U-Value Calculation Report 01 – STIRA Cosy + Loft Ladder System (Attic Hatch)

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Rev No.	Description	Comment	Calculations Prepared by	Checked by	Date
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1 Introduction

This report was commissioned to calculate the wall u-value for an attic roof with STIRA Cosy + Loft Ladder System (Attic Hatch).

2 Summary of Results

Results	
Type	**U value**
STIRA Cosy + Loft Ladder System installed in typical ceiling (below attic)	0.16 $W/m^2 K$

3 Method of U-Value Calculation

3.1 U-value calculation

The U-value calculation was based on BRE Document 'BR 443 Conventions for U-value calculations 2019 Edition'.

As per guidance provided in BR 443:

The point thermal transmittance for discrete fixing brackets (χ) which penetrate an insulation layer was calculated according to BR 497 & BS EN ISO 10211 using Trisco v15 software by Physibel.

The construction detail was modelled as shown in the following pages, this report is valid only for the constructions detail as described here and elsewhere in this report.

Material thermal properties are based on product agrément certificates or in the absence of specific material properties, standard material properties were used from sources such as CIBSE guide A, I.S EN ISO 10456, BS EN ISO 6946 & BR443.

U-values are calculated to take account of heat loss through building elements and take account of repeating thermal bridges, in this case rainscreen brackets.

Heat flow due to non-repeating thermal bridges (e.g. junctions of floor and roof with the external wall) will need to be determined separately and do not form part of this report.

All drawings in this report are for illustration purposes only.

3.2 Basis of U-value calculation

The calculations are based on information detailed below as provided to BET by the client:

- The calculations are based on an average floor area provided by Central Statistics Office Ireland.
- As per Central Statistics Office the average floor area for a dwelling is 113m^2. In this analysis we have assumed all dwellings as two-story dwelling to strain the assessment i.e., 57m^2.
- Area of the door in the analysis is 0.67m^2 (1.218m x 0.55m).
- Resulting point correction of 0.67m^2 per 57m^2 is 0.01 per m^2.
- The insulation used in the attic space is 300mm mineral wool with 0.044 W/mK.
- Airgap corrections used in the calculation is level 0 i.e., there is no air void within the insulation or only minor air voids (not exceeding 5mm) are present.

