



THERMAL MODELLING REPORT

TP11443-003

REPORT ON EVS THERMAL PERFORMANCE

CLIENT

BRANZ Ltd for EVS Ltd

All tests and procedures reported herein, unless indicated, have been performed in accordance with BRANZ ISO9001:2015 Certification



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LIMITATION

The results reported here relate only to the item/s assessed.

TERMS AND CONDITIONS

This report is issued in accordance with the Terms and Conditions as detailed and agreed in the BRANZ Services Agreement for this work.

SIGNATORIES



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1. SCOPE

Thermal modelling of the performance of EVS secondary glazing systems over existing timber and steel-framed window systems was undertaken. This was to provide information about the thermal improvement offered by adding the EVS system into existing window systems.

The scope of the work is as below:

Model the thermal performance of three IGUs each in three different sized timber-framed window sashes. Repeat the modelling in a steel framed system.

The sash sizes are:

- 1) Toilet window of 500 x 600 mm (with and without astragal bars)
- 2) Bedroom window of 600 x 1200 mm
- 3) Lounge window of 1200 x 1200 mm

IGUs are:

- A) 4/6/4 clear
- B) 4/6/4 clear with a low emissivity pane
- C) 4/6/4 clear with a high performance low emissivity pane and Argon gas fill

The details of the three IGUs are listed in the table below.

IGU	Details	Emissivity of low-E pane	U _{cog} W/m ² K
4/6/4 clear	Clear float glass, generic spacer with air fill	0.84	3.28
4/6/4 low-E	Clear float glass in inner pane, Climaguard N70 4 mm in outer pane, generic spacer with air fill	0.171	2.65
4/6/4 low-E Argon	Clear float glass in inner pane, Energy NT 4 mm in outer pane, generic spacer with 90% pure Argon gas fill	0.024	1.98

In the 4/6/4 nomenclature, the 4 refers to the 4 mm thickness of the outside pane, the 6 to the 6 mm air gap between panes, and the final 4 to the 4 mm thickness of the inside pane.

2. PRODUCT

A typical timber window sash and a typical steel window sash and frame with and without the EVS edge support system clips was modelled.

The EVS system was built up as shown in Figure 1 and Figure 2 in sections, where the clips are used around all four sides of a new IGU that is installed over the top of existing single



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glazing, with a 9 mm gap between the inside face of the new IGU and the outside face of the existing single glazing.

