

THERMAL SIMULATION REPORT

Report Number:	GM2011-001
Prepared For:	Steel Window Association 42 Heath Street Tamworth Staffordshire B79 7HJ
Window System Identifier:	W30
Fixed Outer Frame Identifier:	WX7 (Fixed)
Transom Frame Identifier:	W7 (Fixed)
Vent Frame Identifier:	WX7 (Moving)
Glazing System:	4mm Optiwhite – 10 mm 90% Krypton – 4 mm Optitherm S4 Plus
Spacer Bar:	10mm Swiss Spacer V with PIB Primary and 4mm Butyl Secondary sealants
Notes:	

Results

Thermal Transmittance (U_{window})	2.0	W/(m ² K)
Solar Factor (g_{window})	0.55	
Air Leakage Factor (L_{factor})	0.0	W/(m ² K)
BFRC Energy Rating Index	-16	
BFRC Energy rating Band	C	

(Window Configuration as per GGF Document 2.2)
(1230mm wide x 1480mm high –vent next to fixed light)

Report Prepared By Dr Gary Morgan
Therm Consulting

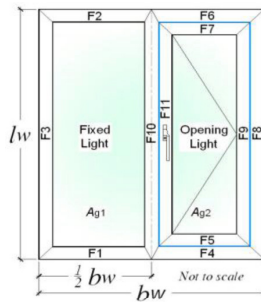
Signed: *G Morgan*

Date: 17th March 2011

The simulations in this report were performed using Therm 5.2.14
according to EN ISO 10077 – 2.
The Therm files generated are attached to this report as appendices



**BFRC Certified
Simulator 016**



Sample Style:
Casement
Fixed Light / Side Hung

Blue line illustrates opening light length (air leakage)

Report Number: **GM2011-001** Issue No.21: 04/03/2009
 Report Date: **17 March 2011**
 Project Details: **4-10-4 Optiwhite - 90% Krypton - Optitherm S4 Plus Swiss Spacer V and Butyl Secondary Sealant**

Input Values:
 Yellow input, green intermediary, blue finals X' DP is no. of decimal places to enter

Parameter	Symbol	Units
Total window height ODP	l_w	1480 mm
Total window width ODP	b_w	1230 mm

Nominal 4mm etc to ODP , others 1DP		
Glazing dimensions and properties:		
Thickness of pane 1	4	mm
Pane 1/2 distance	10	mm
Gas fill (1/2)	Krypton 90%	
Thickness of pane 2	4	mm
Complete next 3 cells for TG IGU		
Pane 2/3 distance		mm
Gas fill (2/3)		
Thickness of pane 3		mm
Glazing Trans. - 3DP	U_g 1.122	W/(m ² ·K)
g-value - 2DP	g_{\perp} 0.74	

Thermal transmittance of window from hot box test		
$U_w - 2DP$		W/(m ² ·K)

Frame dimensions:	(b _f)	Without gasket	Gasket protrusion	With gasket	
		(mm)	(mm)	(mm)	
All frame values to nearest 0.5mm, gaskets to 1DP	F1 fixed sill	37	2.0	39	Total
	F2 fixed head	37	2.0	39	
	F3 fixed jamb	37	2.0	39	
F4 + F5 sash sill	F4 fixed sash sill	35	n/a	35	53
	F5 moving sash sill	16	2.0	18	
F6 + F7 sash head	F6 fixed sash head	35	n/a	35	53
	F7 moving sash head	16	2.0	18	
F8 + F9 sash jamb	F8 Fixed sash jamb	35	n/a	35	53
	F9 moving sash jamb	16	2.0	18	
F10 + F11 mullion	F10 fixed mullion	37	2.0	39	57
	F11 moving mullion	16	2.0	18	
Total gasket area				0.01546	m ²

Window Dimensions:		Area		
Section	Length (m)	Width (m)	No gasket (m ²)	With gasket (m ²)
Fixed Light	1.4060	0.5595	0.7867	0.7788
Opening light	1.3780	0.5295	0.7297	0.7220
Total glazing, A _g			1.5163	1.5008
Frame	(m)	(m)	(m ²)	(m ²)
F1	0.6150	0.0370	0.0217	0.0228
F2	0.6150	0.0370	0.0217	0.0228
F3	1.4800	0.0370	0.0534	0.0562
F4	0.6150	0.0350	0.0206	0.0206
F5	0.5615	0.0160	0.0087	0.0098
F6	0.6150	0.0350	0.0206	0.0206
F7	0.5615	0.0160	0.0087	0.0098
F8	1.4800	0.0350	0.0506	0.0506
F9	1.4100	0.0160	0.0223	0.0251
F10	1.4800	0.0370	0.0534	0.0562
F11	1.4100	0.0160	0.0223	0.0251
Total Frame			0.3041	0.3196
Total Window, A _w			1.8204	1.8204
Percentage fixed light glass area			43.21%	42.78%
Percentage opening light glass area			40.08%	39.66%
Percentage glass area (total)			83.30%	82.45%

Where a U_g value from hot box testing is available, no L_f^{2D} or L_{ψ}^{2D} values need to be entered						
Frame conductance:	All L values to 4DP . All b values to ODP					
	W/(m ² ·K)	b _p (mm)		W/(m ² ·K)	b _g (mm)	
F1 fixed sill	0.4403	190	L_f^{2D}	L_{ψ}^{2D}	0.4228	190
F2 fixed head	0.4403	190			0.4228	190
F3 fixed jamb	0.4403	190			0.4228	190
F4 + F5 sash sill	0.5301	190			0.5128	190
F6 + F7 sash head	0.5301	190			0.5128	190
F8 + F9 sash jamb	0.5301	190			0.5128	190
F10 + F11 mullion	0.9006	380			0.8591	380