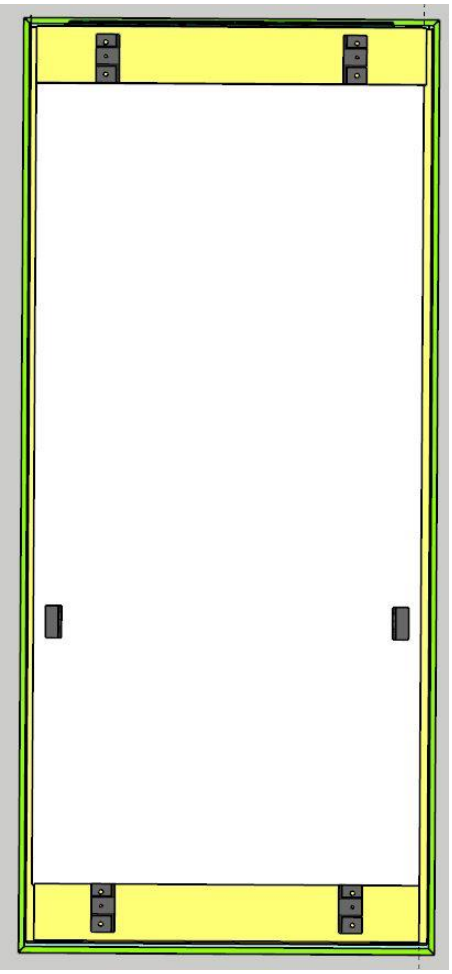

Figure 1 Plan view

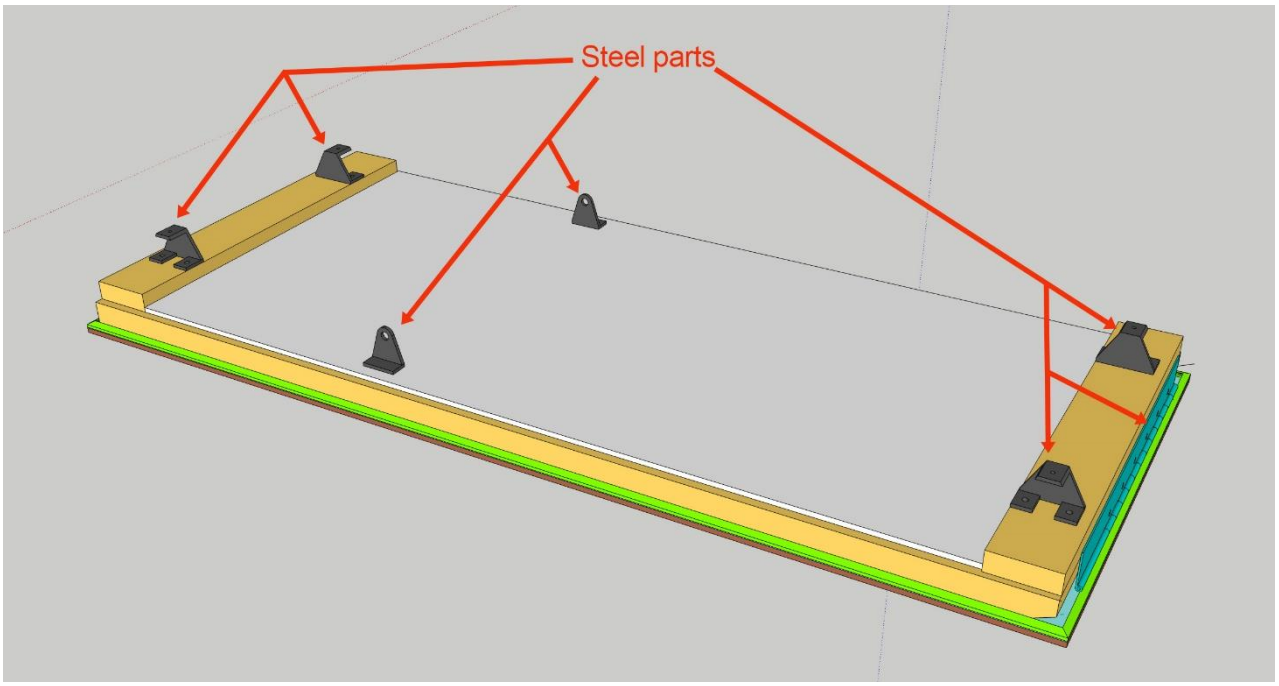

Figure 2 Cosy steel parts mounted

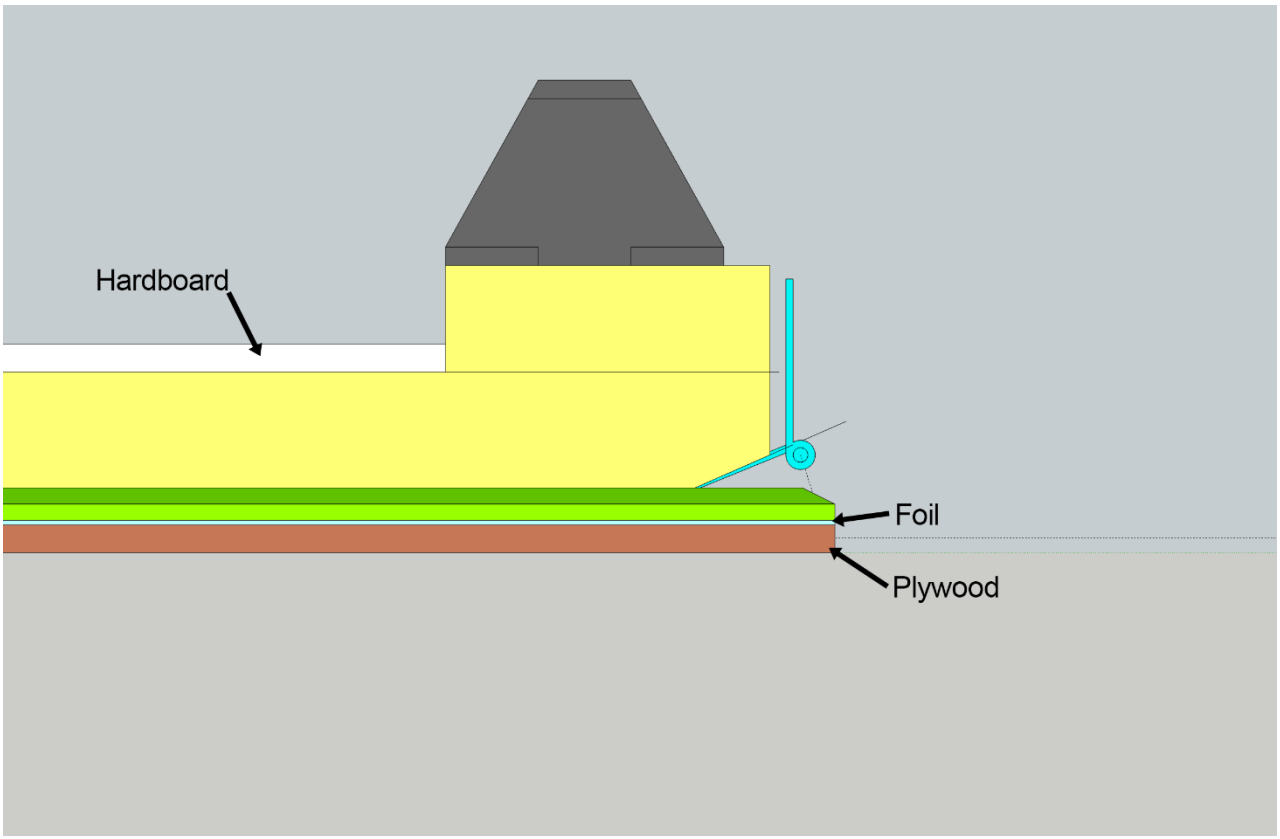