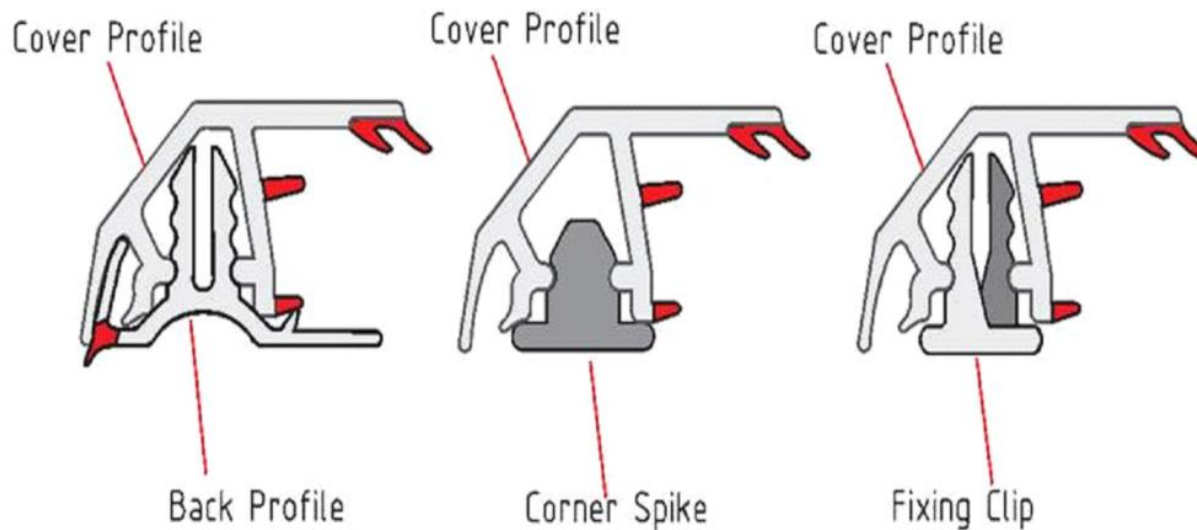


Figure 1: fixing co-extruded uPVC fixing clip

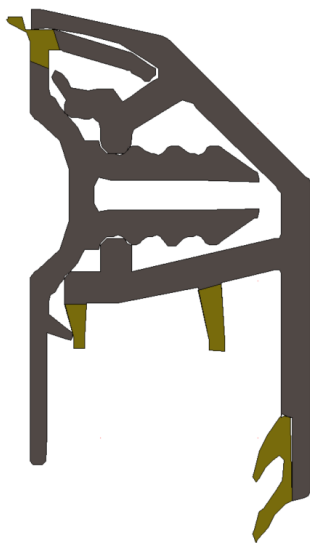


Figure 2: Section through EVS fixing clip as rendered in flixo model.

3. METHOD

The 2D flixo.pro thermal modelling software was used to calculate the thermal performances noted below. The U value of the plan area through the middle of a 2-D window elevation was modelled for each specific sash height, including the sill (below the glazing only), glazing and head (above the glazing only), omitting the jambs. The thermal performance of the head (without glazing) was also modelled. Actual timber sash profiles were used for the timber, using steel profiles from a typical steel window system. Ventilation of the space between the IGU and the existing single glazing was assumed to be low through the approximately 3mm diameter holes in the sides of the EVS clip system. Since the 'Partially ventilated' option in

flixo expects a continuous slot of between 5 and 20 mm wide, the option of 'Unventilated cavity' was chosen, as can be seen in Figure 5.

This allowed a calculation for the U (R) value to be undertaken by using the complete length of the jambs, and determining the proportion of total window area taken up by the strip through the head, glazing and sill for a sash in the same length as was modelled. Then, the proportion of the total window area taken up by the two jambs is calculated. These two proportions are multiplied by the U (or R) values calculated by flixo to determine the U value of the complete window in each size, for each glazing system. This method required each sash size to be modelled separately since the sill and head were included in the central model.

The smallest size was a sash of 500 wide by 600 mm high, with a crucifix astragal bar and 6 mm single glazing – See Figure 3, with Figure 4 showing the same cross-section without the astragal bars. The EVS glazing edge clip was then added into the model based on measurements taken from the actual extrusion and fixings, complete with a 4/6/4 IGU installed over the top of the single glazing, as in Figure 5.

The two other sash sizes were modelled at 1200 mm high (600 x 1200, and 1200 x 1200 mm) separately so that the same U value combination method could be used, as in Figure 6.

