

**REPORT ON THERMAL PERFORMANCE  
OF  
VOLCAN WALL AUSTRALIA  
STRUCTURAL INSULATED CONCRETE PANEL SYSTEMS  
FOR  
WORLD ENVIRONMENTAL SOLUTIONS COMPANY PTY LIMITED (WES)**  
(VOLCAN WALL AUSTRALIA PTY LIMITED IS PART OF THE WES GROUP OF COMPANIES)

**July 2009**



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**Report No: i279b**

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## 1. AIM

To determine the AS/NZS 4859.1:2002/Amdt 1(Dec 2006) Total R-Values of various Volcan Wall building systems incorporating various grades of Expanded Polystyrene (EPS) and various surface treatments.

The client for this calculation set is World Environmental Solutions Pty Limited, The Penthouse, 6/204 Clarence Street, Sydney NSW 2000. p: 1300 667 963, e: contact@volcanwall.com.au, w: www.volcanwall.com.au.

## 2. CALCULATIONS

The calculations are based upon:

- a) AS/NZS 4859.1:2002/Amdt 1(Dec 2006) "Materials for the thermal insulation of buildings. Part 1: General criteria and technical provisions",
- b) the Australian Institute of Refrigeration Air-conditioning & Heating (AIRAH) Handbook Millennium Edition 2000, Section 6, and (if necessary) the ASHRAE Fundamentals Handbook.

Initial results reported are for the **insulation path** only per the original AS/NZS 4859.1:2002 Clause 1.5.3.3 – "Total thermal resistance - A total resistance associated with a material or a system or construction of materials, specified as a Total R, including surface film resistances" to be in alignment with the BCA2007 Specification J1.3 examples.

R-values for parallel-faced air cavities were calculated using the Reflect-3 computer software that is based on Robinson and Powell data and validated by Oakridge National Laboratory, USA. These calculations are iterative and only the converged results are shown. (Note that Reflect-3 calculations are limited to a maximum 100mm air gap until large-scale testing verifies theoretical models.)

Because of normal variations in building materials, the report resistance values for frames and other building materials have an estimated error of 10%.

Total R-values are based on product in-service conditions in accordance with AS/NZS 4859.1:2002/Amdt 1 (Dec 2006) including the alteration of material R for temperature, and derations of foil top emittance due to dust.

## 3. APPLICATION

In accordance with AS/NZS 4859.1:2002/Amdt 1(Dec 2006) Clause K3.1, Total R-values (insulation path) are presented for the Australian summer air temperature difference of 12K (36°C less 24°C), and winter air temperature difference of 6K (18°C less 12°C).

## 4. THERMAL BRIDGING

The original AS/NZS 4859.1:2002 clearly required reporting of the thermal resistance for the insulation path only.

Amendment 1 (Dec 2006) of AS/NZS 4859.1:2002 Clause 1.5.3.3 now states Total R is "representative of the element of construction". This report assumes the "element of construction" is that which typifies the insulation path only, to be consistent with earlier calculations. To emphasise this, this report reports Insulation path Total Thermal Resistance (with abbreviation  $R_{Ti}$ ).

Calculations are also provided for thermal bridging so that the Total R covers the whole building surface.

Calculations include "Added R" to allow direct use with BASIX software.

All calculations were done by:



JAMES M FRICKER  
B.Mech E, M.AIRAH, MIE Aust, CPEng

### **PAPERS PUBLISHED:**

*Computational Analysis of Reflective Air Spaces, AIRAH Journal, Oct 1997*

*Low Energy Housing Design, UNESCO conference, Alice Springs 1990 (co-author with Angelo Delsante, CSIRO)*

