

REPORT 29801/X/01
STEEL WINDOW ASSOCIATION
W40 WINDOW/DOOR SYSTEM
U-VALUE ASSESSMENT

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Steel Windows Association
The Building Centre
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This report comprises
10 pages of text
Plates 1 to 15
Appendix A of 1 page
Appendix B of 10 pages
Appendix C of 1 page
Appendix D of 1 page
Appendix E of 8 pages
Appendix F of 10 pages

For the attention of Mr Darren Joyce

26 October 2006

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CONSULTING ENGINEERS

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Instruction: Email from Darren Joyce of Steel Window Service and Supplies Limited, dated 7th June 2006, and further email dated 26th September 2006.

1. INTRODUCTION

This report describes an assessment of the whole window U-values of numerous variants of a W40 steel-framed window system, with various bead and glazing arrangements. Further analyses have been undertaken of certain variants of this system when used for steel doors.

This report summarises the findings of the assessment. A supplementary CD-ROM issued with this report contains the following additional information:

- copies of the frame profile drawings as supplied by the Steel Window Association, in AutoCAD 'DWG' format;
- copies of the drawings as tidied for the purpose of the analysis, in both AutoCAD 'DWG' and 'DXF' formats;
- copies of the simulation files used to determine the component U- and Ψ -values summarised in this report, in 'THM' format as used by the Therm software program;
- an installable copy of the Therm software;
- a copy of the spreadsheets used to process the Therm data and determine whole window U-values, in MS Excel 'XLS' format.

Further information relating to the assessment is given in Appendices A to E of this report, comprising:

- Appendix A contains a summary of the experience of the analyst;
- Appendix B contains copies of the frame profile drawings as supplied by Steel Window Association;
- Appendix C summarises the material thermal conductivity values used for the analysis;
- Appendix D summarises the boundary conditions assumed for the analysis;
- Appendix E summarises the bead and glazing options that have been analysed, and the results of the analyses for the windows;
- Appendix F summarises the bead and glazing options that have been analysed, and the results of the analyses for the doors.

2. THE ANALYSIS

2.1 Software

The analysis has been undertaken using the freely available software Therm, version 5.2. This software has been downloaded from the web-site of Lawrence Berkeley Laboratory:

<http://windows.lbl.gov/software/therm/therm.html>

This software has been satisfactorily validated against the benchmarks contained in Annex D of the European Standard BS EN ISO 10077-2:2003.

2.2 Method

The analysis has been performed following the guidelines given in BS EN ISO 10077-2 and BRE Report BR443 *Conventions for U-value Calculations* 2002. This method has been used to identify a characteristic U-value for each frame profile and a Ψ -value to account for the interaction with various glazing options.

This method of analysis is based on a two-dimensional cross-section through the window frame, and it is therefore necessary to make certain simplifications for the purpose of the analysis. These simplifications are described in section 2.5 below.

Generic values have been used for the thermal conductivity of each material. These are described in Appendix C of this report.

Boundary conditions and surface resistances have been used as defined in BS EN ISO 10077-2. These are summarised in Appendix D of this report. Note that surface heat transfer coefficients have been defined so as to give the correct surface resistance.

The method also complies with the recommendations given in GGF Glazing Manual Section 2 Part 2.2 *Window and Door System U-values: Provision of Certified Data* (March 2002 edition). The component U- and Ψ -values have been used to calculate overall U-values for the domestic and commercial styles of window defined by the GGF, and for single and double door variants.

2.3 Glazing and Beads

Numerous glazing options have been considered. There are three bead types - aluminium, stainless steel and GRP, and the same frame profiles and overall dimensions have been used throughout. The glazing typically comprises either double glazing, with both aluminium and warm edge glazing spacers, or triple glazing with aluminium glazing spacers.

In the case of the triple glazing the units are always 4/6/4/6/4 mm units, with different coating/gas fill options to give centre-pane U-values of 0.9 or 0.8 W/m²K. For the double glazing various combinations of glass thickness are used (4 and 6 mm monolithic, 6.4 mm laminated) with various cavity widths (12, 14, 16 and 18 mm) and gas fills, to give centre-pane U-values of either 1.1 or 1.0 W/m²K.

In the case of the warm edge glazing spacer an Edgetech SuperSpacer has been assumed, this being a foam rubber spacer with an aluminium/mylar film vapour seal.

For the doors two additional types of infill have been considered, a 35 mm thin panel, with a centre-panel U-value of 0.75 W/m²K, and a 78 mm thick panel with a centre-panel U-value of 0.35 W/m²K.

2.4 Whole-Window and Door U-values

For the purpose of demonstrating compliance with the Building Regulations for England and Wales Approved Documents L1 and L2 the frame characteristic U-values and Ψ -values have been used to calculate whole-window and whole-door U-values.

The whole window U-values are based on the window styles defined in GGF Glazing Manual Section 2 Part 2.2. The first style comprises an opening light and fixed light side-by-side with a dividing mullion, and is referred to here as the 'Domestic' style. The second style comprises a single full-size opening light, and is referred to here as the 'Commercial' style. Both of the reference windows are taken as 1230 mm wide by 1480 mm high.

The whole door U-values are also based on the sizes given in the GGF Glazing Manual, these being a 1000 mm wide by 2000 mm high single door, or a 2000 mm wide by 2000 mm high double door with a central meeting stile.

2.5 Assumptions Made for the Purpose of Simplifying the Analysis

In order to permit the frame profiles to be analysed using two-dimensional methods certain simplifications are made:

- Curved elements are represented as a set of straight lines (facets). As a general rule curves are broken down into at least three facets per 90 degrees of arc;
- The clips or screws which are used to secure the glazing beads have been ignored, since these are highly localised and do not significantly affect the heat loss through the frame;
- Fixing straps are neglected as these are also intermittent and are fixed to the window/door reveal on the warm side of the window/door frame;
- All components are assumed to be in perfect thermal contact, to ensure that the predicted heat loss is maximised;
- The whole internal metal surface of the frames is assumed to be exposed to the room air, thereby maximising the potential for heat loss.

2.6 Reporting Accuracy

It is conventional to report U-values to one decimal place (i.e. to the nearest 0.1 W/m²K) and Ψ -values to two places. However, to ensure that whole window/door U-values are as accurate as possible no 'rounding off' of component U- and Ψ -values is undertaken until after whole window/door U-values have been calculated.

2.7 Analysis Accuracy

Measurement and simulation results are generally considered accurate to within 5%; round-robin testing or analysis of the same product by different assessors working to the same standard results in a set of reported U-values which are within a range of +/- 5%.

Simulation results such as those described in this report are generally based on generic (high) values for material properties and the assumption that components are in perfect thermal contact, which tends to generate U-values which are at the upper end of the error band.

A window which has a true U-value of, say, 2.2 W/m²K, could be determined by measurement to have a U-value of 2.1 W/m²K (an error of -5%) and by simulation to have a U-value of 2.3 W/m²K (an error of +5%). These values are both correct within the bounds of the expected experimental/simulation errors.

3. ANALYSIS RESULTS - WINDOWS

For each glazing/bead option three simulations have been prepared, one for a fixed light perimeter frame, one for an opening light perimeter frame and one for a dividing mullion between a fixed light and an opening light. Typical examples of these frames as analysed are shown in Plates 1 to 3 for a conventional glazing spacer in a double glazed unit (examples shown are with an aluminium glazing bead), Plates 4 to 6 for a warm edge spacer in a double glazed unit (examples shown are with a stainless steel glazing bead), and Plates 7 to 9 for a triple glazed arrangement (examples shown are with a GRP glazing bead).

For each of the frame/glazing combinations two simulations have been performed - one with the glazing replaced with a sheet of insulation material of the same thickness (to determine the characteristic frame U-value) and one with the relevant glazing type (to determine the Ψ -value for the frame-glazing combination).

In each case the void between the perimeter frame and the window reveal is assumed to be filled with a polyurethane or similar expanding foam product.

The results are summarised in Appendix E of this report. In the following sections these results are summarised for each bead type. Where the ‘option’ column contains two numbers, the first of these relates to the ‘Domestic’ window style, and the second relates to the ‘Commercial’ window style - the same opening light framing profile and glazing is used for both styles of window. The whole window U-values are given as both rounded and (in brackets) exact values:

3.1 Aluminium Bead

Option	Glazing		Domestic	Commercial
	Configuration	U-value [W/m ² K]	U-value [W/m ² K]	U-value [W/m ² K]
1	4/16/4 aluminium spacer	1.1	2.3 (2.301)	2.1 (2.088)
62	4/16/4 warm edge spacer	1.1	2.2 (2.238)	2.0 (2.0497)
2	6/12/6 aluminium spacer	1.1	2.4 (2.357)	2.1 (2.125)
63	6/12/6 warm edge spacer	1.1	2.3 (2.286)	2.1 (2.081)
3	6.4/14/4 aluminium spacer	1.1	2.3 (2.309)	2.1 (2.092)
64	6.4/14/4 warm edge spacer	1.1	2.2 (2.246)	2.1 (2.053)
4	6.4/12/6.4 aluminium spacer	1.1	2.4 (2.363)	2.1 (2.129)
65	6.4/12/6.4 warm edge spacer	1.1	2.3 (2.291)	2.1 (2.085)
5 & 33	6/12/6 aluminium spacer	1.0	2.3 (2.288)	2.0 (2.0498)
6 & 34	6/12/6 warm edge spacer	1.0	2.2 (2.216)	2.0 (2.005)
7 & 35	4/6/4/6/4 aluminium spacer	0.9	2.1 (2.147)	1.9 (1.928)
8 & 36	4/6/4/6/4 aluminium spacer	0.8	2.1 (2.074)	1.8 (1.84998)

Typical frame details using the aluminium bead are illustrated in Plates 1 to 3.

3.2 Stainless Steel Bead

Option	Glazing		Domestic	Commercial
	Configuration	U-value [W/m ² K]	U-value [W/m ² K]	U-value [W/m ² K]
9 & 37	4/16/4 aluminium spacer	1.1	2.3 (2.275)	2.1 (2.067)
61	as 9 & 37 but reversed	1.1	2.3 (2.265)	2.1 (2.059)
10 & 38	6/12/6 aluminium spacer	1.1	2.3 (2.330)	2.1 (2.106)
11 & 39	6.4/14/4 aluminium spacer	1.1	2.3 (2.284)	2.1 (2.074)
12 & 40	6.4/12/6.4 aluminium spacer	1.1	2.3 (2.333)	2.1 (2.106)
13 & 41	4/18/4 aluminium spacer	1.1	2.3 (2.269)	2.1 (2.062)
14 & 42	6/14/6 aluminium spacer	1.1	2.3 (2.327)	2.1 (2.103)
15 & 43	6.4/16/4 aluminium spacer	1.1	2.3 (2.280)	2.1 (2.071)
16 & 44	6.4/14/6.4 aluminium spacer	1.1	2.3 (2.332)	2.1 (2.108)
17 & 45	6/12/6 aluminium spacer	1.0	2.3 (2.262)	2.0 (2.031)
18 & 46	6/12/6 warm edge spacer	1.0	2.2 (2.170)	2.0 (1.972)
19 & 47	4/6/4/6/4 aluminium spacer	0.9	2.1 (2.119)	1.9 (1.908)
20 & 48	4/6/4/6/4 aluminium spacer	0.8	2.0 (2.047)	1.8 (1.830)

Option 61 is a repeat of options 9/37, but with the window frames reversed so that the window is externally glazed. No changes have been made to the geometry of the frame profiles.

Typical frame details using the stainless steel bead are shown in Plates 4 to 6.

3.3 GRP Bead

Option	Glazing		Domestic	Commercial
	Configuration	U-value [W/m ² K]	U-value [W/m ² K]	U-value [W/m ² K]
21 & 49	4/16/4 aluminium spacer	1.1	2.2 (2.172)	2.0 (1.999)
22 & 50	6/12/6 aluminium spacer	1.1	2.2 (2.219)	2.0 (2.027)
23 & 51	6.4/14/4 aluminium spacer	1.1	2.2 (2.180)	2.0 (2.003)
24 & 52	6.4/12/6.4 aluminium spacer	1.1	2.2 (2.227)	2.0 (2.035)
25 & 53	4/18/4 aluminium spacer	1.1	2.2 (2.178)	2.0 (2.003)
26 & 54	6/14/6 aluminium spacer	1.1	2.2 (2.226)	2.0 (2.034)
27 & 55	6.4/16/4 aluminium spacer	1.1	2.2 (2.187)	2.0 (2.008)
28 & 56	6.4/14/6.4 aluminium spacer	1.1	2.2 (2.232)	2.0 (2.038)
29 & 57	6/12/6 aluminium spacer	1.0	2.1 (2.14995)	2.0 (1.951)
30 & 58	6/12/6 warm edge spacer	1.0	2.0 (2.007)	1.9 (1.861)
31 & 59	4/6/4/6/4 aluminium spacer	0.9	2.0 (2.003)	1.8 (1.828)
32 & 60	4/6/4/6/4 aluminium spacer	0.8	1.9 (1.929)	1.7 (1.749)

Typical frame details using the GRP bead are shown in Plates 7 to 9.

4. ANALYSIS RESULTS - DOORS

Only one glazing bead type has been considered - an internally glazed aluminium bead. Four main glazing types have been considered - 6/12/6, 6.4/14/4 and 6.4/12/6.4 mm double glazing, and 4/6/4/6/4 mm triple glazing. A range of centre-glazing U-values have been considered, with either a traditional aluminium glazing spacer, or a warm edge glazing spacer (Edgetech SuperSpacer). Three insulating panel infills have also been considered.

Each door has a lock plate arrangement to which the locking hardware is fixed. For a double door this leads to four frame types to be analysed; opening frame with infill, meeting stile with infill both sides, meeting stile with infill one side and lock plate to the other, and dividing frame with infill to one side and lock plate to the other.

In the case of the first type of thin insulated infill panel the inner and outer skins of the infill may or may not be in contact, and so three variants have been considered - one with full contact, one with a 1 mm gap and one with a 3 mm gap between the skins. The same variants have not been applied to the lock plate (which is of the same construction as the thin infill panel) because the lock plate is very small in area and does not have a significant effect on the overall U-value of the door. It is also noted that both thin infill panels and the lock plate do not require the use of a glazing bead, and so the projected widths of the frames (as viewed internally) are less for these items.

Typical examples of the various frame/glazing/infill types as analysed are shown in Plates 10 to 15.

For each of the frame/glazing combinations two simulations have been performed - one with the glazing replaced with a sheet of insulation material of the same thickness (to determine the characteristic frame U-value) and one with the relevant glazing/infill type (to determine the Ψ -value for the frame-glazing combination).

In each case the void between the perimeter frame and the window/door reveal is assumed to be filled with a polyurethane or similar expanding foam product.

The results are summarised in Appendix F of this report. In the following sections these results are summarised for each bead type. Where the 'option' column contains two numbers, the first of these relates to the single door style, and the second relates to the double door style - the same framing profiles and glazing/infill are used for both styles of door. The whole door U-values are given as both rounded and (in brackets) exact values:

4.1 Double Glazing

Option	Glazing/Infill		Single	Double
	Configuration & Spacer	U-value [W/m ² K]	U-value [W/m ² K]	U-value [W/m ² K]
66 & 82	6/12/6 aluminium	1.2	2.4 (2.353)	2.2 (2.201)
67 & 83	6/12/6 warm edge	1.2	2.3 (2.306)	2.2 (2.157)
68 & 84	6/12/6 aluminium	1.1	2.3 (2.281)	2.1 (2.125)
69 & 85	6/12/6 warm edge	1.1	2.2 (2.232)	2.1 (2.079)
70 & 86	6/12/6 aluminium	1.0	2.2 (2.208)	2.0 (2.049)
71 & 87	6/12/6 warm edge	1.0	2.2 (2.159)	2.0 (2.003)
72 & 88	6.4/14/4 aluminium	1.1	2.2 (2.245)	2.1 (2.092)
73 & 89	6.4/14/4 warm edge	1.1	2.2 (2.202)	2.1 (2.050)
74 & 90	6.4/12/6.4 aluminium	1.2	2.4 (2.358)	2.2 (2.205)
75 & 91	6.4/12/6.4 warm edge	1.2	2.3 (2.310)	2.2 (2.160)
76 & 92	6.4/12/6.4 aluminium	1.1	2.3 (2.286)	2.1 (2.130)
77 & 93	6.4/12/6.4 warm edge	1.1	2.2 (2.237)	2.1 (2.084)

4.2 Triple Glazed

Option	Glazing		Single	Double
	Configuration	U-value [W/m ² K]	U-value [W/m ² K]	U-value [W/m ² K]
78 & 94	4/6/4/6/4 aluminium	0.9	2.1 (2.085)	1.9 (1.925)
79 & 95	4/6/4/6/4 aluminium	0.8	2.0 (2.010)	1.8 (1.846)

4.3 Infill Panels

Option	Glazing		Single	Double
	Configuration	U-value [W/m ² K]	U-value [W/m ² K]	U-value [W/m ² K]
80 & 96	35 mm, skins no gap	0.75	2.8 (2.761)	2.6 (2.564)
80 & 96	35 mm, skins 1 mm gap	0.75	2.7 (2.716)	2.5 (2.520)
80 & 96	35 mm, skins 3 mm gap	0.75	2.7 (2.676)	2.5 (2.481)
81 & 97	78 mm panel	0.35	1.8 (1.798)	1.6 (1.613)
98 & 99	35 mm panel type 2	0.75	2.0 (2.006)	1.8 (1.838)

5. SUMMARY

Whole-window U-values have been calculated for 33 different frame and glazing combinations. The results vary from 1.9 to 2.4 W/m²K for a 'Domestic' window style, and from 1.7 to 2.1 W/m²K for a 'Commercial' window style.

Whole-door U-values have been calculated for 16 different frame and infill combinations. the results vary from 1.8 to 2.8 W/m²K for a single door, and from 1.6 to 2.6 W/m²K for a double door.

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for Sandberg LLP

For the attention of Mr Darren Joyce

Dr R M Harris

File reference: 29801x01_rmh_rep.wpd

26 October 2006

PLATES

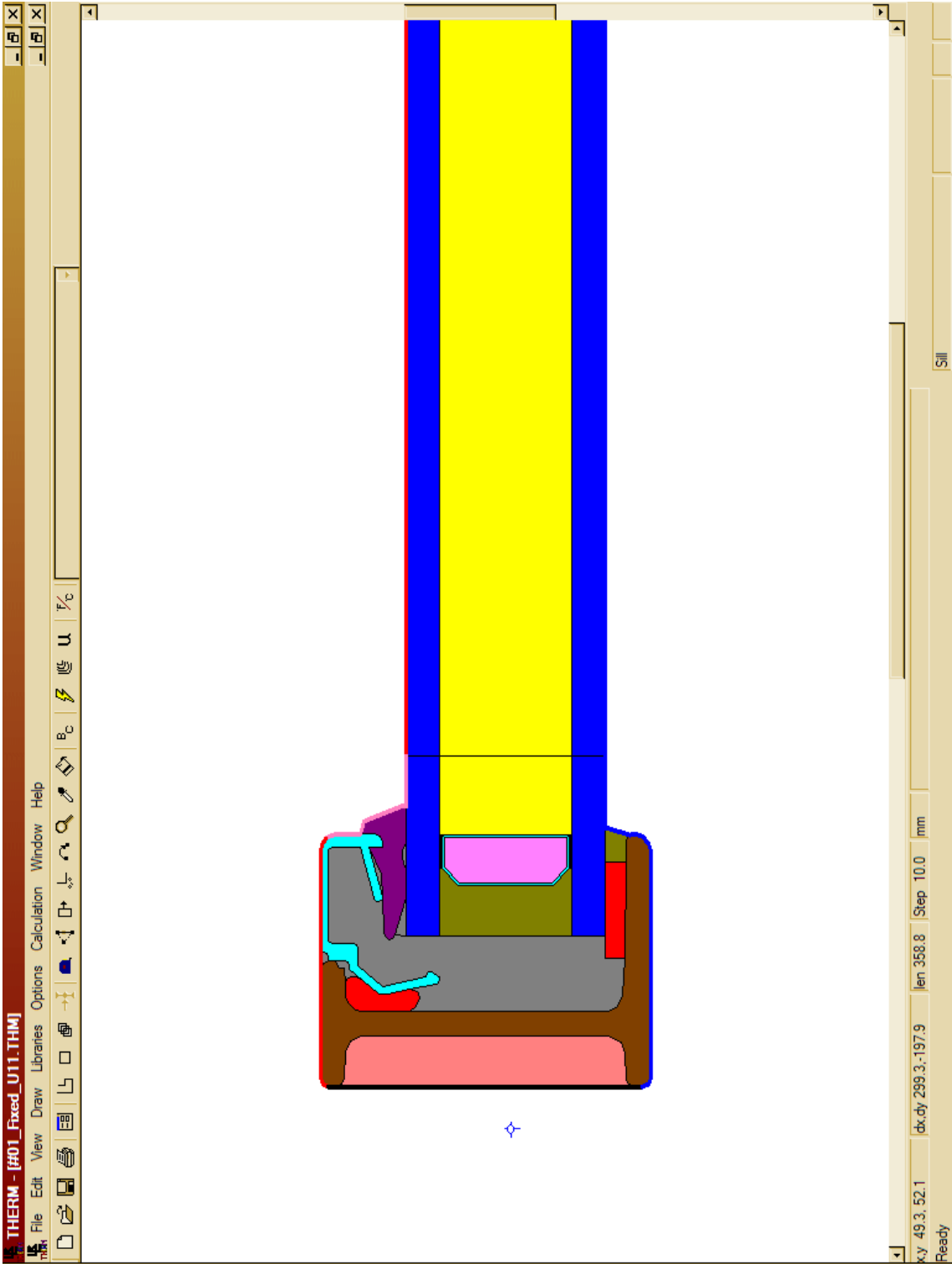


Plate 1 Fixed Perimeter Frame with Double Glazing and Aluminium Edge Spacer, as Analysed

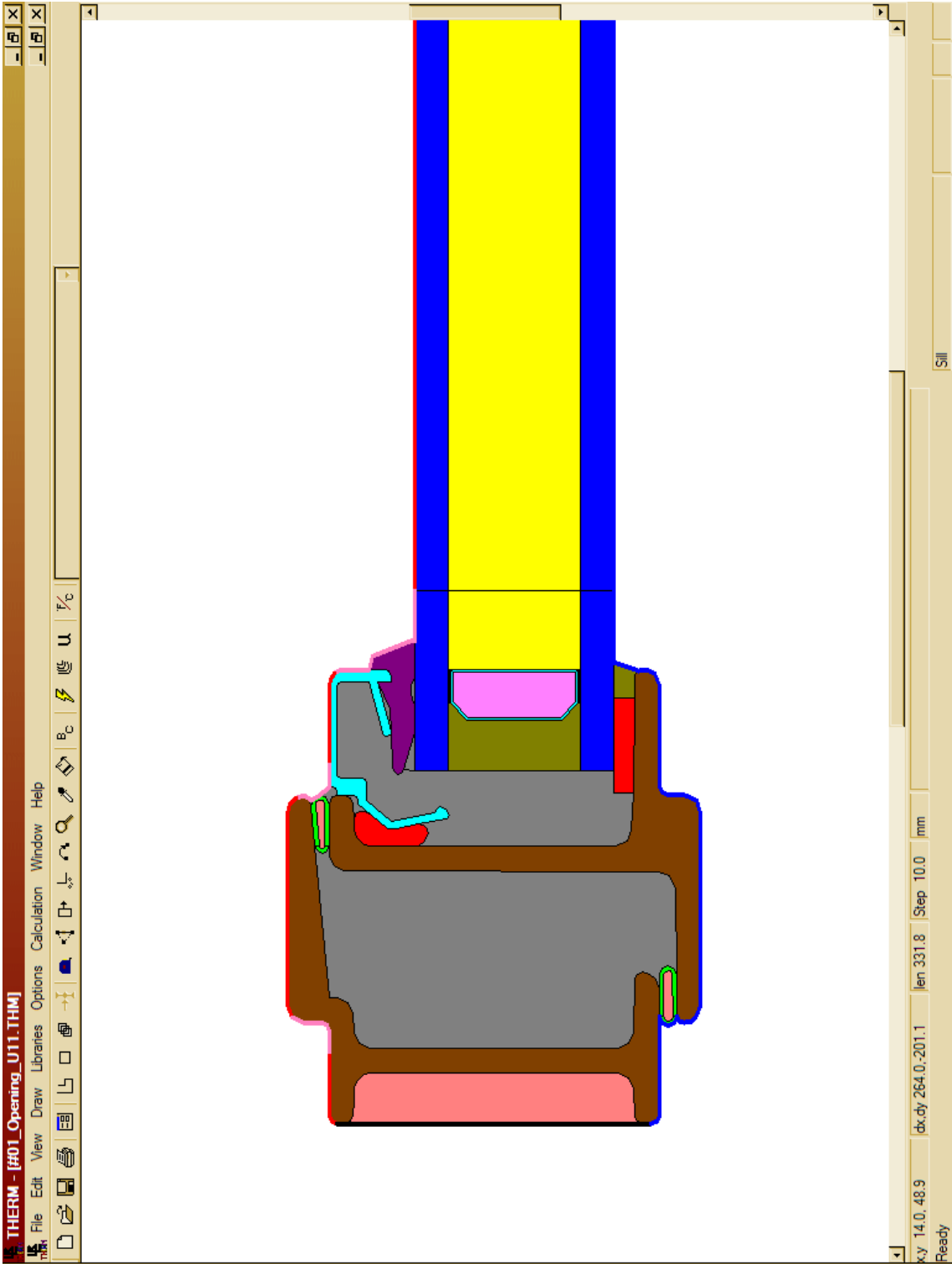


Plate 2 Opening Perimeter Frame with Double Glazing and Aluminium Edge Spacer, as Analysed

