

Report in Accordance with BFRC Guidelines and Regulations

Product description: Clement Conservation Rooflight window

CONFIDENTIAL

Client:	Clement Windows Ltd Weydown Road Industrial Estate Haslemere Surrey GU27 1HR
Project:	Clement Conservation Rooflight.
Project reference:	CU16010-1
Prepared By:	Richard Bate Technical Director
Issue date:	5 th November 2016

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Approved Simulator 001

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1 Introduction

The U-value calculations of the Clement Windows Ltd Conservation Rooflight window detailed below were commissioned by Kevin Romaine of Clement Windows Ltd.

2 Validation of Program

The Therm 5.2 analysis software has been validated against proofs in Annex D (D1 to D10) of BS EN ISO 10077-2:2012.

3 Analysis Method

The frame profile results detailed below are provided by computer simulation using LBL software program THERM 5.2 and BFRG guidelines and regulations.

4 Summary of Results

A summary of results are detailed in the following sections. The details supplied for the analysis as well as all information required to verify the analysis can be found in the attached CD.

4.1 Frame thermal transmittance (following the principles of BS EN ISO 10077-2)

Conservation Rooflight Frame Profile	Frame Thermal Transmittance (U_i)
Head	3.4 W/(m ² ·K)
Jamb	3.4 W/(m ² ·K)
Cill	2.1 W/(m ² ·K)

4.2 Linear thermal transmittance (following the principles of BS EN ISO 10077-2)

Conservation Rooflight Frame Profile	Linear Thermal Transmittance (ψ)
Head	0.030 W/(m·K)
Jamb	0.030 W/(m·K)
Cill	0.059 W/(m·K)

4.3 Centre pane U-Value of glazing calculated in accordance with BS EN 673.

Glazing Unit	Centre Pane U-value (U_g)
4-16-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm Total+), Argon filled, Float Outerpane(Saint Gobain Planiclear) glazing unit with Saint Gobain Swiss Ultimate spacer bar with 3mm PU/PS secondary seal.	1.2 W/(m ² ·K)

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4.4 The thermal performance of the windows (Uw) in accordance with BFRC guidelines and regulations:

Conservation Rooflight Frame Profile	Window U-Value
Mild Steel frame system with with 4-16-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm Total+), Argon filled, Float Outerpane(Saint Gobain Planiclear) glazing unit with Saint Gobain Swiss Ultimate spacer bar with 3mm PU/PS secondary seal.	1.5 W/(m ² ·K)

4.5 The Effective L₅₀ in accordance with BFRC guidelines and regulations:

Conservation Rooflight Frame Profile	Effective L ₅₀
Air permeability at 50 pa	0.03 W/(m ² ·K)

4.6 Total solar energy transmittance (g) in accordance with EN 410

Conservation Rooflight Frame Profile	g _{window}
Mild Steel frame system with with 4-16-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm Total+), Argon filled, Float Outerpane(Saint Gobain Planiclear) glazing unit with Saint Gobain Swiss Ultimate spacer bar with 3mm PU/PS secondary seal.	0.58


5.0 BFRC Rating

5.1 Clement Conservation Rooflight window system

Conservation Rooflight Frame Profile	Rating
Mild Steel frame system with with 4-16-4 Low-E 0.05 uncorrected emissivity (Saint Gobain Planitherm Total+), Argon filled, Float Outerpane(Saint Gobain Planiclear) glazing unit with Saint Gobain Swiss Ultimate spacer bar with 3mm PU/PS secondary seal.	+24 (Rating Scale A+)

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6.0 Authorisation

	Prepared by:
Signature:	
Name:	Richard Bate
Title:	Technical Director

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Technical Specification

Profiles	Ref. No.	Material Type/Manufacturer's Name & Density (Timber only)	Dimensions (Height & Width)
Outer Frame	OF1	Mild Steel , Glavanized & Powder coated - Metrol	30mm x 88.5 mm
Transom/ Mullion	N/A	N/A	mm x mm
Casement Vent	VP1	Mild Steel , Glavanized & Powder coated - Metrol	30mm x 102mm
Glazing Bead	N/A	N/A	mm x mm
Joint Type	N/A	N/A	
Joint Adhesives	N/A	N/A	

Reinforce- ments	Ref. No.	Material Type/ Manufacturer's Name	Dimensions (Height & Width)
Outer Frame	N/A	N/A	mm x mm
Transom/ Mullion	N/A	N/A	mm x mm
Casement Vent	N/A	N/A	mm x mm