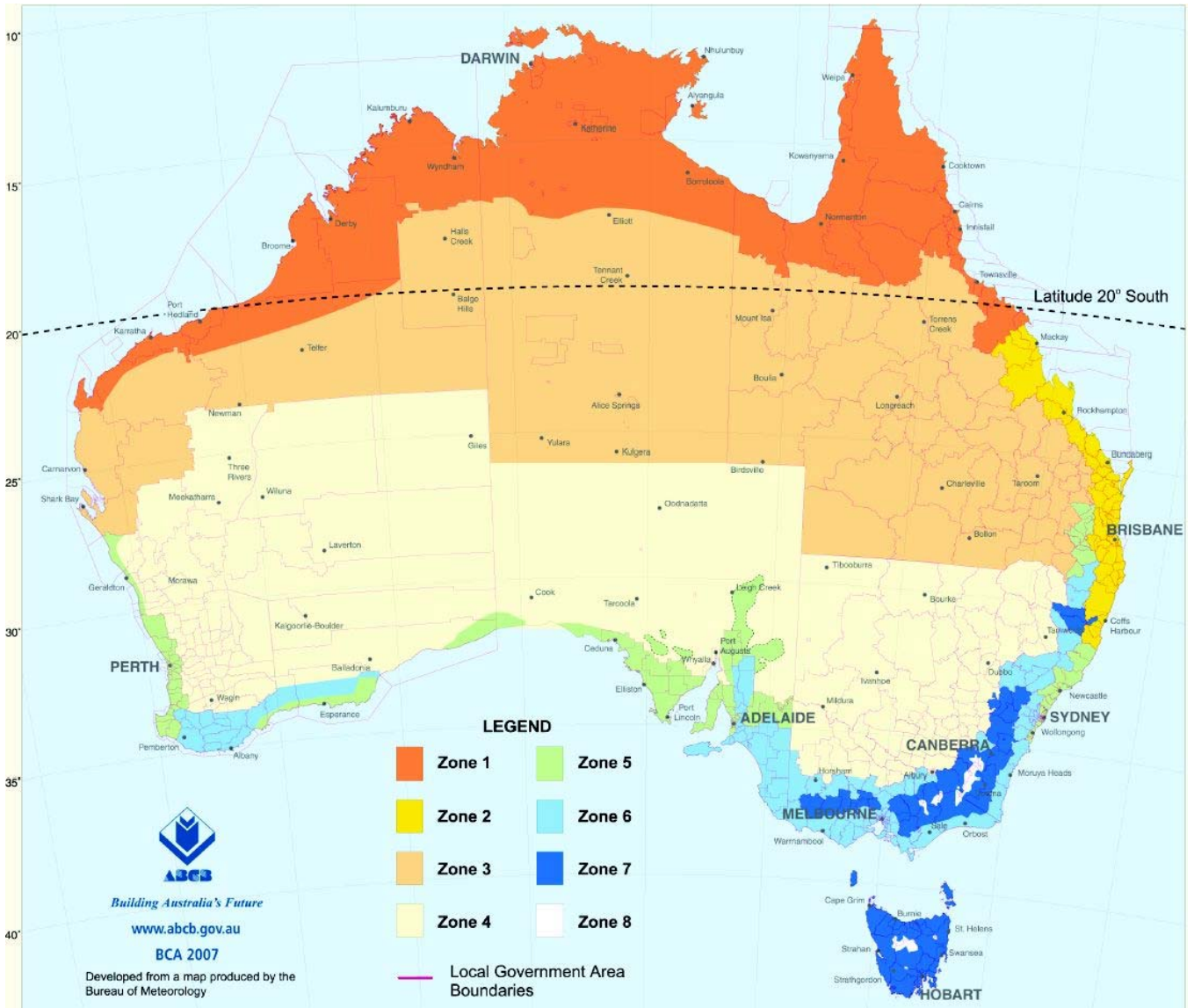
*Calculation of Energy Targets, ASHRAE Journal, Oct 1987.*

*Testing and Modelling Flexible Air Duct Insulation Performance, 21<sup>st</sup> International Conference on Thermal Insulation (co-author with Dr Peter Johnson, RMIT)*

## **APPENDIX 1 – BCA 2009 REQUIREMENTS**

Building roof, wall and floor thermal requirements for Australia are set by the BCA 2009 for each Climate Zone and each Building Class.

The following map shows the **Climate Zones**<sup>1</sup>.



Most Australian buildings are in Climate Zone 6.  
 Many others are in Climate Zones 2, 5, and 7.

More detailed Climate Zones maps can be accessed from  
<http://www.abcb.gov.au/go/whatweredoing/workprogram/projectsae/energy/eemaps>

<sup>1</sup> Courtesy of BCA

**APPENDIX 2 – BCA 2009 BUILDING CLASSES**

Building Classes are described as follows:

<b>BCA BUILDING CLASSIFICATIONS</b>	
Class 1a: Detached house, or one of a group of attached dwellings	Housing
Class 1a: Boarding house, guest house, hostel (with total floor area less than 300 sqm and with not more than 12 residents).	
Class 1a: Detached house, attached dwellings	Residential buildings (apartments, flats, hotels etc.)
Class 2: A building containing two or more sole-occupancy units, each being a separate dwelling	
Class 3: Boarding houses, guest houses, hostels, lodging-houses or backpackers accommodation. A residential part of a hotel, motel, school, a health-care building or a detention centre. Buildings for the aged, children or disabilities accommodation	
Class 4: A dwelling part of a building in Class 5, 6, 7, 8 or 9	
Class 5: Commercial office buildings excluding Class 6-9 buildings	
Class 6: Shop or other retail buildings for the sale of goods, eg restaurant, barber’s shop, laundry, market, showroom and service station	Public or commercial buildings (offices, shops, factories, hospitals etc.)
Class 7a: Car parks	
Class 7b: A building for storage or display of goods or produce for sale by wholesale.	
Class 8: Laboratories, production areas, industrial buildings	
Class 9a: A health-care building, school	
Class 9b: Assembly buildings, trade workshops, laboratories in schools, but excluding parts of another class.	Housing
Class 9c: Aged care buildings	
Class 10: A non-habitable building or structure (garage, shed, fenced antenna, swimming pool).	