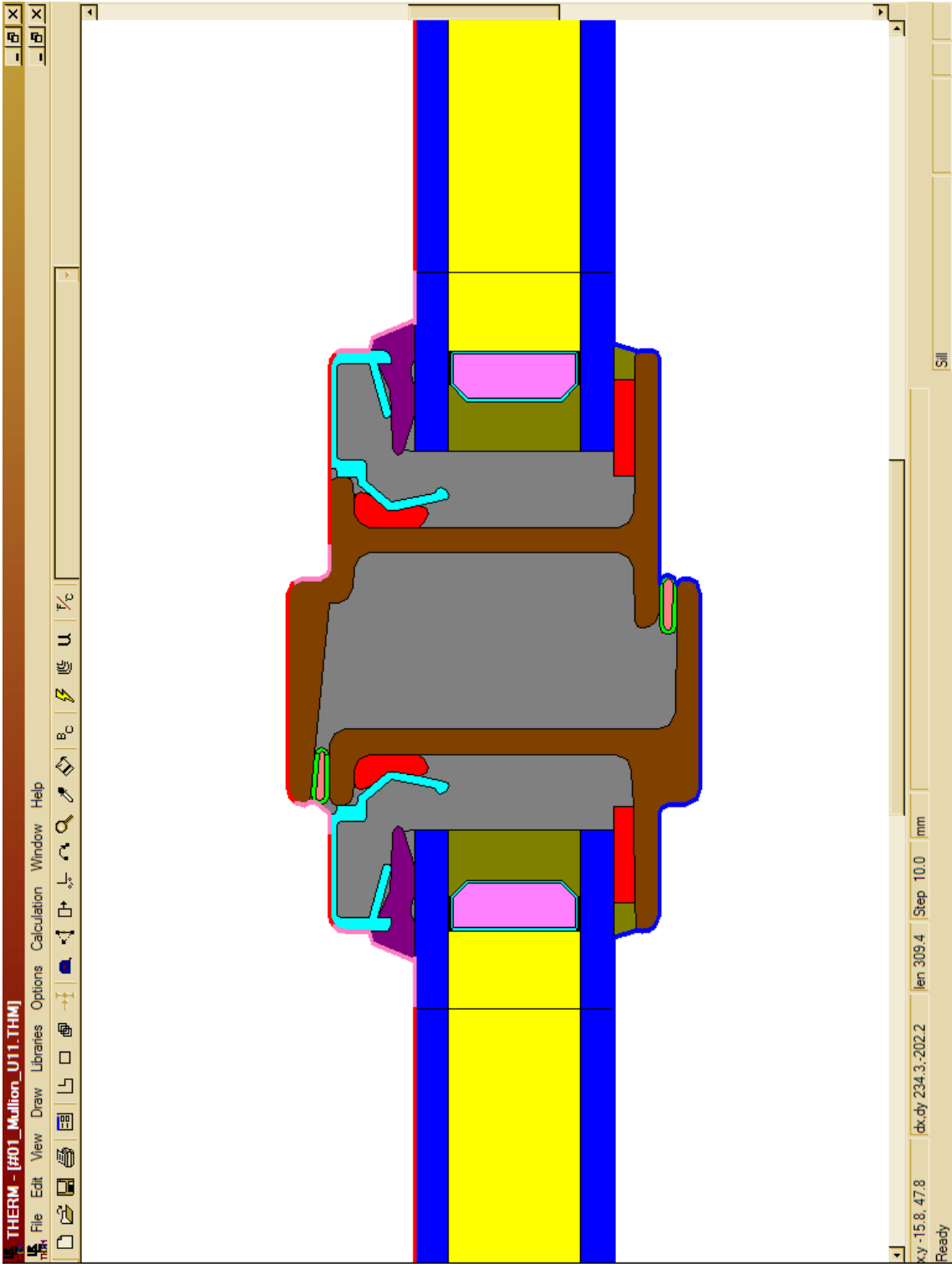


Plate 3 Mullion Frame with Double Glazing and Aluminium Edge Spacer, as Analysed

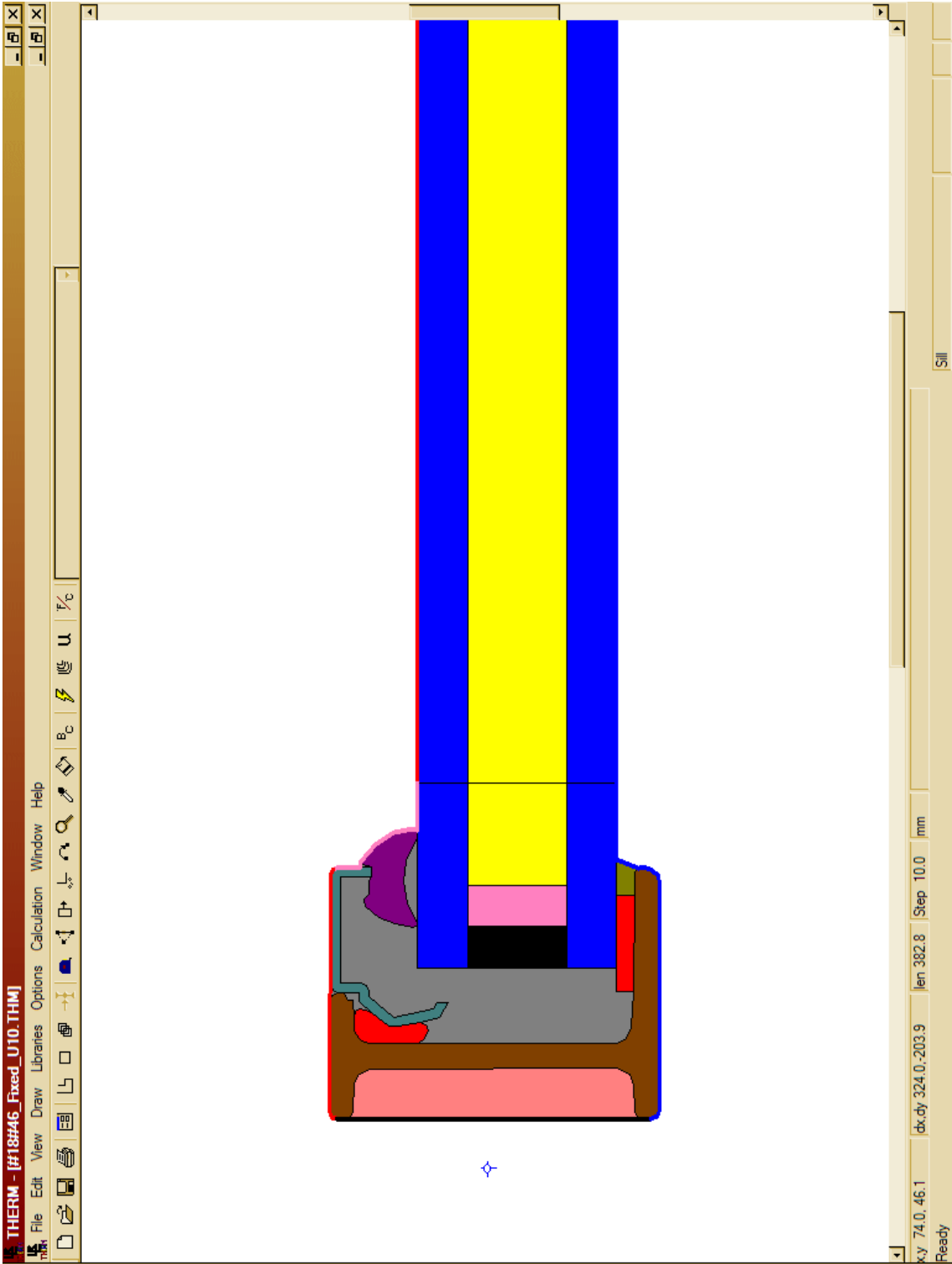


Plate 4 Fixed Perimeter Frame with Double Glazing and Warm Edge Glazing Spacer, as Analysed

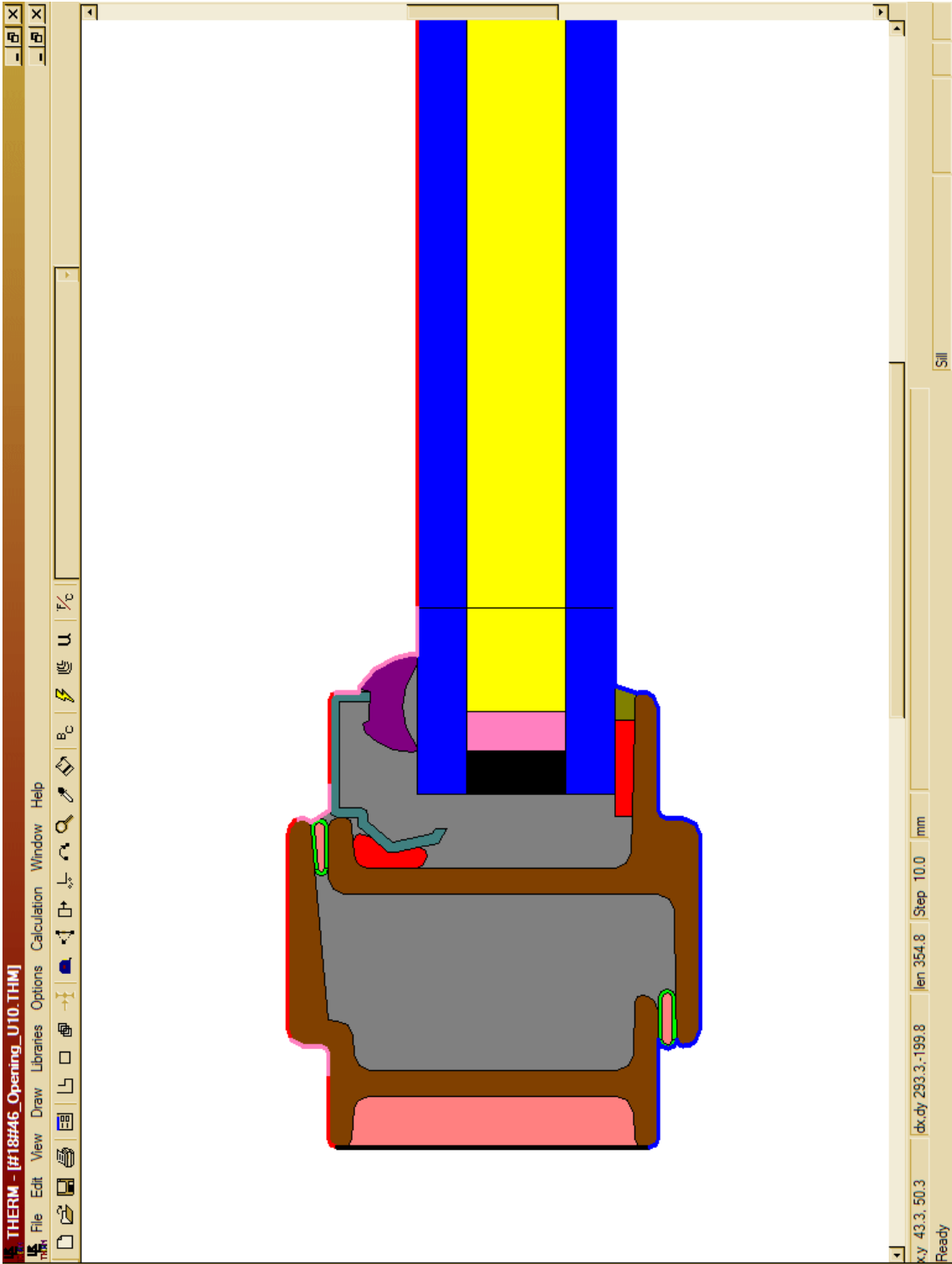


Plate 5 Opening Perimeter Frame with Double Glazing and Warm Edge Glazing Spacer, as Analysed

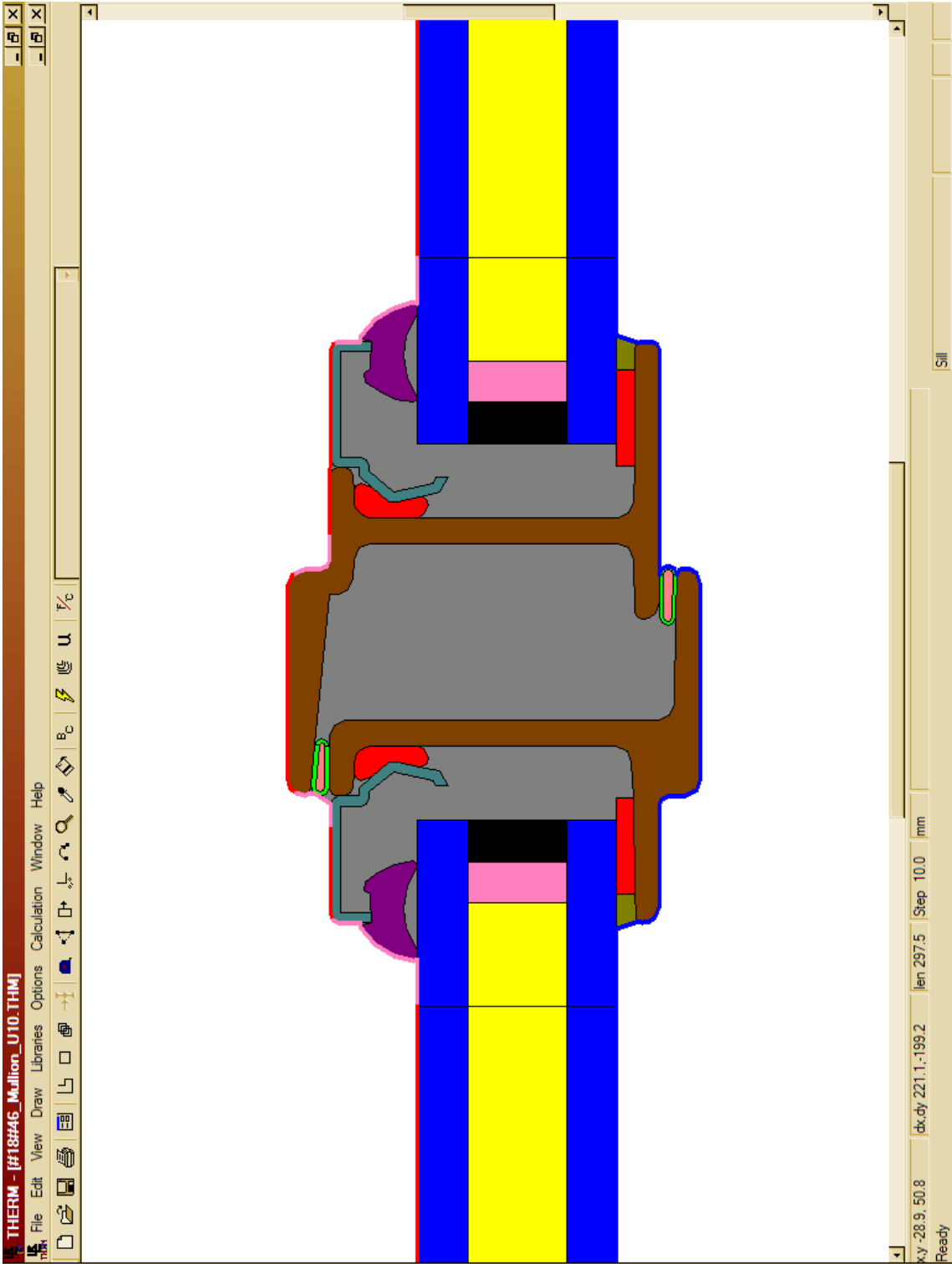


Plate 6 Mullion Frame with Double Glazing and Warm Edge Glazing Spacer, as Analysed

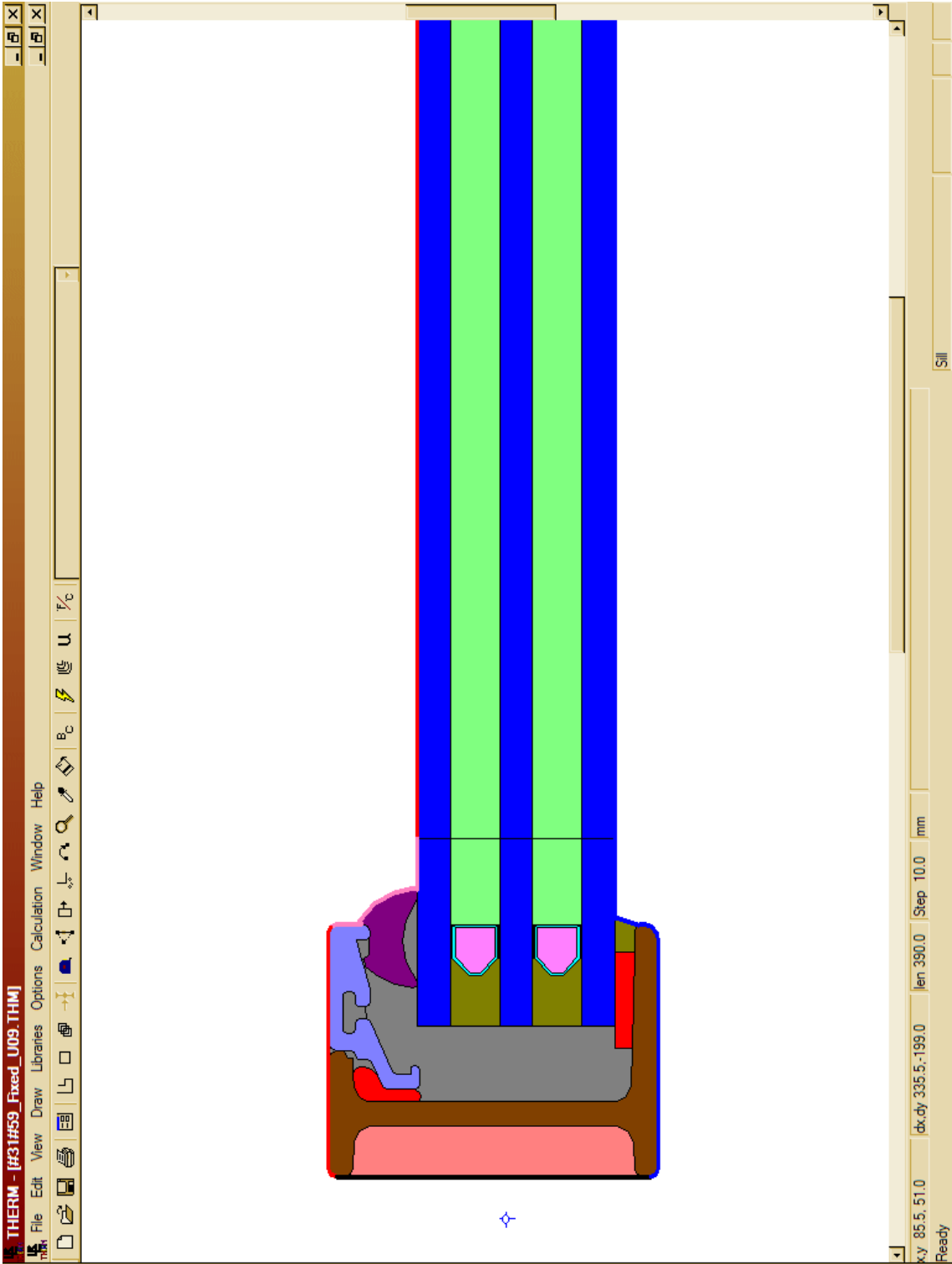


Plate 7 Fixed Perimeter Frame with Triple Glazing and Aluminium Edge Spacer, as Analysed

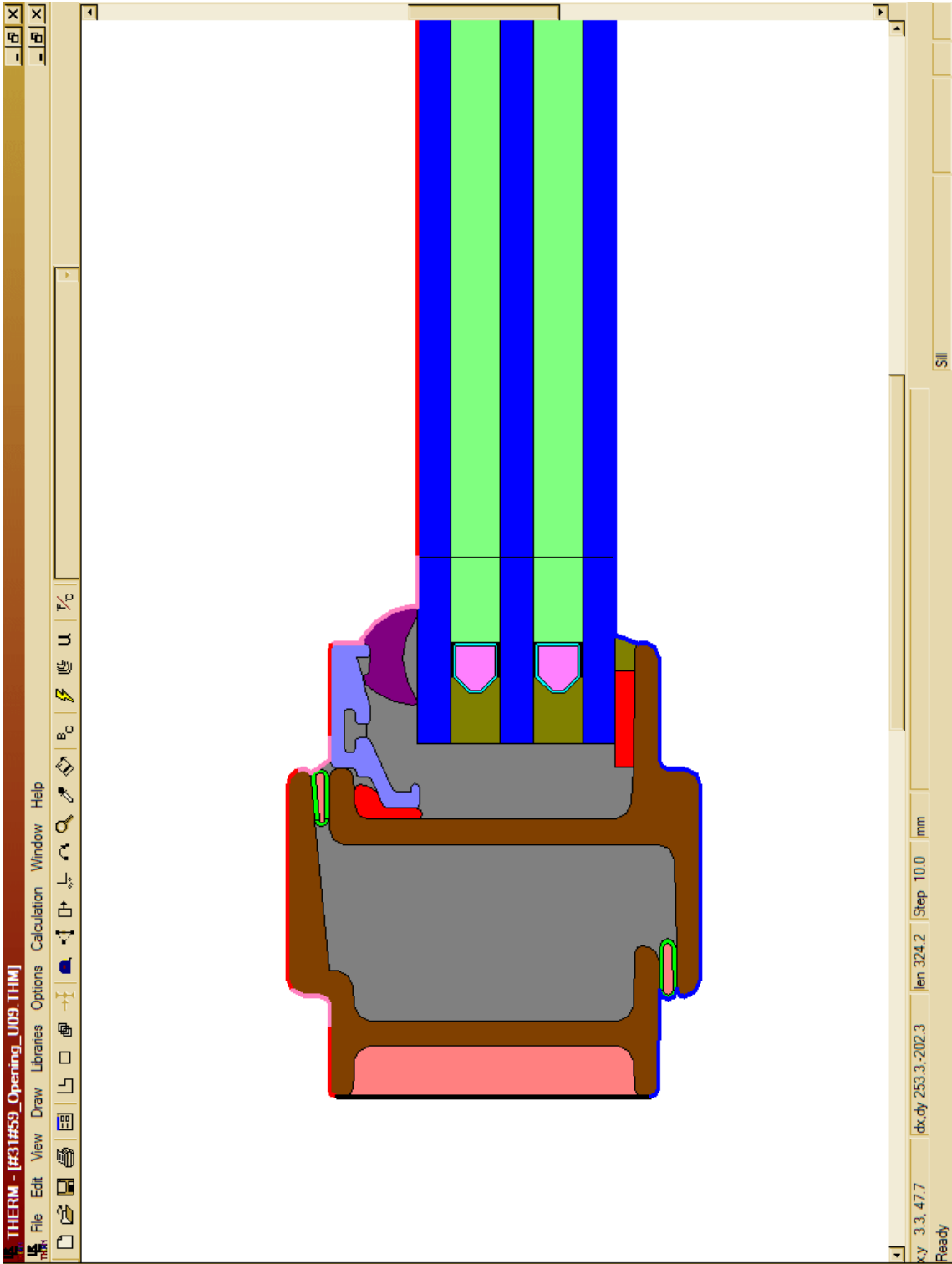


Plate 8 Opening Perimeter Frame with Triple Glazing and Aluminium Edge Spacer, as Analysed

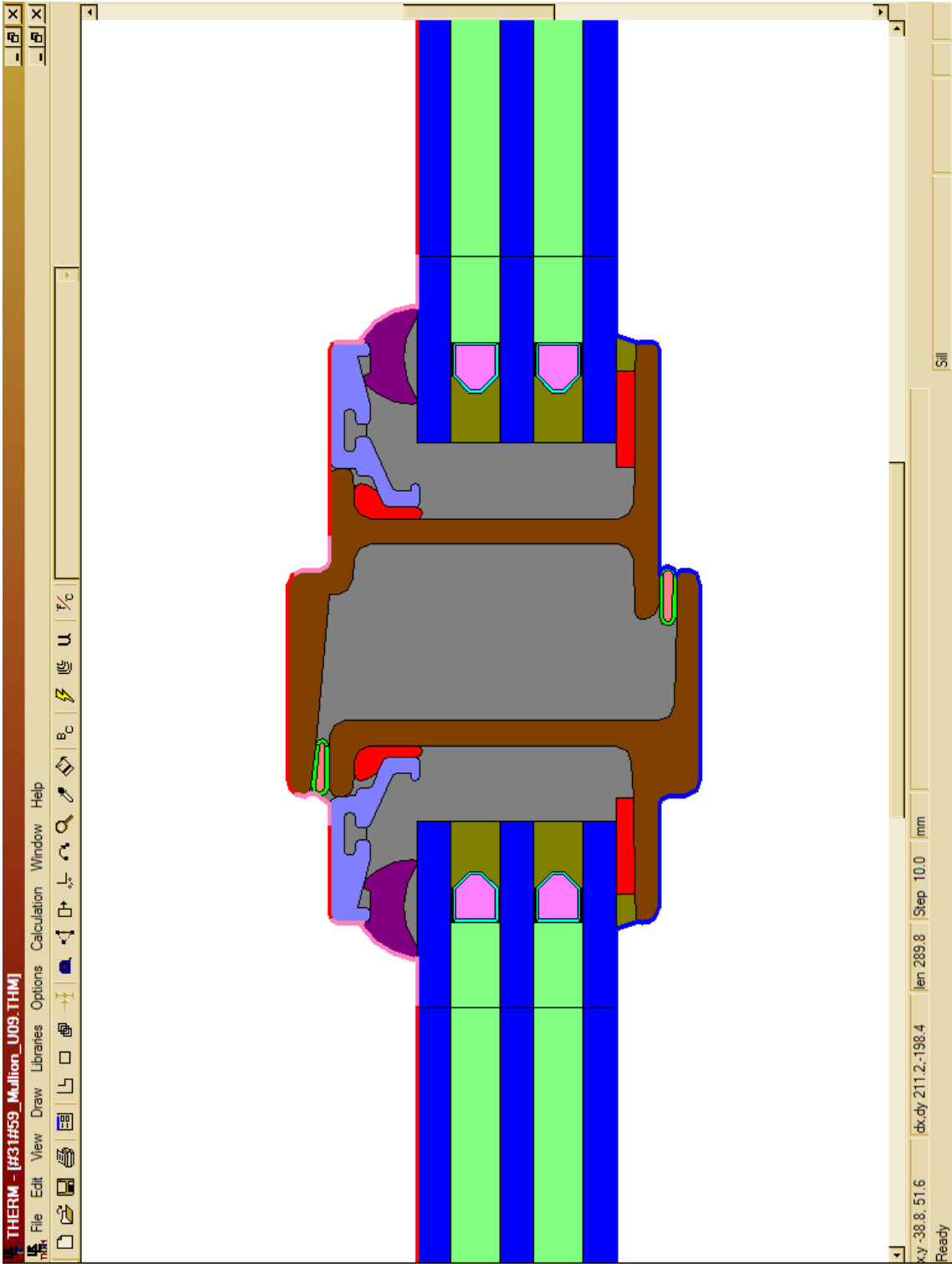


Plate 9 Mullion Frame with Triple Glazing and Aluminium Edge Spacer, as Analysed

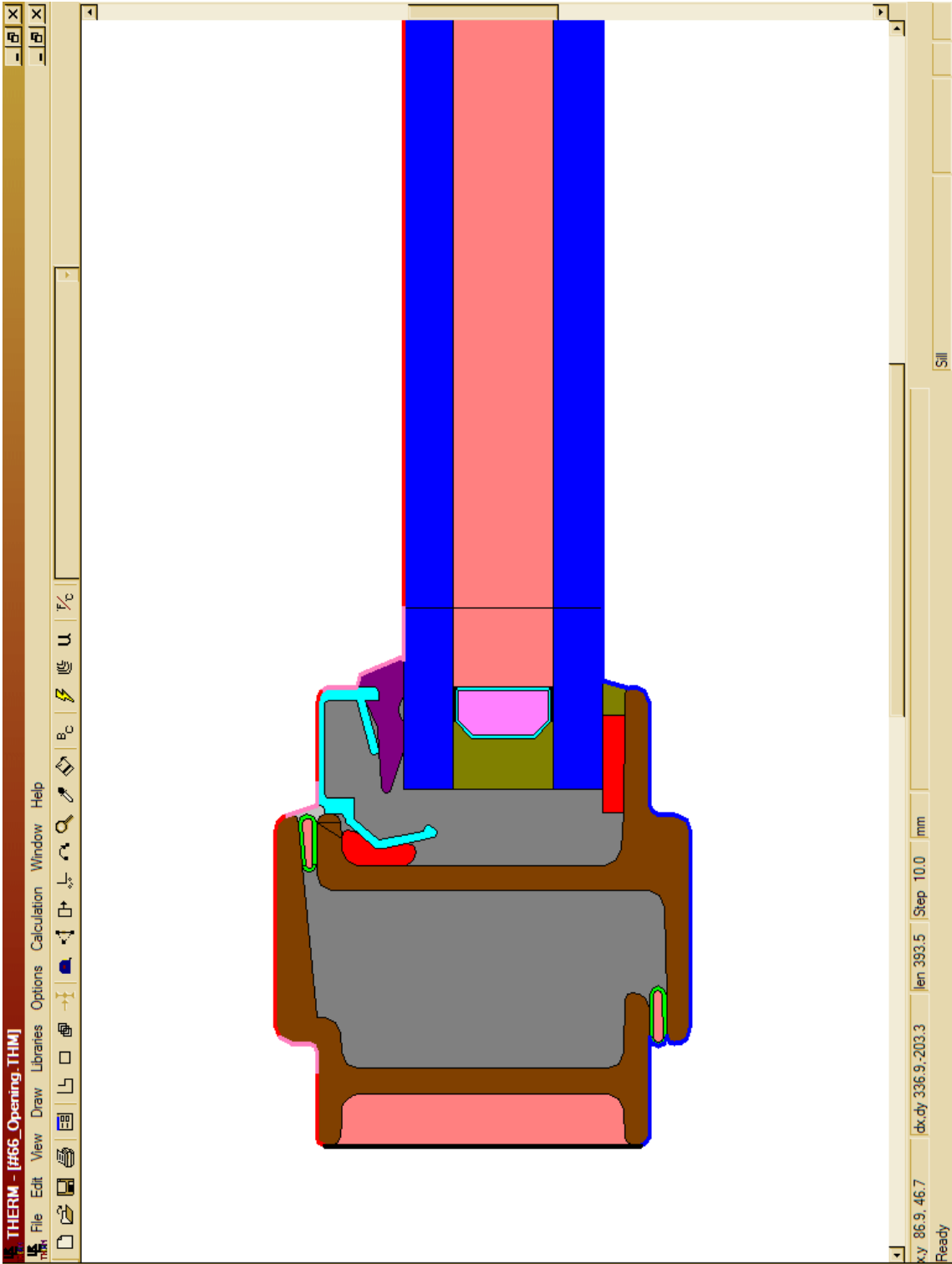


Plate 10 Opening Frame with Double Glazing and Aluminium Edge Spacer, as Analysed