Weather Seals	Ref. No.	Material Type/ Manufacturer's Name	Continuous or Joined @ Corners
Glazing Bead	Silicone	Arbosil	
Glazing Rebate	Silicone	Arbosil	
Casement Perimeter Seal	N/A	N/A	
Frame Rebate	EPDM	SJG International	

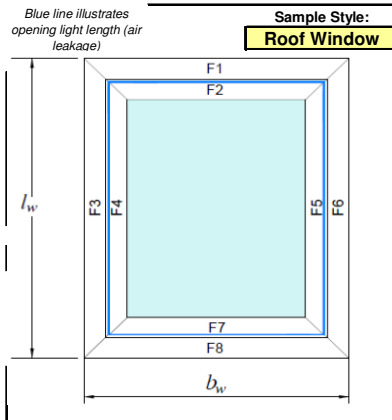
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Glazing Component	Specification
Overall sealed unit: 1. Thickness (mm)	1. 24mm
Outer pane 1. Thickness (mm) 2. Manufacturer 3. Description	1. 4mm 2. Saint Gobain 3. Planiclear
Inner pane: 1. Thickness 2. Manufacturer 3. Description	1. 4mm 2. Saint Gobain 3. Planitherm Total+
Spacer bar: 1. Manufacturer 2. Description	1. Saint Gobain 2. Swiss Ultimate
Cavity 1. Distance (mm) 2. Gas %	1. 16mm 2. Argon 90% Air 10%
Edge seal 1. Manufacturer 2. Description	1. N/A 2. Polyisobutylene : Primary , 3mm PU/PS Secondary

Additional Notes
<p>Air leakage data is taken from Wintech Test report ref. R15828-1, dated 4th March 2016 (data at 50Pa pressure = 0.65).</p> <p>Solar heat gain figures are calculated from g-values supplied by the product manufacturer from EN 410 calculations for the glass units used in this simulation. The value used is 0.73.</p>

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BFRC Spreadsheet



Report Number: **U16010-1** Report Issue Status: 2 (06/08/2013)
 Report Date: **30 April 2016**
 Project Details: **Clement Conservation Rooflight**

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

Parameter	Symbol	Value	Units
Total Window height ODP	L_w	1480	mm
Total Window width ODP	b_w	1230	mm

Frame dimensions to nearest mm and gasket protrusions to nearest 0.1mm	Frame heights, (mm)		
	Internal, b_i	Gasket protrusion, b_{gf}	Combo, b_j
F1 fixed top rail	8	N/A	30
F2 moving top rail	23	13.0	
F3 top hinge (LH) jamb (fixed sash)	8	N/A	30
F4 top hinge (LH) jamb (moving frame)	23		
F5 top close (RH) jamb (moving sash)	8	13.0	30
F6 top close (RH) jamb (fixed frame)	23	N/A	
F7 bottom moving rail	4	17.3	30
F8 bottom fixed rail	27	N/A	

Frame offset: **No**

Nominal 4mm etc to **ODP**, others **1DP**

Glazing dimensions and properties:

Thickness of pane 1	4	mm
Pane 1/2 distance	16	mm
Gas fill (1/2)	Argon 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	1.195 W/(m ² ·K)
g-value - 2DP	g_L	0.73

Window Dimensions:

Panel	Length, l	Width, b	Area, A (No Gasket)	Area, A (Gasket)
	m	m	m ²	m ²
Glazing	1.4180	1.1680	1.6562	1.6028
Frame	m	m	m ²	m ²
F1	1.2300	0.0080	0.0097	0.0097
F2	1.1990	0.0230	0.0272	0.0423
F3	1.4800	0.0080	0.0117	0.0117
F4	1.4450	0.0230	0.0329	0.0329
F5	1.4450	0.0080	0.0115	0.0297
F6	1.4800	0.0230	0.0336	0.0336
F7	1.1990	0.0040	0.0047	0.0248
F8	1.2300	0.0270	0.0328	0.0328
Total Frame			1.1642	0.2176
Total Window, Ad			1.8204	1.8204
Percentage upper panel area			90.98%	88.05%

Solar Factor, g-value:

F_w	0.9
g_w	0.58

U_{Window}	U_w	1.47	W/(m ² ·K)
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U-VALUES SHOWN TO THE RIGHT ARE NOT USED FOR GENERATING A RATING. THEY MAY BE USED TO SHOW IN-SITU PERFORMANCE FOR USE IN SAP OR SBEM