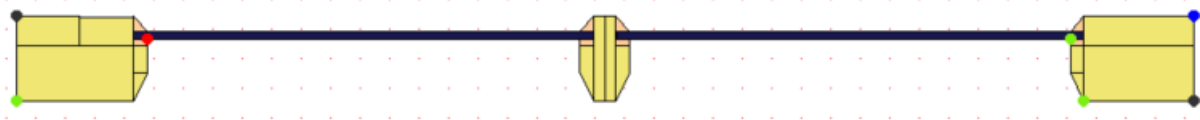


Figure 3: flixo model of base timber-framed single glazing

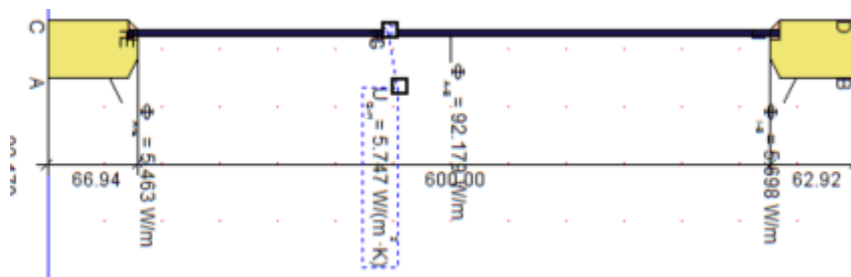


Figure 4: flixo model of base timber framed sash without astragal bars

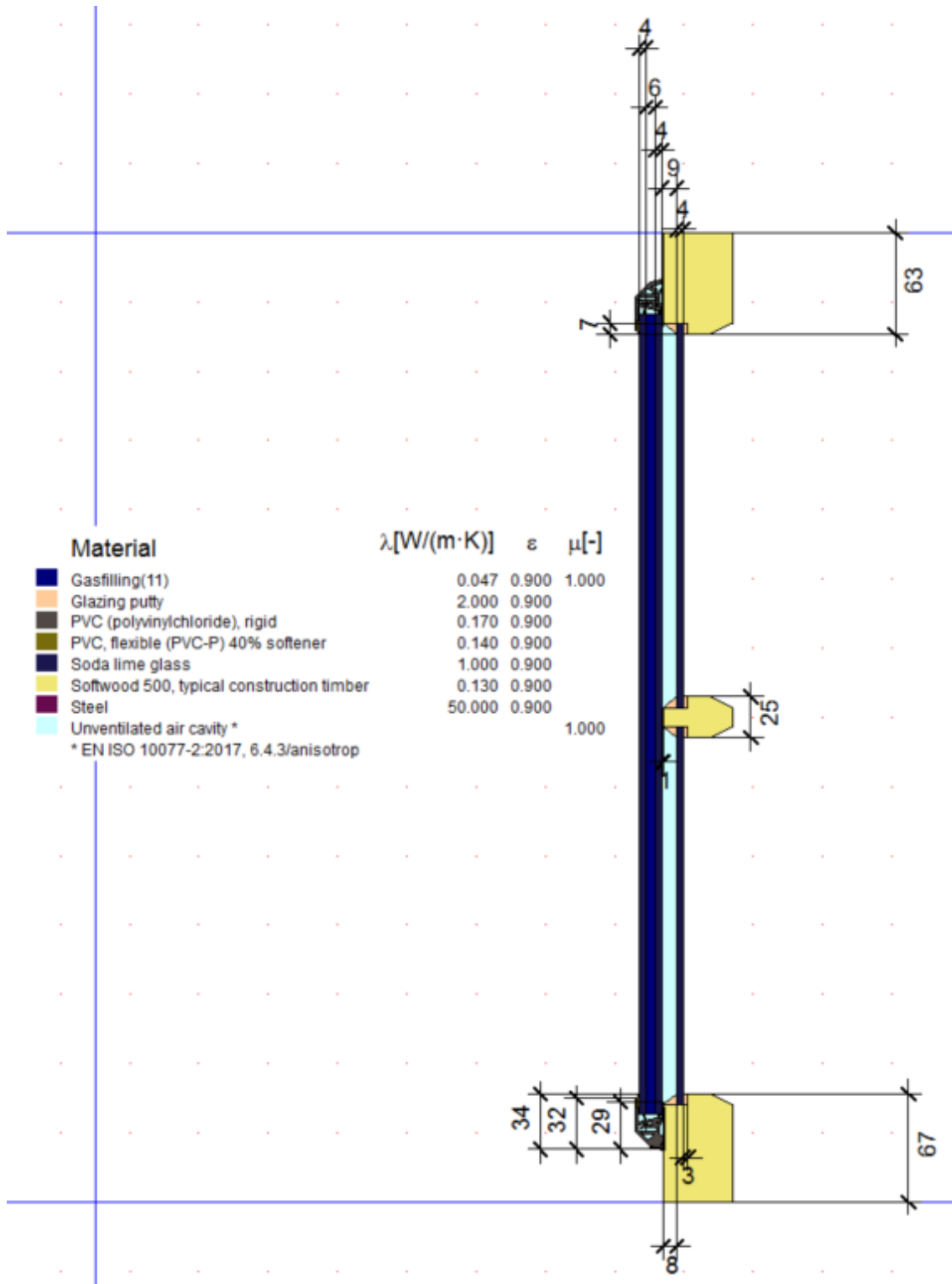


Figure 5: flixo model with dimensions and materials for the 500 x 600 mm sash with astragal bars