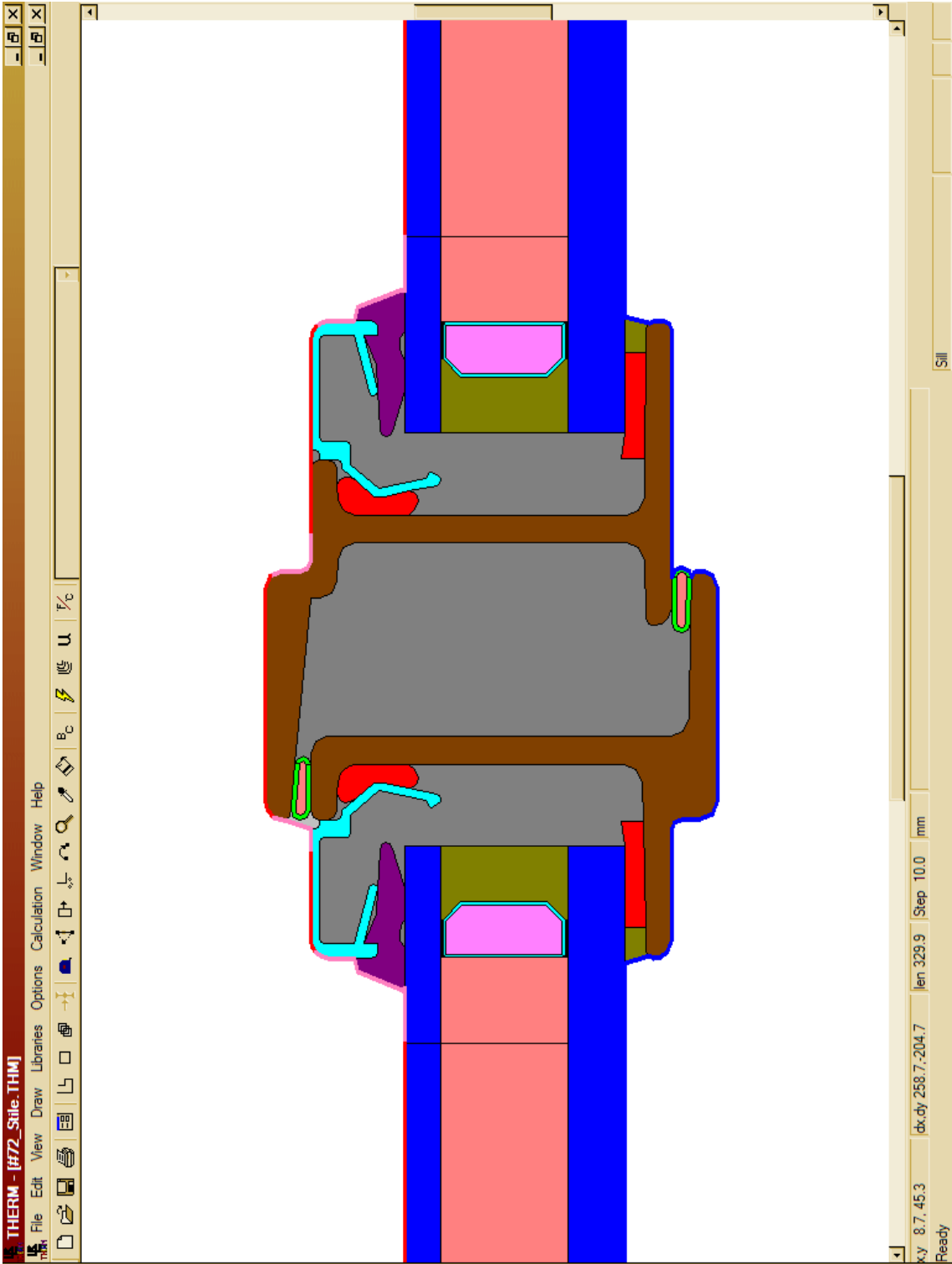


Plate 11 Meeting Stile Frame with Double Glazing Both Sides and Aluminium Edge Spacer, as Analysed

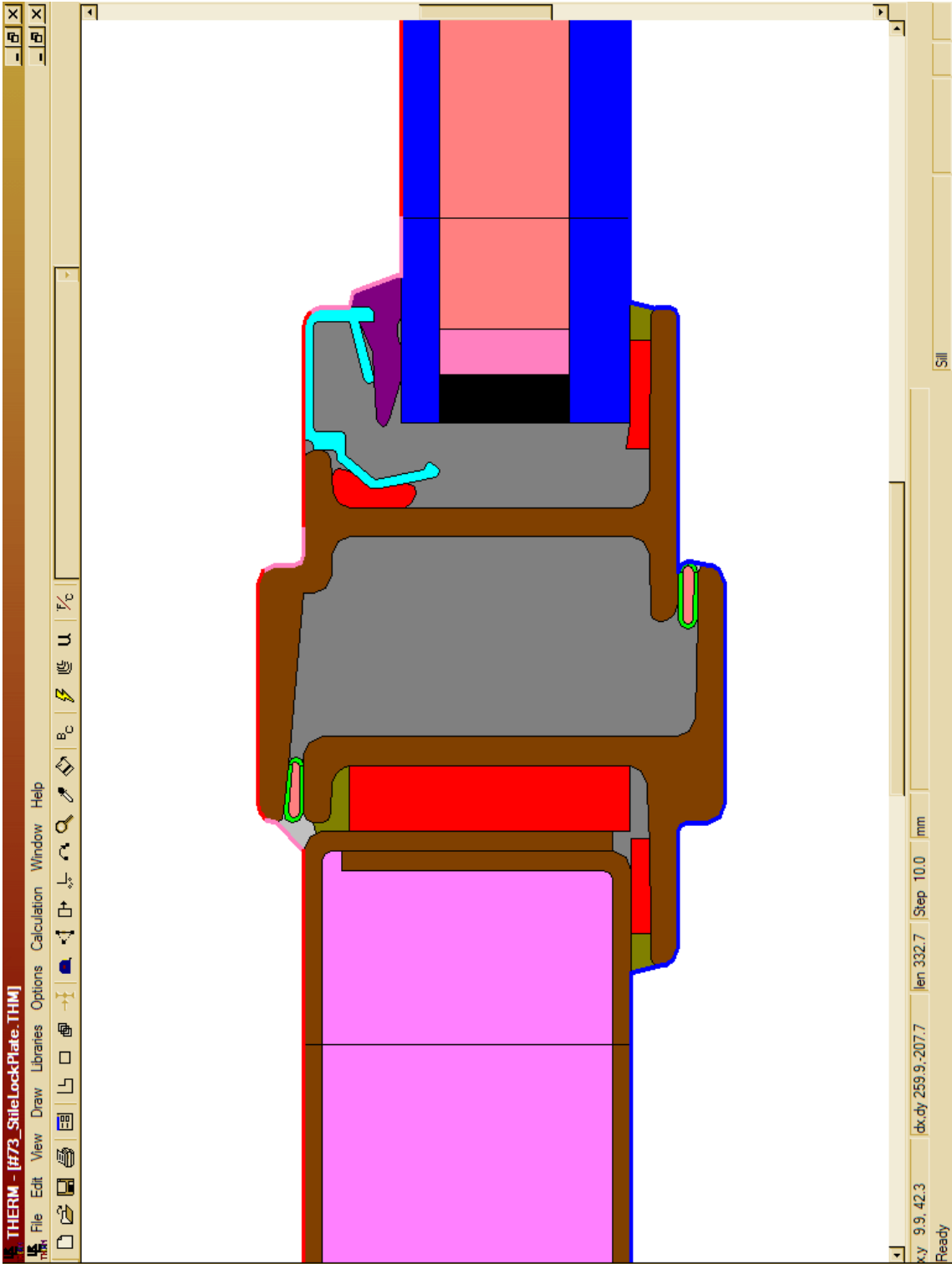


Plate 12 Meeting Stile Frame with Lock Plate One Side and Warm Edge Spacer, as Analysed

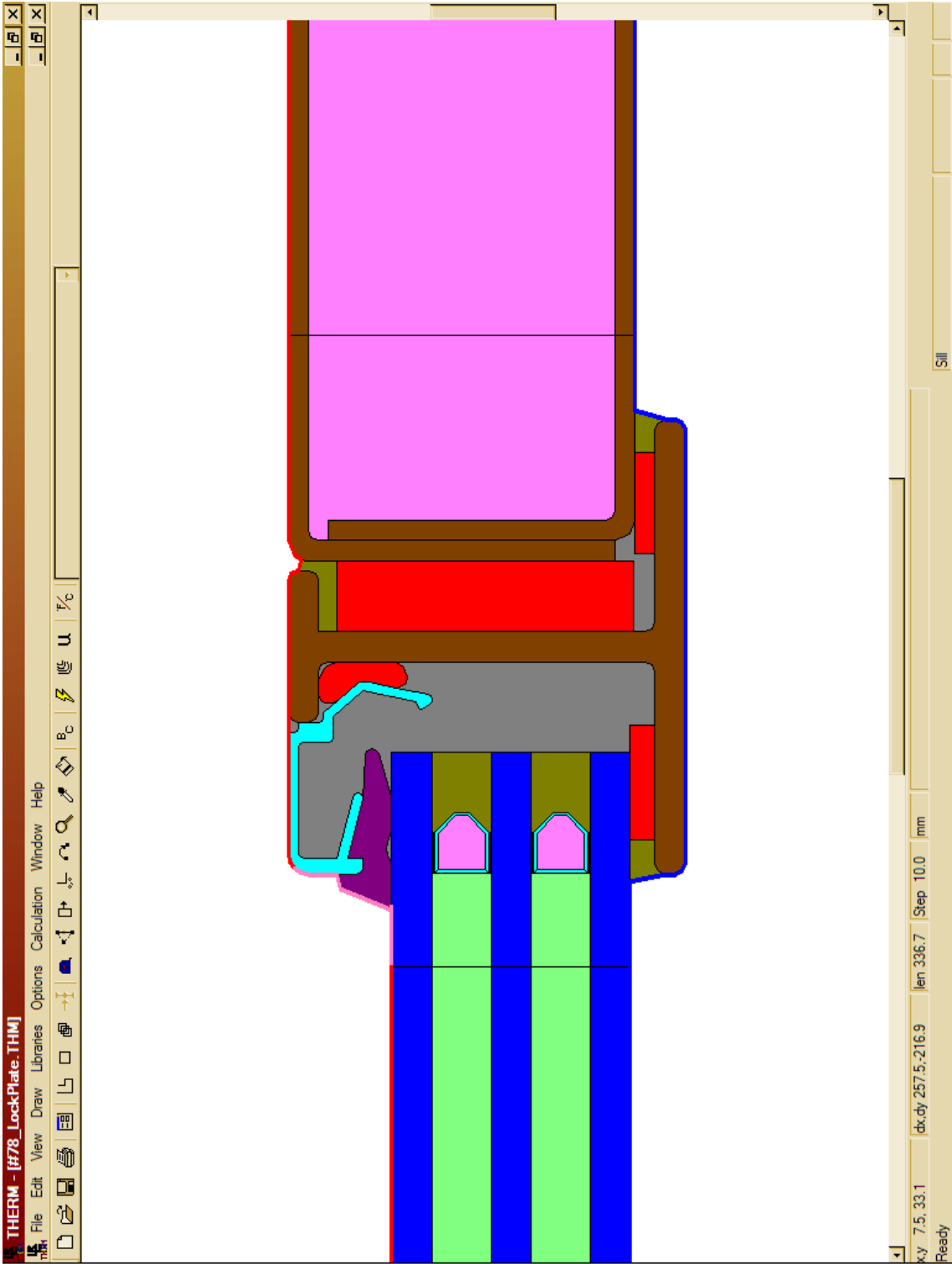


Plate 13 Lock Plate Divider Frame with Triple Glazing and Aluminium Edge Spacer, as Analysed

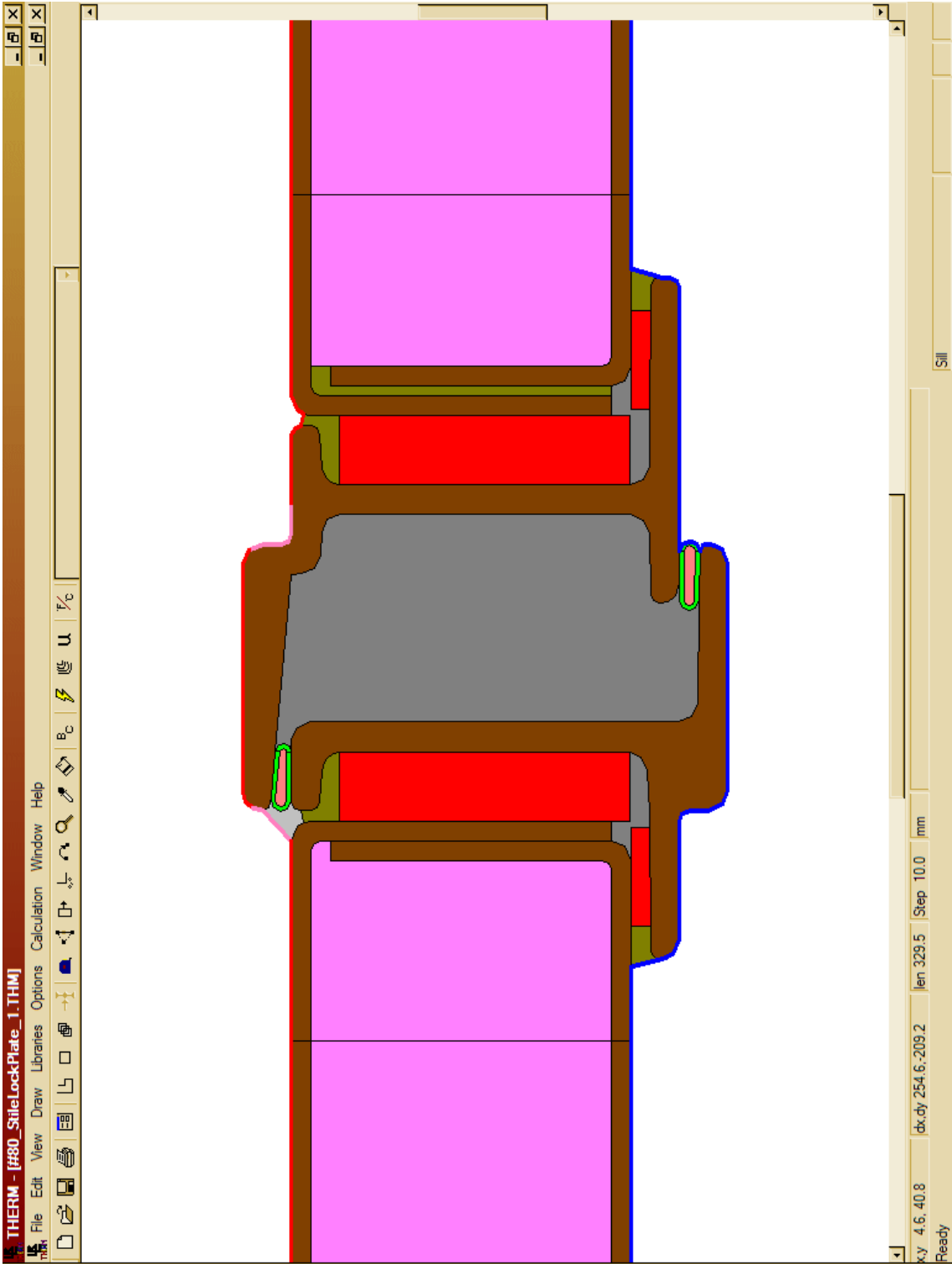


Plate 14 Meeting Stile Frame with Thin Infill Panel (1 mm Gap Between Skins at Edge) and Lock Plate (No Gap Between Skins), as Analysed

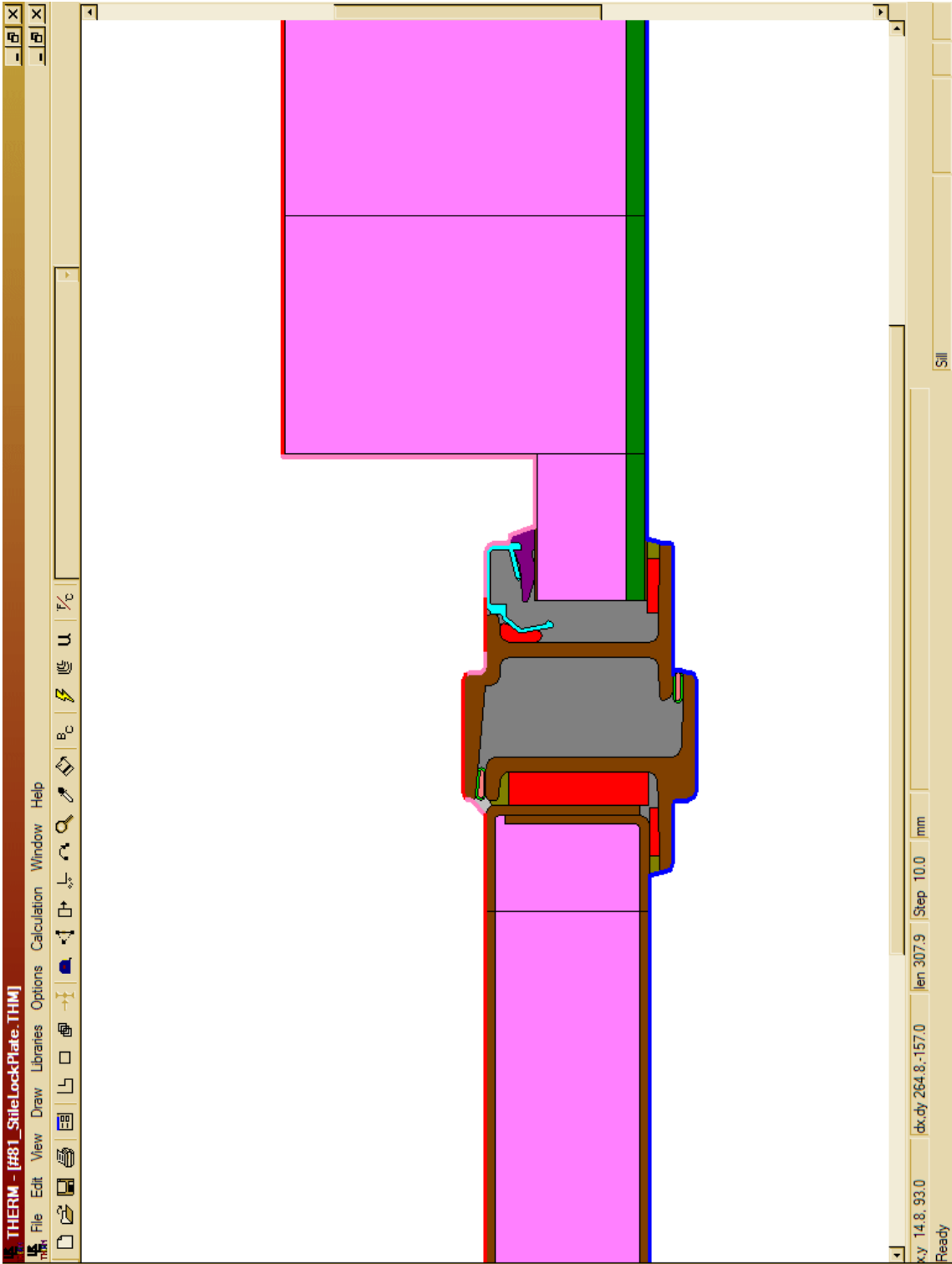


Plate 15 Meeting Stile with Thick Infill Panel and Lock Plate, as Analysed

APPENDIX A

Summary of Experience of Analyst Dr Richard Harris

Summary of Experience of Analyst Dr Richard Harris

Dr Richard Harris has been involved with the use of FEA to analyse heat flows through facade details for more than nine years, six of which were as a Research Engineer in the employ of the Centre for Window and Cladding Technology (CWCT) at the University of Bath.

More than 1,000 analyses (both 2-d and 3-d) have been performed for research and consultancy purposes, and the author was a contributor to a joint project between the CWCT and the National Physical Laboratory to compare the results of FEA analysis and measurement of product U-values. An accuracy of better than 5% was achieved when comparing simulated and measured U-values. Similarly the error between simulated and measured point temperatures was found to be generally better than 5% of the overall temperature difference (i.e. for an overall temperature difference of 20 deg C the temperature error was less than 1 deg C).

Dr Richard Harris is also the author of several thermal performance related CWCT publications, comprising:

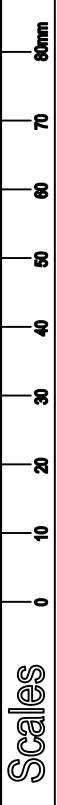
- Guide to the design of thermally improved glazing frames (1995).
- Standard for specifying and assessing for heat transfer (the U-value) (1998).
- Standard for specifying and assessing for condensation risk (1998).
- Guide to good practice for assessing glazing frame U-values (1998).
- Guide to good practice for assessing heat transfer and condensation risk for a curtain wall (1998).
- The effect of edge details on heat transfer through insulated panels (1999).

Dr Harris is Certified Simulator number 007 of the British Fenestration Rating Council (BFRC). Details of this scheme can be found on the BFRC web-site at <http://www.bfrc.org>.