Solar Factor, g-value:	F_w	0.9
	g_w	0.55

Air Leakage loss:			
Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - 2DP			
Opening light length	3.9430	m	Total air leakage
	L_{50} 0.15	m ³ /(m ² ·h)	Heat loss = 0.0165 L_{50}
			0.276 m ³ /h
			0.00 W/(m ² ·K)

U_{window}	U_w 1.99	W/(m ² ·K)
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Other parameters needed for calculation, taken from simulations: $\lambda_p = 0.035$ W/(m·K) $R_{se} = 0.04$ m²·K/W $R_{sb} = 0.13$ m²·K/W
 Panel thickness, $d_p = d_g = 0.018$ m $R_p = 0.5143$ m²·K/W $R_{tot} = 0.6843$ m²·K/W $U_p = 1.4614$ W/(m²·K)

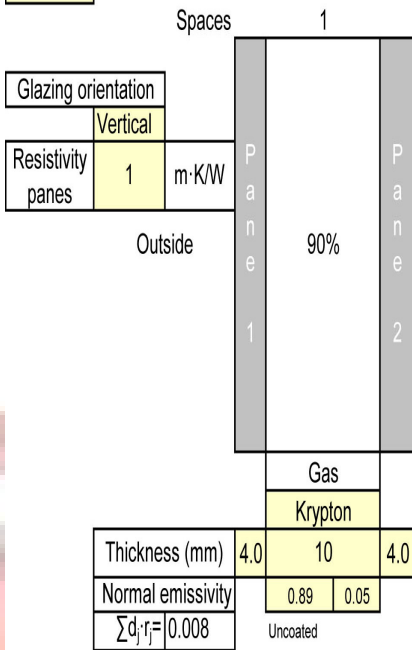
BFRG Rating kWh/(m ² ·yr)	Label index	EWER Rating Scale	Window Rating
≥ 0	-16	A	C
-10 to <0		B	
-20 to <-10		C	
-30 to <-20		D	
-50 to <-30		E	
-70 to <-50		F	
<-70		G	

BFRG Rating =	
218.6g _{window} - 68.5 x (U _{window} + Effective L ₅₀) =	-16.09
Climate zone is:	UK
Thermal transmittance, W/(m ² ·K)	U_{window} 2
Solar factor	g_{window} 0.55
Window air leakage heat loss, W/(m ² ·K)	L_{factor} 0.00



Simulator Name: **Dr Gary Morgan** BFRG Certified Simulator **016**

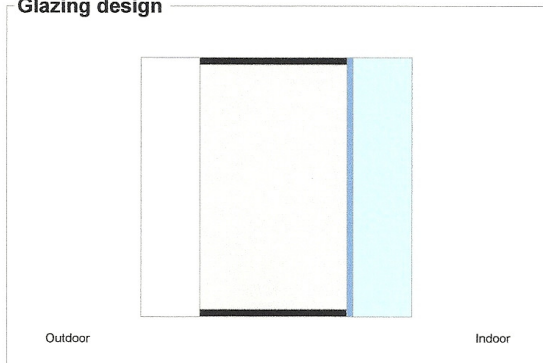
Number of spaces	1
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For uncoated surfaces input 0.89 for normal emissivity, which corresponds to a corrected emissivity of 0.837

Iteration number	U value		λ_{eff}	
	W/(m ² -K)	$\sum 1/h_s$ (m ² -K)/W	W/(mK)	ΔT
1	1.122	0.7147	0.0140	15
2	1.122	0.7147	0.0140	15

Glazing design



	First glazing	Second glazing
Gas		Krypton 92% 10mm
Coating		PLANITHERM TOTAL+
First glass	DIAMANT 4mm	PLANILUX 4mm
Coating		
Layer		
Coating		
Second glass		
Coating		

Manufacturing sizes

Nominal thickness : **18.0 mm**
 Weight : **20.0 kg/m²**

Luminous factors

Transmittance : **81 %**
 Outdoor reflectance : **12 %**
 Indoor reflectance : **12 %**

Energy factors EN 410

Transmittance : **63 %**
 Outdoor reflectance : **22 %**
 Indoor reflectance : **19 %**
 Absorptance A1 : **3 %**
 Absorptance A2 : **13 %**

Solar factor g : **0.74**
 Shading coefficient : **0.85**

Thermal transmission - 0° related to vertical position

Ug : **1.1 W/(m²/K)**



Dr Gary Morgan
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This Calumen® II program has been approved by TNO S&I to do ITC (Initial Type Calculations), for the purpose of an ITT Report according to EN 673 and EN 410 intended uses. Ref. Report TNO No TC-RAP-06-17286/mso

Note – g value is calculated for Diamant and Planitherm Total Plus as per Pilkington's instructions regarding non-availability of Spectrum for Optitherm S4.



Certificate of Test: Chilt/P10036

Steel Window Association
42 Heath Street
Tamworth
Staffordshire
B79 7HJ

This document confirms that performance testing was conducted on 8 April 2010. Testing was conducted to the following standard:-

- BS 6375 Part 1:2009 Performance of windows and doors - Part 1: Classification for weathertightness and guidance on selection and specification. The following results were achieved.