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

Thermal transmittance of Window from hot box testing $U_d - 2dp$ W/(m²·K)
 Where a U_d value from hot box testing is available, no $L_{T,2D}$ or $L_{\psi,2D}$ values need to be entered

Frame conduction:	All L values to ODP			
	$L_{T,2D}$	W/(m ² ·K)	b_g (mm)	$L_{\psi,2D}$
F1+F2 top rail		0.3289	190	0.3640
F3+F4 (LH) jamb		0.3289	190	0.3640
F5+F6 (RH) jamb		0.3289	190	0.3640
F7+F8 bottom rail		0.2868	190	0.3504

Frame:	b_i	U_i	A_i (no gaskets)	Frame Heat, HU	ψ	l_g	Junction heat, H_j
Section	m	W/(m ² ·K)	m ²	W/K	W/(m·K)	m	W/K
F1+F2 top rail	0.0310	3.4472	0.0369	0.1273	0.0301	1.1680	0.0351
F3+F4 (LH) jamb	0.0310	3.4472	0.0446	0.1538	0.0301	1.4180	0.0427
F5+F6 (RH) jamb	0.0310	3.4472	0.0451	0.1554	0.0301	1.4180	0.0427
F7+F8 bottom rail	0.0310	2.0891	0.0375	0.0784	0.0586	1.1680	0.0684
Totals			0.1642	0.5150		Total	0.1889

Air Leakage loss:

Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - 2DP		0.65	m ³ /(m·h)
Opening light length	5.2880 m	Total air leakage	3.437 m ³ /h
L_{50}	1.89 m ³ /(m ² ·h)	Heat loss = 0.0165 L_{50}	0.03 W/(m ² ·K)

Other parameters:

Panel thickness, $d_p = d_g =$	0.024 m	$\lambda_p =$	0.035 W/(m·K)
$R_{sp} =$	0.04 m ² ·K/W	$R_p =$	0.6857 m ² ·K/W
$R_{tot} =$	0.8557 m ² ·K/W	$R_{sp} =$	0.13 m ² ·K/W
		$U_p =$	1.1686 W/(m ² ·K)



Double	Glazing	U-value (Wm ⁻² K ⁻¹)	
Inclination of Roof		Adjustment	Final (1dp)
	70° (vertical)	0.0	1.5
	<70° and >60°	0.2	1.7
	≤60° and >40°	0.3	1.8
	≤40° and >20°	0.4	1.9
	≤20° (horizontal)	0.5	2.0

BFRC Rating =	218.6g window - 68.5 x (U_{window} + Effective L_{50}) =	24.04
Climate zone is:		UK
Thermal transmittance, W/(m²·K)	U_{window}	1.5
Solar factor	g_{window}	0.58
Window air leakage heat loss, W/(m²·K)	L_{factor}	0.03

Simulator Name: **Richard Bate** BFRC Certified Simulator **001**

BS EN 673 Spreadsheet

Version 12 18/06/2015. Calculations according to BS EN 673:2011

Number of spaces	Help		Spaces 1	
Glazing orientation	Vertical		90%	
Resistivity panes	1	m·K/W	Pane 1	Pane 2
Outside				
Calculate		Gas Argon		
Thickness (mm)	4.0	16	4.0	
Normal emissivity		0.89	0.05	
$\sum d_j \cdot r_{j-1}$	0.008	Uncoated		

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

External, R_{se}	0.04	(m ² ·K)/W
Internal, R_{si}	0.13	(m ² ·K)/W

Iteration number	U value	$\sum 1/h_s$	λ_{eff}	ΔT
	W/(m ² ·K)	(m ² ·K)/W		
1	1.195	0.65864	0.0243	15
2	1.195	0.65864	0.0243	15

Thermal Conductance Values Used

Material/Conductance W/(m.K)	Reference
Softwood / 0.13	(Annex A BS EN ISO 10077-2)
Steel / 50.0	(Annex A BS EN ISO 10077-2)
EPDM / 0.25	(Annex A BS EN ISO 10077-2)
Sodalime Glass / 1.0	(Annex A BS EN ISO 10077-2)
Pu/Ps / 0.40	(Annex A BS EN ISO 10077-2)
Swiss Spacer Ultimate / 0.14	2-box values from European Warm Edge Working Group BF Datasheets
Silicone / 0.35	(Annex A BS EN ISO 10077-2)