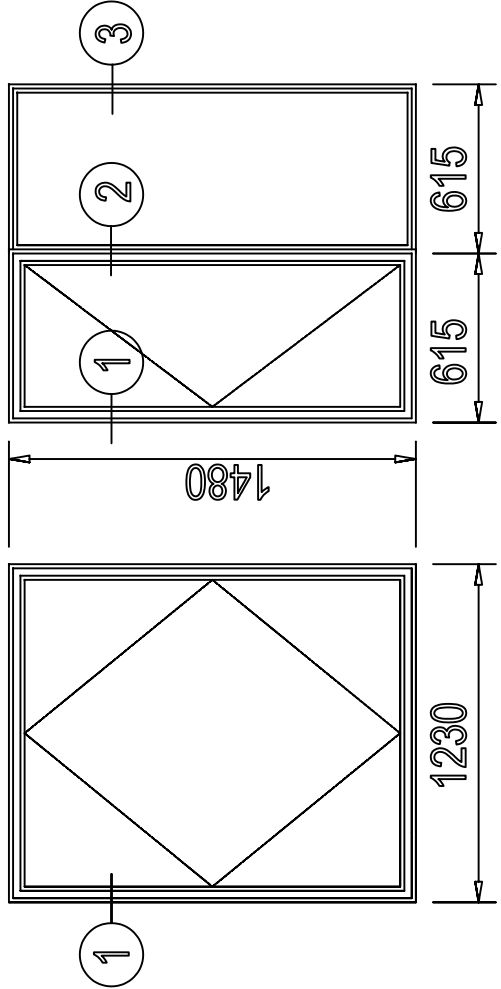
APPENDIX B

Detail Drawings as supplied by the Steel Windows Association



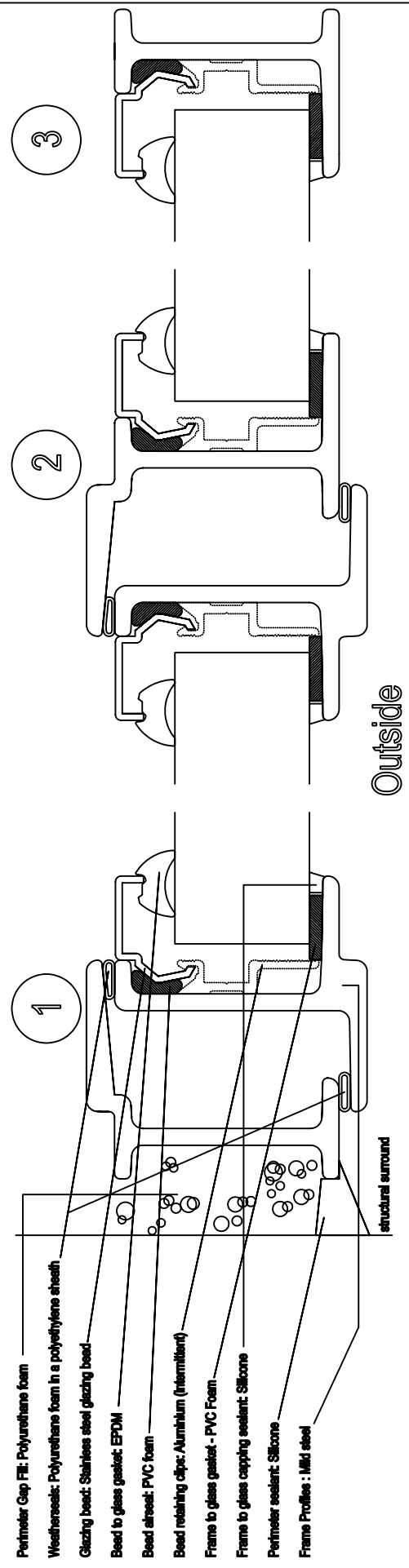
Commercial S.R.W

Domestic S.R.W



Range: W40
 Bead: Stainless Steel
 Glass: 24mm (4/16/4)

Note: Fixing lugs (with associated PVC fixing sleeves) and fixing screws omitted for clarity



- Perimeter Gap Fill: Polyurethane foam
- Weatherseals: Polyurethane foam in a polyethylene sheath
- Glazing bead: Stainless steel glazing bead
- Bead to glass gasket: EPDM
- Bead sleeve: PVC foam
- Bead retaining clip: Aluminium (Inertium)
- Frame to glass gasket - PVC Foam
- Frame to glass capping sealant: Silicone
- Perimeter sealant: Silicone
- Frame Profiles: Mild steel

Drp. No.: SWA/2006L/001
 Drawn by: DJ
 Date: June 2006
 Scale: Details Full Size

Simulation of Thermal Transmission
 for 2006 Document L Compliance

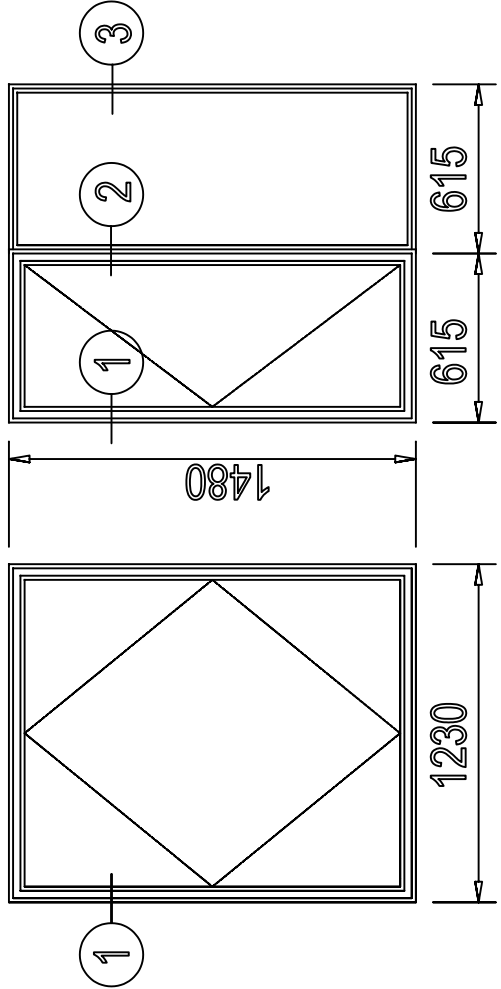
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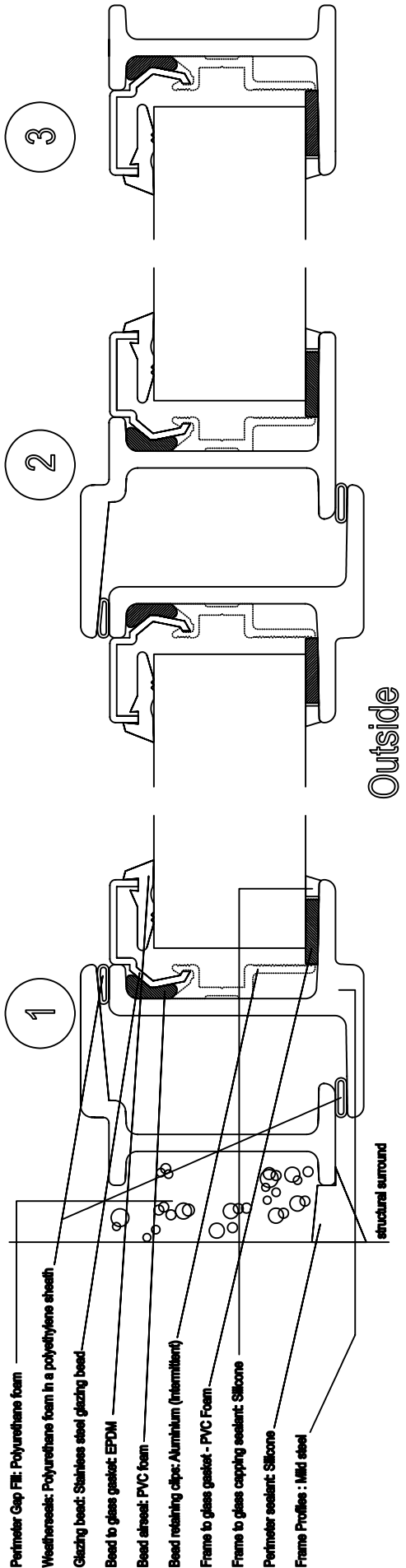
Commercial S.R.W

Domestic S.R.W



Range: W40
 Bead: Stainless Steel
 Glass: 26.8mm (6.4/14/6.4)

Note: Fixing lugs (with associated PVCu fixing shims) and fixing screws omitted for clarity



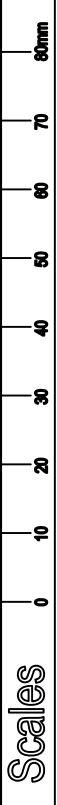
- Perimeter Gap Filler: Polyurethane foam
- Weatherseals: Polyurethane foam in a polyethylene sheath
- Glazing bead: Stainless steel glazing bead
- Bead to glass gasket: EPDM
- Bead astragal: PVC foam
- Bead retaining clip: Aluminium (intermittent)
- Frame to glass gasket - PVC Foam
- Frame to glass capping sealant: Silicone
- Perimeter sealant: Silicone
- Frame Profiles: Mild steel

Drng. No.: SWA/2006L/002
 Drawn by: DJ
 Date: June 2006
 Scale: Details Full Size

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 for 2006 Document L Compliance

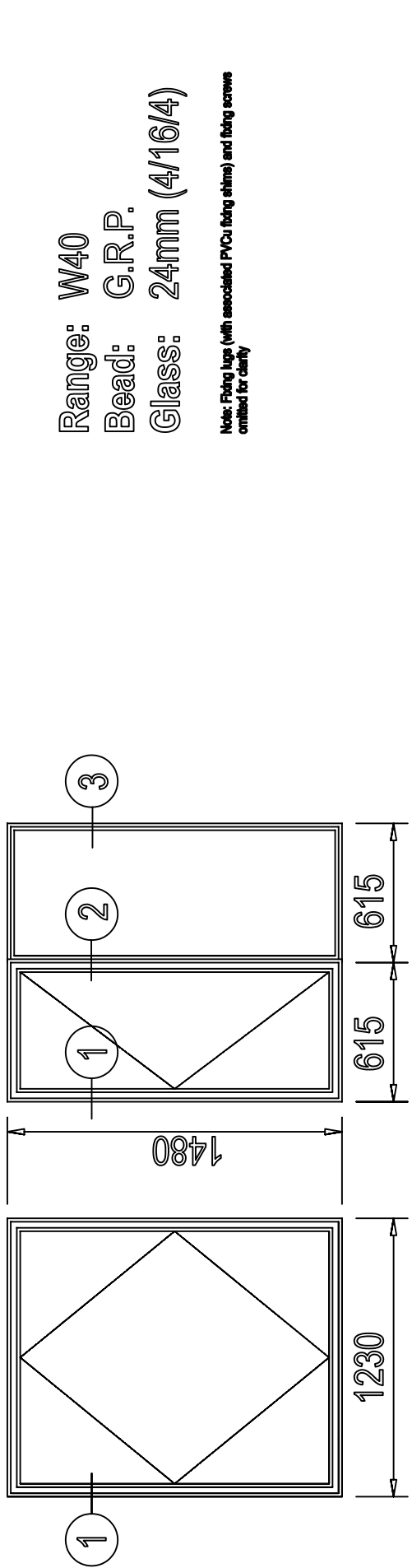
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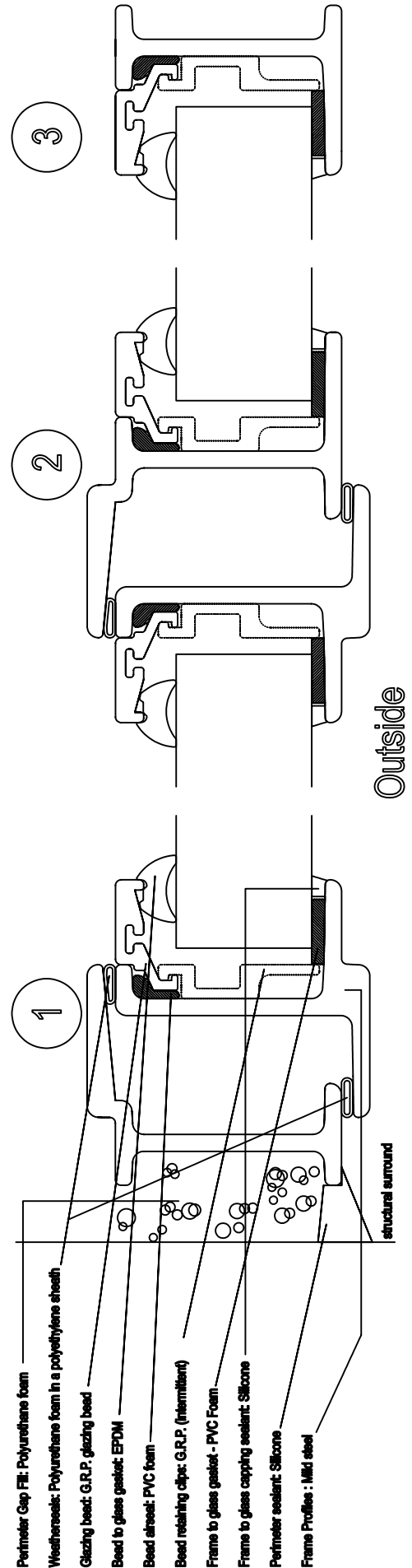
Commercial S.R.W

Domestic S.R.W



Range: W40
 Bead: G.R.P.
 Glass: 24mm (4/16/4)

Note: Fixing lugs (with associated PVCu fixing shims) and fixing screws omitted for clarity



Drp. No.: SWA/2006L/003
 Drawn by: DJ
 Date: June 2006
 Scale: Details Full Size

Simulation of Thermal Transmission
 for 2006 Document L Compliance

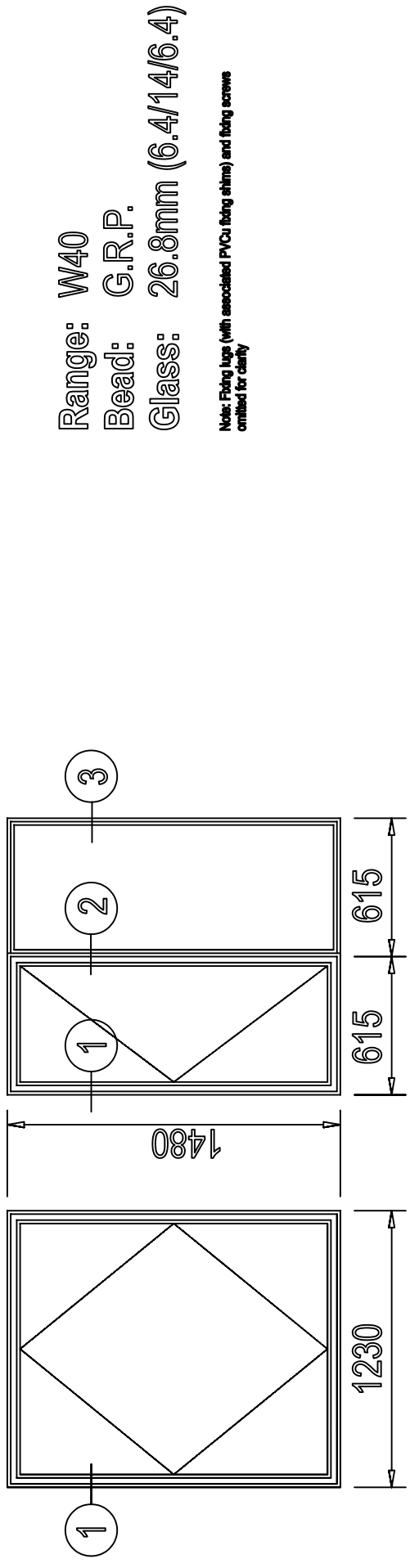
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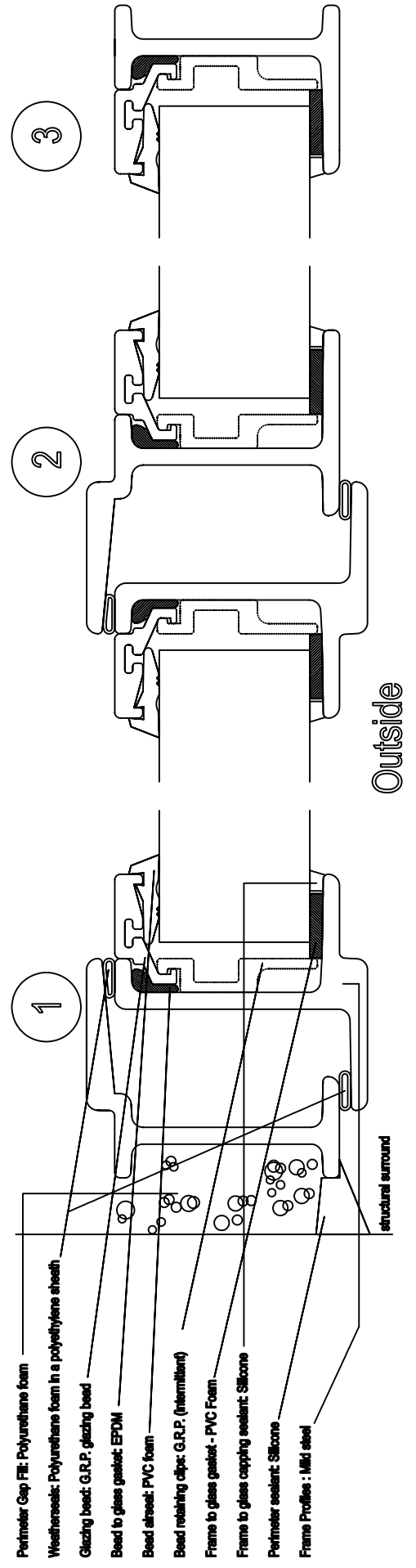
Commercial S.R.W

Domestic S.R.W



Range: W40
 Bead: G.R.P.
 Glass: 26.8mm (6.4/14/6.4)

Note: Fixing lugs (with associated PVCu fixing shims) and fixing screws omitted for clarity



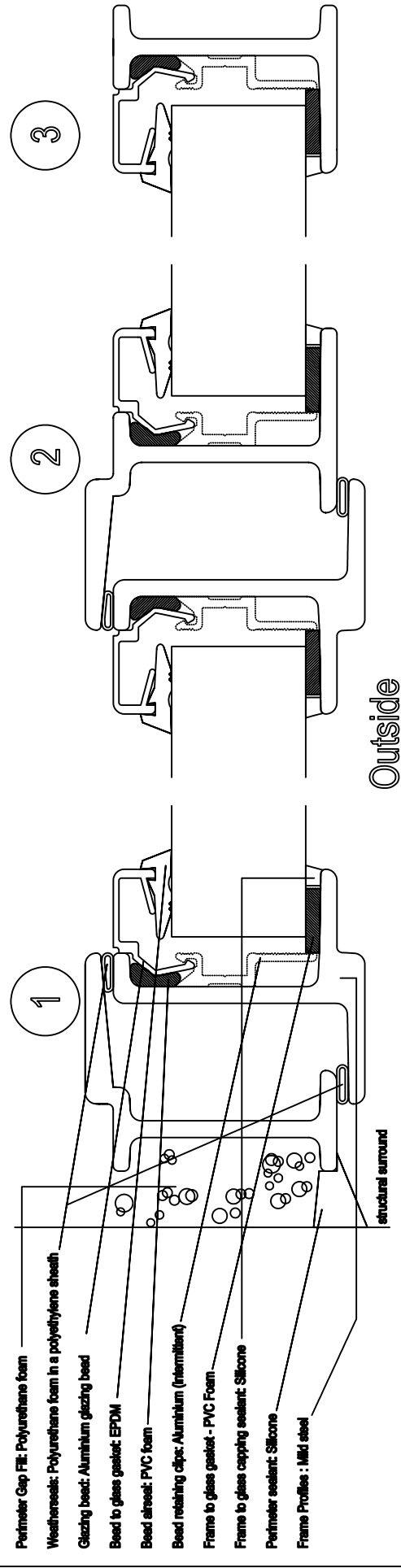
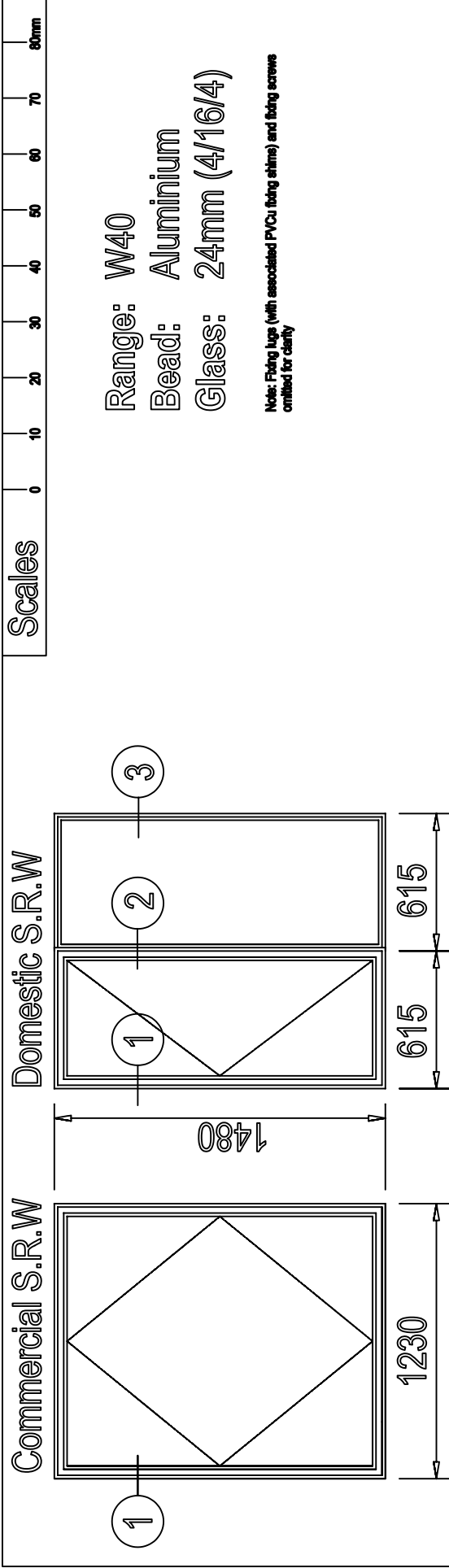
- Perimeter Gap Filler: Polyurethane foam
- Weatherseals: Polyurethane foam in a polyethylene sheath
- Glazing bead: G.R.P. glazing bead
- Bead to glass gasket: EPDM
- Bead astragal: PVC foam
- Bead retaining clip: G.R.P. (intermittent)
- Frame to glass gasket - PVC Foam
- Frame to glass capping sealant: Silicone
- Perimeter sealant: Silicone
- Frame Profiles: Mild steel

Drwg. No.: SWA/2006L/004
 Drawn by: DJ
 Date: June 2006
 Scale: Details Full Size

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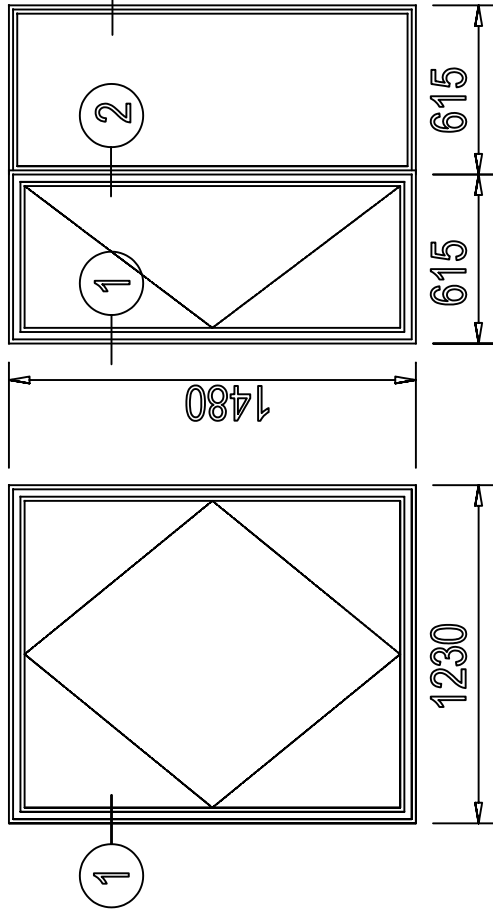
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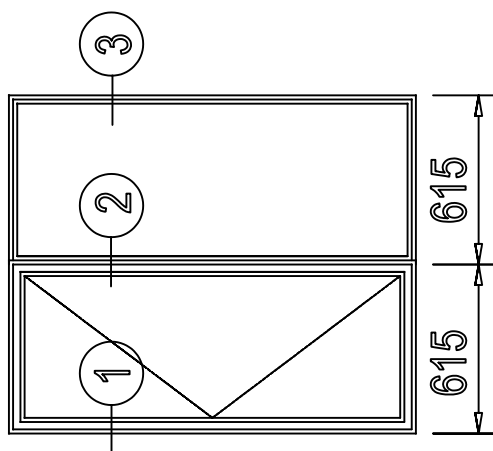
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Commercial S.R.W

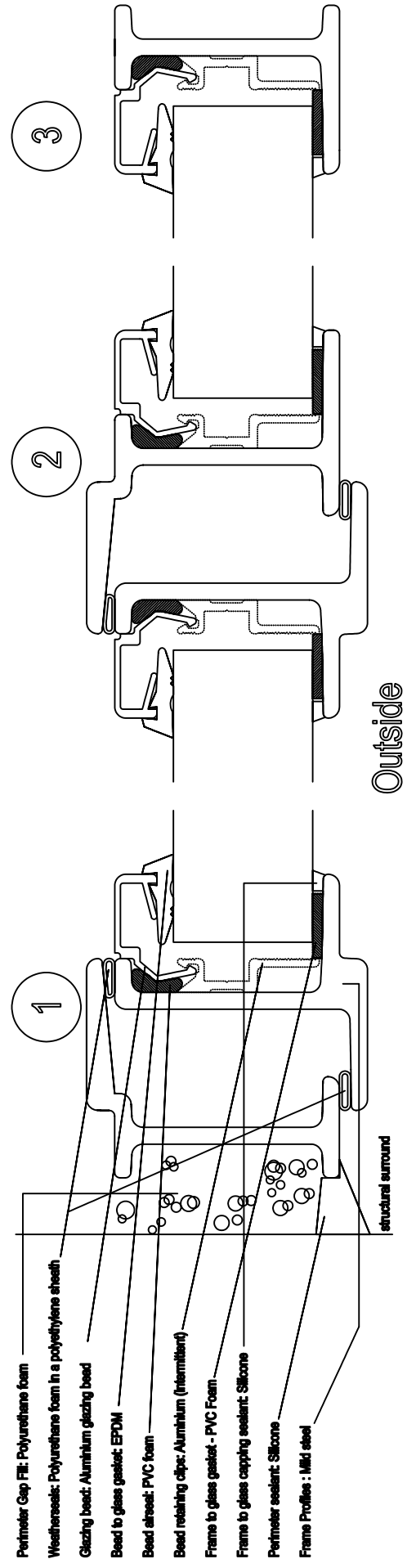


Domestic S.R.W



Range: W40
 Bead: Aluminium
 Glass: 24.8mm (6.4/12/6.4)

Note: Fixing lugs (with associated PVCu fixing shims) and fixing screws omitted for clarity



- Perimeter Gap Filler: Polyurethane foam
- Weatherseals: Polyurethane foam in a polyethylene sheath
- Glazing bead: Aluminium glazing bead
- Bead to glass gasket: EPDM
- Bead shims: PVC foam
- Bead retaining clips: Aluminium (intermittent)
- Frame to glass gasket - PVC Foam
- Frame to glass capping sealant: Silicone
- Perimeter sealant: Silicone
- Frame Profiles: Mild steel

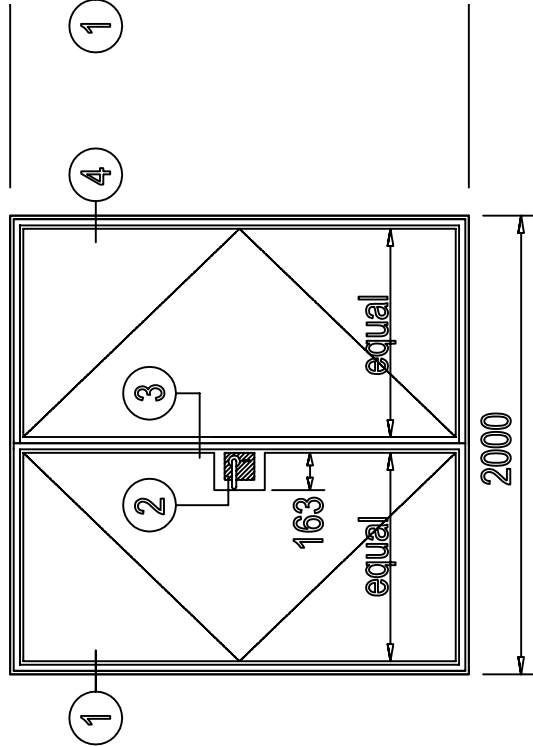
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 Drawn by: DJ
 Date: June 2006
 Scale: Details Full Size

Simulation of Thermal Transmission
 for 2006 Document L Compliance

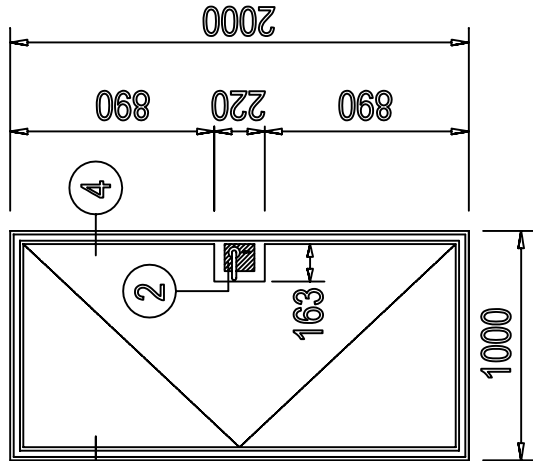
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Commercial / Domestic
S.R.D (double)