**APPENDIX 3 – BCA 2009 MINIMUM TOTAL R-VALUES**

The following table shows the required Total R-values for ceilings, walls and floors for the different building classes and different climate zones.

BCA 2009 - MINIMUM TOTAL R-VALUES FOR EACH CLIMATE ZONE	Darwin, Cairns, Townsville	Brisbane, Crafton		Alice Springs	Albury, Mildura	Adelaide, Perth, Sydney East, Wollongong	Melbourne, Sydney West, Geelong, Mt Gambier,	Canberra, Hobart, most of Tasmania	Thredbo, Cooma
	1	2	2	3	4	5	6	7	8
CLIMATE ZONE:	1	2	2	3	4	5	6	7	8
BUILDING CLASS	<300m >300m								
<b>ROOFS / CEILINGS (vertical heat flow)</b>									
Class 2, 3, 4 (part), or 9c aged care:	2.2	2.2	2.5	2.2	3.0	2.7	3.2	3.8	4.3
Class 1 & 10 (housing):	2.7	2.7	3.0	2.7	3.5	3.2	3.7	4.3	4.8
Heat flow:	Downwards		Dwn & up		Upwards				
Class 5, 6, 7, 8, 9a or 9b:	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	4.3
Heat flow:	Downwards							Upwards	
<b>FLOORS (suspended, unenclosed perimeter, vertical heat flow)</b>									
Class 2, 3, 4 (part), or 9c aged care:	Nil	Nil	Nil	Nil	Nil	Nil	1.0	1.0	2.5
Class 5, 6, 7, 8, 9a or 9b:	1.5	Nil	Nil	1.5	1.5	Nil	1.5	1.5	2.5
Class 1 & 10 (housing):	Nil	Nil	Nil	Nil	2.0	Nil	2.0	2.5	3.0
Heat flow:	Upwards		Dwn & up		Downwards				
<b>WALLS (exterior, horizontal heat flow)</b>									
Class 2, 3, 4 (part), or 9c aged care:	1.4	1.4	1.4	1.4	1.7	1.4	1.7	1.9	2.8
Class 5, 6, 7, 8, 9a or 9b:	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	2.8
Class 1 & 10 (housing):	1.9	1.9	1.9	1.9	2.2	1.9	2.2	2.4	3.3
Class 1 & 10 (slab, housing):	1.4	1.4	A	1.4	A	A	A+1	A+1	A+1.5

**NOTES:**

From BCA 2009 Vol 1, Table J1.5

From BCA 2009 Vol 2, Table 3.12.1.3

For Class 1 & 10 Note "A", see BCA2009 for more detail of insulation requirements for 220+kg/m<sup>2</sup> surface.

The above summary table is a guide only. Please refer BCA 2009 for details and other options.

The table, used in conjunction with R-calcs, assists determination of required added insulation thermal resistance for compliance purposes.

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28/07/2009

For **Class 1 & 10 (housing)**, the thermal requirement of an external wall depends on the surface density.

E.g., for Climate Zone 6:

(a) If the surface density is less than 220kg/sqm, the requirement is Total R2.2.

If the surface density is greater than 220kg/sqm (e.g. tilt concrete slab) and

(b) it does not abut a concrete slab floor, the added insulation requirement is R1.0.

OR

(c) it abuts a concrete slab floor, the added insulation requirement is R0.5.

For **Class 5, 6, 7, 8, 9a, & 9b (commercial)**, the thermal requirement of an external wall also depends on the surface density.

E.g., for Climate Zone 1, 2, 3, 4, 5, 6 & 7

(a) If the surface density is less than 220kg/sqm, the requirement is Total R1.8.

OR

(b) If the surface density is greater than 220kg/sqm, the added insulation requirement varies from R0.5 to R1.0 or the Total R requirement is R1.4, depending on several factors.