Figure 3 Inner frame side view

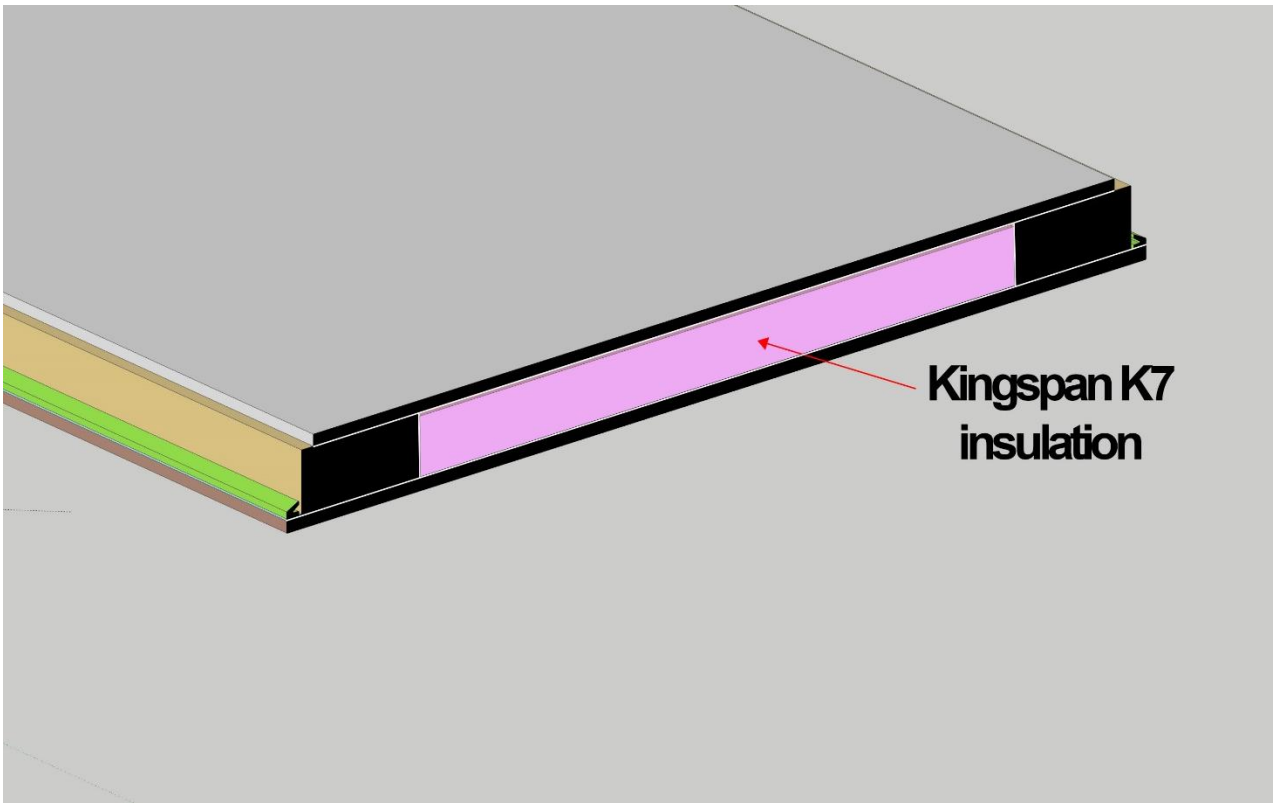

Figure 4 Inner Frame Section View

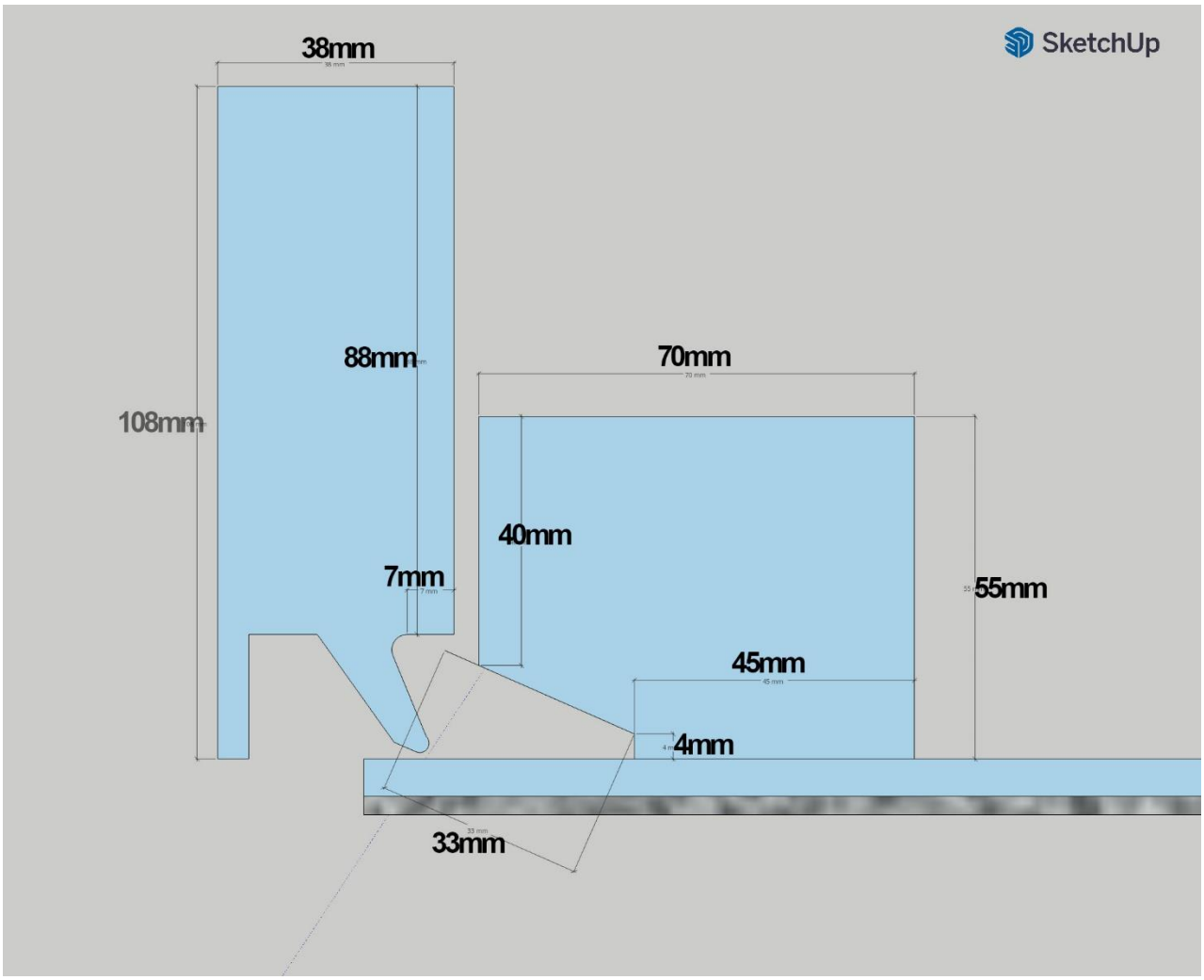

Figure 5 Dimensions

4 STIRA Cosy + Loft Ladder System (Attic Hatch)

4.1 Point Thermal Bridge χ-value Calculation.

The Point Thermal Bridge (χ-value) for the bracket that penetrates the outer insulation layer was calculated as follows:

4.1.1 Graphics

The thermal model is constructed with a plane of symmetry surrounding the door:

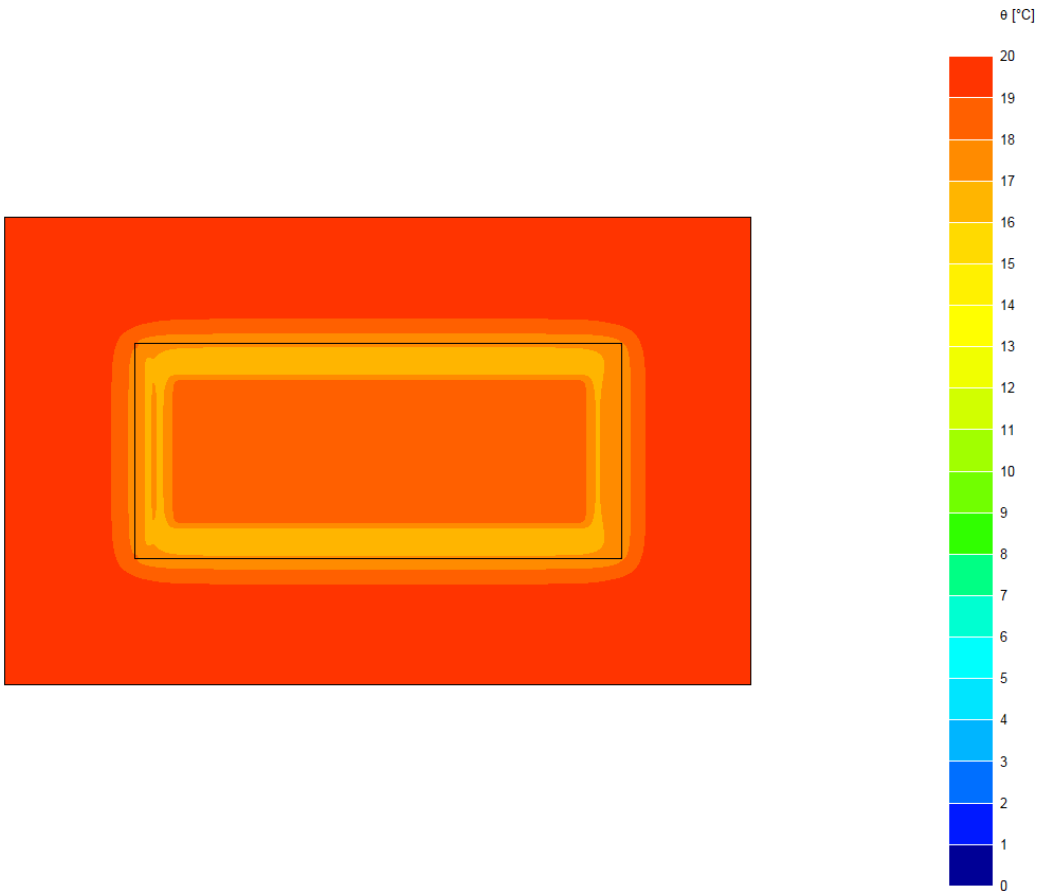

Figure 6 Isotherms including bracket (colour increment of 1°C, line increment of 5°C).

4.1.2 Point Thermal Bridge (χ-value):

Thermal Point Summary				
STIRA Cosy + Loft Ladder System (Attic Hatch)				
Q	21.038		U	0.14
Ti	20		A	2
Te	0		X	0.7719
L^{3D}	1.0519			

$$L^{3D} = \frac{Q}{T_i - T_e} \quad (W/K) \qquad (9)$$

where:

Q = total heat flow from the internal to the external environment (W)
T_i and T_e = temperatures of the internal and external environments (°C).

$$\chi = L^{3D} - \sum (U \times A) - \sum \Psi \times \ell \quad (W/K) \qquad (10)$$

where:

L^{3D} = thermal coupling coefficient
U = U-value (W/m^2K) of the flanking element
A = area (m^2) over which U applies
Ψ = linear thermal transmittance of the linear thermal bridge
ℓ = length (m) over which Ψ applies.