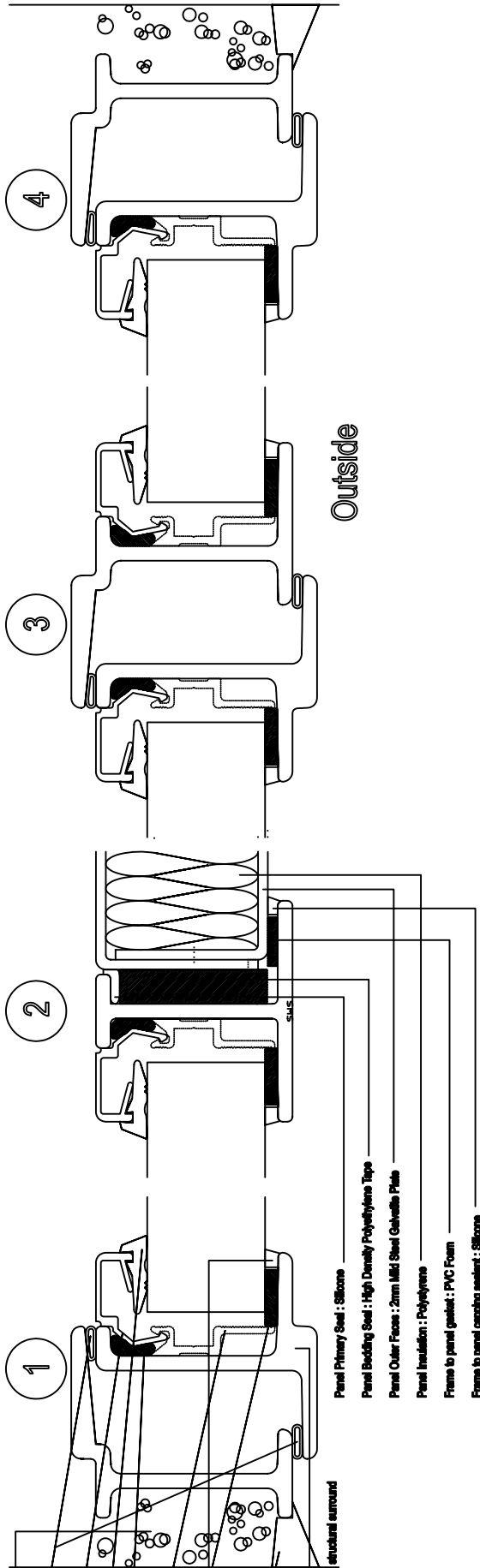
Commercial / Domestic
S.R.D (single)



Range: W40
Bead: Aluminium
Glass: 24mm (4/16/4)

Note: Flang lips (with associated PVCu fixing clips) and fixing screws omitted for clarity

- 1 Perimeter Gap Filler: Polyurethane foam
- 2 Weatherseal: Polyurethane foam in a polyethylene sheath
- 3 Glazing bead: Aluminium glazing bead
- 4 Bead to glass gasket: EPDM
- 5 Bead to frame gasket: PVC foam
- 6 Bead retaining clip: Aluminium (interlocking)
- 7 Frame to glass gasket: PVC Foam
- 8 Frame to glass gasket: Silicone
- 9 Perimeter sealant: Silicone
- 10 Frame Profile: Mild steel



- Panel Primary Seal : Silicone
- Panel Bedding Seal : High Density Polyethylene Tape
- Panel Outer Face : 2mm Mild Steel Galvanneal Plate
- Panel Insulation : Polyethylene
- Frame to panel gasket : PVC Foam
- Frame to panel capting sealant : Silicone

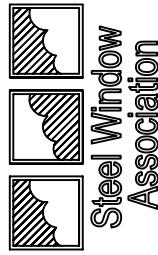
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Drawn by: DJ

Date: Aug 2006

Scale: Details Full Size

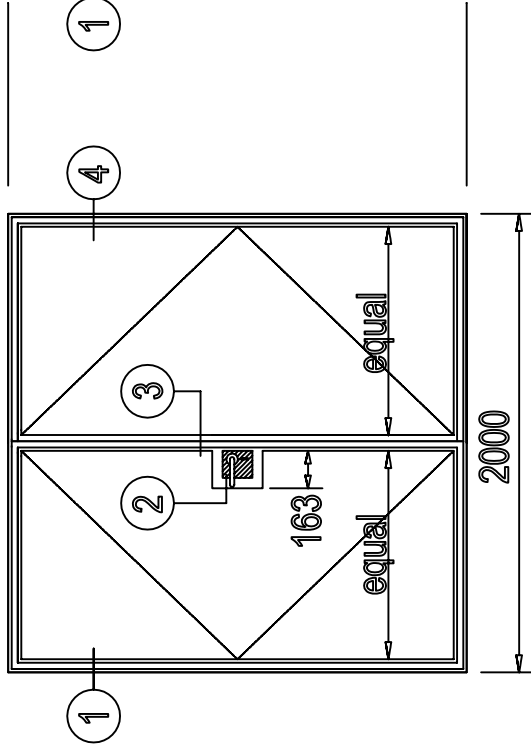
Simulation of Thermal Transmission
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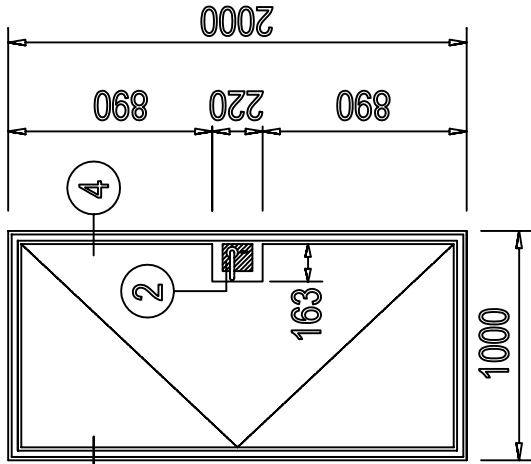
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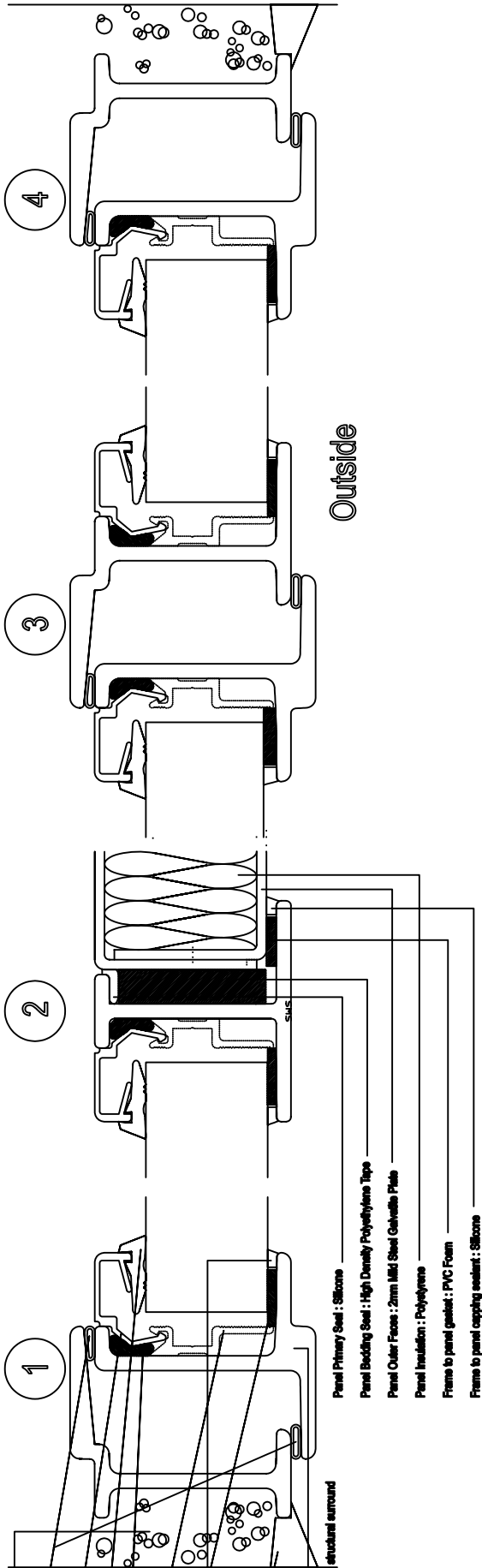
Range: W40

Bead: Aluminium

Glass: 24.8mm (6.4/14/4)

Note: Flang lips (with associated PVCu fixing clips) and fixing screws omitted for clarity

- Panther Cap FE Polyurethane foam
- Weatherseal: Polyurethane foam in a polyethylene sheath
- Glazing bead: Aluminium glazing bead
- Bead to glass gasket: EPDM
- Bead to PVC foam
- Bead retaining clip: Aluminium (intermittent)
- Frame to glass gasket: PVC Foam
- Frame to glass gasket: Silicone
- Panther sealant: Silicone
- Frame Profiles: Mild steel



Drwg. No.: SWA2006L008

Drawn by: DJ

Date: Aug 2006

Scale: Details Full Size

Simulation of Thermal Transmission
for 2006 Document L Compliance

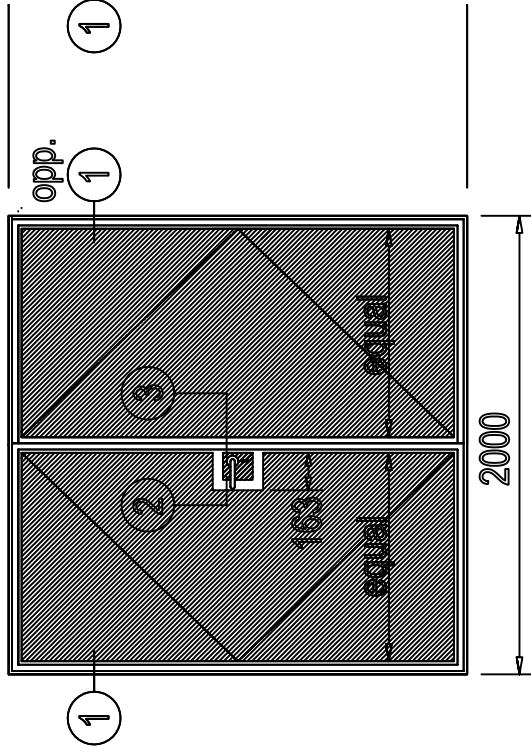


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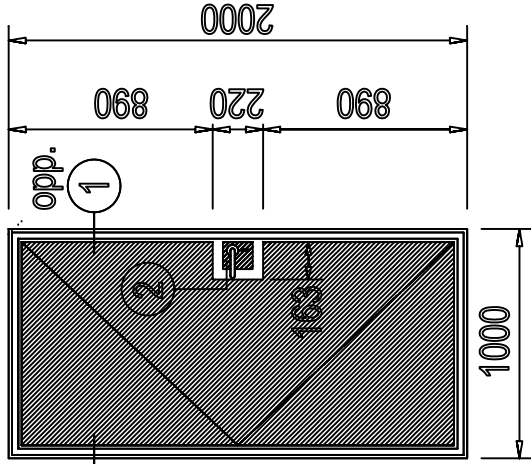
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S.R.D (single)



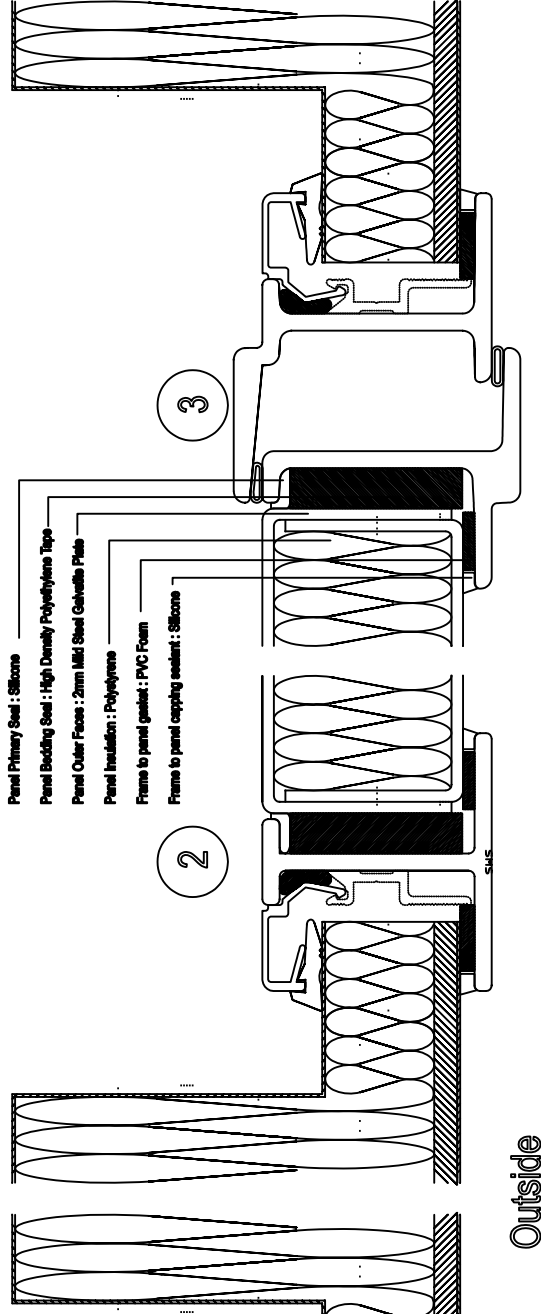
Range: W40
Bead: Aluminium
Panel: 78mm (rebated to 24mm) high insulating vinyl coated steel faced panels.

Note: Filing lips (with associated PVCs filing skins) and filing screws omitted for clarity

78mm thick (rebated down to 24mm) composite panel comprising:
Outer face of 0.5mm vinyl coated steel key, bonded to:
4mm Weather Board Ply (W.B.P.), bonded to:
78mm / 19mm foamed polyethylene core, bonded to:
Inner face of 0.5mm vinyl coated steel key
(centre pane U value: 0.35 W/M2K)

Panetmiser Gap Filler: Polyurethane foam
Weatherseal: Polyurethane foam in a polyethylene sheath
Glazing beed: Aluminium glazing beed
Beed to glass gasket: EPDM
Beed to frame: PVC foam
Beed to glass gasket: Aluminium (Aluminium)
Frame to glass gasket: PVC Foam
Frame to glass gasket: Silicone
Panetmiser sealant: Silicone
Frame Profiles: Mild steel

Panel Primary Seal: Silicone
Panel Bedding Seal: High Density Polyethylene Tape
Panel Outer Faces: 2mm Mill Steel Galvalume Plate
Panel Insulation: Polyethylene
Frame to panel gasket: PVC Foam
Frame to panel capping sealant: Silicone



Drwg. No.: SWA2006L009
Drawn by: DJ
Date: Aug 2006
Scale: Details Full Size

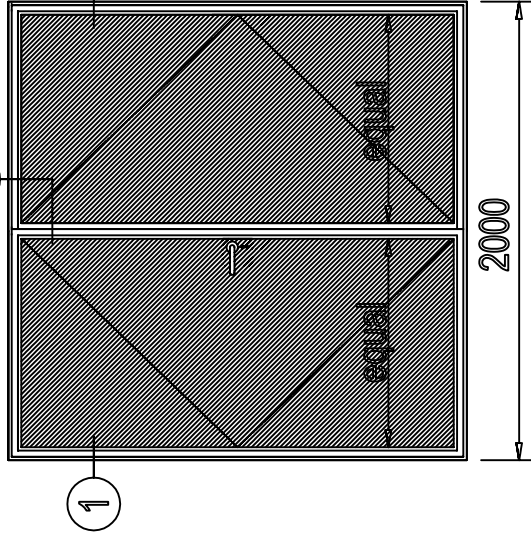
Simulation of Thermal Transmission
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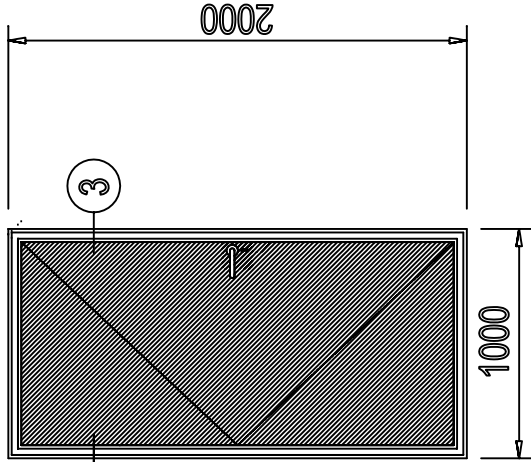
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S.R.D (double) ②



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S.R.D (single)

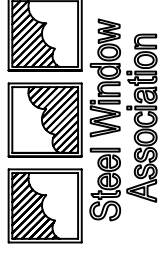


Range: W40
Bead: n/app
Panel: 35mm double tray insulated (polystyrene) pressed steel panel

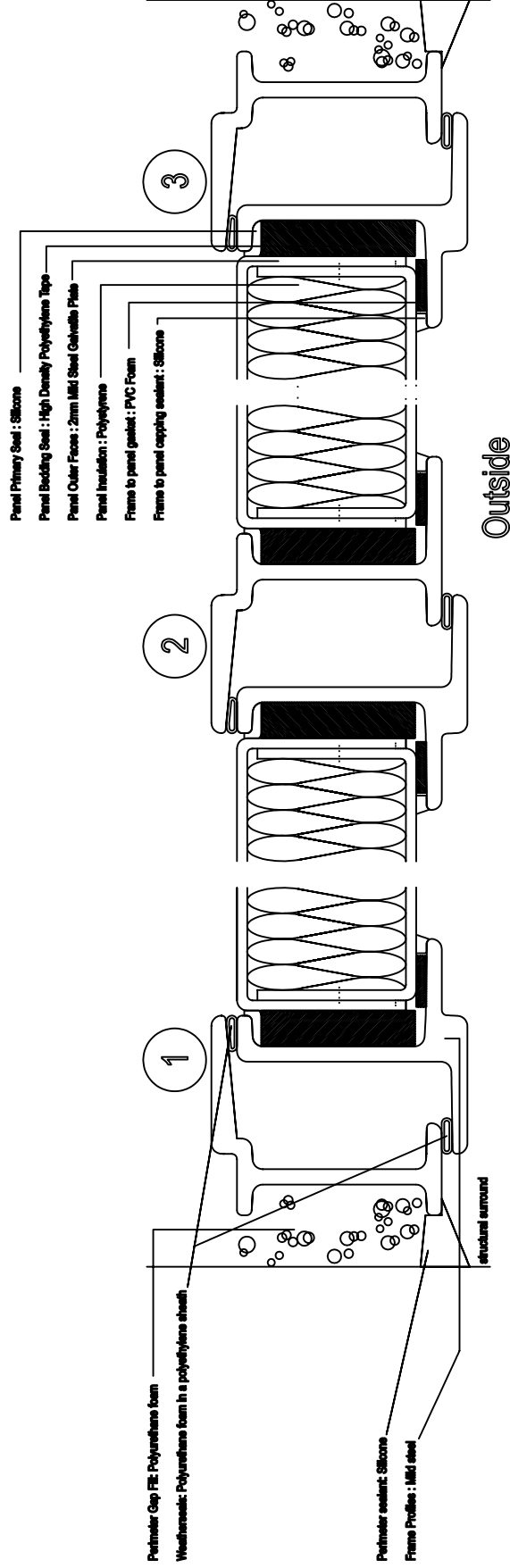
Note: Fixing legs (with associated PVCu fixing sleeve) and fixing screws omitted for clarity

Drwg. No.: SWA2006L010
Drawn by: DJ
Date: Aug 2006
Scale: Details Full Size

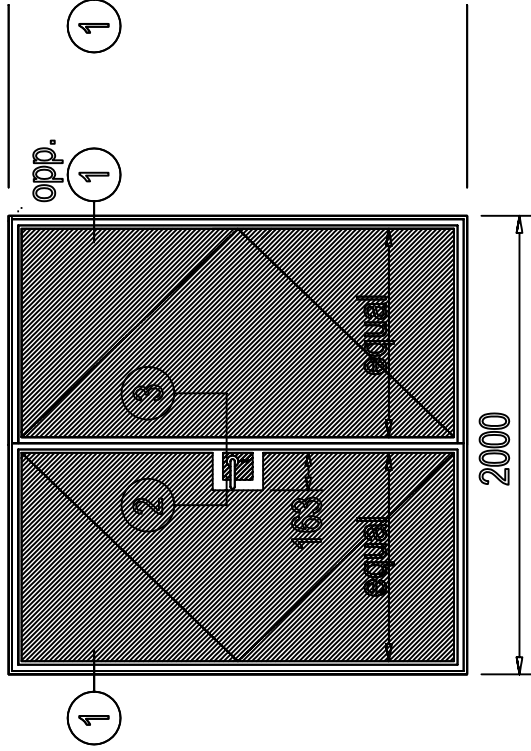
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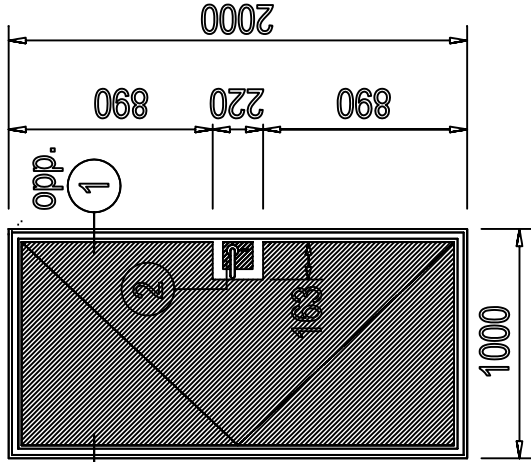
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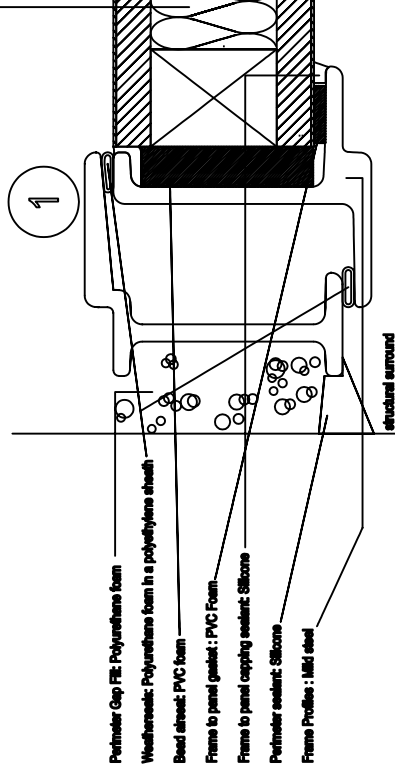
Commercial / Domestic
S.R.D (single)



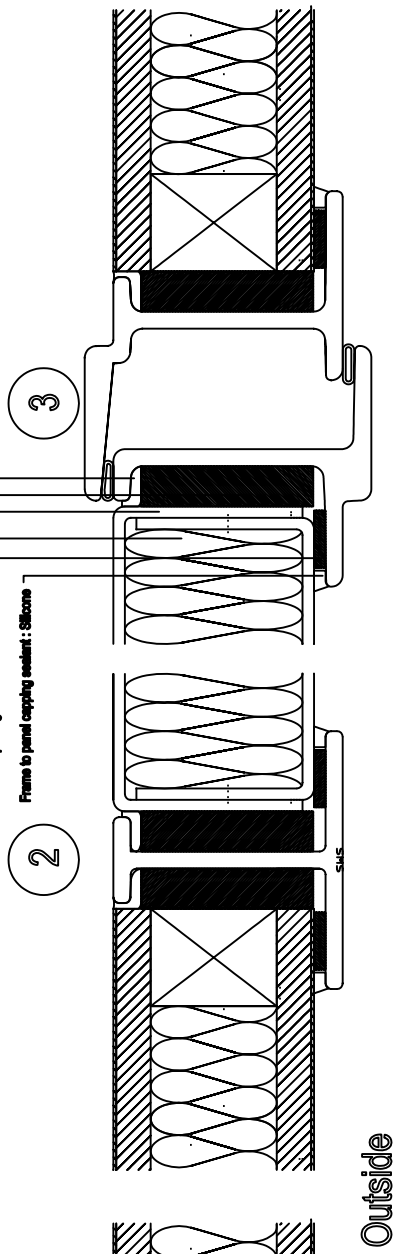
Range: W40
Bead: n/app
Panel: 35mm high insulating vinyl coated steel faced panels.

Note: Filing lips (with associated PVCs filing skins) and filing screws omitted for clarity

35mm thick composite panel comprising:
Outer skin of 0.5mm vinyl coated steel plate, bonded to:
8mm Weather Board Ply (W.B.P.), bonded to:
25mm extruded polystyrene insulation core, bonded to:
8mm Weather Board Ply (W.B.P.), bonded to:
Inner skin of 0.5mm vinyl coated steel plate.
Edge detail: 22x25mm PVCu filing block
(centre pane U value: 0.75 W/M2K)

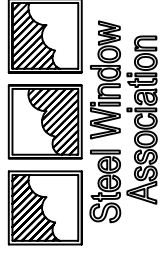


Panel Primary Seal : Silicone
Panel Bedding Seal : High Density Polyethylene Tape
Panel Outer Faces : 2mm Mild Steel Galvanneal Plate
Panel Insulation : Polyurethane
Frame to panel gasket : PVC Foam
Frame to panel capping sealant : Silicone



Drwg. No.: SWA2006L011
Drawn by: DJ
Date: Nov 2006
Scale: Details Full Size

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APPENDIX C

Material Thermal Conductivity Values used for the Analysis

Material Thermal Conductivity Values used for the Analysis

The following materials are used in the details described in this report:

Colour	Material	Use	Conductivity [W/mK]
	Aluminium alloy	Glazing spacer, beads	160.0
	Mild steel	Frame profiles	50.0
	Stainless steel	Glazing bead	17.0
	Glass	Glass	1.0
	HD polythene	Weatherseal skin	0.50
	Silicone	Sealant	0.35
	Glass-filled plastic	GRP glazing bead	0.30
	EPDM rubber	Glazing gaskets	0.25
	Butyl	Glazing unit primary seal	0.24
	Plywood	Infill panel layer	0.24
	Foam rubber	Warm edge glazing spacer	0.162
	Polyurethane foam	Perimeter filler and weatherseal core	0.05
	Foam elastomer	Glazing tape, bead seals	0.05
	Insulant	Panel for characteristic simulation	0.035
	Polystyrene foam	Insulation core	0.027
	Air	Unventilated cavities	various

All solid material thermal conductivity values have been taken from BS EN ISO 12524:2000 *Building Materials and Products - Hygrothermal Properties - Tabulated Design Values*.

All small air-filled cavity equivalent thermal conductivity values have been determined according to the method defined in BS EN ISO 10077-2. The thermal conductivity of cavities is determined automatically by the Therm software.

The glazing gas-space thermal conductivity value has been determined to give the correct centre-glazing U-values.

APPENDIX D

Boundary Conditions assumed for the Analysis

Boundary Conditions assumed for the Analysis

The following boundary conditions are used:

- Internal temperature:

$$T_i = 20 \text{ deg C}$$

- External temperature:

$$T_e = 0 \text{ deg C}$$

- Internal surface resistance, vertical wall surfaces:

$$R_{si} = 0.13 \text{ m}^2\text{K/W}$$

Note: This is modelled using a surface heat transfer coefficient of 7.69 W/m²K.