**SUMMARY OF RESULTS**

JMF Calc set		Total R Summer	Total R Winter	Insulation "Added R" (winter)
<b>279.07</b>	<b>WALLS</b> 125mm SL Volcan Wall Structural Concrete Insulated Panels (25mm Cement Render, 75mm SL Grade EPS, 25mm Cement Render)	R1.80	R1.89	R1.69
<b>279.08</b>	150mm SL Volcan Wall Structural Concrete Insulated Panels (25mm Cement Render, 100mm SL Grade EPS, 25mm Cement Render)	R2.28	R2.39	R2.19
<b>279.09</b>	175mm SL Volcan Wall Structural Concrete Insulated Panels (25mm Cement Render, 125mm SL Grade EPS, 25mm Cement Render)	R2.74	R2.88	R2.68
<b>279.10</b>	200mm SL Volcan Wall Structural Concrete Insulated Panels (25mm Cement Render, 150mm SL Grade EPS, 25mm Cement Render)	R3.20	R3.35	R3.15

NOTES:

- (a) The above results are for 6K (winter) & 12K (summer) air-to-air temperature differences and for other AS/NZS 4859.1:2002/Amdt 1 2006 assumptions detailed in the notes on the relevant individual calculation sheets.
- (b) The above results include adjustment for system 3.48mm mild steel truss thermal bridging. Using 3.48mm stainless steel truss would reduce thermal bridging, and improve Total R by R0.2 to R0.5.

- (c) The adjacent table shows conductivities for Australian EPS grades. Using VH Grade instead of SL Grade would raise Total R by about 10%
 

EPS Grade	k at 23°C
Grade L	0.0427
<b>Grade SL</b>	0.0407
Grade S	0.0394
Grade M	0.0380
Grade H	0.0365
Grade VH	0.0349

- (d) For insulation product labelling to AS/NZS 4859.1:2002, these calculations require endorsement from a recognised laboratory per Section 4.3 of the standard.

Revision date 28/07/2009

Signed:



All calculations performed by James Fricker, B Mech Eng, CPEng, M.AIRAH, M.EngAust



**THERMAL INSULATION EVALUATION BY CALCULATION**

**125mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 75mm SL Grade EPS, 25mm Cement Render)  
(insulation path)**

**Calculation: 279.07w**

Evaluation for Winter, 12.0°C ambient air temperature, 18.0°C inside air temperature.

Wall Element (Insulation path)	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm	k at 23°C	Note
Outside air film:	0.040	<b>12.00</b>	12.11	12.06	0.11			1
12.5mm cement render:	0.010	12.11	12.14	12.13	0.03	12.5	1.3	4,5
Steel mesh:	0.000	12.14	12.14	12.14	0.00	0.0		3
12.5mm cement render:	0.010	12.14	12.17	12.16	0.03	12.5	1.3	4
<b>75mm SL Grade EPS</b>	<b>1.901</b>	12.17	17.60	14.89	5.43	75.0	0.0407	5
12.5mm cement render:	0.010	17.60	17.63	17.62	0.03	12.5	1.3	4
Steel mesh:	0.000	17.63	17.63	17.63	0.00	0.0		3
12.5mm cement render:	0.010	17.63	17.66	17.64	0.03	12.5	1.3	4,5
Indoor air film (unreflective surface):	<u>0.120</u>	17.66	<b>18.00</b>	17.83	<u>0.34</u>			2
<b>Total Thermal Resistance R<sub>Ti</sub> =</b>	<b>2.10</b>	m <sup>2</sup> .K/W			6.00	125		

**Corresponding Total Conductance (k<sub>Ti</sub>): 0.48 W/(m<sup>2</sup>.K)**

**NOTES:**

Calculated 16/6/09 22:19

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**Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings**

- AS/NZS 4859.1:2002/Amdt 1 2006, Clause K5(a)
- AS/NZS 4859.1:2002/Amdt 1 2006, Table K1
- 2007 AIRAH Technical Handbook pages 164-177
- Cement render conductivity estimated as k=1.3 W/(m.K) based on 2160 kg/m<sup>3</sup> density.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- SL Grade Expanded Polystyrene (EPS)  
Assumes k=0.0407 W/m.K for 23°C. R adjusted 0.39%/K in line with AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1  
For different EPS cores, see the table in "Conclusion".
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
- This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.IEAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 75mm SL Grade EPS, the WINTER Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 18°-12° = 6K) is:

**R2.10 m<sup>2</sup>.KW**

Signed:

*James Fricker*



Application results for various EPS grades  
(75mm, 14.9°C mean and 6K Δt)

EPS Grade	k at 23°C	EPS R	Total R	Added R value
Class L	0.0427	1.814	2.01	-0.09
<b>Class SL</b>	<b>0.0407</b>	<b>1.901</b>	<b>2.10</b>	0.00
Class S	0.0394	1.964	2.16	0.06
Class M	0.0380	2.036	2.23	0.14
Class H	0.0365	2.119	2.32	0.22
Class VH	0.0349	2.215	2.41	0.31
	(W/m.K)	\ m <sup>2</sup> .K/W /		

**THERMAL INSULATION EVALUATION BY CALCULATION**

**125mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 75mm SL Grade EPS, 25mm Cement Render)  
(insulation path)**

**Calculation: 279.07s**

Evaluation for Summer, 36.0°C ambient air temperature, 24.0°C inside air temperature.

