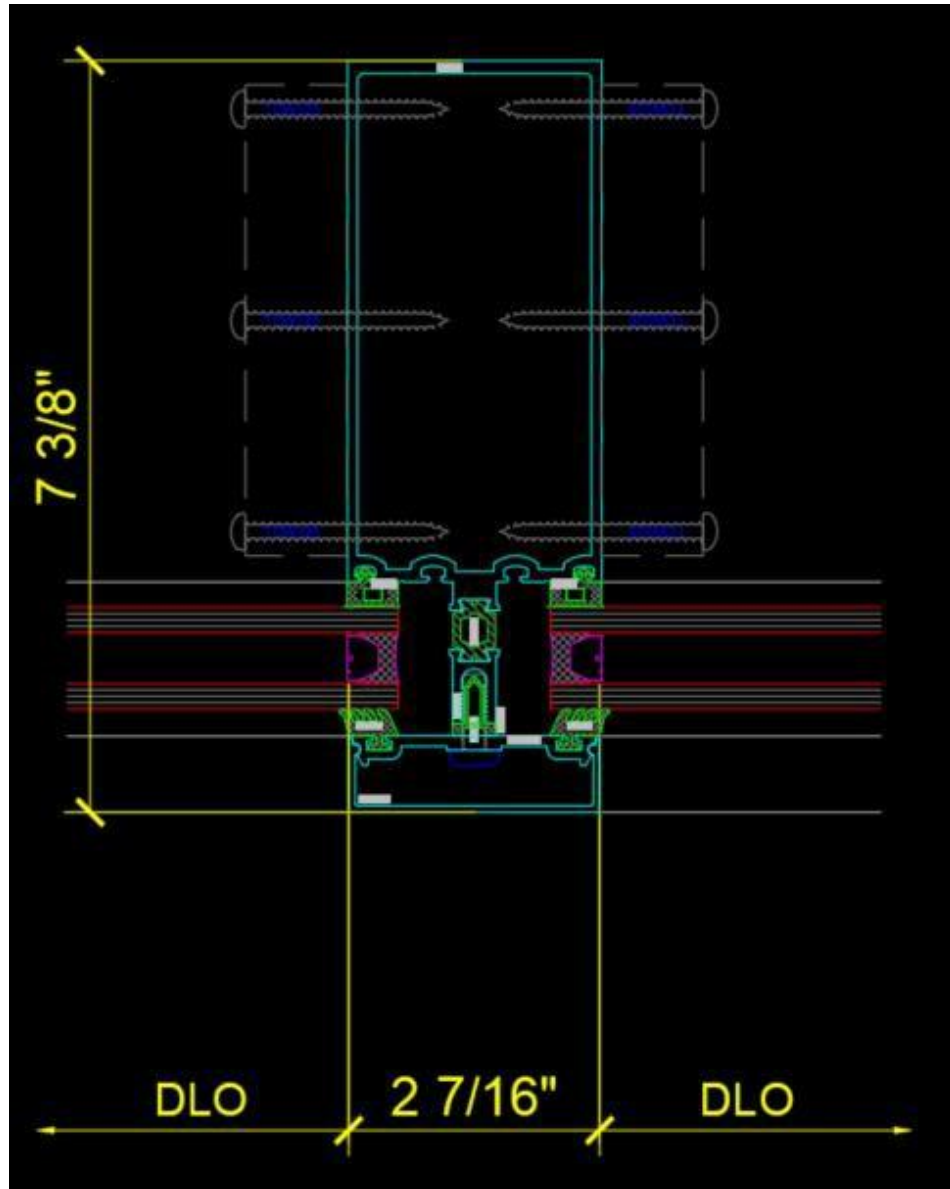


Figure 11: Individual part drawings – CB3000-1



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|                                                                     |                               |                |                             |                |             |
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| Project:<br><b>Clearbrook Curtainwall Thermal Simulation Report</b> |                               |                | Project No:<br>13460-16639  |                |             |
| Product Models<br>CB2000, CB3000 Config. 1, CB3000 Config. 2        |                               |                | Client:<br>Clearbrook Glass |                |             |
| Calc. by<br>EO                                                      | Simulation Date<br>25/05/2022 | Chk'd by<br>TW | Report Date<br>30/05/2022   | Revision<br>R1 | Page:<br>13 |