Product tested	W-30 Side Hung Casement Window		
Summary of testing and classification			
	Test Standard	Classification standard	Result
Air permeability	BS EN 1026: 2000	BS EN 12207: 2000	600Pa (Class 4)
Watertightness	BS EN 1027: 2000	BS EN 12208: 2000	750Pa (E750)
Wind resistance	BS EN 12211: 2000	BS EN 12210: 2000	1600Pa (Class A4)
Exposure category	BS 6375: Part 1: 2009		1600

Air leakage at 50pa was 0.2m³/h positive pressure and 0.3m³/h negative pressure. The perimeter length of opening light was 3.42m

The results relate only to the specimen tested, as detailed in technical specification document number Chilt/P10036/tec1

Paul Andrews –
Head of Section Mechanical Testing
Date:

Vincent Kerrigan -
Technical Manager
Date: 19-07-2010

Chiltern Dynamics

Chiltern House, Stocking Lane, Hughenden Valley, High Wycombe, HP14 4ND, United Kingdom

Tel: 01494 569800 Fax: 01494 564895

Web: www.chilternfire.co.uk

Email: cif@chilternfire.co.uk

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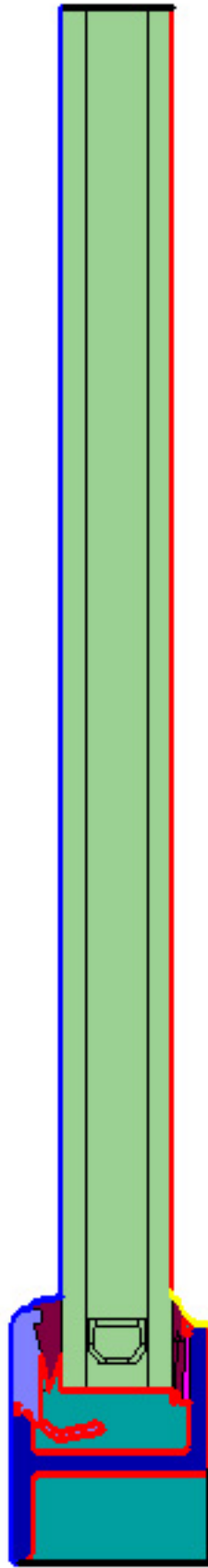
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Air leakage calculation

Chiltern Dynamics report number Chilt /P10036 gives the positive and negative airflows at 50 Pa as 0.2 m³/h and 0.3 m³/h respectively. The opening light length is given as 3.42 m

Thus the average air infiltration rate per m opening light length is given by:

$$((0.2 + 0.3) / 2) / 3.42 = 0.07 \text{ m}^3/(\text{m}\cdot\text{h})$$



Therm Version 5.2 (5.2.14)
 Date: Thu Mar 17 15:42:59 2011

Created by:
 Created for:

Therm Filename: D:\MyDocs from Thermbridge\Therm Output Files\Steel Window Association\September 2010\W30\With Swiss Spacer\fixed_Panel Swiss V.THM
 Cross Section Type: Sill
 Underlay Name:

U-factors

Name	Length mm	Basis	U-factor W/m2-K
Linear Transmittance	1000.00	Custom	0.4403

Solid Materials

Name	Conductivity W/m-K	Emissivity
CEN Insulation Panel	0.04	0.90
CEN EPDM	0.25	0.90
CEN PVC Foam Elastomer	0.05	0.90
CEN Aluminium Si Alloys	160.00	0.90
CEN Steel	50.00	0.90

Cavities

Name: CEN Cavity (Unventilated) - Detailed
 Gas Fill: Air
 Convection Model: CEN
 Radiation Model: Advanced

Poly Keff ID Height	Heat Cavity Flow Dir	Side 1		Side 2		Dimension		Nu #
		Temp	Emis	Temp	Emis	Horz.	Vert.	
W/m-K	mm	C		C		mm	mm	
26 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	1.16	1.66	N/A
140 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	0.52	0.41	N/A
136 0.0459	Horizontal N/A	7.00	0.90	-4.00	0.90	28.30	13.22	N/A
43 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	0.61	3.64	N/A
2 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	0.71	1.15	N/A
9 0.0307	Horizontal N/A	15.00	0.90	5.00	0.90	19.50	10.67	N/A

Name: CEN Cavity (Slightly Ventilated) - Detailed
 Gas Fill: Air
 Convection Model: CEN Ventilated
 Radiation Model: Advanced

Poly Keff ID Height	Heat Cavity Flow Dir	Side 1		Side 2		Dimension		Nu #
		Temp	Emis	Temp	Emis	Horz.	Vert.	
W/m-K	mm	C		C		mm	mm	
139 0.0500	Horizontal N/A	7.00	0.90	-4.00	0.90	0.79	1.58	N/A

Glazing Systems

None

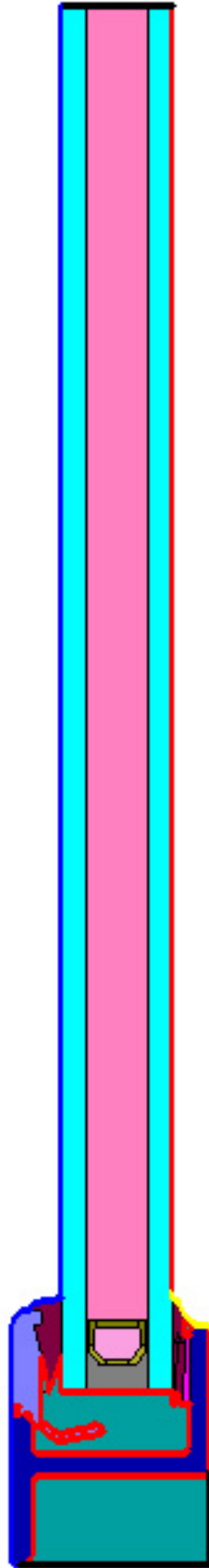
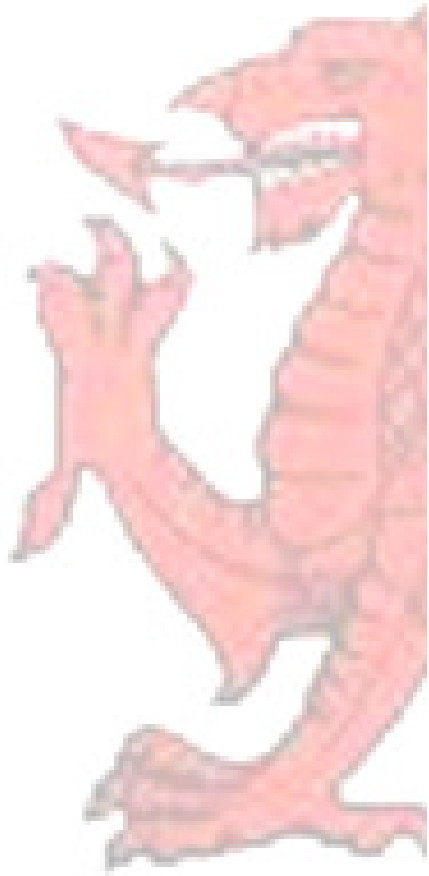
Standard Boundary Conditions