Wall Element (Insulation path)	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm	k at 23°C	Note
Outside air film:	0.040	<b>36.00</b>	35.76	35.88	0.24			1
12.5mm cement render:	0.010	35.76	35.70	35.73	0.06	12.5	1.3	4,5
Steel mesh:	0.000	35.70	35.70	35.70	0.00	0.0		3
12.5mm cement render:	0.010	35.70	35.64	35.67	0.06	12.5	1.3	4
<b>75mm SL Grade EPS</b>	<b>1.791</b>	35.64	24.84	30.24	10.80	75.0	0.0407	5
12.5mm cement render:	0.010	24.84	24.78	24.81	0.06	12.5	1.3	4
Steel mesh:	0.000	24.78	24.78	24.78	0.00	0.0		3
12.5mm cement render:	0.010	24.78	24.72	24.75	0.06	12.5	1.3	4,5
Indoor air film (unreflective surface):	<u>0.120</u>	24.72	<b>24.00</b>	24.36	<u>0.72</u>			2
<b>Total Thermal Resistance R<sub>Ti</sub> =</b>	<b>1.99</b>	m <sup>2</sup> .K/W				12.00	125	

**Corresponding Total Conductance (k<sub>Ti</sub>): 0.50 W/(m<sup>2</sup>.K)**

**NOTES:**

Calculated 16/6/09 22:19

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**Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings**

- AS/NZS 4859.1:2002/Amdt 1 2006, Clause K5(a)
- AS/NZS 4859.1:2002/Amdt 1 2006, Table K1
- 2007 AIRAH Technical Handbook pages 164-177
- Cement render conductivity estimated as k=1.3 W/(m.K) based on 2160 kg/m<sup>3</sup> density.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- SL Grade Expanded Polystyrene (EPS)  
Assumes k=0.0407 W/m.K for 23°C. R adjusted 0.39%/K in line with AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1  
For different EPS cores, see the table in "Conclusion".
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
- This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.EngAust, CPEng.

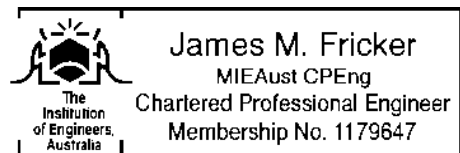
**CONCLUSION:**

For the insulation path in the above wall arrangement with 75mm SL Grade EPS, the SUMMER Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 36°-24° = 12K) is:

**R1.99 m<sup>2</sup>.KW**

Signed:

*James Fricker*



Application results for various EPS grades  
(75mm, 30.2°C mean and 12K Δt)

EPS Grade	k at 23°C	EPS R	Total R	Added R value
Class L	0.0427	1.708	1.91	-0.08
<b>Class SL</b>	<b>0.0407</b>	<b>1.791</b>	<b>1.99</b>	0.00
Class S	0.0394	1.850	2.05	0.06
Class M	0.0380	1.918	2.12	0.13
Class H	0.0365	1.996	2.19	0.21
Class VH	0.0349	2.087	2.29	0.30
	(W/m.K)	\ m <sup>2</sup> .K/W /		

**THERMAL BRIDGING CALCULATION**

**125mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 75mm SL Grade EPS, 25mm Cement Render)**

**WINTER (heat flow out)**

Calc: **279.07w**

**SUMMER (heat flow in)**

**279.07s**

**Calc: 279.07B**

	Insul.	Frame	Insul.	Frame	
Thermal path area (sqm):	0.029990	0.000010	0.029990	0.000010	
Thermal path area ratio:	99.97%	0.03%	99.97%	0.03%	
	R (m <sup>2</sup> .K/W)		R (m <sup>2</sup> .K/W)		
Outside air film:	0.040		0.040		
12.5mm cement render:	0.010		0.010		R
12.5mm cement render:	0.010	-	0.010	-	
<b>75mm SL Grade EPS</b>	<b>1.901</b>	-	<b>1.791</b>	-	
<b>3.48mmØ x 224mm mild steel Z bar truss:</b>	-	<b>0.005</b>	-	<b>0.005</b>	
12.5mm cement render:	0.010	-	0.010	-	
12.5mm cement render:	0.010		0.010		R
Indoor air film (unreflective surface):	0.120		0.120		
Path Total R:	2.10	0.18	1.99	0.18	a
<b>Overall Total R:</b>	<b>R1.89</b>		<b>R1.80</b>		b
% reduction due to bridging:	10.0%		9.4%		=(a-b)/a*100%
<b>Added R due to EPS insulation:</b>	<b>R1.69</b>		<b>R1.60</b>		