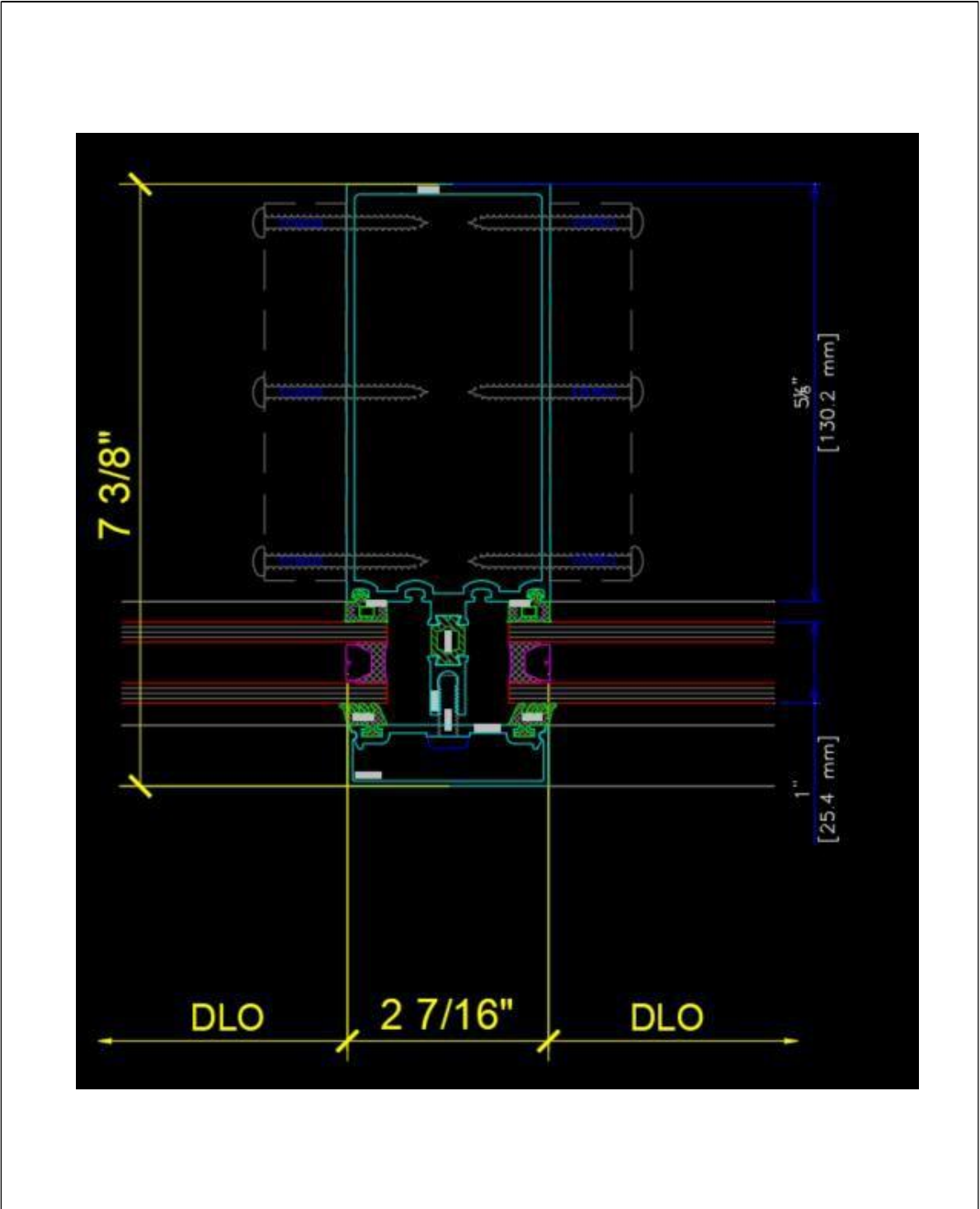


Figure 12: Individual part drawings – CB3000-2




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|                                                                     |                               |                |                           |                             |             |
|---------------------------------------------------------------------|-------------------------------|----------------|---------------------------|-----------------------------|-------------|
| Project:<br><b>Clearbrook Curtainwall Thermal Simulation Report</b> |                               |                |                           | Project No:<br>13460-16639  |             |
| Product Models<br>CB2000, CB3000 Config. 1, CB3000 Config. 2        |                               |                |                           | Client:<br>Clearbrook Glass |             |
| Calc. by<br>EO                                                      | Simulation Date<br>25/05/2022 | Chk'd by<br>TW | Report Date<br>30/05/2022 | Revision<br>R1              | Page:<br>14 |