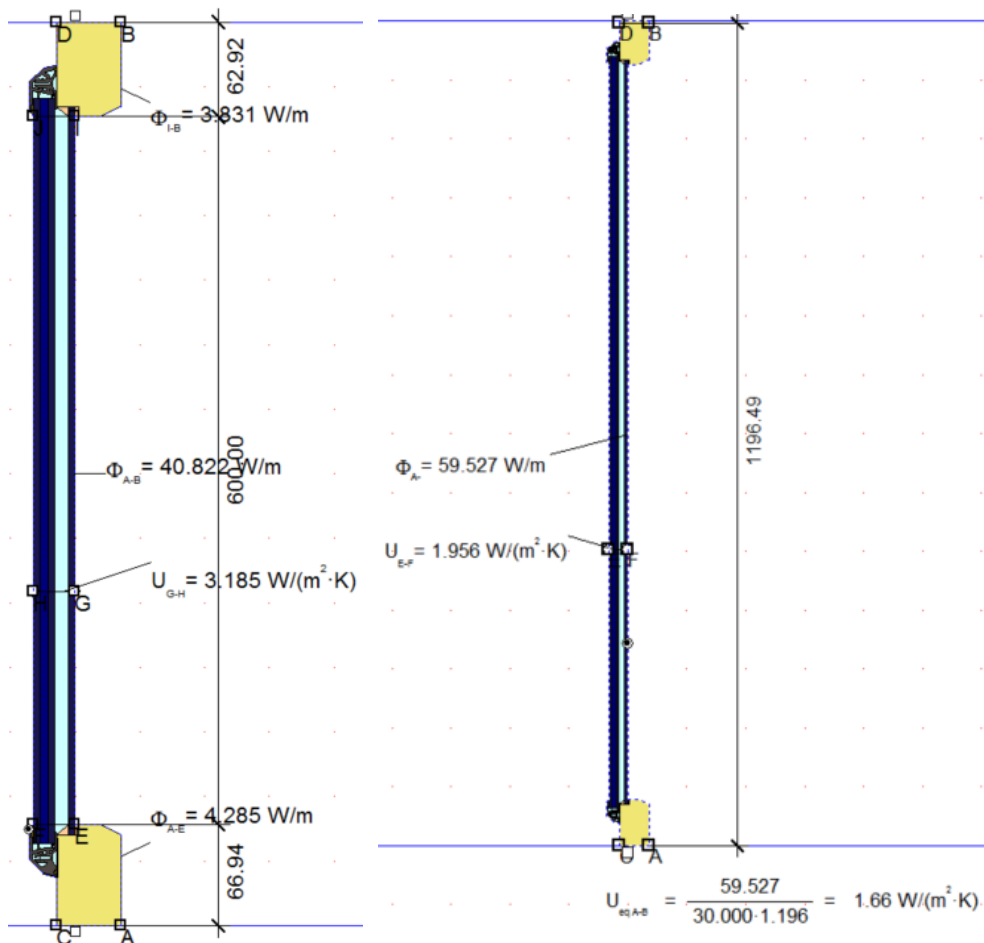


Figure 6: Report 3 - timber framed window with clear 4/6/4 IGU with low emissivity pane and Argon gas in 600 mm height and 1200 mm height

Figure 7 shows the typical calculation undertaken to calculate the total product performance from the partial thermal models undertaken by flixo.

500 x 600 4/6/4 clear w/o astragal bar report 1						
	height	width	Area (m ²)	%	U	R
Overall	0.6	0.5	0.3	1		
jamb 1	0.6	0.067	0.040	0.13		
jamb 2	0.6	0.067	0.040	0.13		
Head	0.067	0.366	0.025	0.08		
Sill	0.067	0.366	0.025	0.08		
Glazing unit (4/6/4)	0.466	0.366	0.171	0.57	3.28	0.3049
Totals			0.3	1.00		
Vertical U/R	0.6	0.366	0.2196	0.73	2.27	0.44
Head (jambs)	0.60	0.134	0.0804	0.268	2.13	0.47
totals		0.5		1.00	2.23	0.45

Figure 7: Example calculation of total R value from flixo calculations for model 1

The flixo model built for a large steel-framed single glazing system with large un-covered outer frame is shown in Figure 8, and the EVS clip system adding in the IGU with three different glazing systems.