Name	Temperature C	Film Coefficient W/m2-K
CEN Exterior	0.00	25.000
CEN Interior	20.00	7.692
CEN Red Rad	20.00	5.000

Calculation Specifications

Mesh Parameter : 9
Estimated Error: 2.9%
Calculations done in Version 5.2 (5.2.14)





Glazing Systems

None

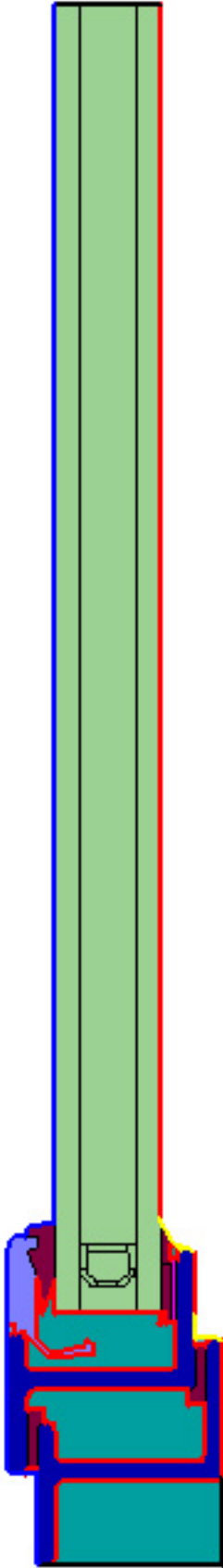
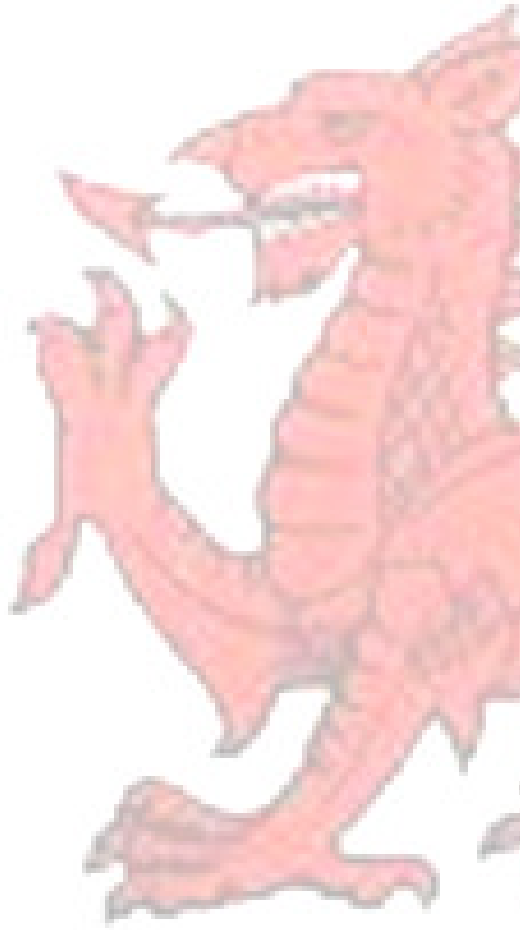
Standard Boundary Conditions

Name	Temperature C	Film Coefficient W/m2-K
CEN Exterior	0.00	25.000
CEN Interior	20.00	7.692
CEN Red Rad	20.00	5.000

Calculation Specifications

Mesh Parameter : 9
Estimated Error: 3.2%
Calculations done in Version 5.2 (5.2.14)





Therm Version 5.2 (5.2.14)
 Date: Thu Mar 17 15:45:03 2011

Created by:
 Created for:

Therm Filename: D:\MyDocs from Thermbridge\Therm Output Files\Steel Window Association\September 2010\W30\With Swiss Spacer\opener_Panel Swiss.THM
 Cross Section Type: Sill
 Underlay Name:

U-factors

Name	Length mm	Basis	U-factor W/m2-K
Linear transmittance	1000.00	Custom	0.5301

Solid Materials

Name	Conductivity W/m-K	Emissivity
CEN Insulation Panel	0.04	0.90
CEN EPDM	0.25	0.90
CEN PVC Foam Elastomer	0.05	0.90
CEN Aluminium Si Alloys	160.00	0.90
CEN Steel	50.00	0.90

Cavities

Name: CEN Cavity (Unventilated) - Detailed
 Gas Fill: Air
 Convection Model: CEN
 Radiation Model: Advanced

Poly Keff ID Height	Heat Cavity Flow Dir	Side 1		Side 2		Dimension		Nu #
		Temp	Emis	Temp	Emis	Horz. mm	Vert. mm	
W/m-K	mm	C		C				
26 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	1.16	1.66	N/A
140 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	0.52	0.41	N/A
203 0.0459	Horizontal N/A	7.00	0.90	-4.00	0.90	28.30	13.22	N/A
55 0.0460	Horizontal N/A	7.00	0.90	-4.00	0.90	28.36	10.28	N/A
31 0.0250	Horizontal N/A	15.00	0.90	5.00	0.90	0.61	3.64	N/A
33 0.0250	Horizontal N/A	15.00	0.90	5.00	0.90	0.71	1.15	N/A
34 0.0307	Horizontal N/A	15.00	0.90	5.00	0.90	19.50	10.67	N/A