| Cross Section | Material                                   | Conductivity (W/mK) | Depth (m)      | Conductivity (Btu-in/h-ft <sup>2</sup> -F) | Depth (in)                    | R (m <sup>2</sup> K/W) | R (h-ft <sup>2</sup> -F/Btu-in) |
|---------------|--------------------------------------------|---------------------|----------------|--------------------------------------------|-------------------------------|------------------------|---------------------------------|
| 1             | Air Cavity - Default is 0.024 W/mK         | 0.024               | 0.005334       | 0.168                                      | 0.21                          | 0.2201                 | 1.2500                          |
| 2             | Aluminum                                   | 160.003             | 0.003175       | 1109.380                                   | 0.125                         | 0.0000                 | 0.0001                          |
| 3             | Vinyl                                      | 0.170               | 0.00556        | 1.180                                      | 0.219                         | 0.0327                 | 0.1856                          |
| 4             | Air Cavity - Default is 0.024 W/mK         | 0.024               | 0.01836        | 0.168                                      | 0.723                         | 0.7579                 | 4.3036                          |
| 5             |                                            | 0.000               | 0              | 0.000                                      | 0                             | 0.0000                 | 0.0000                          |
| 6             |                                            | 0.000               | 0              | 0.000                                      | 0                             | 0.0000                 | 0.0000                          |
| 7             |                                            | 0.000               | 0              | 0.000                                      | 0                             | 0.0000                 | 0.0000                          |
|               |                                            |                     | <b>0.03244</b> |                                            | <b>1.277</b>                  | <b>1.0107</b>          | <b>5.7393</b>                   |
|               |                                            |                     | <b>Dt</b>      |                                            | <b>Dt</b>                     | <b>Rt</b>              | <b>Rt</b>                       |
|               | Calculated conductivity                    |                     | <u>Metric</u>  |                                            | <u>Inch-Pounds</u>            |                        |                                 |
|               |                                            |                     | Kn = Dt/Rt     |                                            | Kn = Dt/Rt                    |                        |                                 |
|               |                                            |                     | Kn= 0.0321     |                                            | 0.22                          |                        |                                 |
|               | Other conductivities required              |                     | SI Units       |                                            | IP Units                      |                        |                                 |
|               |                                            | Stainless steel:    |                |                                            |                               |                        |                                 |
|               |                                            | Kb= 17.00           |                |                                            | 117.869                       |                        |                                 |
|               | Calculate the fraction of bolt to no bolt: |                     |                |                                            |                               |                        |                                 |
|               |                                            | Bolt head width:    |                |                                            |                               |                        |                                 |
|               |                                            | Wb= 12.4            |                |                                            | 0.49                          |                        |                                 |
|               |                                            | Bolt spacing:       |                |                                            |                               |                        |                                 |
|               |                                            | Sb= 228.6           |                |                                            | 9                             |                        |                                 |
|               | Fraction of thermal bridging:              |                     |                |                                            |                               |                        |                                 |
|               |                                            | Fb= 0.054           |                |                                            | 0.054                         |                        |                                 |
|               |                                            | 5.4 %               |                |                                            | 5.4 %                         |                        |                                 |
|               | Fraction of non thermal bridging:          |                     |                |                                            |                               |                        |                                 |
|               |                                            | Fn= 0.946           |                |                                            | 0.946                         |                        |                                 |
|               |                                            | 94.6 %              |                |                                            | 94.6 %                        |                        |                                 |
|               | New keff in Therm: (Fb*Kb+Fn*Kn)           |                     |                |                                            |                               |                        |                                 |
|               |                                            | keff= 0.96          |                |                                            | 6.63                          |                        |                                 |
|               |                                            | (W/mK)              |                |                                            | (Btu-in/h-ft <sup>2</sup> -F) |                        |                                 |

Figure 13: Thermal Bridge Calculation – CB2000

|                                                                                                                                                                                                                                                                    |                                                                            |                                      |                       |                                  |                                    |                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------|-----------------------|----------------------------------|------------------------------------|--------------------|
|  <p><b>LAYTON</b><br/>CONSULTING LTD</p> <p>GLAZING, CLADDING, &amp; SPECIALTY STRUCTURAL ENGINEERING<br/>Suite 233 - 18525 53<sup>rd</sup> Ave., Surrey, BC, Canada, V3S 7A4</p> | <b>Project:</b><br><b>Clearbrook Curtainwall Thermal Simulation Report</b> |                                      |                       |                                  | <b>Project No:</b><br>13460-16639  |                    |
|                                                                                                                                                                                                                                                                    | <b>Product Models</b><br>CB2000, CB3000 Config. 1, CB3000 Config. 2        |                                      |                       |                                  | <b>Client:</b><br>Clearbrook Glass |                    |
|                                                                                                                                                                                                                                                                    | <b>Calc. by</b><br>EO                                                      | <b>Simulation Date</b><br>25/05/2022 | <b>Chk'd by</b><br>TW | <b>Report Date</b><br>30/05/2022 | <b>Revision</b><br>R1              | <b>Page:</b><br>15 |