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Spacer Conductivity

April 2013 – No.19 – Revision Index 0

'WARM EDGE' WORKING PARTY



Data sheet Psi values for windows

based on determination of the equivalent thermal conductivity of spacers by measurement

SWISSPACER®

SWISSPACER®
Vetrotech Saint-Gobain (International) AG
Zweigniederlassung Kreuzlingen
Sonnenwiesenstrasse 15
CH-8280 Kreuzlingen

	Product name	Spacer height in mm	Material	Thickness d in mm
Cross-section	Ultimate SWISSPACER	6.5	Plastic / Multilayer – polyester coated film "High Tech Gas Barrier Foil"	1.0 0.097

Representative frame profile		Metal with thermal break	Plastic	Wood	Wood / Metal
	Representative psi value double sheet thermally insulating glass W/mK	16 Double-sheet insulating glass $U_g = 1.1 \text{ W/m}^2\text{K}$	0.036	0.032	0.031
Representative psi value triple sheet thermally insulating glass W/mK	12 4 12 4 12 Triple-sheet insulating glass $U_g = 0.7 \text{ W/m}^2\text{K}$	0.031	0.030	0.029	0.030

No Box model Characteristic values	Space between panes h ₂ 2 h ₁ 1	Space between panes in mm	$\lambda_{eq,2D}$ in W/mK	
			Box 1 - h ₁ = 3 mm	Box 2 - h ₂ = 6.5 mm
		Can be used for all spacer widths	0.40	0.14