Name: CEN Cavity (Slightly Ventilated) - Detailed
 Gas Fill: Air
 Convection Model: CEN Ventilated
 Radiation Model: Advanced

Poly Keff ID Height	Heat Cavity Flow Dir	Side 1		Side 2		Dimension		Nu #
		Temp	Emis	Temp	Emis	Horz. mm	Vert. mm	
W/m-K	mm	C		C				
139 0.0500	Horizontal N/A	7.00	0.90	-4.00	0.90	0.79	1.58	N/A
8 0.0500	Horizontal N/A	7.00	0.90	-4.00	0.90	2.59	0.87	N/A
7 0.0500	Horizontal N/A	7.00	0.90	-4.00	0.90	2.60	0.87	N/A

Glazing Systems

None

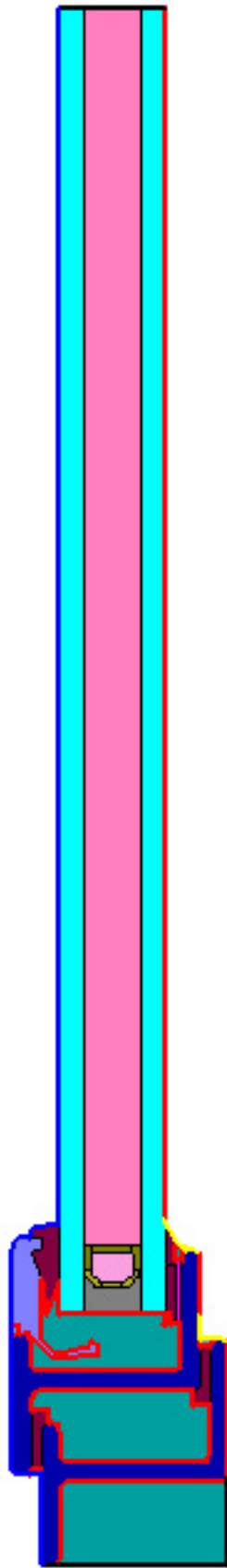
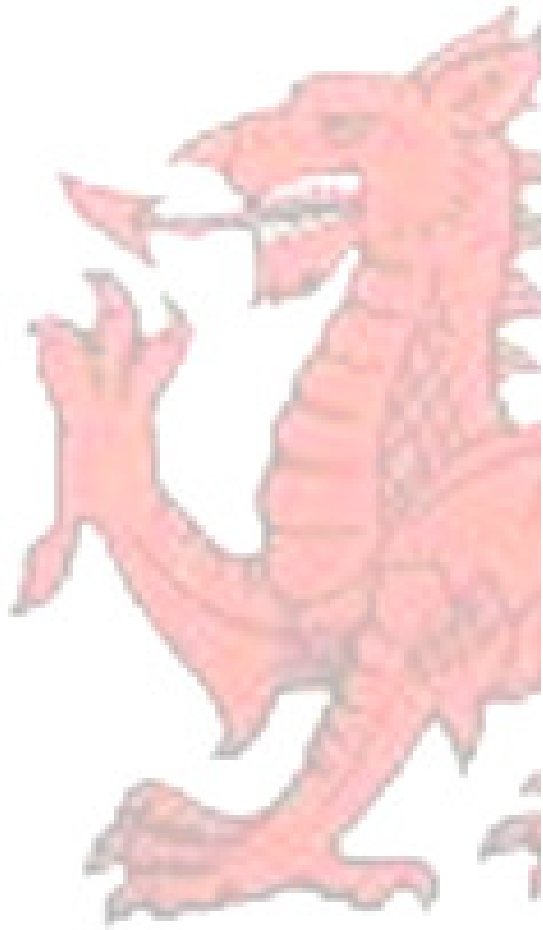
Standard Boundary Conditions

Name	Temperature C	Film Coefficient W/m ² -K
CEN Exterior	0.00	25.000
CEN Interior	20.00	7.692
CEN Red Rad	20.00	5.000

Calculation Specifications

Mesh Parameter : 9
Estimated Error: 3.6%
Calculations done in Version 5.2 (5.2.14)





8	Horizontal	7.00	0.90	-4.00	0.90	2.59	0.87	N/A
0.0500	N/A							
7	Horizontal	7.00	0.90	-4.00	0.90	2.60	0.87	N/A
0.0500	N/A							