4.2 U-value calculation

U-value calculation
by BRE U-value Calculator version 2.04g

Element type: Roof - Pitched roof - insulated ceiling
Calculation Method: I.S. EN ISO 6946

Layer	d (mm)	λ layer	λ bridge	Fraction	R layer	R bridge	Description
					0.100		Rsi
1	12.5	0.210			0.060		Plasterboard
2	150	0.044	0.130	0.0900	3.409	1.154	Mineral wool quilt
3	150	0.044			3.409		Mineral wool quilt
4		R-value[1]			0.200		Roof space
					0.040		Rse
	313 mm				7.218		

[1]Roof space - tiled roof, with felt or sarking boards

Total resistance: Upper limit: 6.934 Lower limit: 6.708 Ratio: 1.034 Average: 6.821 m²K/W

U-value (uncorrected) 0.147

U-value corrections

Air gaps in layer 2	ΔU = 0.000	(Level 0)
Discrete brackets:	ΔU = 0.009	(0.01 per m², χ = 0.772)

Total ΔU 0.009 (6.3% of U)

U-value (corrected) 0.156
U-value (rounded) 0.16 W/m²K

4.3 Trisco results

4.3.1 Graphics:

Figure 7 Material geometry.

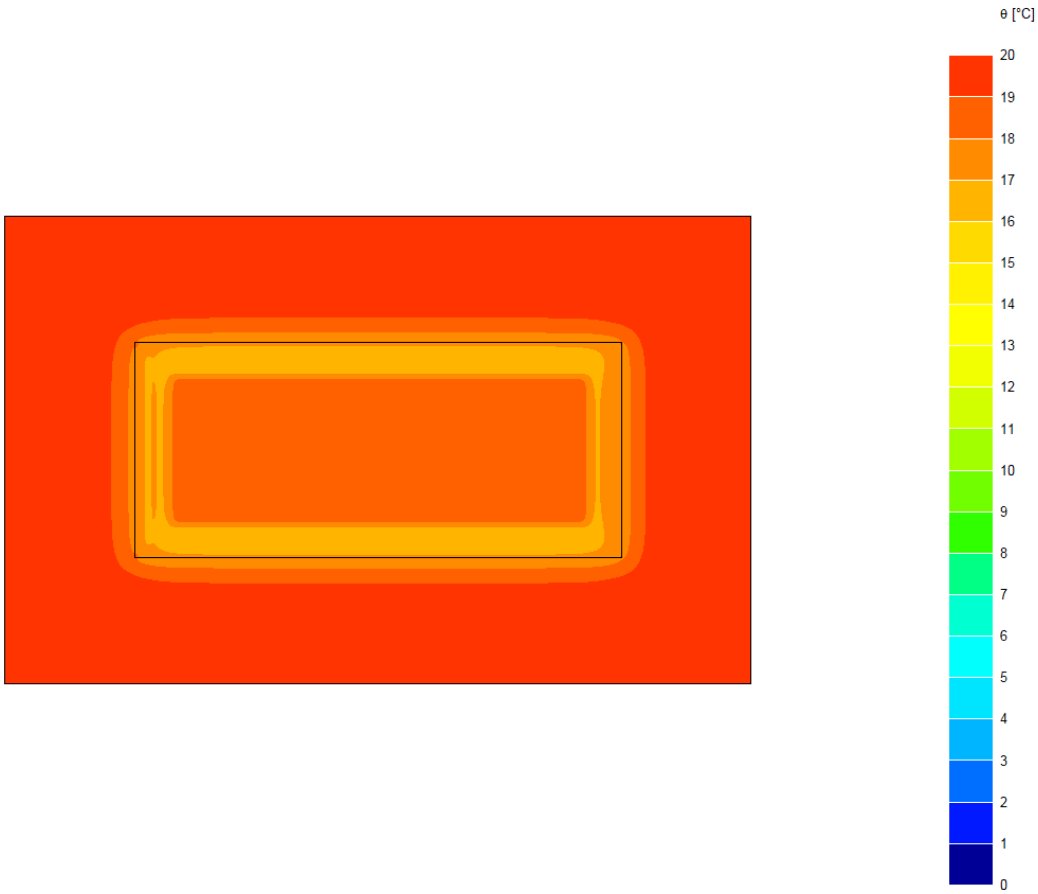

Figure 8 Isotherms (colour increment of 1°C, line increment of 5°C).