**NOTES:**

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- The above estimates the resulting (overall) Total R from the two parallel heat paths -  
a. through the insulation      b. through the steel bar truss
- Overall resulting Total R calculated by Isothermal Planes Method per AS/NZS 4859.1:2002/Amdt 1/2006
- Reinforcing steel mesh within each whythe assumed to be relevant isothermal planes.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- Refer JMF calculations 140.71&w to AS/NZS 4859.1:2002/Amdt 1 2006 for assumptions.
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.EngAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 75mm SL Grade EPS, the WINTER overall Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 18°-12° = 6K) is:

**R1.89 m<sup>2</sup>.K/W after considering thermal bridging for this specific case.**

Similarly,

the SUMMER overall Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 36°-24° = 12K) is:

**R1.80 m<sup>2</sup>.K/W after considering thermal bridging for this specific case.**

Signed:




**Total R for other EPS grades**

EPS Grade	Winter	Summer
Class L	<b>R1.82</b>	<b>R1.74</b>
<b>Class SL</b>	<b>R1.89</b>	<b>R1.80</b>
Class S	<b>R1.94</b>	<b>R1.85</b>
Class M	<b>R2.00</b>	<b>R1.90</b>
Class H	<b>R2.06</b>	<b>R1.97</b>
Class VH	<b>R2.14</b>	<b>R2.04</b>

**THERMAL INSULATION EVALUATION BY CALCULATION**

**150mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 100mm SL Grade EPS, 25mm Cement Render)  
(insulation path)**

**Calculation: 279.08w**

Evaluation for Winter, 12.0°C ambient air temperature, 18.0°C inside air temperature.

Wall Element (Insulation path)	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm	k at 23°C	Note
Outside air film:	0.040	<b>12.00</b>	12.09	12.04	0.09			1
12.5mm cement render:	0.010	12.09	12.11	12.10	0.02	12.5	1.3	4,5
Steel mesh:	0.000	12.11	12.11	12.11	0.00	0.0		3
12.5mm cement render:	0.010	12.11	12.13	12.12	0.02	12.5	1.3	4
<b>100mm SL Grade EPS</b>	<b>2.535</b>	12.13	17.69	14.91	5.56	100.0	0.0407	5
12.5mm cement render:	0.010	17.69	17.72	17.70	0.02	12.5	1.3	4
Steel mesh:	0.000	17.72	17.72	17.72	0.00	0.0		3
12.5mm cement render:	0.010	17.72	17.74	17.73	0.02	12.5	1.3	4,5
Indoor air film (unreflective surface):	<u>0.120</u>	17.74	<b>18.00</b>	17.87	<u>0.26</u>			2
<b>Total Thermal Resistance R<sub>Ti</sub> =</b>	<b>2.73</b>	m <sup>2</sup> .K/W		6.00		150		
<b>Corresponding Total Conductance (k<sub>Ti</sub>):</b>	<b>0.37</b>	W/(m <sup>2</sup> .K)						

**NOTES:**

Calculated 16/6/09 22:19

Ref: 279\_B.xls

**Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings**

- AS/NZS 4859.1:2002/Amdt 1 2006, Clause K5(a)
- AS/NZS 4859.1:2002/Amdt 1 2006, Table K1
- 2007 AIRAH Technical Handbook pages 164-177
- Cement render conductivity estimated as k=1.3 W/(m.K) based on 2160 kg/m<sup>3</sup> density.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- SL Grade Expanded Polystyrene (EPS)  
Assumes k=0.0407 W/m.K for 23°C. R adjusted 0.39%/K in line with AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1  
For different EPS cores, see the table in "Conclusion".
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
- This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.IEAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 100mm SL Grade EPS, the WINTER Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 18°-12° = 6K) is:

**R2.73 m<sup>2</sup>.K/W**

Signed:




Application results for various EPS grades  
(100mm, 14.9°C mean and 6K Δt)

EPS Grade	k at 23°C	EPS R	Total R	Added R value
Class L	0.0427	2.418	2.62	-0.12
<b>Class SL</b>	<b>0.0407</b>	<b>2.535</b>	<b>2.73</b>	0.00
Class S	0.0394	2.619	2.82	0.08
Class M	0.0380	2.714	2.91	0.18
Class H	0.0365	2.825	3.02	0.29
Class VH	0.0349	2.954	3.15	0.42
	(W/m.K)	\ m <sup>2</sup> .K/W /		

**THERMAL INSULATION EVALUATION BY CALCULATION**

**150mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 100mm SL Grade EPS, 25mm Cement Render)  
(insulation path)**

**Calculation: 279.08s**

Evaluation for Summer, 36.0°C ambient air temperature, 24.0°C inside air temperature.