- Internal surface resistance, sheltered vertical wall surfaces:

$$R_{si} = 0.20 \text{ m}^2\text{K/W}$$

Note: This is modelled using a surface heat transfer coefficient of 5.00 W/m²K.

- External surface resistance, all surfaces:

$$R_{se} = 0.04 \text{ m}^2\text{K/W}$$

Note: This is modelled using a surface heat transfer coefficient of 25.0 W/m²K.

APPENDIX E

Summary of Bead and Glazing Options, and Results for Windows

Option	Fixed frame											U-value Uf	Ψ-value ψ	
	Panel U Up	Glazing U Ug	Projected width		Total heat loss		Infill heat loss		Frame heat loss		U-value Uf			Ψ-value ψ
			Overall	Frame	Insulated	Glazed	Insulated	Glazed	Insulated	Glazed				
b	bf	L2d1	L2d2	L2dp	L2dg	L2df1	L2df2	L2df1	L2df2	U-value Uf	Ψ-value ψ			
1	1.17	1.10	220.0	30.0	0.4280	0.4696	0.2223	0.2090	0.2057	0.2606	6.857	0.055		
2	1.17	1.10	220.0	30.0	0.4280	0.4825	0.2223	0.2090	0.2057	0.2735	6.857	0.068		
3	1.15	1.10	220.0	30.0	0.4249	0.4718	0.2185	0.2090	0.2064	0.2628	6.880	0.056		
4	1.14	1.10	220.0	30.0	0.4218	0.4839	0.2166	0.2090	0.2052	0.2749	6.840	0.070		
5 & 33	1.17	1.00	220.0	30.0	0.4280	0.4668	0.2223	0.1900	0.2057	0.2768	6.857	0.071		
6 & 34	1.17	1.00	220.0	30.0	0.4280	0.4495	0.2223	0.1900	0.2057	0.2595	6.857	0.054		
7 & 35	1.17	0.90	220.0	30.0	0.4280	0.4339	0.2223	0.1710	0.2057	0.2629	6.857	0.057		
8 & 36	1.17	0.80	220.0	30.0	0.4283	0.4172	0.2223	0.1520	0.2060	0.2652	6.867	0.059		
9 & 37	1.17	1.10	220.0	30.0	0.4231	0.4645	0.2223	0.2090	0.2008	0.2555	6.693	0.055		
10 & 38	1.17	1.10	220.0	30.0	0.4232	0.4769	0.2223	0.2090	0.2009	0.2679	6.697	0.067		
11 & 39	1.15	1.10	220.0	30.0	0.4200	0.4667	0.2185	0.2090	0.2015	0.2577	6.717	0.056		
12 & 40	1.14	1.10	220.0	30.0	0.4169	0.4780	0.2166	0.2090	0.2003	0.2690	6.677	0.069		
13 & 41	1.10	1.10	220.0	30.0	0.4072	0.4633	0.2090	0.2090	0.1982	0.2543	6.607	0.056		
14 & 42	1.10	1.10	220.0	30.0	0.4072	0.4764	0.2090	0.2090	0.1982	0.2674	6.607	0.069		
15 & 43	1.08	1.10	220.0	30.0	0.4043	0.4659	0.2052	0.2090	0.1991	0.2569	6.637	0.058		
16 & 44	1.07	1.10	220.0	30.0	0.4016	0.4774	0.2033	0.2090	0.1983	0.2684	6.610	0.070		
17 & 45	1.17	1.00	220.0	30.0	0.4232	0.4613	0.2223	0.1900	0.2009	0.2713	6.697	0.070		
18 & 46	1.17	1.00	220.0	30.0	0.4232	0.4396	0.2223	0.1900	0.2009	0.2496	6.697	0.049		
19 & 47	1.17	0.90	220.0	30.0	0.4231	0.4281	0.2223	0.1710	0.2008	0.2571	6.693	0.056		
20 & 48	1.17	0.80	220.0	30.0	0.4231	0.4114	0.2223	0.1520	0.2008	0.2594	6.693	0.059		
21 & 49	1.17	1.10	220.0	30.0	0.3898	0.4420	0.2223	0.2090	0.1675	0.2330	5.583	0.066		
22 & 50	1.17	1.10	220.0	30.0	0.3898	0.4533	0.2223	0.2090	0.1675	0.2443	5.583	0.077		
23 & 51	1.15	1.10	220.0	30.0	0.3867	0.4440	0.2185	0.2090	0.1682	0.2350	5.607	0.067		
24 & 52	1.14	1.10	220.0	30.0	0.3837	0.4546	0.2166	0.2090	0.1671	0.2456	5.570	0.079		
25 & 53	1.10	1.10	220.0	30.0	0.3742	0.4433	0.2090	0.2090	0.1652	0.2343	5.507	0.069		
26 & 54	1.10	1.10	220.0	30.0	0.3742	0.4548	0.2090	0.2090	0.1652	0.2458	5.507	0.081		
27 & 55	1.08	1.10	220.0	30.0	0.3715	0.4459	0.2052	0.2090	0.1663	0.2369	5.543	0.071		
28 & 56	1.07	1.10	220.0	30.0	0.3687	0.4560	0.2033	0.2090	0.1654	0.2470	5.513	0.082		
29 & 57	1.17	1.00	220.0	30.0	0.3898	0.4375	0.2223	0.1900	0.1675	0.2475	5.583	0.080		
30 & 58	1.17	1.00	220.0	30.0	0.3898	0.4037	0.2223	0.1900	0.1675	0.2137	5.583	0.046		
31 & 59	1.17	0.90	220.0	30.0	0.3898	0.4028	0.2223	0.1710	0.1675	0.2318	5.583	0.064		
32 & 60	1.17	0.80	220.0	30.0	0.3898	0.3860	0.2223	0.1520	0.1675	0.2340	5.583	0.067		
61	1.17	1.10	220.0	30.0	0.4167	0.4629	0.2223	0.2090	0.1944	0.2539	6.480	0.059		
62	1.17	1.10	220.0	30.0	0.4280	0.4547	0.2223	0.2090	0.2057	0.2457	6.857	0.040		
63	1.17	1.10	220.0	30.0	0.4280	0.4655	0.2223	0.2090	0.2057	0.2565	6.857	0.051		
64	1.15	1.10	220.0	30.0	0.4249	0.4568	0.2185	0.2090	0.2064	0.2478	6.880	0.041		
65	1.14	1.10	220.0	30.0	0.4218	0.4668	0.2166	0.2090	0.2052	0.2578	6.840	0.053		

Option	Panel U		Glazing U		Opening Frame		Projected width		Total heat loss		Infill heat loss		Frame heat loss		U-value Uf	Ψ-value ψ
	Up	Ug	b	bf	Insulated L2d1	Glazed L2d2	Insulated L2dp	Glazed L2dg	Insulated L2df1	Glazed L2df2	Insulated L2dp	Glazed L2dg	Insulated L2df1	Glazed L2df2		
															Overall	Frame
1	1.17	1.10	244.0	54.0	0.5729	0.6164	0.2223	0.2090	0.3506	0.4074	0.2223	0.2090	0.3506	0.4074	6.493	0.057
2	1.17	1.10	244.0	54.0	0.5730	0.6298	0.2223	0.2090	0.3507	0.4208	0.2223	0.2090	0.3507	0.4208	6.494	0.070
3	1.15	1.10	244.0	54.0	0.5699	0.6178	0.2185	0.2090	0.3514	0.4088	0.2185	0.2090	0.3514	0.4088	6.507	0.057
4	1.14	1.10	244.0	54.0	0.5669	0.6314	0.2166	0.2090	0.3503	0.4224	0.2166	0.2090	0.3503	0.4224	6.487	0.072
5 & 33	1.17	1.00	244.0	54.0	0.5730	0.6143	0.2223	0.1900	0.3507	0.4243	0.2223	0.1900	0.3507	0.4243	6.494	0.074
6 & 34	1.17	1.00	244.0	54.0	0.5729	0.5978	0.2223	0.1900	0.3506	0.4078	0.2223	0.1900	0.3506	0.4078	6.493	0.057
7 & 35	1.17	0.90	244.0	54.0	0.5730	0.5817	0.2223	0.1710	0.3507	0.4107	0.2223	0.1710	0.3507	0.4107	6.494	0.060
8 & 36	1.17	0.80	244.0	54.0	0.5730	0.5651	0.2223	0.1520	0.3507	0.4131	0.2223	0.1520	0.3507	0.4131	6.494	0.062
9 & 37	1.17	1.10	244.0	54.0	0.5664	0.6090	0.2223	0.2090	0.3441	0.4000	0.2223	0.2090	0.3441	0.4000	6.372	0.056
10 & 38	1.17	1.10	244.0	54.0	0.5677	0.6232	0.2223	0.2090	0.3454	0.4142	0.2223	0.2090	0.3454	0.4142	6.396	0.069
11 & 39	1.15	1.10	244.0	54.0	0.5647	0.6116	0.2185	0.2090	0.3462	0.4026	0.2185	0.2090	0.3462	0.4026	6.411	0.056
12 & 40	1.14	1.10	244.0	54.0	0.5604	0.6233	0.2166	0.2090	0.3438	0.4143	0.2166	0.2090	0.3438	0.4143	6.367	0.071
13 & 41	1.10	1.10	244.0	54.0	0.5498	0.6074	0.2090	0.2090	0.3408	0.3984	0.2090	0.2090	0.3408	0.3984	6.311	0.058
14 & 42	1.10	1.10	244.0	54.0	0.5511	0.6223	0.2090	0.2090	0.3421	0.4133	0.2090	0.2090	0.3421	0.4133	6.335	0.071
15 & 43	1.08	1.10	244.0	54.0	0.5484	0.6106	0.2052	0.2090	0.3432	0.4016	0.2052	0.2090	0.3432	0.4016	6.356	0.058
16 & 44	1.07	1.10	244.0	54.0	0.5458	0.6239	0.2033	0.2090	0.3425	0.4149	0.2033	0.2090	0.3425	0.4149	6.343	0.072
17 & 45	1.17	1.00	244.0	54.0	0.5677	0.6076	0.2223	0.1900	0.3454	0.4176	0.2223	0.1900	0.3454	0.4176	6.396	0.072
18 & 46	1.17	1.00	244.0	54.0	0.5677	0.5863	0.2223	0.1900	0.3454	0.3963	0.2223	0.1900	0.3454	0.3963	6.396	0.051
19 & 47	1.17	0.90	244.0	54.0	0.5677	0.5747	0.2223	0.1710	0.3454	0.4037	0.2223	0.1710	0.3454	0.4037	6.396	0.058
20 & 48	1.17	0.80	244.0	54.0	0.5677	0.5581	0.2223	0.1520	0.3454	0.4061	0.2223	0.1520	0.3454	0.4061	6.396	0.061
21 & 49	1.17	1.10	244.0	54.0	0.5323	0.5857	0.2223	0.2090	0.3100	0.3767	0.2223	0.2090	0.3100	0.3767	5.741	0.067
22 & 50	1.17	1.10	244.0	54.0	0.5309	0.5959	0.2223	0.2090	0.3086	0.3869	0.2223	0.2090	0.3086	0.3869	5.715	0.078
23 & 51	1.15	1.10	244.0	54.0	0.5293	0.5870	0.2185	0.2090	0.3108	0.3780	0.2185	0.2090	0.3108	0.3780	5.756	0.067
24 & 52	1.14	1.10	244.0	54.0	0.5263	0.5987	0.2166	0.2090	0.3097	0.3897	0.2166	0.2090	0.3097	0.3897	5.735	0.080
25 & 53	1.10	1.10	244.0	54.0	0.5166	0.5871	0.2090	0.2090	0.3076	0.3781	0.2090	0.2090	0.3076	0.3781	5.696	0.071
26 & 54	1.10	1.10	244.0	54.0	0.5166	0.5985	0.2090	0.2090	0.3076	0.3895	0.2090	0.2090	0.3076	0.3895	5.696	0.082
27 & 55	1.08	1.10	244.0	54.0	0.5139	0.5889	0.2052	0.2090	0.3087	0.3799	0.2052	0.2090	0.3087	0.3799	5.717	0.071
28 & 56	1.07	1.10	244.0	54.0	0.5113	0.6001	0.2033	0.2090	0.3080	0.3911	0.2033	0.2090	0.3080	0.3911	5.704	0.083
29 & 57	1.17	1.00	244.0	54.0	0.5309	0.5801	0.2223	0.1900	0.3086	0.3901	0.2223	0.1900	0.3086	0.3901	5.715	0.081
30 & 58	1.17	1.00	244.0	54.0	0.5323	0.5473	0.2223	0.1900	0.3100	0.3573	0.2223	0.1900	0.3100	0.3573	5.741	0.047
31 & 59	1.17	0.90	244.0	54.0	0.5323	0.5469	0.2223	0.1710	0.3100	0.3759	0.2223	0.1710	0.3100	0.3759	5.741	0.066
32 & 60	1.17	0.80	244.0	54.0	0.5323	0.5301	0.2223	0.1520	0.3100	0.3781	0.2223	0.1520	0.3100	0.3781	5.741	0.068
61	1.17	1.10	244.0	54.0	0.5611	0.6062	0.2223	0.2090	0.3388	0.3972	0.2223	0.2090	0.3388	0.3972	6.274	0.058
62	1.17	1.10	244.0	54.0	0.5729	0.6024	0.2223	0.2090	0.3506	0.3934	0.2223	0.2090	0.3506	0.3934	6.493	0.043
63	1.17	1.10	244.0	54.0	0.5730	0.6139	0.2223	0.2090	0.3507	0.4049	0.2223	0.2090	0.3507	0.4049	6.494	0.054
64	1.15	1.10	244.0	54.0	0.5699	0.6037	0.2185	0.2090	0.3514	0.3947	0.2185	0.2090	0.3514	0.3947	6.507	0.043
65	1.14	1.10	244.0	54.0	0.5669	0.6153	0.2166	0.2090	0.3503	0.4063	0.2166	0.2090	0.3503	0.4063	6.487	0.056

Option	Mullion Frame															
	Panel U		Glazing U		Overall Frame		Projected width		Total heat loss		Infill heat loss		Frame heat loss		U-value Uf	Ψ-value ψ
	Up	Ug	b	bf	Insulated	Glazed	L2d1	L2d2	Insulated	Glazed	L2dp	L2dg	Insulated	Glazed		
1	1.17	1.10	449.0	69.0	0.9070	0.9915	0.4446	0.4180	0.4624	0.5735	0.4446	0.4180	0.4624	0.5735	6.701	0.056
2	1.17	1.10	449.0	69.0	0.9074	1.0178	0.4446	0.4180	0.4628	0.5998	0.4446	0.4180	0.4628	0.5998	6.707	0.069
3	1.15	1.10	449.0	69.0	0.9010	0.9958	0.4370	0.4180	0.4640	0.5778	0.4370	0.4180	0.4640	0.5778	6.725	0.057
4	1.14	1.10	449.0	69.0	0.8948	1.0205	0.4332	0.4180	0.4616	0.6025	0.4332	0.4180	0.4616	0.6025	6.690	0.070
5 & 33	1.17	1.00	449.0	69.0	0.9074	0.9866	0.4446	0.3800	0.4628	0.6066	0.4446	0.3800	0.4628	0.6066	6.707	0.072
6 & 34	1.17	1.00	449.0	69.0	0.9075	0.9516	0.4446	0.3800	0.4629	0.5716	0.4446	0.3800	0.4629	0.5716	6.709	0.054
7 & 35	1.17	0.90	449.0	69.0	0.9071	0.9208	0.4446	0.3420	0.4625	0.5788	0.4446	0.3420	0.4625	0.5788	6.703	0.058
8 & 36	1.17	0.80	449.0	69.0	0.9071	0.8875	0.4446	0.3040	0.4625	0.5835	0.4446	0.3040	0.4625	0.5835	6.703	0.060
9 & 37	1.17	1.10	449.0	69.0	0.8971	0.9809	0.4446	0.4180	0.4525	0.5629	0.4446	0.4180	0.4525	0.5629	6.558	0.055
10 & 38	1.17	1.10	449.0	69.0	0.8972	1.0060	0.4446	0.4180	0.4526	0.5880	0.4446	0.4180	0.4526	0.5880	6.559	0.068
11 & 39	1.15	1.10	449.0	69.0	0.8909	0.9847	0.4370	0.4180	0.4539	0.5667	0.4370	0.4180	0.4539	0.5667	6.578	0.056
12 & 40	1.14	1.10	449.0	69.0	0.8850	1.0084	0.4332	0.4180	0.4518	0.5904	0.4332	0.4180	0.4518	0.5904	6.548	0.069
13 & 41	1.10	1.10	449.0	69.0	0.8648	0.9792	0.4180	0.4180	0.4468	0.5612	0.4180	0.4180	0.4468	0.5612	6.475	0.057
14 & 42	1.10	1.10	449.0	69.0	0.8647	1.0048	0.4180	0.4180	0.4467	0.5868	0.4180	0.4180	0.4467	0.5868	6.474	0.070
15 & 43	1.08	1.10	449.0	69.0	0.8592	0.9830	0.4104	0.4180	0.4488	0.5650	0.4104	0.4180	0.4488	0.5650	6.504	0.058
16 & 44	1.07	1.10	449.0	69.0	0.8535	1.0072	0.4066	0.4180	0.4469	0.5892	0.4066	0.4180	0.4469	0.5892	6.477	0.071
17 & 45	1.17	1.00	449.0	69.0	0.8972	0.9747	0.4446	0.3800	0.4526	0.5947	0.4446	0.3800	0.4526	0.5947	6.559	0.071
18 & 46	1.17	1.00	449.0	69.0	0.8972	0.9312	0.4446	0.3800	0.4526	0.5512	0.4446	0.3800	0.4526	0.5512	6.559	0.049
19 & 47	1.17	0.90	449.0	69.0	0.8970	0.9084	0.4446	0.3420	0.4524	0.5664	0.4446	0.3420	0.4524	0.5664	6.557	0.057
20 & 48	1.17	0.80	449.0	69.0	0.8970	0.8750	0.4446	0.3040	0.4524	0.5710	0.4446	0.3040	0.4524	0.5710	6.557	0.059
21 & 49	1.17	1.10	449.0	69.0	0.8304	0.9364	0.4446	0.4180	0.3858	0.5184	0.4446	0.4180	0.3858	0.5184	5.591	0.066
22 & 50	1.17	1.10	449.0	69.0	0.8304	0.9590	0.4446	0.4180	0.3858	0.5410	0.4446	0.4180	0.3858	0.5410	5.591	0.078
23 & 51	1.15	1.10	449.0	69.0	0.8243	0.9399	0.4370	0.4180	0.3873	0.5219	0.4370	0.4180	0.3873	0.5219	5.613	0.067
24 & 52	1.14	1.10	449.0	69.0	0.8183	0.9617	0.4332	0.4180	0.3851	0.5437	0.4332	0.4180	0.3851	0.5437	5.581	0.079
25 & 53	1.10	1.10	449.0	69.0	0.7991	0.9389	0.4180	0.4180	0.3811	0.5209	0.4180	0.4180	0.3811	0.5209	5.523	0.070
26 & 54	1.10	1.10	449.0	69.0	0.7992	0.9618	0.4180	0.4180	0.3812	0.5438	0.4180	0.4180	0.3812	0.5438	5.525	0.081
27 & 55	1.08	1.10	449.0	69.0	0.7936	0.9436	0.4104	0.4180	0.3832	0.5256	0.4104	0.4180	0.3832	0.5256	5.554	0.071
28 & 56	1.07	1.10	449.0	69.0	0.7883	0.9642	0.4066	0.4180	0.3817	0.5462	0.4066	0.4180	0.3817	0.5462	5.532	0.082
29 & 57	1.17	1.00	449.0	69.0	0.8304	0.9275	0.4446	0.3800	0.3858	0.5475	0.4446	0.3800	0.3858	0.5475	5.591	0.081
30 & 58	1.17	1.00	449.0	69.0	0.8304	0.8593	0.4446	0.3800	0.3858	0.4793	0.4446	0.3800	0.3858	0.4793	5.591	0.047
31 & 59	1.17	0.90	449.0	69.0	0.8304	0.8580	0.4446	0.3420	0.3858	0.5160	0.4446	0.3420	0.3858	0.5160	5.591	0.065
32 & 60	1.17	0.80	449.0	69.0	0.8304	0.8243	0.4446	0.3040	0.3858	0.5203	0.4446	0.3040	0.3858	0.5203	5.591	0.067
61	1.17	1.10	449.0	69.0	0.8854	0.9775	0.4446	0.4180	0.4408	0.5595	0.4446	0.4180	0.4408	0.5595	6.388	0.059
62	1.17	1.10	449.0	69.0	0.9069	0.9615	0.4446	0.4180	0.4623	0.5435	0.4446	0.4180	0.4623	0.5435	6.700	0.041
63	1.17	1.10	449.0	69.0	0.9075	0.9837	0.4446	0.4180	0.4629	0.5657	0.4446	0.4180	0.4629	0.5657	6.709	0.051
64	1.15	1.10	449.0	69.0	0.9010	0.9655	0.4370	0.4180	0.4640	0.5475	0.4370	0.4180	0.4640	0.5475	6.725	0.042
65	1.14	1.10	449.0	69.0	0.8948	0.9864	0.4332	0.4180	0.4616	0.5684	0.4332	0.4180	0.4616	0.5684	6.690	0.053

Option	Panel U	Up	Glazing U	Ug	Summary											
					Glazing			Fixed Frame			Opening Frame			Mullion Frame		
					U-value	Width	ψ	U-value	Width	ψ	U-value	Width	ψ	U-value	Width	ψ
1	1.17	1.10	1.10	1.100	30.0	0.8567	0.0549	54.0	6.4926	0.0568	69.0	6.7014	0.0556			
2	1.17	1.10	1.10	1.100	30.0	0.8567	0.0678	54.0	6.4944	0.0701	69.0	6.7072	0.0685			
3	1.15	1.10	1.10	1.100	30.0	0.8800	0.0564	54.0	6.5074	0.0574	69.0	6.7246	0.0569			
4	1.14	1.10	1.10	1.100	30.0	0.8400	0.0697	54.0	6.4870	0.0721	69.0	6.6899	0.0704			
5 & 33	1.17	1.00	1.00	1.000	30.0	0.8567	0.0711	54.0	6.4944	0.0736	69.0	6.7072	0.0719			
6 & 34	1.17	1.00	1.00	1.000	30.0	0.8567	0.0538	54.0	6.4926	0.0572	69.0	6.7087	0.0544			
7 & 35	1.17	0.90	0.90	0.900	30.0	0.8567	0.0572	54.0	6.4944	0.0600	69.0	6.7029	0.0582			
8 & 36	1.17	0.80	0.80	0.800	30.0	0.8667	0.0592	54.0	6.4944	0.0624	69.0	6.7029	0.0605			
9 & 37	1.17	1.10	1.10	1.100	30.0	0.6933	0.0547	54.0	6.3722	0.0559	69.0	6.5580	0.0552			
10 & 38	1.17	1.10	1.10	1.100	30.0	0.6967	0.0670	54.0	6.3963	0.0688	69.0	6.5594	0.0677			
11 & 39	1.15	1.10	1.10	1.100	30.0	0.7167	0.0562	54.0	6.4111	0.0564	69.0	6.5783	0.0564			
12 & 40	1.14	1.10	1.10	1.100	30.0	0.6767	0.0687	54.0	6.3667	0.0705	69.0	6.5478	0.0693			
13 & 41	1.10	1.10	1.10	1.100	30.0	0.6067	0.0561	54.0	6.3111	0.0576	69.0	6.4754	0.0572			
14 & 42	1.10	1.10	1.10	1.100	30.0	0.6067	0.0692	54.0	6.3352	0.0712	69.0	6.4739	0.0700			
15 & 43	1.08	1.10	1.10	1.100	30.0	0.6367	0.0578	54.0	6.3556	0.0584	69.0	6.5043	0.0581			
16 & 44	1.07	1.10	1.10	1.100	30.0	0.6100	0.0701	54.0	6.3426	0.0724	69.0	6.4768	0.0712			
17 & 45	1.17	1.00	1.00	1.000	30.0	0.6967	0.0704	54.0	6.3963	0.0722	69.0	6.5594	0.0711			
18 & 46	1.17	1.00	1.00	1.000	30.0	0.6967	0.0487	54.0	6.3963	0.0509	69.0	6.5594	0.0493			
19 & 47	1.17	0.90	0.90	0.900	30.0	0.6933	0.0563	54.0	6.3963	0.0583	69.0	6.5565	0.0570			
20 & 48	1.17	0.80	0.80	0.800	30.0	0.6933	0.0586	54.0	6.3963	0.0607	69.0	6.5565	0.0593			
21 & 49	1.17	1.10	1.10	1.100	30.0	0.5833	0.0655	54.0	5.7407	0.0667	69.0	5.5913	0.0663			
22 & 50	1.17	1.10	1.10	1.100	30.0	0.5833	0.0768	54.0	5.7148	0.0783	69.0	5.5913	0.0776			
23 & 51	1.15	1.10	1.10	1.100	30.0	0.5607	0.0668	54.0	5.7556	0.0672	69.0	5.6130	0.0673			
24 & 52	1.14	1.10	1.10	1.100	30.0	0.5700	0.0785	54.0	5.7352	0.0800	69.0	5.5812	0.0793			
25 & 53	1.10	1.10	1.10	1.100	30.0	0.5067	0.0691	54.0	5.6963	0.0705	69.0	5.5232	0.0699			
26 & 54	1.10	1.10	1.10	1.100	30.0	0.5067	0.0806	54.0	5.6963	0.0819	69.0	5.5246	0.0813			
27 & 55	1.08	1.10	1.10	1.100	30.0	0.5433	0.0706	54.0	5.7167	0.0712	69.0	5.5536	0.0712			
28 & 56	1.07	1.10	1.10	1.100	30.0	0.5133	0.0816	54.0	5.7037	0.0831	69.0	5.5319	0.0823			
29 & 57	1.17	1.00	1.00	1.000	30.0	0.5833	0.0800	54.0	5.7148	0.0815	69.0	5.5913	0.0808			
30 & 58	1.17	1.00	1.00	1.000	30.0	0.5833	0.0462	54.0	5.7407	0.0473	69.0	5.5913	0.0467			
31 & 59	1.17	0.90	0.90	0.900	30.0	0.5833	0.0643	54.0	5.7407	0.0659	69.0	5.5913	0.0651			
32 & 60	1.17	0.80	0.80	0.800	30.0	0.5833	0.0665	54.0	5.7407	0.0681	69.0	5.5913	0.0672			
61	1.17	1.10	1.10	1.100	30.0	0.4800	0.0595	54.0	6.2741	0.0584	69.0	6.3884	0.0594			
62	1.17	1.10	1.10	1.100	30.0	0.8567	0.0400	54.0	6.4926	0.0428	69.0	6.7000	0.0406			
63	1.17	1.10	1.10	1.100	30.0	0.8567	0.0508	54.0	6.4944	0.0542	69.0	6.7087	0.0514			
64	1.15	1.10	1.10	1.100	30.0	0.8800	0.0414	54.0	6.5074	0.0433	69.0	6.7246	0.0418			
65	1.14	1.10	1.10	1.100	30.0	0.8400	0.0526	54.0	6.4870	0.0560	69.0	6.6899	0.0534			