| Cross Section | Material                                   | Conductivity (W/mK) | Depth (m)      | Conductivity (Btu-in/h-ft <sup>2</sup> -F) | Depth (in)                    | R (m <sup>2</sup> K/W) | R (h-ft <sup>2</sup> -F/Btu-in) |
|---------------|--------------------------------------------|---------------------|----------------|--------------------------------------------|-------------------------------|------------------------|---------------------------------|
| 1             | Air Cavity - Default is 0.024 W/mK         | 0.024               | 0.00384048     | 0.168                                      | 0.1512                        | 0.1585                 | 0.9000                          |
| 2             | Aluminum                                   | 160.003             | 0.00359664     | 1109.380                                   | 0.1416                        | 0.0000                 | 0.0001                          |
| 3             | EPDM                                       | 0.250               | 0.00316        | 1.730                                      | 0.1243                        | 0.0127                 | 0.0718                          |
| 4             | Air Cavity - Default is 0.024 W/mK         | 0.024               | 0.01836        | 0.168                                      | 0.723                         | 0.7579                 | 4.3036                          |
| 5             |                                            | 0.000               | 0              | 0.000                                      | 0                             | 0.0000                 | 0.0000                          |
| 6             |                                            | 0.000               | 0              | 0.000                                      | 0                             | 0.0000                 | 0.0000                          |
| 7             |                                            | 0.000               | 0              | 0.000                                      | 0                             | 0.0000                 | 0.0000                          |
|               |                                            |                     | <b>0.02896</b> |                                            | <b>1.1401</b>                 | <b>0.9291</b>          | <b>5.2755</b>                   |
|               |                                            |                     | <b>Dt</b>      |                                            | <b>Dt</b>                     | <b>Rt</b>              | <b>Rt</b>                       |
|               | Calculated conductivity                    |                     | <u>Metric</u>  |                                            | <u>Inch-Pounds</u>            |                        |                                 |
|               |                                            |                     | Kn = Dt/Rt     |                                            | Kn = Dt/Rt                    |                        |                                 |
|               |                                            |                     | Kn= 0.0312     |                                            | 0.22                          |                        |                                 |
|               | Other conductivities required              |                     | SI Units       |                                            | IP Units                      |                        |                                 |
|               |                                            | Stainless steel:    |                |                                            |                               |                        |                                 |
|               |                                            | Kb= 17.00           |                |                                            | 117.869                       |                        |                                 |
|               | Calculate the fraction of bolt to no bolt: |                     |                |                                            |                               |                        |                                 |
|               |                                            | Bolt head width:    |                |                                            |                               |                        |                                 |
|               |                                            | Wb= 12.4            |                |                                            | 0.49                          |                        |                                 |
|               |                                            | Bolt spacing:       |                |                                            |                               |                        |                                 |
|               |                                            | Sb= 228.6           |                |                                            | 9                             |                        |                                 |
|               | Fraction of thermal bridging:              |                     |                |                                            |                               |                        |                                 |
|               |                                            | Fb= 0.054           |                |                                            | 0.054                         |                        |                                 |
|               |                                            | 5.4 %               |                |                                            | 5.4 %                         |                        |                                 |
|               | Fraction of non thermal bridging:          |                     |                |                                            |                               |                        |                                 |
|               |                                            | Fn= 0.946           |                |                                            | 0.946                         |                        |                                 |
|               |                                            | 94.6 %              |                |                                            | 94.6 %                        |                        |                                 |
|               | New keff in Therm: (Fb*Kb+Fn*Kn)           |                     |                |                                            |                               |                        |                                 |
|               |                                            | keff= 0.96          |                |                                            | 6.62                          |                        |                                 |
|               |                                            | (W/mK)              |                |                                            | (Btu-in/h-ft <sup>2</sup> -F) |                        |                                 |