Wall Element (Insulation path)	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm	k at 23°C	Note
Outside air film:	0.040	<b>36.00</b>	35.81	35.91	0.19			1
12.5mm cement render:	0.010	35.81	35.77	35.79	0.04	12.5	1.3	4,5
Steel mesh:	0.000	35.77	35.77	35.77	0.00	0.0		3
12.5mm cement render:	0.010	35.77	35.73	35.75	0.04	12.5	1.3	4
<b>100mm SL Grade EPS</b>	<b>2.388</b>	35.73	24.65	30.19	11.08	100.0	0.0407	5
12.5mm cement render:	0.010	24.65	24.60	24.62	0.04	12.5	1.3	4
Steel mesh:	0.000	24.60	24.60	24.60	0.00	0.0		3
12.5mm cement render:	0.010	24.60	24.56	24.58	0.04	12.5	1.3	4,5
Indoor air film (unreflective surface):	<u>0.120</u>	24.56	<b>24.00</b>	24.28	<u>0.56</u>			2
<b>Total Thermal Resistance R<sub>Ti</sub> =</b>	<b><u>2.59</u></b>	m <sup>2</sup> .K/W		12.00		150		
<b>Corresponding Total Conductance (k<sub>Ti</sub>):</b>	<b><u>0.39</u></b>	W/(m <sup>2</sup> .K)						

**NOTES:**

Calculated 16/6/09 22:19

Ref: 279\_B.xls

**Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings**

- AS/NZS 4859.1:2002/Amdt 1 2006, Clause K5(a)
- AS/NZS 4859.1:2002/Amdt 1 2006, Table K1
- 2007 AIRAH Technical Handbook pages 164-177
- Cement render conductivity estimated as k=1.3 W/(m.K) based on 2160 kg/m<sup>3</sup> density.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- SL Grade Expanded Polystyrene (EPS)  
Assumes k=0.0407 W/m.K for 23°C. R adjusted 0.39%/K in line with AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1  
For different EPS cores, see the table in "Conclusion".
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
- This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.EngAust, CPEng.

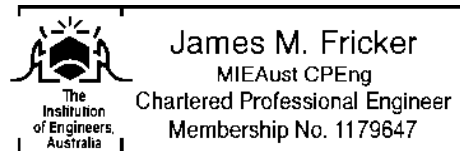
**CONCLUSION:**

For the insulation path in the above wall arrangement with 100mm SL Grade EPS, the SUMMER Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 36°-24° = 12K) is:

**R2.59 m<sup>2</sup>.K/W**

Signed:

*James Fricker*



Application results for various EPS grades  
(100mm, 30.2°C mean and 12K Δt)

EPS Grade	k at 23°C	EPS R	Total R	Added R value
Class L	0.0427	2.278	2.48	-0.11
<b>Class SL</b>	<b>0.0407</b>	<b>2.388</b>	<b>2.59</b>	0.00
Class S	0.0394	2.468	2.67	0.08
Class M	0.0380	2.558	2.76	0.17
Class H	0.0365	2.662	2.86	0.27
Class VH	0.0349	2.783	2.98	0.39
	(W/m.K)	\ m <sup>2</sup> .K/W /		

**THERMAL BRIDGING CALCULATION**

**150mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 100mm SL Grade EPS, 25mm Cement Render)**

**WINTER (heat flow out)**

Calc: **279.08w**

**SUMMER (heat flow in)**

**279.08s**

**Calc: 279.08B**

	Insul.	Frame	Insul.	Frame	
Thermal path area (sqm):	0.029990	0.000010	0.029990	0.000010	
Thermal path area ratio:	99.97%	0.03%	99.97%	0.03%	
	R (m <sup>2</sup> .K/W)		R (m <sup>2</sup> .K/W)		
Outside air film:	0.040		0.040		
12.5mm cement render:	0.010		0.010		R
12.5mm cement render:	0.010	-	0.010	-	
<b>100mm SL Grade EPS</b>	<b>2.535</b>	-	<b>2.388</b>	-	
<b>3.48mmØ x 236mm mild steel Z bar truss:</b>	-	<b>0.005</b>	-	<b>0.005</b>	
12.5mm cement render:	0.010	-	0.010	-	
12.5mm cement render:	0.010		0.010		R
Indoor air film (unreflective surface):	0.120		0.120		
Path Total R:	2.73	0.18	2.59	0.18	a
<b>Overall Total R:</b>	<b>R2.39</b>		<b>R2.28</b>		b
% reduction due to bridging:	12.5%		11.8%		=(a-b)/a*100%
<b>Added R due to EPS insulation:</b>	<b>R2.19</b>		<b>R2.08</b>		