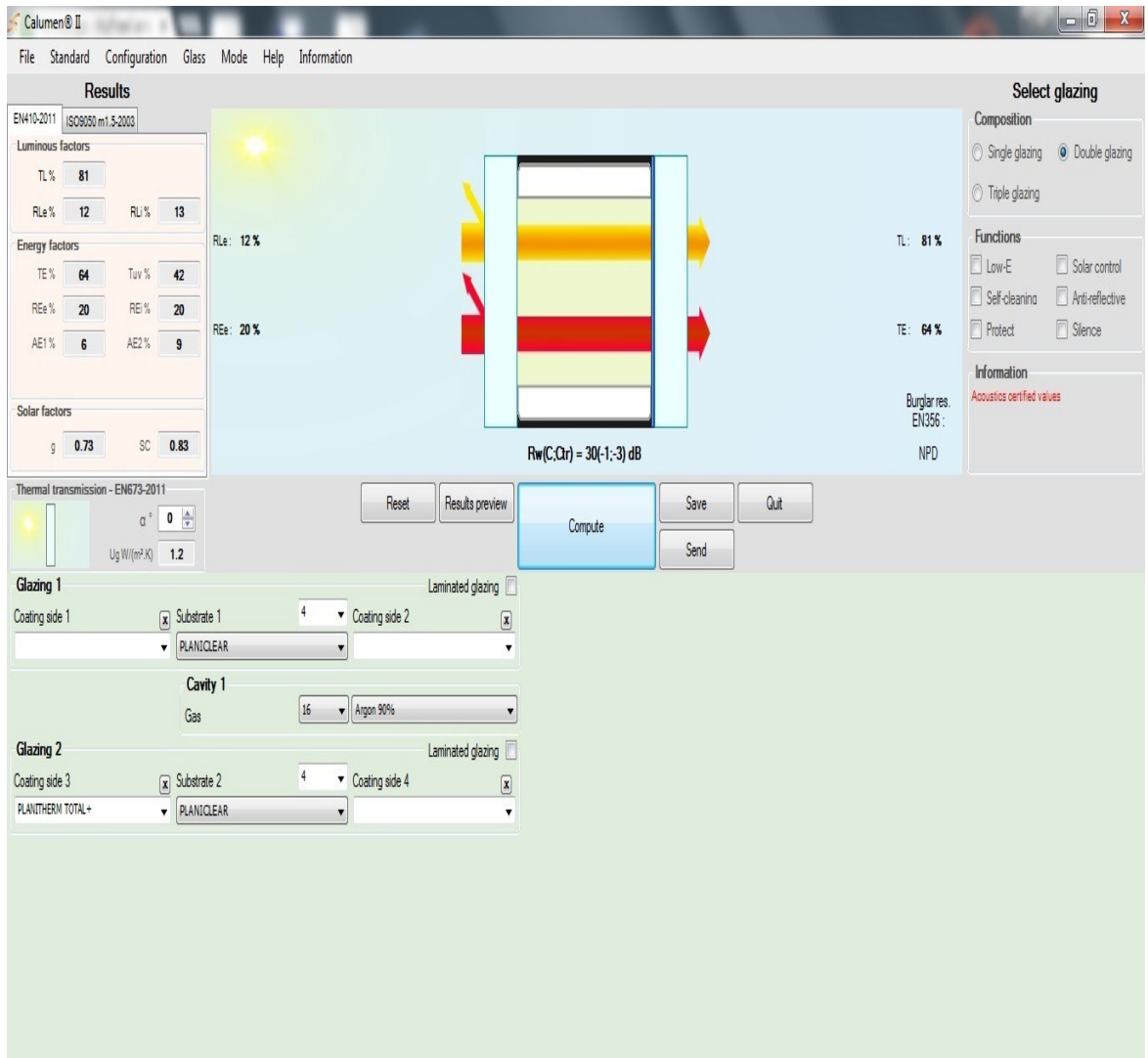
Explanations

The equivalent thermal conductivity has been determined in accordance with the IfT guideline WA-17/1 "Thermally improved spacers – Determination of the equivalent thermal conductivity by measurement". The representative linear heat transfer coefficients calculated in this way (representative psi values) apply to typical frame profiles and glazing for the determination of the heat transfer coefficient U_w of windows. They have been determined under the boundary conditions (frame profiles, glazing, glass mounting depth, back covering, primary and secondary sealant) defined in the IfT guideline WA-08/2 "Thermally improved spacers – Part 1: Determination of the representative Psi value for window frame profiles". This guideline also governs the area of validity and application of the representative psi values. In order to avoid rounding errors, the psi values in the data sheet have been given at 0.001 W/mK. The method for the arithmetical determination of the psi values has an accuracy of ± 0.003 W/mK. Differences of less than 0.005 W/mK are not significant. For further information, refer to the Bulletin 004/2008 "Compass Warm Edge" for Windows" of Bundesverband Flachglas.

Ermittlung der Kennwerte durch:

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G-Value Source



Calumen II

File Standard Configuration Glass Mode Help Information

Results

EN410-2011 ISO9050 m1.5-2003

Luminous factors

TL % **81**

RLe % **12** RL % **13**

Energy factors

TE % **64** Tuv % **42**

REe % **20** REI % **20**

AE1 % **6** AE2 % **9**

Solar factors

g **0.73** SC **0.83**

Thermal transmission - EN673-2011

α^* **0**

Ug W/(m².K) **1.2**

Reset Results preview Compute Save Out Send

Glazing 1 Laminated glazing

Coating side 1 Substrate 1 **4** Coating side 2

PLANNICLEAR

Cavity 1

Gas **16** Argon 90%

Glazing 2 Laminated glazing

Coating side 3 Substrate 2 **4** Coating side 4

PLANTHERM TOTAL+ PLANNICLEAR

Select glazing

Composition

Single glazing Double glazing Triple glazing

Functions

Low-E Solar control

Self-cleaning Anti-reflective

Protect Silence

Information

Burglar res. EN356: NPJ

Acoustics certified values

TL: **81 %**

TE: **64 %**

Rw(C,Ctr) = 30(-1;-3) dB

Re: **12 %**

Ree: **20 %**

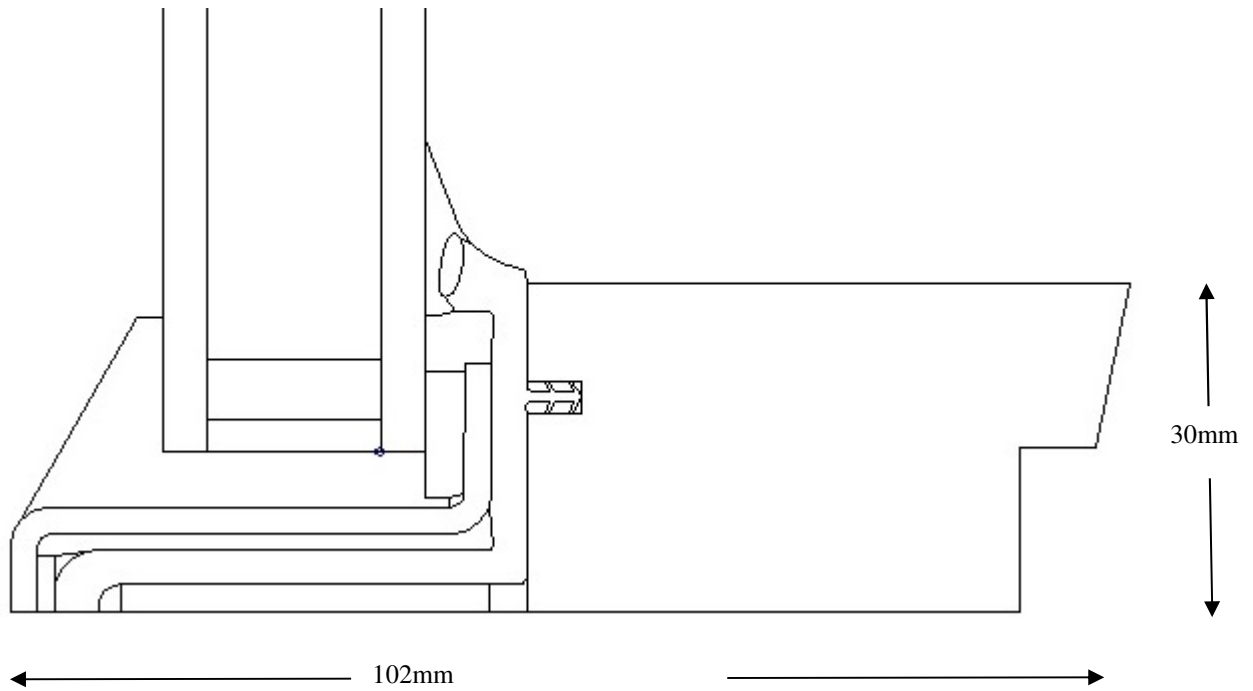
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Appendix

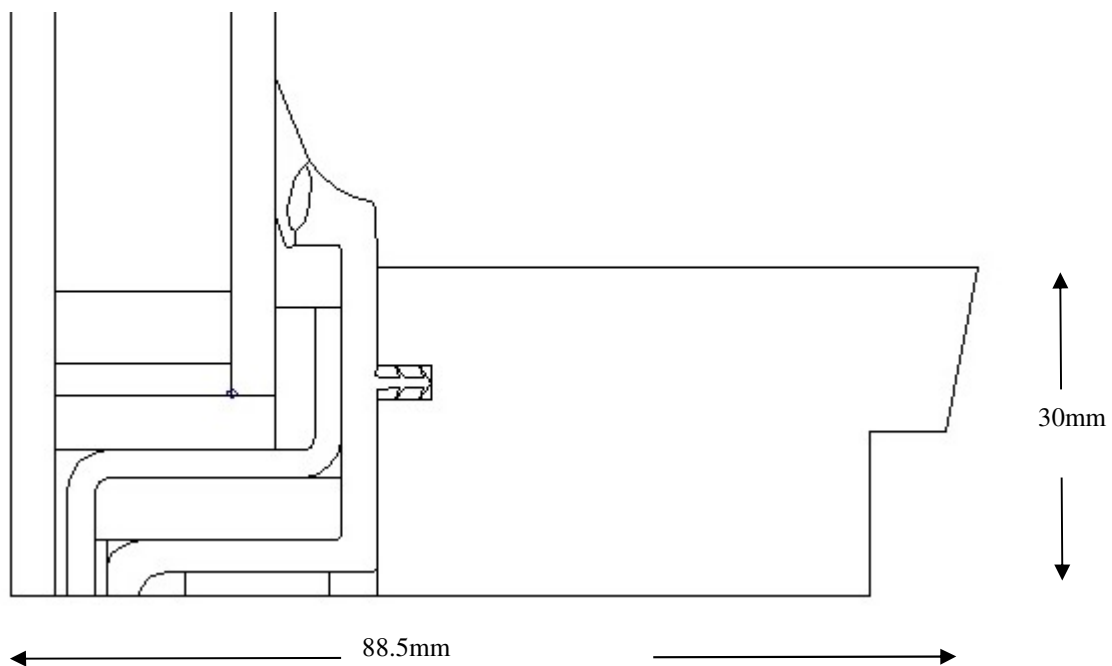
Profile Drawings

(See Technical Specification for dimensions)

Head / Jamb



Cill Profile



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