4.3.2 Trisco Data Summary:

TRISCO data file cosy stira 01.trc
Number of nodes **2416033**

Material properties table:

Col.	Name	lambda [W/mK]	eps [-]
12	hardwood	0.180	
15	softwood	0.130	
30	softwood	0.130	
61	EPDM	0.250	
103	polyurethane_(PU)_foam	0.050	
118	Kingspan_K7	0.022	
124	plywood_500_kg/m3	0.130	
131	Mineral_Wool_	0.044	
161	gypsum_plasterboard	0.250	
192	cavity_non-vent_horizonta	0.056	
193	cavity_non-vent_horizonta	0.242	
194	cavity_non-vent_horizonta	0.033	
195	cavity_non-vent_horizonta	0.059	
196	cavity_non-vent_horizonta	0.086	
197	cavity_non-vent_horizonta	0.059	
198	cavity_non-vent_horizonta	0.071	

Boundary condition table:

Col.	Name	t [°C]	h [W/m²K]	q [W/m²]	ta [°C]	tr [°C]	hc [W/m²K]	Pc [W]
171	External_(Sheltered)	0.0	10.00	0				
172	External_(Sheltered)	0.0	7.70	0				
182	Internal_(Up)	20.0	10.00	0				

4.3.3 FULL TRISCO RESULTS

TRISCO - Calculation Results

TRISCO data file: cosy stira 01.trc

Number of nodes = 2416033
Heat flow divergence for total object = 5.86352e-05 %
Heat flow divergence for worst node = 0.373691 %

2D/3D surplus thermal transmittance
dL = Q/(ti-te) - U1*A1 = 0.769 W/K
Equivalent thermal transmittance
Ueq = Q/((ti-te)*A1) = 0.525 W/(m².K)
  Q = 21.038 W
  ti = 20.0000°C
  te = 0.0000°C
  U1 = 0.141 W/(m².K)
       Xmin=1 Xmax=104 Ymin=0 Ymax=0 Zmin=0 Zmax=0
  A1 = 2.00256 m²
       Xmin=1 Xmax=1 Ymin=0 Ymax=195 Zmin=0 Zmax=142

Col.	Type	Name	tmin [°C]	X	Y	Z	tmax [°C]	X	Y	Z
12	MATERIAL	hardwood	1.1710	59	68	69	5.9362	53	82	52
15	MATERIAL	softwood	0.3790	83	67	100	18.4760	9	182	13
30	MATERIAL	softwood	0.7147	68	54	43	16.6950	8	38	106
61	MATERIAL	EPDM	14.5712	8	67	52	18.2894	7	73	70
103	MATERIAL	polyurethane_(PU)_foam	15.1567	9	68	108	17.4505	8	145	24
118	MATERIAL	Kingspan_K7	2.2735	51	70	71	18.2426	8	73	70
124	MATERIAL	plywood_500_kg/m3	14.7185	7	67	52	18.8297	1	73	73
131	MATERIAL	Mineral_Wool_	0.0081	104	69	13	19.5569	18	195	142
161	MATERIAL	gypsum_plasterboard	15.8236	9	68	119	19.7049	1	194	141
171	BC_SIMPL	External_(Sheltered)	0.0081	104	69	13	4.4782	68	123	57
172	BC_SIMPL	External_(Sheltered)	0.0081	104	69	13	8.6907	53	123	43
182	BC_SIMPL	Internal_(Up)	16.3942	1	67	52	19.7049	1	194	141
192	EQUIMAT	cavity_non-vent_horizonta	12.2614	43	131	71	17.4095	16	128	13
193	EQUIMAT	cavity_non-vent_horizonta	4.1031	68	123	97	16.7874	8	133	36
194	EQUIMAT	cavity_non-vent_horizonta	1.5613	53	70	71	6.2439	51	82	59
195	EQUIMAT	cavity_non-vent_horizonta	15.1273	9	68	107	16.9398	8	33	108
196	EQUIMAT	cavity_non-vent_horizonta	3.2999	68	38	96	16.8757	8	33	106
197	EQUIMAT	cavity_non-vent_horizonta	15.1274	9	68	35	16.9398	8	33	34
198	EQUIMAT	cavity_non-vent_horizonta	13.3537	42	170	71	18.2924	9	174	13

Col.	Type	Name	ta [°C]	Flow in [W]	Flow out [W]
171	BC_SIMPL	External_(Sheltered)		0.0000	14.5729
172	BC_SIMPL	External_(Sheltered)		0.0000	6.4654
182	BC_SIMPL	Internal_(Up)		21.0386	0.0000