Glazing Systems

None

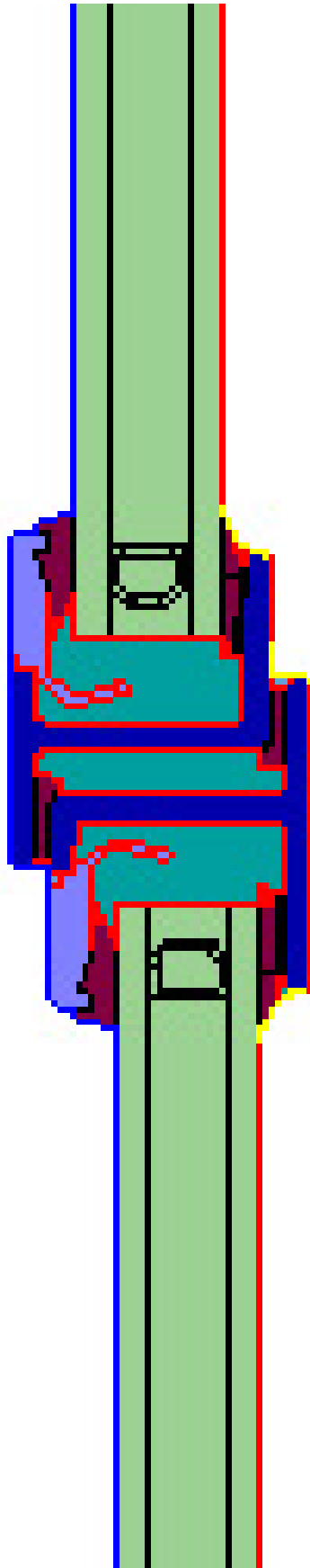
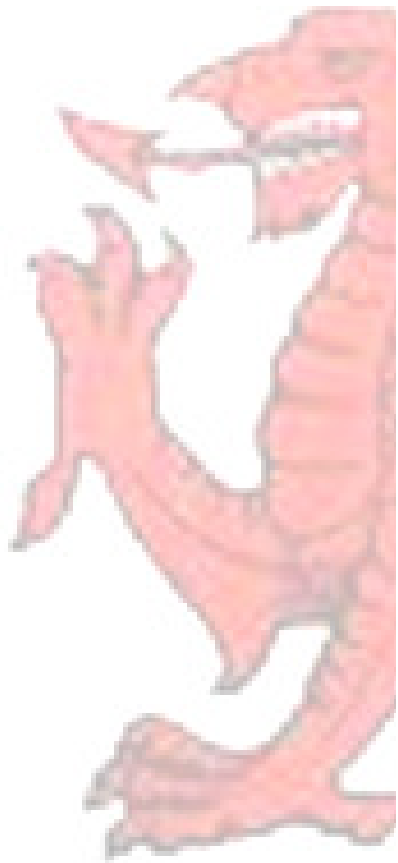
Standard Boundary Conditions

Name	Temperature C	Film Coefficient W/m2-K
CEN Exterior	0.00	25.000
CEN Interior	20.00	7.692
CEN Red Rad	20.00	5.000

Calculation Specifications

Mesh Parameter : 9
Estimated Error: 4%
Calculations done in Version 5.2 (5.2.14)





Therm Version 5.2 (5.2.14)
 Date: Thu Mar 17 15:47:50 2011

Created by:
 Created for:

Therm Filename: D:\MyDocs from Thermbridge\Therm Output Files\Steel Window Association\September 2010\W30\With Swiss Spacer\mullion_Panel Swiss V.THM
 Cross Section Type: Sill
 Underlay Name:

U-factors

Name	Length mm	Basis	U-factor W/m2-K
Linear transmittance	1000.00	Custom	0.9006

Solid Materials

Name	Conductivity W/m-K	Emissivity
CEN Insulation Panel	0.04	0.90
CEN EPDM	0.25	0.90
CEN PVC Foam Elastomer	0.05	0.90
CEN Aluminium Si Alloys	160.00	0.90
CEN Steel	50.00	0.90

Cavities

Name: CEN Cavity (Unventilated) - Detailed
 Gas Fill: Air
 Convection Model: CEN
 Radiation Model: Advanced

Poly Keff ID Height	Heat Cavity Flow Dir	Side 1		Side 2		Dimension		Nu #
		Temp	Emis	Temp	Emis	Horz. mm	Vert. mm	
W/m-K	mm	C		C				
151 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	0.52	0.41	N/A
9 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	0.52	0.41	N/A
14 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	29.10	4.79	N/A
66 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	1.16	1.67	N/A
148 0.0250	Horizontal N/A	7.00	0.90	-4.00	0.90	1.16	1.67	N/A
117 0.0250	Horizontal N/A	15.00	0.90	5.00	0.90	0.61	3.64	N/A
118 0.0250	Horizontal N/A	15.00	0.90	5.00	0.90	0.71	1.15	N/A
119 0.0307	Horizontal N/A	15.00	0.90	5.00	0.90	19.50	10.67	N/A
122 0.0250	Horizontal N/A	15.00	0.90	5.00	0.90	0.61	3.64	N/A
124 0.0250	Horizontal N/A	15.00	0.90	5.00	0.90	0.71	1.15	N/A
125 0.0307	Horizontal N/A	15.00	0.90	5.00	0.90	19.51	10.67	N/A

Name: CEN Cavity (Slightly Ventilated) - Detailed
 Gas Fill: Air
 Convection Model: CEN Ventilated
 Radiation Model: Advanced

Poly Keff ID Height	Heat Cavity Flow Dir	Side 1		Side 2		Dimension		Nu #
		Temp	Emis	Temp	Emis	Horz. mm	Vert. mm	
W/m-K	mm	C		C				
150 0.0500	Horizontal N/A	7.00	0.90	-4.00	0.90	0.79	1.58	N/A

8	Horizontal	7.00	0.90	-4.00	0.90	0.79	1.58	N/A
0.0500	N/A							
23	Horizontal	7.00	0.90	-4.00	0.90	2.60	0.84	N/A
0.0500	N/A							
22	Horizontal	7.00	0.90	-4.00	0.90	2.74	0.90	N/A
0.0500	N/A							