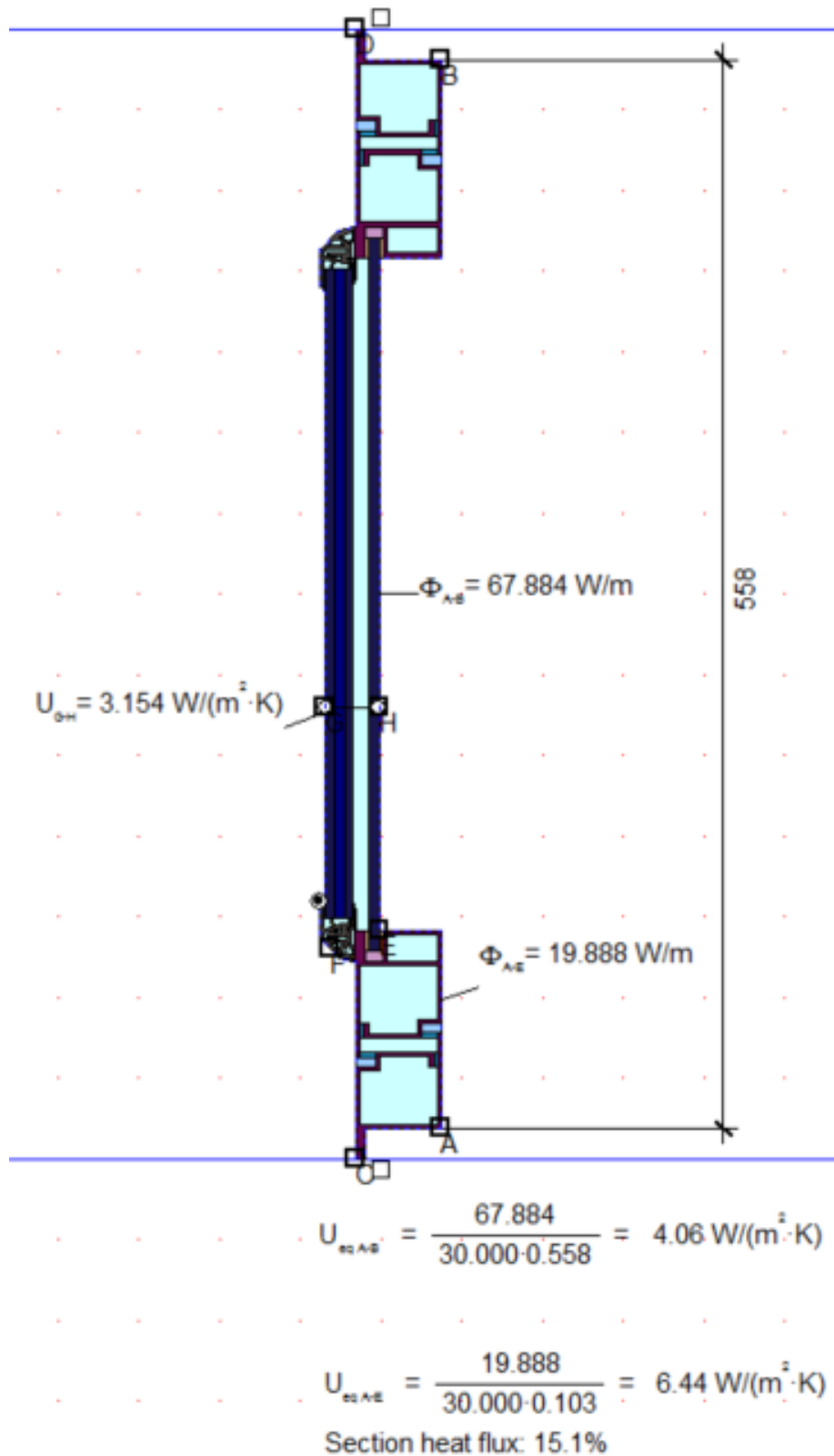


Figure 8: Report 10 – large format steel framed window with clear 4/6/4 IGU in 500 x 600 mm size



4. RESULTS

Results are reported as below.