Option	Panel U		Fixed frame			Opening frame			Mullion frame - Fixed		
	Up	Glazing U	Area	Length Glazed	Heat loss U	Area	Length Glazed	Heat loss U	Area	Length Glazed	Heat loss U
1	1.17	1.10	0.0787	2.5300	0.5396	0.1389	0.1384	0.8986	0.1372	0.0435	0.2915
2	1.17	1.10	0.0787	2.5300	0.5396	0.1715	0.1384	0.8988	0.1694	0.0435	0.2918
3	1.15	1.10	0.0787	2.5300	0.5415	0.1427	0.1384	0.9006	0.1387	0.0435	0.2925
4	1.14	1.10	0.0787	2.5300	0.5383	0.1763	0.1384	0.8978	0.1742	0.0435	0.2910
5 & 33	1.17	1.00	0.0787	2.5300	0.5396	0.1799	0.1384	0.8988	0.1778	0.0435	0.2918
6 & 34	1.17	1.00	0.0787	2.5300	0.5396	0.1361	0.1384	0.8986	0.1382	0.0435	0.2918
7 & 35	1.17	0.90	0.0787	2.5300	0.5396	0.1447	0.1384	0.8988	0.1450	0.0435	0.2916
8 & 36	1.17	0.80	0.0787	2.5300	0.5404	0.1498	0.1384	0.8988	0.1508	0.0435	0.2916
9 & 37	1.17	1.10	0.0787	2.5300	0.5268	0.1384	0.1384	0.8819	0.1351	0.0435	0.2853
10 & 38	1.17	1.10	0.0787	2.5300	0.5270	0.1695	0.1384	0.8852	0.1662	0.0435	0.2853
11 & 39	1.15	1.10	0.0787	2.5300	0.5286	0.1422	0.1384	0.8873	0.1363	0.0435	0.2862
12 & 40	1.14	1.10	0.0787	2.5300	0.5255	0.1738	0.1384	0.8811	0.1703	0.0435	0.2848
13 & 41	1.10	1.10	0.0787	2.5300	0.5199	0.1419	0.1384	0.8735	0.1392	0.0435	0.2817
14 & 42	1.10	1.10	0.0787	2.5300	0.5199	0.1751	0.1384	0.8768	0.1720	0.0435	0.2816
15 & 43	1.08	1.10	0.0787	2.5300	0.5223	0.1462	0.1384	0.8796	0.1411	0.0435	0.2829
16 & 44	1.07	1.10	0.0787	2.5300	0.5202	0.1774	0.1384	0.8778	0.1749	0.0435	0.2817
17 & 45	1.17	1.00	0.0787	2.5300	0.5270	0.1781	0.1384	0.8852	0.1744	0.0435	0.2853
18 & 46	1.17	1.00	0.0787	2.5300	0.5270	0.1232	0.1384	0.8852	0.1230	0.0435	0.2853
19 & 47	1.17	0.90	0.0787	2.5300	0.5268	0.1424	0.1384	0.8852	0.1409	0.0435	0.2852
20 & 48	1.17	0.80	0.0787	2.5300	0.5268	0.1483	0.1384	0.8852	0.1467	0.0435	0.2852
21 & 49	1.17	1.10	0.0787	2.5300	0.4394	0.1657	0.1384	0.7945	0.1611	0.0435	0.2432
22 & 50	1.17	1.10	0.0787	2.5300	0.4394	0.1943	0.1384	0.7909	0.1892	0.0435	0.2432
23 & 51	1.15	1.10	0.0787	2.5300	0.4412	0.1690	0.1384	0.7966	0.1624	0.0435	0.2442
24 & 52	1.14	1.10	0.0787	2.5300	0.4384	0.1986	0.1384	0.7937	0.1933	0.0435	0.2428
25 & 53	1.10	1.10	0.0787	2.5300	0.4334	0.1748	0.1384	0.7884	0.1703	0.0435	0.2403
26 & 54	1.10	1.10	0.0787	2.5300	0.4334	0.2039	0.1384	0.7884	0.1979	0.0435	0.2403
27 & 55	1.08	1.10	0.0787	2.5300	0.4363	0.1786	0.1384	0.7912	0.1720	0.0435	0.2416
28 & 56	1.07	1.10	0.0787	2.5300	0.4339	0.2064	0.1384	0.7894	0.2008	0.0435	0.2406
29 & 57	1.17	1.00	0.0787	2.5300	0.4394	0.2024	0.1384	0.7909	0.1969	0.0435	0.2432
30 & 58	1.17	1.00	0.0787	2.5300	0.4394	0.1169	0.1384	0.7945	0.1143	0.0435	0.2432
31 & 59	1.17	0.90	0.0787	2.5300	0.4394	0.1627	0.1384	0.7945	0.1592	0.0435	0.2432
32 & 60	1.17	0.80	0.0787	2.5300	0.4394	0.1682	0.1384	0.7945	0.1645	0.0435	0.2432
61	1.17	1.10	0.0787	2.5300	0.5100	0.1505	0.1384	0.8683	0.1411	0.0435	0.2779
62	1.17	1.10	0.0787	2.5300	0.5396	0.1012	0.1384	0.8986	0.1034	0.0435	0.2915
63	1.17	1.10	0.0787	2.5300	0.5396	0.1285	0.1384	0.8988	0.1309	0.0435	0.2918
64	1.15	1.10	0.0787	2.5300	0.5415	0.1047	0.1384	0.9006	0.1046	0.0435	0.2925
65	1.14	1.10	0.0787	2.5300	0.5383	0.1331	0.1384	0.8978	0.1353	0.0435	0.2910

Option	Panel U	Mullion frame - Opening			Glazing			Total		Average			
		Up	Area	Length Glazed	U	Heat loss	ψ	Area	Ag	Heat loss U	qtot	Area	U-value
1	1.17	1.10	0.0556	1.3720	0.3726	0.0762	1.5043	1.6547	4.1883	1.8204	2.301	1.8204	2.301
2	1.17	1.10	0.0556	1.3720	0.3729	0.0940	1.5043	1.6547	4.2900	1.8204	2.357	1.8204	2.357
3	1.15	1.10	0.0556	1.3720	0.3739	0.0781	1.5043	1.6547	4.2035	1.8204	2.309	1.8204	2.309
4	1.14	1.10	0.0556	1.3720	0.3720	0.0967	1.5043	1.6547	4.3010	1.8204	2.363	1.8204	2.363
5 & 33	1.17	1.00	0.0556	1.3720	0.3729	0.0986	1.5043	1.5043	4.1659	1.8204	2.288	1.8204	2.288
6 & 34	1.17	1.00	0.0556	1.3720	0.3730	0.0746	1.5043	1.5043	4.0334	1.8204	2.216	1.8204	2.216
7 & 35	1.17	0.90	0.0556	1.3720	0.3727	0.0798	1.5043	1.3539	3.9086	1.8204	2.147	1.8204	2.147
8 & 36	1.17	0.80	0.0556	1.3720	0.3727	0.0830	1.5043	1.2034	3.7764	1.8204	2.074	1.8204	2.074
9 & 37	1.17	1.10	0.0556	1.3720	0.3646	0.0757	1.5043	1.6547	4.1409	1.8204	2.275	1.8204	2.275
10 & 38	1.17	1.10	0.0556	1.3720	0.3647	0.0929	1.5043	1.6547	4.2418	1.8204	2.330	1.8204	2.330
11 & 39	1.15	1.10	0.0556	1.3720	0.3658	0.0774	1.5043	1.6547	4.1585	1.8204	2.284	1.8204	2.284
12 & 40	1.14	1.10	0.0556	1.3720	0.3641	0.0951	1.5043	1.6547	4.2478	1.8204	2.333	1.8204	2.333
13 & 41	1.10	1.10	0.0556	1.3720	0.3600	0.0785	1.5043	1.6547	4.1306	1.8204	2.269	1.8204	2.269
14 & 42	1.10	1.10	0.0556	1.3720	0.3599	0.0961	1.5043	1.6547	4.2357	1.8204	2.327	1.8204	2.327
15 & 43	1.08	1.10	0.0556	1.3720	0.3616	0.0797	1.5043	1.6547	4.1508	1.8204	2.280	1.8204	2.280
16 & 44	1.07	1.10	0.0556	1.3720	0.3601	0.0976	1.5043	1.6547	4.2455	1.8204	2.332	1.8204	2.332
17 & 45	1.17	1.00	0.0556	1.3720	0.3647	0.0975	1.5043	1.5043	4.1175	1.8204	2.262	1.8204	2.262
18 & 46	1.17	1.00	0.0556	1.3720	0.3647	0.0676	1.5043	1.5043	3.9504	1.8204	2.170	1.8204	2.170
19 & 47	1.17	0.90	0.0556	1.3720	0.3645	0.0782	1.5043	1.3539	3.8581	1.8204	2.119	1.8204	2.119
20 & 48	1.17	0.80	0.0556	1.3720	0.3645	0.0814	1.5043	1.2034	3.7257	1.8204	2.047	1.8204	2.047
21 & 49	1.17	1.10	0.0556	1.3720	0.3109	0.0910	1.5043	1.6547	3.9547	1.8204	2.172	1.8204	2.172
22 & 50	1.17	1.10	0.0556	1.3720	0.3109	0.1065	1.5043	1.6547	4.0393	1.8204	2.219	1.8204	2.219
23 & 51	1.15	1.10	0.0556	1.3720	0.3121	0.0923	1.5043	1.6547	3.9681	1.8204	2.180	1.8204	2.180
24 & 52	1.14	1.10	0.0556	1.3720	0.3103	0.1088	1.5043	1.6547	4.0532	1.8204	2.227	1.8204	2.227
25 & 53	1.10	1.10	0.0556	1.3720	0.3071	0.0959	1.5043	1.6547	3.9641	1.8204	2.178	1.8204	2.178
26 & 54	1.10	1.10	0.0556	1.3720	0.3072	0.1115	1.5043	1.6547	4.0527	1.8204	2.226	1.8204	2.226
27 & 55	1.08	1.10	0.0556	1.3720	0.3088	0.0977	1.5043	1.6547	3.9820	1.8204	2.187	1.8204	2.187
28 & 56	1.07	1.10	0.0556	1.3720	0.3076	0.1128	1.5043	1.6547	4.0631	1.8204	2.232	1.8204	2.232
29 & 57	1.17	1.00	0.0556	1.3720	0.3109	0.1109	1.5043	1.5043	3.9138	1.8204	2.14995	1.8204	2.14995
30 & 58	1.17	1.00	0.0556	1.3720	0.3109	0.0641	1.5043	1.5043	3.6540	1.8204	2.007	1.8204	2.007
31 & 59	1.17	0.90	0.0556	1.3720	0.3109	0.0893	1.5043	1.3539	3.6455	1.8204	2.003	1.8204	2.003
32 & 60	1.17	0.80	0.0556	1.3720	0.3109	0.0923	1.5043	1.2034	3.5120	1.8204	1.929	1.8204	1.929
61	1.17	1.10	0.0556	1.3720	0.3552	0.0814	1.5043	1.6547	4.1235	1.8204	2.265	1.8204	2.265
62	1.17	1.10	0.0556	1.3720	0.3725	0.0557	1.5043	1.6547	4.0749	1.8204	2.238	1.8204	2.238
63	1.17	1.10	0.0556	1.3720	0.3730	0.0705	1.5043	1.6547	4.1610	1.8204	2.286	1.8204	2.286
64	1.15	1.10	0.0556	1.3720	0.3739	0.0573	1.5043	1.6547	4.0891	1.8204	2.246	1.8204	2.246
65	1.14	1.10	0.0556	1.3720	0.3720	0.0733	1.5043	1.6547	4.1713	1.8204	2.291	1.8204	2.291

Option	Panel U		Opening frame		Glazing		Total		Average U-value		
	Up	Glazing U	Area	Length Glazed	U	Heat loss	ψ	Area		Heat loss	Area
		Ug	Af	Lf	q1	q2	Ag	qg	qtot	Atot	Ucommercial
1	1.17	1.10	0.2810	4.9880	1.8244	0.2833	1.5394	1.6933	3.8011	1.8204	2.088
2	1.17	1.10	0.2810	4.9880	1.8249	0.3497	1.5394	1.6933	3.8679	1.8204	2.125
3	1.15	1.10	0.2810	4.9880	1.8286	0.2863	1.5394	1.6933	3.8082	1.8204	2.092
4	1.14	1.10	0.2810	4.9880	1.8229	0.3596	1.5394	1.6933	3.8758	1.8204	2.129
5 & 33	1.17	1.00	0.2810	4.9880	1.8249	0.3671	1.5394	1.5394	3.7315	1.8204	2.0498
6 & 34	1.17	1.00	0.2810	4.9880	1.8244	0.2853	1.5394	1.5394	3.6491	1.8204	2.005
7 & 35	1.17	0.90	0.2810	4.9880	1.8249	0.2993	1.5394	1.3855	3.5097	1.8204	1.928
8 & 36	1.17	0.80	0.2810	4.9880	1.8249	0.3113	1.5394	1.2315	3.3677	1.8204	1.84998
9 & 37	1.17	1.10	0.2810	4.9880	1.7906	0.2788	1.5394	1.6933	3.7628	1.8204	2.067
10 & 38	1.17	1.10	0.2810	4.9880	1.7974	0.3432	1.5394	1.6933	3.8339	1.8204	2.106
11 & 39	1.15	1.10	0.2810	4.9880	1.8015	0.2813	1.5394	1.6933	3.7762	1.8204	2.074
12 & 40	1.14	1.10	0.2810	4.9880	1.7890	0.3517	1.5394	1.6933	3.8340	1.8204	2.106
13 & 41	1.10	1.10	0.2810	4.9880	1.7734	0.2873	1.5394	1.6933	3.7541	1.8204	2.062
14 & 42	1.10	1.10	0.2810	4.9880	1.7802	0.3551	1.5394	1.6933	3.8287	1.8204	2.103
15 & 43	1.08	1.10	0.2810	4.9880	1.7859	0.2913	1.5394	1.6933	3.7706	1.8204	2.071
16 & 44	1.07	1.10	0.2810	4.9880	1.7823	0.3611	1.5394	1.6933	3.8367	1.8204	2.108
17 & 45	1.17	1.00	0.2810	4.9880	1.7974	0.3601	1.5394	1.5394	3.6969	1.8204	2.031
18 & 46	1.17	1.00	0.2810	4.9880	1.7974	0.2539	1.5394	1.5394	3.5906	1.8204	1.972
19 & 47	1.17	0.90	0.2810	4.9880	1.7974	0.2908	1.5394	1.3855	3.4736	1.8204	1.908
20 & 48	1.17	0.80	0.2810	4.9880	1.7974	0.3028	1.5394	1.2315	3.3317	1.8204	1.830
21 & 49	1.17	1.10	0.2810	4.9880	1.6131	0.3327	1.5394	1.6933	3.6392	1.8204	1.999
22 & 50	1.17	1.10	0.2810	4.9880	1.6059	0.3906	1.5394	1.6933	3.6898	1.8204	2.027
23 & 51	1.15	1.10	0.2810	4.9880	1.6173	0.3352	1.5394	1.6933	3.6458	1.8204	2.003
24 & 52	1.14	1.10	0.2810	4.9880	1.6116	0.3990	1.5394	1.6933	3.7040	1.8204	2.035
25 & 53	1.10	1.10	0.2810	4.9880	1.6007	0.3517	1.5394	1.6933	3.6457	1.8204	2.003
26 & 54	1.10	1.10	0.2810	4.9880	1.6007	0.4085	1.5394	1.6933	3.7025	1.8204	2.034
27 & 55	1.08	1.10	0.2810	4.9880	1.6064	0.3551	1.5394	1.6933	3.6549	1.8204	2.008
28 & 56	1.07	1.10	0.2810	4.9880	1.6027	0.4145	1.5394	1.6933	3.7106	1.8204	2.038
29 & 57	1.17	1.00	0.2810	4.9880	1.6059	0.4065	1.5394	1.5394	3.5518	1.8204	1.951
30 & 58	1.17	1.00	0.2810	4.9880	1.6131	0.2359	1.5394	1.5394	3.3885	1.8204	1.861
31 & 59	1.17	0.90	0.2810	4.9880	1.6131	0.3287	1.5394	1.3855	3.3273	1.8204	1.828
32 & 60	1.17	0.80	0.2810	4.9880	1.6131	0.3397	1.5394	1.2315	3.1844	1.8204	1.749
61	1.17	1.10	0.2810	4.9880	1.7630	0.2913	1.5394	1.6933	3.7477	1.8204	2.059
62	1.17	1.10	0.2810	4.9880	1.8244	0.2135	1.5394	1.6933	3.7312	1.8204	2.0497
63	1.17	1.10	0.2810	4.9880	1.8249	0.2703	1.5394	1.6933	3.7886	1.8204	2.081
64	1.15	1.10	0.2810	4.9880	1.8286	0.2160	1.5394	1.6933	3.7379	1.8204	2.053
65	1.14	1.10	0.2810	4.9880	1.8229	0.2793	1.5394	1.6933	3.7955	1.8204	2.085

APPENDIX F

Summary of Bead and Glazing Options, and Results for Doors

Config. Ref:	Single or Double Door	Bead	Double / Triple Glazed ?	Unit Thickness	Outer	Airspace (outer)	Central Pane	Airspace (inner)	Inner	Centre Pane U Value	Spacer	Glazing side in W40 frame	Resultant frame and glass combined U value:
66	Single	7mm topped aluminium	Double	24	6	12			6	1.2	Standard Aluminium	Internally Glazed	2.4 (2.353)
82	Double	7mm topped aluminium	Double	24	6	12			6	1.2	Standard Aluminium	Internally Glazed	2.2 (2.201)
67	Single	7mm topped aluminium	Double	24	6	12			6	1.2	Warm Edge Spacer	Internally Glazed	2.3 (2.306)
83	Double	7mm topped aluminium	Double	24	6	12			6	1.2	Warm Edge Spacer	Internally Glazed	2.2 (2.157)
68	Single	7mm topped aluminium	Double	24	6	12			6	1.1	Standard Aluminium	Internally Glazed	2.3 (2.281)
84	Double	7mm topped aluminium	Double	24	6	12			6	1.1	Standard Aluminium	Internally Glazed	2.1 (2.125)
69	Single	7mm topped aluminium	Double	24	6	12			6	1.1	Warm Edge Spacer	Internally Glazed	2.2 (2.232)
85	Double	7mm topped aluminium	Double	24	6	12			6	1.1	Warm Edge Spacer	Internally Glazed	2.1 (2.079)
70	Single	7mm topped aluminium	Double	24	6	12			6	1.0	Standard Aluminium	Internally Glazed	2.2 (2.208)
86	Double	7mm topped aluminium	Double	24	6	12			6	1.0	Standard Aluminium	Internally Glazed	2 (2.049)
71	Single	7mm topped aluminium	Double	24	6	12			6	1.0	Warm Edge Spacer	Internally Glazed	2.2 (2.159)
87	Double	7mm topped aluminium	Double	24	6	12			6	1.0	Warm Edge Spacer	Internally Glazed	2 (2.003)
72	Single	7mm topped aluminium	Double	24.4	6.4	14			4	1.1	Standard Aluminium	Internally Glazed	2.2 (2.245)
88	Double	7mm topped aluminium	Double	24.4	6.4	14			4	1.1	Standard Aluminium	Internally Glazed	2.1 (2.092)
73	Single	7mm topped aluminium	Double	24.4	6.4	14			4	1.1	Warm Edge Spacer	Internally Glazed	2.2 (2.202)
89	Double	7mm topped aluminium	Double	24.4	6.4	14			4	1.1	Warm Edge Spacer	Internally Glazed	2.1 (2.05)
74	Single	7mm topped aluminium	Double	24.8	6.4	12			6.4	1.2	Standard Aluminium	Internally Glazed	2.4 (2.358)
90	Double	7mm topped aluminium	Double	24.8	6.4	12			6.4	1.2	Standard Aluminium	Internally Glazed	2.2 (2.205)
75	Single	7mm topped aluminium	Double	24.8	6.4	12			6.4	1.2	Warm Edge Spacer	Internally Glazed	2.3 (2.31)
91	Double	7mm topped aluminium	Double	24.8	6.4	12			6.4	1.2	Warm Edge Spacer	Internally Glazed	2.2 (2.16)
76	Single	7mm topped aluminium	Double	24.8	6.4	12			6.4	1.1	Standard Aluminium	Internally Glazed	2.3 (2.286)
92	Double	7mm topped aluminium	Double	24.8	6.4	12			6.4	1.1	Standard Aluminium	Internally Glazed	2.1 (2.13)
77	Single	7mm topped aluminium	Double	24.8	6.4	12			6.4	1.1	Warm Edge Spacer	Internally Glazed	2.2 (2.237)
93	Double	7mm topped aluminium	Double	24.8	6.4	12			6.4	1.1	Warm Edge Spacer	Internally Glazed	2.1 (2.084)
78	Single	7mm topped aluminium	Triple	24	4	6	4	6	4	0.9	Standard Aluminium	Internally Glazed	2.1 (2.085)
94	Double	7mm topped aluminium	Triple	24	4	6	4	6	4	0.9	Standard Aluminium	Internally Glazed	1.9 (1.925)
79	Single	7mm topped aluminium	Triple	24	4	6	4	6	4	0.8	Standard Aluminium	Internally Glazed	2 (2.01)
95	Double	7mm topped aluminium	Triple	24	4	6	4	6	4	0.8	Standard Aluminium	Internally Glazed	1.8 (1.846)
80	Single	N/A	N/A	35			thin insulated panel			0.75	N/A	Internally Glazed	2.8 (2.761)
96	Double	N/A	N/A	35			thin insulated panel			0.75	N/A	Internally Glazed	2.6 (2.564)
80(1)	Single	N/A	N/A	35			thin insulated panel			0.75	N/A	Internally Glazed	2.7 (2.716)
96(1)	Double	N/A	N/A	35			thin insulated panel			0.75	N/A	Internally Glazed	2.5 (2.52)
80(3)	Single	N/A	N/A	35			thin insulated panel			0.75	N/A	Internally Glazed	2.7 (2.676)
96(3)	Double	N/A	N/A	35			thin insulated panel			0.75	N/A	Internally Glazed	2.5 (2.481)
81	Single	7mm topped aluminium	N/A	78			thick insulated panel			0.35	N/A	Internally Glazed	1.8 (1.798)
97	Double	7mm topped aluminium	N/A	78			thick insulated panel			0.35	N/A	Internally Glazed	1.6 (1.613)
98	Single	N/A	N/A	35			thin insulated panel type 2			0.75	N/A	Internally Glazed	2 (2.006)
99	Double	N/A	N/A	35			thin insulated panel type 2			0.75	N/A	Internally Glazed	1.8 (1.838)

Notes

All 4mm and 6mm glasses are either annealed or toughened
All 6.4mm glasses are 6.4mm laminated safety glass (3/0.38/3)

Option	Opening Frame															
	Infill Insu		Infill		Lock Plate Insu		Lock Plate		Lock Plate		Projected width		ψ			
	Up	Ug	Ulp	Ulp	Ulp	UI	Overall	Frame	Insulated	Glazed	Insulated	Glazed		U-value		
66 & 82	1.169	1.200	0.855	0.855	0.759	0.759	244.0	54.0	0.5722	0.6447	0.2221	0.2280	0.3501	0.4167	6.483	0.067
67 & 83	1.169	1.200	0.855	0.855	0.759	0.759	244.0	54.0	0.5722	0.6293	0.2221	0.2280	0.3501	0.4013	6.483	0.051
68 & 84	1.169	1.100	0.855	0.855	0.759	0.759	244.0	54.0	0.5722	0.6290	0.2221	0.2090	0.3501	0.4200	6.483	0.070
69 & 85	1.169	1.100	0.855	0.855	0.759	0.759	244.0	54.0	0.5722	0.6132	0.2221	0.2090	0.3501	0.4042	6.483	0.054
70 & 86	1.169	1.000	0.855	0.855	0.759	0.759	244.0	54.0	0.5722	0.6134	0.2221	0.1900	0.3501	0.4234	6.483	0.073
71 & 87	1.169	1.000	0.855	0.855	0.759	0.759	244.0	54.0	0.5722	0.5973	0.2221	0.1900	0.3501	0.4073	6.483	0.057
72 & 88	1.153	1.100	0.855	0.855	0.759	0.759	244.0	54.0	0.5694	0.6171	0.2191	0.2090	0.3503	0.4081	6.488	0.058
73 & 89	1.153	1.100	0.855	0.855	0.759	0.759	244.0	54.0	0.5694	0.6030	0.2191	0.2090	0.3503	0.3940	6.488	0.044
74 & 90	1.138	1.200	0.855	0.855	0.759	0.759	244.0	54.0	0.5662	0.6464	0.2162	0.2280	0.3500	0.4184	6.481	0.068
75 & 91	1.138	1.200	0.855	0.855	0.759	0.759	244.0	54.0	0.5662	0.6307	0.2162	0.2280	0.3500	0.4027	6.481	0.053
76 & 92	1.138	1.100	0.855	0.855	0.759	0.759	244.0	54.0	0.5662	0.6308	0.2162	0.2090	0.3500	0.4218	6.481	0.072
77 & 93	1.138	1.100	0.855	0.855	0.759	0.759	244.0	54.0	0.5662	0.6147	0.2162	0.2090	0.3500	0.4057	6.481	0.056
78 & 94	1.169	0.900	0.855	0.855	0.759	0.759	244.0	54.0	0.5724	0.5810	0.2221	0.1710	0.3503	0.4100	6.487	0.060
79 & 95	1.169	0.800	0.855	0.855	0.759	0.759	244.0	54.0	0.5724	0.5644	0.2221	0.1520	0.3503	0.4124	6.487	0.062
80 & 96	0.855	0.759	0.855	0.855	0.759	0.759	229.0	39.0	0.4258	0.7994	0.1625	0.1442	0.2634	0.6552	6.753	0.392
(1)	0.855	0.759	0.855	0.855	0.759	0.759	229.0	39.0	0.4258	0.7849	0.1625	0.1442	0.2634	0.6407	6.753	0.377
(3)	0.855	0.759	0.855	0.855	0.759	0.759	229.0	39.0	0.4258	0.7719	0.1625	0.1442	0.2634	0.6277	6.753	0.364
81 & 97	0.417	0.346	0.855	0.855	0.759	0.759	244.0	54.0	0.4366	0.5327	0.0792	0.0657	0.3574	0.4670	6.618	0.110
98 & 99	0.855	0.750	0.855	0.855	0.759	0.759	229.0	39.0	0.4301	0.5550	0.1625	0.1425	0.2677	0.4125	6.863	0.145