**Figure 14: Thermal Bridge Calculation – CB3000-1**



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|                                                                     |                               |                |                           |                             |             |
|---------------------------------------------------------------------|-------------------------------|----------------|---------------------------|-----------------------------|-------------|
| Project:<br><b>Clearbrook Curtainwall Thermal Simulation Report</b> |                               |                |                           | Project No:<br>13460-16639  |             |
| Product Models<br>CB2000, CB3000 Config. 1, CB3000 Config. 2        |                               |                |                           | Client:<br>Clearbrook Glass |             |
| Calc. by<br>EO                                                      | Simulation Date<br>25/05/2022 | Chk'd by<br>TW | Report Date<br>30/05/2022 | Revision<br>R1              | Page:<br>16 |

| Cross Section | Material                                   | Conductivity (W/mK) | Depth (m)      | Conductivity (Btu-in/h-ft <sup>2</sup> -F) | Depth (in)                    | R (m <sup>2</sup> K/W) | R (h-ft <sup>2</sup> -F/Btu-in) |
|---------------|--------------------------------------------|---------------------|----------------|--------------------------------------------|-------------------------------|------------------------|---------------------------------|
| 1             | Air Cavity - Default is 0.024 W/mK         | 0.024               | 0.00384048     | 0.168                                      | 0.1512                        | 0.1585                 | 0.9000                          |
| 2             | Aluminum                                   | 160.003             | 0.00359664     | 1109.380                                   | 0.1416                        | 0.0000                 | 0.0001                          |
| 3             | Air Cavity - Default is 0.024 W/mK         | 0.024               | 0.00316        | 0.168                                      | 0.1243                        | 0.1303                 | 0.7399                          |
| 4             | Air Cavity - Default is 0.024 W/mK         | 0.024               | 0.01836        | 0.168                                      | 0.723                         | 0.7579                 | 4.3036                          |
| 5             |                                            | 0.000               | 0              | 0.000                                      | 0                             | 0.0000                 | 0.0000                          |
| 6             |                                            | 0.000               | 0              | 0.000                                      | 0                             | 0.0000                 | 0.0000                          |
| 7             |                                            | 0.000               | 0              | 0.000                                      | 0                             | 0.0000                 | 0.0000                          |
|               |                                            |                     | <b>0.02896</b> |                                            | <b>1.1401</b>                 | <b>1.0467</b>          | <b>5.9436</b>                   |
|               |                                            |                     | <b>Dt</b>      |                                            | <b>Dt</b>                     | <b>Rt</b>              | <b>Rt</b>                       |
|               | Calculated conductivity                    |                     | Metric         |                                            | Inch-Pounds                   |                        |                                 |
|               |                                            |                     | Kn = Dt/Rt     |                                            | Kn = Dt/Rt                    |                        |                                 |
|               |                                            |                     | Kn= 0.0277     |                                            | 0.19                          |                        |                                 |
|               | Other conductivities required              |                     | SI Units       |                                            | IP Units                      |                        |                                 |
|               |                                            | Stainless steel:    |                |                                            |                               |                        |                                 |
|               |                                            | Kb= 17.00           |                |                                            | 117.869                       |                        |                                 |
|               | Calculate the fraction of bolt to no bolt: |                     |                |                                            |                               |                        |                                 |
|               |                                            | Bolt head width:    |                |                                            |                               |                        |                                 |
|               |                                            | Wb= 12.4            |                |                                            | 0.49                          |                        |                                 |
|               |                                            | Bolt spacing:       |                |                                            |                               |                        |                                 |
|               |                                            | Sb= 228.6           |                |                                            | 9                             |                        |                                 |
|               | Fraction of thermal bridging:              |                     |                |                                            |                               |                        |                                 |
|               |                                            | Fb= 0.054           |                |                                            | 0.054                         |                        |                                 |
|               |                                            | 5.4 %               |                |                                            | 5.4 %                         |                        |                                 |
|               | Fraction of non thermal bridging:          |                     |                |                                            |                               |                        |                                 |
|               |                                            | Fn= 0.946           |                |                                            | 0.946                         |                        |                                 |
|               |                                            | 94.6 %              |                |                                            | 94.6 %                        |                        |                                 |
|               | New keff in Therm: (Fb*Kb+Fn*Kn)           |                     |                |                                            |                               |                        |                                 |
|               |                                            | keff= 0.95          |                |                                            | 6.60                          |                        |                                 |
|               |                                            | (W/mK)              |                |                                            | (Btu-in/h-ft <sup>2</sup> -F) |                        |                                 |

Figure 15: Thermal Bridge Calculation – CB3000-2