Glazing Systems

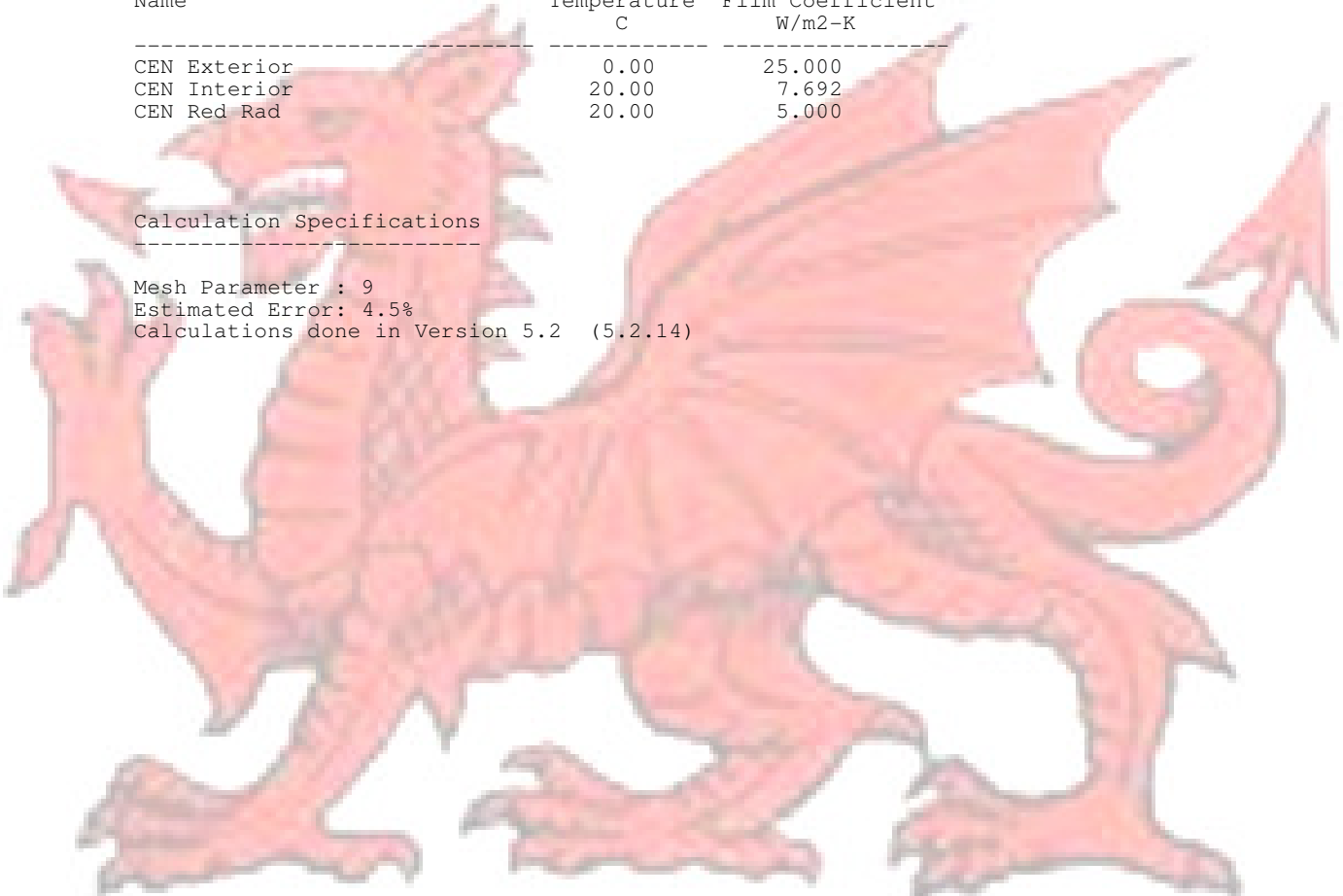
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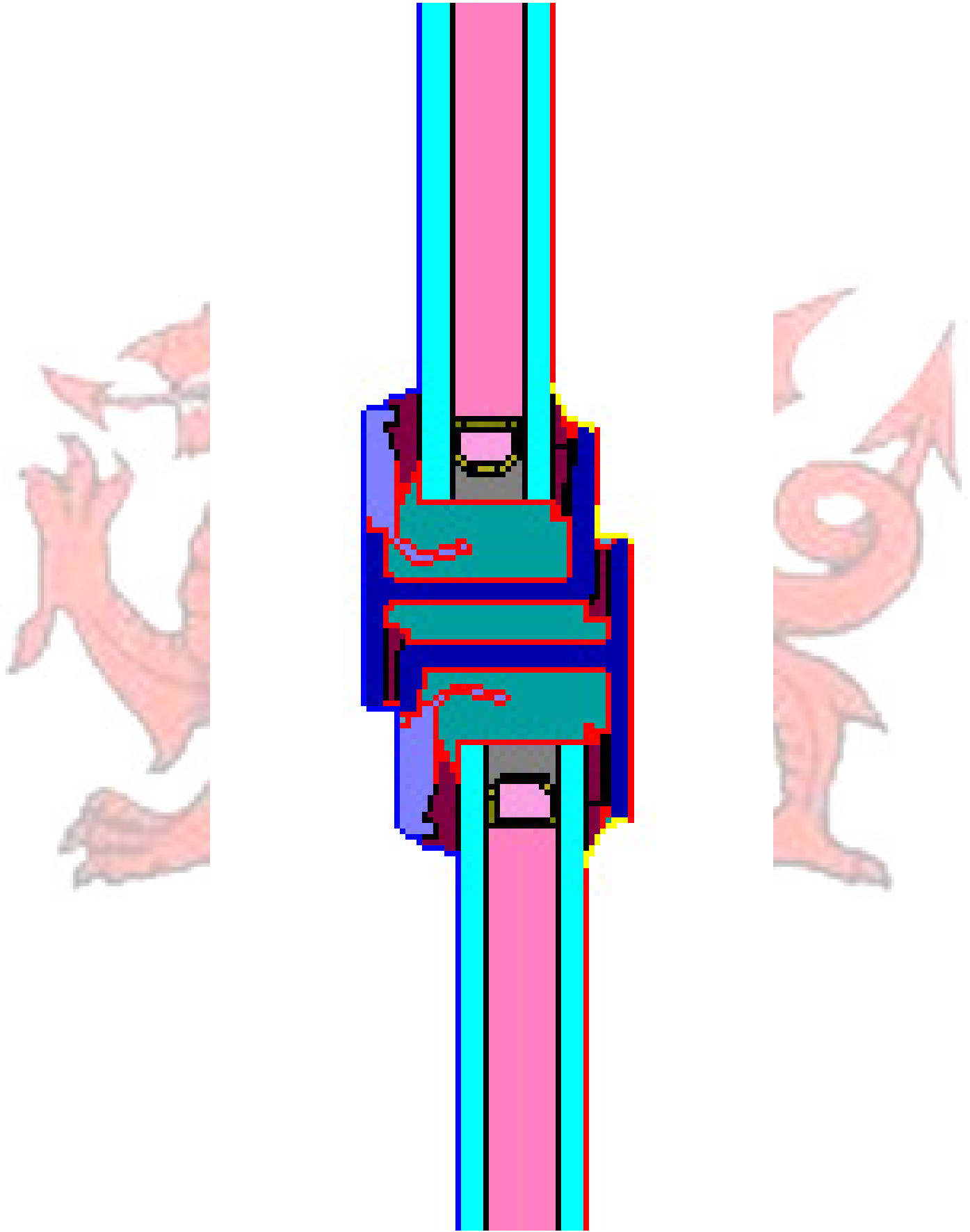
Standard Boundary Conditions