Option	Stile	Projected width		Total heat loss		Infill heat loss		Frame heat loss		U-value	Ψ-value
		Overall	Frame	Insulated	Glazed	Insulated	Glazed	Insulated	Glazed		
		b	bf	L2d1	L2d2	L2dp	L2dg	L2df1	L2df2	Uf	Ψ
66 & 82		449.0	69.0	0.9062	1.0481	0.4442	0.4560	0.4620	0.5921	6.695	0.065
67 & 83		449.0	69.0	0.9062	1.0187	0.4442	0.4560	0.4620	0.5627	6.695	0.050
68 & 84		449.0	69.0	0.9062	1.0166	0.4442	0.4180	0.4620	0.5986	6.695	0.068
69 & 85		449.0	69.0	0.9062	0.9863	0.4442	0.4180	0.4620	0.5683	6.695	0.053
70 & 86		449.0	69.0	0.9062	0.9853	0.4442	0.3800	0.4620	0.6053	6.695	0.072
71 & 87		449.0	69.0	0.9062	0.9543	0.4442	0.3800	0.4620	0.5743	6.695	0.056
72 & 88		449.0	69.0	0.9004	0.9946	0.4381	0.4180	0.4623	0.5766	6.699	0.057
73 & 89		449.0	69.0	0.9004	0.9650	0.4381	0.4180	0.4623	0.5470	6.699	0.042
74 & 90		449.0	69.0	0.8932	1.0508	0.4324	0.4560	0.4608	0.5948	6.678	0.067
75 & 91		449.0	69.0	0.8932	1.0212	0.4324	0.4560	0.4608	0.5652	6.678	0.052
76 & 92		449.0	69.0	0.8932	1.0194	0.4324	0.4180	0.4608	0.6014	6.678	0.070
77 & 93		449.0	69.0	0.8932	0.9890	0.4324	0.4180	0.4608	0.5710	6.678	0.055
78 & 94		449.0	69.0	0.9063	0.9197	0.4442	0.3420	0.4621	0.5777	6.697	0.058
79 & 95		449.0	69.0	0.9063	0.8865	0.4442	0.3040	0.4621	0.5825	6.697	0.060
80 & 96		419.0	39.0	0.6260	1.3659	0.3249	0.2884	0.3011	1.0775	7.721	0.388
(1)		419.0	39.0	0.6258	1.3349	0.3249	0.2884	0.3009	1.0465	7.715	0.373
(3)		419.0	39.0	0.6258	1.3077	0.3249	0.2884	0.3009	1.0193	7.715	0.359
81 & 97		449.0	69.0	0.6367	0.8170	0.1585	0.1315	0.4782	0.6855	6.931	0.104
98 & 99		419.0	39.0	0.6277	0.8688	0.3249	0.2850	0.3028	0.5838	7.764	0.141

Option	Stile with Lock Plate														
	Projected width			Total heat loss			Infill heat loss			Frame heat loss					
	Overall	Frame	Insulated	Lock Plate Only	Glazing + Lock Plate	Infill	Lock Plate Insu	Lock Plate Insu	Lock Plate Only	Glazing + Lock Plate	U-value	Lock Plate	Glazing		
	b	bf	L2d1	L2d2	L2d3	L2dpi	L2dp	L2dipi	L2dip	L2df1	L2df2	L2df3	Uf	ψlp	ψg
66 & 82	434.0	54.0	0.7597	1.1326	1.2025	0.2221	0.2280	0.1625	0.1442	0.3751	0.7663	0.8303	6.947	0.391	0.064
67 & 83	434.0	54.0	0.7597	1.1326	1.1851	0.2221	0.2280	0.1625	0.1442	0.3751	0.7663	0.8129	6.947	0.391	0.047
68 & 84	434.0	54.0	0.7597	1.1326	1.1867	0.2221	0.2090	0.1625	0.1442	0.3751	0.7663	0.8335	6.947	0.391	0.067
69 & 85	434.0	54.0	0.7597	1.1326	1.1688	0.2221	0.2090	0.1625	0.1442	0.3751	0.7663	0.8156	6.947	0.391	0.049
70 & 86	434.0	54.0	0.7597	1.1326	1.1710	0.2221	0.1900	0.1625	0.1442	0.3751	0.7663	0.8368	6.947	0.391	0.071
71 & 87	434.0	54.0	0.7597	1.1326	1.1527	0.2221	0.1900	0.1625	0.1442	0.3751	0.7663	0.8185	6.947	0.391	0.052
72 & 88	434.0	54.0	0.7566	1.1294	1.1766	0.2191	0.2090	0.1625	0.1442	0.3751	0.7661	0.8234	6.946	0.391	0.057
73 & 89	434.0	54.0	0.7566	1.1294	1.1605	0.2191	0.2090	0.1625	0.1442	0.3751	0.7661	0.8073	6.946	0.391	0.041
74 & 90	434.0	54.0	0.7535	1.1262	1.2035	0.2162	0.2280	0.1625	0.1442	0.3748	0.7658	0.8313	6.941	0.391	0.066
75 & 91	434.0	54.0	0.7535	1.1262	1.1862	0.2162	0.2280	0.1625	0.1442	0.3748	0.7658	0.8140	6.941	0.391	0.048
76 & 92	434.0	54.0	0.7535	1.1262	1.1878	0.2162	0.2090	0.1625	0.1442	0.3748	0.7658	0.8346	6.941	0.391	0.069
77 & 93	434.0	54.0	0.7535	1.1262	1.1701	0.2162	0.2090	0.1625	0.1442	0.3748	0.7658	0.8169	6.941	0.391	0.051
78 & 94	434.0	54.0	0.7597	1.1326	1.1378	0.2221	0.1710	0.1625	0.1442	0.3751	0.7663	0.8226	6.947	0.391	0.056
79 & 95	434.0	54.0	0.7597	1.1326	1.1212	0.2221	0.1520	0.1625	0.1442	0.3751	0.7663	0.8250	6.947	0.391	0.059
80 & 96	419.0	39.0	0.6260	1.0057	1.3659	0.1625	0.1442	0.1625	0.1442	0.3011	0.6990	1.0775	7.721	0.398	0.378
(1)	419.0	39.0	0.6259	1.0056	1.3499	0.1625	0.1442	0.1625	0.1442	0.3010	0.6989	1.0615	7.718	0.398	0.363
(3)	419.0	39.0	0.6259	1.0055	1.3355	0.1625	0.1442	0.1625	0.1442	0.3010	0.6988	1.0471	7.718	0.398	0.348
81 & 97	434.0	54.0	0.6252	0.9997	1.0835	0.0792	0.0657	0.1625	0.1442	0.3835	0.7763	0.8736	7.102	0.393	0.097
98 & 99	419.0	39.0	0.6233	1.0033	1.1117	0.1625	0.1425	0.1625	0.1442	0.2984	0.6966	0.8250	7.651	0.398	0.128

Option	Lock Plate		Total heat loss			Infill heat loss			Frame heat loss			U-value	Lock Plate	Glazing		
	Projected width		Lock Plate	Glazing +	Infill	Infill	Lock Plate	Insulated	Lock Plate	Glazing +	Uf				ψlp	ψg
	Overall	Frame	Only	Lock Plate	Insu	L2dp	L2dipi	L2df1	Only	Lock Plate						
	b	bf	L2d1	L2d2	L2d3	L2dpi	L2dipi	L2df1	L2df2	L2df3						
66 & 82	410.0	30.0	0.6283	0.9924	1.0622	0.2221	0.1625	0.2437	0.6261	0.6900	8.125	0.382	0.064			
67 & 83	410.0	30.0	0.6283	0.9924	1.0450	0.2221	0.1625	0.2437	0.6261	0.6728	8.125	0.382	0.047			
68 & 84	410.0	30.0	0.6283	0.9924	1.0464	0.2221	0.1625	0.2437	0.6261	0.6932	8.125	0.382	0.067			
69 & 85	410.0	30.0	0.6283	0.9924	1.0288	0.2221	0.1625	0.2437	0.6261	0.6756	8.125	0.382	0.050			
70 & 86	410.0	30.0	0.6283	0.9924	1.0308	0.2221	0.1625	0.2437	0.6261	0.6966	8.125	0.382	0.071			
71 & 87	410.0	30.0	0.6283	0.9924	1.0128	0.2221	0.1625	0.2437	0.6261	0.6786	8.125	0.382	0.053			
72 & 88	410.0	30.0	0.6254	0.9894	1.0360	0.2191	0.1625	0.2439	0.6261	0.6828	8.129	0.382	0.057			
73 & 89	410.0	30.0	0.6254	0.9894	1.0201	0.2191	0.1625	0.2439	0.6261	0.6669	8.129	0.382	0.041			
74 & 90	410.0	30.0	0.6222	0.9858	1.0635	0.2162	0.1625	0.2435	0.6254	0.6913	8.118	0.382	0.066			
75 & 91	410.0	30.0	0.6222	0.9858	1.0461	0.2162	0.1625	0.2435	0.6254	0.6739	8.118	0.382	0.049			
76 & 92	410.0	30.0	0.6222	0.9858	1.0478	0.2162	0.1625	0.2435	0.6254	0.6946	8.118	0.382	0.069			
77 & 93	410.0	30.0	0.6222	0.9858	1.0300	0.2162	0.1625	0.2435	0.6254	0.6768	8.118	0.382	0.051			
78 & 94	410.0	30.0	0.6283	0.9923	0.9979	0.2221	0.1625	0.2437	0.6260	0.6827	8.125	0.382	0.057			
79 & 95	410.0	30.0	0.6283	0.9923	0.9813	0.2221	0.1625	0.2437	0.6260	0.6851	8.125	0.382	0.059			
80 & 96	395.0	15.0	0.4856	0.8604	1.2236	0.1625	0.1625	0.1607	0.5537	0.9352	10.713	0.393	0.381			
(1)	395.0	15.0	0.4856	0.8605	1.2074	0.1625	0.1625	0.1607	0.5538	0.9190	10.713	0.393	0.365			
(3)	395.0	15.0	0.4856	0.8605	1.1932	0.1625	0.1625	0.1607	0.5538	0.9048	10.713	0.393	0.351			
81 & 97	410.0	30.0	0.4887	0.8549	0.9409	0.0792	0.1625	0.2470	0.6315	0.7310	8.234	0.384	0.099			
98 & 99	395.0	15.0	0.4831	0.8584	0.9710	0.1625	0.1625	0.1582	0.5517	0.6843	10.547	0.394	0.133			

Option	Summary			Lock Plate			Opening Frame			Stile with Infill Both Sides			Stile with Lock Plate One Side			Lock Plate Divider		
	Infill U-value	U-value	ψ	U-value	U-value	ψ	Width	U-value	ψ	ψ	Width	U-value	ψ	ψ	Width	U-value	ψ	ψ
66 & 82	1.200	0.759	0.0666	69.0	6.6954	0.0651	69.0	6.4831	0.0666	0.0651	54.0	6.9470	0.0640	30.0	8.1247	0.0639	0.3823	
67 & 83	1.200	0.759	0.0512	69.0	6.6954	0.0504	69.0	6.4831	0.0512	0.0504	54.0	6.9470	0.0466	30.0	8.1247	0.0467	0.3823	
68 & 84	1.100	0.759	0.0699	69.0	6.6954	0.0683	69.0	6.4831	0.0699	0.0683	54.0	6.9470	0.0672	30.0	8.1247	0.0671	0.3823	
69 & 85	1.100	0.759	0.0541	69.0	6.6954	0.0532	69.0	6.4831	0.0541	0.0532	54.0	6.9470	0.0493	30.0	8.1247	0.0495	0.3823	
70 & 86	1.000	0.759	0.0733	69.0	6.6954	0.0717	69.0	6.4831	0.0733	0.0717	54.0	6.9470	0.0705	30.0	8.1247	0.0705	0.3823	
71 & 87	1.000	0.759	0.0572	69.0	6.6954	0.0562	69.0	6.4831	0.0572	0.0562	54.0	6.9470	0.0522	30.0	8.1247	0.0525	0.3823	
72 & 88	1.100	0.759	0.0578	69.0	6.6994	0.0572	69.0	6.4876	0.0578	0.0572	54.0	6.9459	0.0573	30.0	8.1293	0.0567	0.3822	
73 & 89	1.100	0.759	0.0437	69.0	6.6994	0.0424	69.0	6.4876	0.0437	0.0424	54.0	6.9459	0.0412	30.0	8.1293	0.0408	0.3822	
74 & 90	1.200	0.759	0.0684	69.0	6.6777	0.0670	69.0	6.4811	0.0684	0.0670	54.0	6.9413	0.0655	30.0	8.1177	0.0659	0.3818	
75 & 91	1.200	0.759	0.0527	69.0	6.6777	0.0522	69.0	6.4811	0.0527	0.0522	54.0	6.9413	0.0482	30.0	8.1177	0.0485	0.3818	
76 & 92	1.100	0.759	0.0718	69.0	6.6777	0.0703	69.0	6.4811	0.0718	0.0703	54.0	6.9413	0.0688	30.0	8.1177	0.0692	0.3818	
77 & 93	1.100	0.759	0.0557	69.0	6.6777	0.0551	69.0	6.4811	0.0557	0.0551	54.0	6.9413	0.0511	30.0	8.1177	0.0514	0.3818	
78 & 94	0.900	0.759	0.0597	69.0	6.6968	0.0578	69.0	6.4869	0.0597	0.0578	54.0	6.9470	0.0563	30.0	8.1247	0.0567	0.3822	
79 & 95	0.800	0.759	0.0621	69.0	6.6968	0.0602	69.0	6.4869	0.0621	0.0602	54.0	6.9470	0.0587	30.0	8.1247	0.0591	0.3822	
80 & 96	0.759	0.759	0.3918	39.0	7.7205	0.3882	39.0	6.7526	0.3918	0.3882	39.0	7.7205	0.3784	15.0	10.7133	0.3814	0.3930	
(1)	0.759	0.759	0.3773	39.0	7.7154	0.3728	39.0	6.7526	0.3773	0.3728	39.0	7.7179	0.3625	15.0	10.7133	0.3651	0.3931	
(3)	0.759	0.759	0.3643	39.0	7.7154	0.3592	39.0	6.7526	0.3643	0.3592	39.0	7.7179	0.3482	15.0	10.7133	0.3509	0.3931	
81 & 97	0.346	0.759	0.1096	69.0	6.9310	0.1036	69.0	6.6180	0.1096	0.1036	54.0	7.1022	0.0973	30.0	8.2340	0.0995	0.3844	
98 & 99	0.750	0.759	0.1449	39.0	7.7641	0.1405	39.0	6.8628	0.1449	0.1405	39.0	7.6513	0.1284	15.0	10.5467	0.1326	0.3935	

Option	Opening frame with infill				Opening frame with lock plate				Lock plate divider frame					
	Area	Length	Infill	Heat loss U ψ	Area	Length	Infill	Heat loss U ψ	Area	Length	Infill	Lock plate Length	U	ψ_1
66 & 82	Af	Lf	q1	q2	Af	Lf	q3	q4	Af	Lf1	Lf2	q5	q6	q7
67 & 83	0.3005	5.3480	1.9479	0.3562	0.0119	0.1600	0.0770	0.0107	0.0146	0.5460	0.4260	0.1185	0.0349	0.1629
68 & 84	0.3005	5.3480	1.9479	0.2739	0.0119	0.1600	0.0770	0.0082	0.0146	0.5460	0.4260	0.1185	0.0255	0.1629
69 & 85	0.3005	5.3480	1.9479	0.3739	0.0119	0.1600	0.0770	0.0112	0.0146	0.5460	0.4260	0.1185	0.0366	0.1629
70 & 86	0.3005	5.3480	1.9479	0.2894	0.0119	0.1600	0.0770	0.0087	0.0146	0.5460	0.4260	0.1185	0.0270	0.1629
71 & 87	0.3005	5.3480	1.9479	0.3921	0.0119	0.1600	0.0770	0.0117	0.0146	0.5460	0.4260	0.1185	0.0385	0.1629
72 & 88	0.3005	5.3480	1.9492	0.3060	0.0119	0.1600	0.0770	0.0092	0.0146	0.5460	0.4260	0.1185	0.0287	0.1629
73 & 89	0.3005	5.3480	1.9492	0.3090	0.0119	0.1600	0.0771	0.0092	0.0146	0.5460	0.4260	0.1185	0.0309	0.1628
74 & 90	0.3005	5.3480	1.9473	0.2335	0.0119	0.1600	0.0771	0.0070	0.0146	0.5460	0.4260	0.1185	0.0223	0.1628
75 & 91	0.3005	5.3480	1.9473	0.3659	0.0119	0.1600	0.0770	0.0109	0.0146	0.5460	0.4260	0.1184	0.0360	0.1627
76 & 92	0.3005	5.3480	1.9473	0.2819	0.0119	0.1600	0.0770	0.0084	0.0146	0.5460	0.4260	0.1184	0.0265	0.1627
77 & 93	0.3005	5.3480	1.9473	0.3841	0.0119	0.1600	0.0770	0.0115	0.0146	0.5460	0.4260	0.1184	0.0378	0.1627
78 & 94	0.3005	5.3480	1.9473	0.2980	0.0119	0.1600	0.0770	0.0089	0.0146	0.5460	0.4260	0.1184	0.0281	0.1627
79 & 95	0.3005	5.3480	1.9490	0.3193	0.0119	0.1600	0.0771	0.0096	0.0146	0.5460	0.4260	0.1185	0.0310	0.1628
80 & 96	0.3005	5.3480	1.9490	0.3322	0.0119	0.1600	0.0771	0.0099	0.0146	0.5460	0.4260	0.1185	0.0323	0.1628
(1)	0.2205	5.4980	1.4890	2.1543	0.0074	0.1600	0.0500	0.0627	0.0068	0.4860	0.4260	0.0733	0.1854	0.1674
(3)	0.2205	5.4980	1.4890	2.0746	0.0074	0.1600	0.0500	0.0604	0.0068	0.4860	0.4260	0.0733	0.1775	0.1675
81 & 97	0.2205	5.4980	1.4890	2.0031	0.0074	0.1600	0.0500	0.0583	0.0068	0.4860	0.4260	0.0733	0.1706	0.1675
98 & 99	0.3005	5.3480	1.9884	0.5861	0.0119	0.1600	0.0786	0.0175	0.0146	0.5460	0.4260	0.1201	0.0543	0.1638
	0.2205	5.4980	1.5133	0.7964	0.0074	0.1600	0.0509	0.0232	0.0068	0.4860	0.4260	0.0721	0.0644	0.1676

Option	Infill		Lock plate		Total		Average	
	Area	Heat loss U	Area	Heat loss U	Heat loss	Area	U-value	U-value
	Ag	qg	Alp	qg	qtot	Atot	Usingle	
66 & 82	1.6518	1.9822	0.0213	0.0162	4.7064	2.0000	2.353	
67 & 83	1.6518	1.9822	0.0213	0.0162	4.6121	2.0000	2.306	
68 & 84	1.6518	1.8170	0.0213	0.0162	4.5611	2.0000	2.281	
69 & 85	1.6518	1.8170	0.0213	0.0162	4.4645	2.0000	2.232	
70 & 86	1.6518	1.6518	0.0213	0.0162	4.4165	2.0000	2.208	
71 & 87	1.6518	1.6518	0.0213	0.0162	4.3180	2.0000	2.159	
72 & 88	1.6518	1.8170	0.0213	0.0162	4.4899	2.0000	2.245	
73 & 89	1.6518	1.8170	0.0213	0.0162	4.4036	2.0000	2.202	
74 & 90	1.6518	1.9822	0.0213	0.0162	4.7165	2.0000	2.358	
75 & 91	1.6518	1.9822	0.0213	0.0162	4.6205	2.0000	2.310	
76 & 92	1.6518	1.8170	0.0213	0.0162	4.5718	2.0000	2.286	
77 & 93	1.6518	1.8170	0.0213	0.0162	4.4734	2.0000	2.237	
78 & 94	1.6518	1.4866	0.0213	0.0162	4.1700	2.0000	2.085	
79 & 95	1.6518	1.3214	0.0213	0.0162	4.0193	2.0000	2.010	
80 & 96	1.7440	1.3237	0.0213	0.0162	5.5220	2.0000	2.761	
(1)	1.7440	1.3237	0.0213	0.0162	5.4320	2.0000	2.716	
(3)	1.7440	1.3237	0.0213	0.0162	5.3516	2.0000	2.676	
81 & 97	1.6518	0.5715	0.0213	0.0162	3.5965	2.0000	1.798	
98 & 99	1.7440	1.3080	0.0213	0.0162	4.0120	2.0000	2.006	

Option	Opening frame with infill				Stile with infill both sides				Stile with lock plate one side					
	Area	Length	U	Heat loss ψ	Area	Length	U	Heat loss ψ	Area	Infill	Length	U	Heat loss ψ_1	ψ_2
66 & 82	Af	Lf	q1	q2	Af	Lf	q3	q4	Af	Lf1	Lf2	q5	q6	q7
67 & 83	0.4203	7.4300	2.7251	0.4949	0.1195	3.4040	0.8001	0.2215	0.0086	0.1600	0.1600	0.0600	0.0102	0.0626
68 & 84	0.4203	7.4300	2.7251	0.3805	0.1195	3.4040	0.8001	0.1714	0.0086	0.1600	0.1600	0.0600	0.0075	0.0626
69 & 85	0.4203	7.4300	2.7251	0.5194	0.1195	3.4040	0.8001	0.2325	0.0086	0.1600	0.1600	0.0600	0.0108	0.0626
70 & 86	0.4203	7.4300	2.7251	0.4020	0.1195	3.4040	0.8001	0.1810	0.0086	0.1600	0.1600	0.0600	0.0079	0.0626
71 & 87	0.4203	7.4300	2.7251	0.5447	0.1195	3.4040	0.8001	0.2439	0.0086	0.1600	0.1600	0.0600	0.0113	0.0626
72 & 88	0.4203	7.4300	2.7270	0.4251	0.1195	3.4040	0.8006	0.1912	0.0086	0.1600	0.1600	0.0600	0.0084	0.0626
73 & 89	0.4203	7.4300	2.7270	0.4292	0.1195	3.4040	0.8006	0.1946	0.0086	0.1600	0.1600	0.0600	0.0092	0.0626
74 & 90	0.4203	7.4300	2.7270	0.3245	0.1195	3.4040	0.8006	0.1442	0.0086	0.1600	0.1600	0.0600	0.0066	0.0626
75 & 91	0.4203	7.4300	2.7242	0.5084	0.1195	3.4040	0.7980	0.2281	0.0086	0.1600	0.1600	0.0600	0.0105	0.0626
76 & 92	0.4203	7.4300	2.7242	0.3917	0.1195	3.4040	0.7980	0.1778	0.0086	0.1600	0.1600	0.0600	0.0077	0.0626
77 & 93	0.4203	7.4300	2.7242	0.5336	0.1195	3.4040	0.7980	0.2394	0.0086	0.1600	0.1600	0.0600	0.0110	0.0626
78 & 94	0.4203	7.4300	2.7242	0.4140	0.1195	3.4040	0.7980	0.1876	0.0086	0.1600	0.1600	0.0600	0.0082	0.0626
79 & 95	0.4203	7.4300	2.7267	0.4436	0.1195	3.4040	0.8003	0.1968	0.0086	0.1600	0.1600	0.0600	0.0090	0.0626
80 & 96	0.3059	7.6100	2.0657	0.4615	0.1195	3.4040	0.8003	0.2050	0.0086	0.1600	0.1600	0.0600	0.0094	0.0626
(1)	0.3059	7.6100	2.0657	2.9819	0.0687	3.4940	0.5305	1.3563	0.0062	0.1600	0.1600	0.0482	0.0606	0.0637
(3)	0.3059	7.6100	2.0657	2.8716	0.0687	3.4940	0.5302	1.3025	0.0062	0.1600	0.1600	0.0482	0.0580	0.0637
81 & 97	0.4203	7.4300	2.7818	2.7726	0.1195	3.4040	0.5302	1.2550	0.0062	0.1600	0.1600	0.0482	0.0557	0.0637
98 & 99	0.3059	7.6100	2.0994	0.8143	0.1195	3.4040	0.8283	0.3528	0.0086	0.1600	0.1600	0.0614	0.0156	0.0628
				1.1023	0.0687	3.4940	0.5335	0.4909	0.0062	0.1600	0.1600	0.0477	0.0205	0.0637

Option	Lock plate divider frame				Infill			Lock plate			Total			Average U-value
	Area	Length	Length	Lock plate	U	ψ1	ψ2	Area	Heat loss U	Area	Heat loss U	Area	Heat loss U	
	Af	Lf1	Lf2		q8	q9	q10	Ag	q11	Alp	q12	qtot	Atot	Usingle
66 & 82	0.0146	0.5460	0.4560		0.1013	0.0349	0.1784	3.4133	4.0959	0.0237	0.0180	8.8030	4.0000	2.201
67 & 83	0.0146	0.5460	0.4560		0.1013	0.0254	0.1784	3.4133	4.0959	0.0237	0.0180	8.6262	4.0000	2.157
68 & 84	0.0146	0.5460	0.4560		0.1013	0.0367	0.1784	3.4133	3.7546	0.0237	0.0180	8.4995	4.0000	2.125
69 & 85	0.0146	0.5460	0.4560		0.1013	0.0269	0.1784	3.4133	3.7546	0.0237	0.0180	8.3179	4.0000	2.079
70 & 86	0.0146	0.5460	0.4560		0.1013	0.0385	0.1784	3.4133	3.4133	0.0237	0.0180	8.1971	4.0000	2.049
71 & 87	0.0146	0.5460	0.4560		0.1013	0.0285	0.1784	3.4133	3.4133	0.0237	0.0180	8.0118	4.0000	2.003
72 & 88	0.0146	0.5460	0.4560		0.1013	0.0313	0.1783	3.4133	3.7546	0.0237	0.0180	8.3666	4.0000	2.092
73 & 89	0.0146	0.5460	0.4560		0.1013	0.0225	0.1783	3.4133	3.7546	0.0237	0.0180	8.2001	4.0000	2.050
74 & 90	0.0146	0.5460	0.4560		0.1012	0.0358	0.1783	3.4133	4.0959	0.0237	0.0180	8.8209	4.0000	2.205
75 & 91	0.0146	0.5460	0.4560		0.1012	0.0263	0.1783	3.4133	4.0959	0.0237	0.0180	8.6417	4.0000	2.160
76 & 92	0.0146	0.5460	0.4560		0.1012	0.0376	0.1783	3.4133	3.7546	0.0237	0.0180	8.5184	4.0000	2.130
77 & 93	0.0146	0.5460	0.4560		0.1012	0.0279	0.1783	3.4133	3.7546	0.0237	0.0180	8.3346	4.0000	2.084
78 & 94	0.0146	0.5460	0.4560		0.1013	0.0307	0.1784	3.4133	3.0719	0.0237	0.0180	7.6993	4.0000	1.925
79 & 95	0.0146	0.5460	0.4560		0.1013	0.0321	0.1784	3.4133	2.7306	0.0237	0.0180	7.3857	4.0000	1.846
80 & 96	0.0068	0.4860	0.4260		0.0528	0.1839	0.1695	3.5910	2.7256	0.0213	0.0162	10.2549	4.0000	2.564
(1)	0.0068	0.4860	0.4260		0.0528	0.1762	0.1695	3.5910	2.7256	0.0213	0.0162	10.0801	4.0000	2.520
(3)	0.0068	0.4860	0.4260		0.0528	0.1692	0.1695	3.5910	2.7256	0.0213	0.0162	9.9243	4.0000	2.481
81 & 97	0.0146	0.5460	0.4560		0.1036	0.0531	0.1791	3.4133	1.1810	0.0237	0.0180	6.4516	4.0000	1.613
98 & 99	0.0068	0.4860	0.4260		0.0523	0.0624	0.1697	3.5910	2.6933	0.0213	0.0162	7.3520	4.0000	1.838