Timber framed models										
	Ucog	Rcog	Size (m)	R	Size (m)	R	Size (m)	R	Size (m)	R
	W/m ² K	m ² K/W	0.5 x 0.6	m ² K/W	0.5 x 0.6	m ² K/W	0.6 x 1.2	m ² K/W	1.2 x 1.2	m ² K/W
Single clear only			Base with astragal bars	0.22	Base without astragal bars	0.22	Base	0.20	Base	0.19
+ 4/6/4 clear	3.28	0.30	Model 1*	0.43	Model 1	0.45	Model 4	0.45	Model 7	0.45
+ 4/6/4 low-E	2.65	0.38	Model 2*	0.49	Model 2	0.50	Model 5	0.50	Model 8	0.50
+ 4/6/4 low-E Arg	1.98	0.51	Model 3*	0.55	Model 3	0.56	Model 6	0.58	Model 9	0.59

Table 1: Timber framed system performance

Here it can be seen in the first line of results in Table 1 that the basic single clear timber sash modelled as the toilet window with 500 x 600 mm sash starts with an R value of 0.22 m²K/W with a single crossing astragal bar. Removing the astragal bar reduces the R value, but this is less than 0.01 m²K/W, so is not reported. The outer frame is not modelled, although it has an R value of between 0.4 and 0.5 m²K/W. The larger sash (bedroom window) without astragal bars (600 x 1200 mm) has a slightly lower (poorer) R value of 0.20 m²K/W. The lounge window (largest sash) of 1200 x 1200 has an R value of 0.19 m²K/W, which is the value used in the New Zealand Standard NZS 4218:2009 (Small Building Energy Efficiency) for timber framed single glazing.

When the EVS system with a basic 4/6/4 double glazing unit (IGU) is added with the edge clips and support, the R value for the sash with the smallest pane (model 1) doubles from 0.22 to 0.43 m²K/W with astragal bars, or 0.45 m²K/W without the astragal bars. (Second line of data in Table 1). The best thermal performance of 0.59 m²K/W is achieved with the largest pane (1200 x 1200 mm) and the 4/6/4 IGU with a high-performance low emissivity pane and Argon gas fill.

Steel framed models									
	Ucog	Rcog	Size (m)	R	Size (m)	R	Size (m)	R	
			0.5 x 0.6	m ² K/W	0.6 x 1.2	m ² K/W	1.2 x 1.2	m ² K/W	
Single clear only			Base	0.16	Base	0.16	Base	0.16	
+ 4/6/4 clear	3.28	0.30	Model 10	0.21	Model 13	0.26	Model 16	0.29	
+ 4/6/4 low-E	2.65	0.38	Model 11	0.22	Model 14	0.28	Model 17	0.31	
+ 4/6/4 low-E Argon	1.98	0.51	Model 12	0.23	Model 15	0.29	Model 18	0.33	

Table 2: Steel framed system performance

In

Steel framed models									
	Ucog	Rcog	Size (m)	R	Size (m)	R	Size (m)	R	
			0.5 x 0.6	m ² K/W	0.6 x 1.2	m ² K/W	1.2 x 1.2	m ² K/W	
Single clear only			Base	0.16	Base	0.16	Base	0.16	



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+ 4/6/4 clear	3.28	0.30	Model 10	0.21	Model 13	0.26	Model 16	0.29
+ 4/6/4 low-E	2.65	0.38	Model 11	0.22	Model 14	0.28	Model 17	0.31
+ 4/6/4 low-E Argon	1.98	0.51	Model 12	0.23	Model 15	0.29	Model 18	0.33

Table 2 it can be seen that the smallest steel framed single glazing system with outer frame starts at an R value of 0.16 m²K/W, and increases to 0.33 m²K/W in the largest pane with the high-performance low emissivity glass and Argon gas fill. This model was undertaken with a large uncovered outer frame, and represents the poorest performance that would be achieved with the EVS system added over a steel framing system.

It is expected that if modelling was undertaken purely on a steel sash (not including the outer frame), or with the exterior steel framing covered with an insulating material, that the thermal performance would be significantly improved.

5. REFERENCES

NZS 4218:2009 Small building Energy Efficiency. Standards New Zealand.



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