Name	Temperature C	Film Coefficient W/m2-K
CEN Exterior	0.00	25.000
CEN Interior	20.00	7.692
CEN Red Rad	20.00	5.000

Calculation Specifications

Mesh Parameter : 9
 Estimated Error: 4.5%
 Calculations done in Version 5.2 (5.2.14)





Therm Version 5.2 (5.2.14)
 Date: Thu Mar 17 15:49:01 2011

Created by:
 Created for:

Therm Filename: D:\MyDocs from Thermbridge\Therm Output Files\Steel Window Association\September 2010\W30\With Swiss Spacer\mullion_glass Swiss V.THM
 Cross Section Type: Sill
 Underlay Name:

U-factors

Name	Length mm	Basis	U-factor W/m2-K
Linear transmittance	1000.00	Custom	0.8591

Solid Materials

Name	Conductivity W/m-K	Emissivity
CEN Polyisobutylene	0.20	0.90
CEN Swiss Spacer Plastic and Steel	0.31	0.90
CEN Swiss Spacer Plastic Only	0.16	0.90
CEN Molecular Sieve	0.10	0.90
CEN Glass	1.00	0.90
4 10 4 Planitherm Total Plus 9 0% Krypton	0.01	0.90
CEN Butyl Solid / Hot Melt	0.24	0.90
CEN EPDM	0.25	0.90
CEN PVC Foam Elastomer	0.05	0.90
CEN Aluminium Si Alloys	160.00	0.90
CEN Steel	50.00	0.90

Cavities

Name: CEN Cavity (Unventilated) - Detailed
 Gas Fill: Air
 Convection Model: CEN
 Radiation Model: Advanced

Poly Keff	Heat Cavity Flow Dir	ID	Height	Side 1		Side 2		Dimension		Nu #
				Temp	Emis	Temp	Emis	Horz.	Vert.	
W/m-K	mm			C		C		mm	mm	
0.0250	151	Horizontal	N/A	7.00	0.90	-4.00	0.90	0.52	0.41	N/A
0.0250	9	Horizontal	N/A	7.00	0.90	-4.00	0.90	0.52	0.41	N/A
0.0250	14	Horizontal	N/A	7.00	0.90	-4.00	0.90	29.10	4.79	N/A
0.0250	66	Horizontal	N/A	7.00	0.90	-4.00	0.90	1.16	1.67	N/A
0.0250	148	Horizontal	N/A	7.00	0.90	-4.00	0.90	1.16	1.67	N/A
0.0250	117	Horizontal	N/A	15.00	0.90	5.00	0.90	0.61	3.64	N/A
0.0250	118	Horizontal	N/A	15.00	0.90	5.00	0.90	0.71	1.15	N/A
0.0307	119	Horizontal	N/A	15.00	0.90	5.00	0.90	19.50	10.67	N/A
0.0250	122	Horizontal	N/A	15.00	0.90	5.00	0.90	0.61	3.64	N/A
0.0250	124	Horizontal	N/A	15.00	0.90	5.00	0.90	0.71	1.15	N/A
0.0307	125	Horizontal	N/A	15.00	0.90	5.00	0.90	19.51	10.67	N/A

Name: CEN Cavity (Slightly Ventilated) - Detailed
 Gas Fill: Air
 Convection Model: CEN Ventilated
 Radiation Model: Advanced

Poly Keff	Heat Cavity	Side 1	Side 2	Dimension	Nu
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ID	Flow	Temp	Emis	Temp	Emis	Horz.	Vert.	#
Height	Dir	C		C		mm	mm	
W/m-K	mm							
150	Horizontal	7.00	0.90	-4.00	0.90	0.79	1.58	N/A
0.0500	N/A							
8	Horizontal	7.00	0.90	-4.00	0.90	0.79	1.58	N/A
0.0500	N/A							
23	Horizontal	7.00	0.90	-4.00	0.90	2.60	0.84	N/A
0.0500	N/A							
22	Horizontal	7.00	0.90	-4.00	0.90	2.74	0.90	N/A
0.0500	N/A							

Glazing Systems

None

Standard Boundary Conditions

Name	Temperature	Film Coefficient
	C	W/m2-K
CEN Exterior	0.00	25.000
CEN Interior	20.00	7.692
CEN Red Rad	20.00	5.000

Calculation Specifications

Mesh Parameter : 9
 Estimated Error: 4.8%
 Calculations done in Version 5.2 (5.2.14)