**NOTES:**

Calculated 28/7/09 15:40

Ref: 279\_B.xls

- The above estimates the resulting (overall) Total R from the two parallel heat paths -  
a. though the insulation      b. through the steel bar truss
- Overall resulting Total R calculated by Isothermal Planes Method per AS/NZS 4859.1:2002/Amdt 1/2006
- Reinforcing steel mesh within each whythe assumed to be relevant isothermal planes.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- Refer JMF calculations 140.71&w to AS/NZS 4859.1:2002/Amdt 1 2006 for assumptions.
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.EngAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 100mm SL Grade EPS, the WINTER overall Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 18°-12° = 6K) is:

**R2.39 m<sup>2</sup>.K/W after considering thermal bridging for this specific case.**

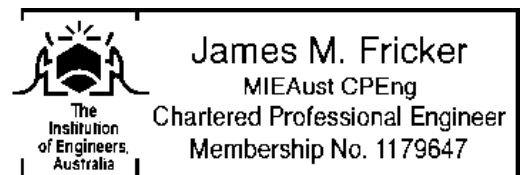
Similarly,

the SUMMER overall Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 36°-24° = 12K) is:

**R2.28 m<sup>2</sup>.K/W after considering thermal bridging for this specific case.**

Signed:

*James Fricker*



**Total R for other EPS grades**

EPS Grade	Winter	Summer
Class L	<b>R2.30</b>	<b>R2.20</b>
<b>Class SL</b>	<b>R2.39</b>	<b>R2.28</b>
Class S	<b>R2.45</b>	<b>R2.34</b>
Class M	<b>R2.53</b>	<b>R2.41</b>
Class H	<b>R2.61</b>	<b>R2.49</b>
Class VH	<b>R2.70</b>	<b>R2.58</b>

## **THERMAL INSULATION EVALUATION BY CALCULATION**

### **175mm SL Volcan Wall Structural Concrete Insulated Panels (25mm Cement Render, 125mm SL Grade EPS, 25mm Cement Render) (insulation path)**

**Calculation: 279.09w**

Evaluation for Winter, 12.0°C ambient air temperature, 18.0°C inside air temperature.

Wall Element (Insulation path)	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm	k at 23°C	Note
Outside air film:	0.040	<b>12.00</b>	12.07	12.04	0.07			1
12.5mm cement render:	0.010	12.07	12.09	12.08	0.02	12.5	1.3	4,5
Steel mesh:	0.000	12.09	12.09	12.09	0.00	0.0		3
12.5mm cement render:	0.010	12.09	12.11	12.10	0.02	12.5	1.3	4
<b>125mm SL Grade EPS</b>	<b>3.168</b>	12.11	17.75	14.93	5.65	125.0	0.0407	5
12.5mm cement render:	0.010	17.75	17.77	17.76	0.02	12.5	1.3	4
Steel mesh:	0.000	17.77	17.77	17.77	0.00	0.0		3
12.5mm cement render:	0.010	17.77	17.79	17.78	0.02	12.5	1.3	4,5
Indoor air film (unreflective surface):	<u>0.120</u>	17.79	<b>18.00</b>	17.89	<u>0.21</u>			2
<b>Total Thermal Resistance R<sub>Ti</sub> =</b>	<b><u>3.37</u></b>	m <sup>2</sup> .K/W				<u>6.00</u>	<u>175</u>	
<b>Corresponding Total Conductance (k<sub>Ti</sub>):</b>	<b><u>0.30</u></b>	W/(m <sup>2</sup> .K)						

**NOTES:**

Calculated 16/6/09 22:19

Ref: 279\_B.xls

**Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings**

- AS/NZS 4859.1:2002/Amdt 1 2006, Clause K5(a)
- AS/NZS 4859.1:2002/Amdt 1 2006, Table K1
- 2007 AIRAH Technical Handbook pages 164-177
- Cement render conductivity estimated as k=1.3 W/(m.K) based on 2160 kg/m<sup>3</sup> density.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- SL Grade Expanded Polystyrene (EPS)  
Assumes k=0.0407 W/m.K for 23°C. R adjusted 0.39%/K in line with AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1  
For different EPS cores, see the table in "Conclusion".
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
- This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.IEAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 125mm SL Grade EPS, the WINTER Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 18°-12° = 6K) is:

**R3.37 m<sup>2</sup>.K/W**

Signed:




Application results for various EPS grades  
(125mm, 14.9°C mean and 6K Δt)

EPS Grade	k at 23°C	EPS R	Total R	Added R value
Class L	0.0427	3.022	3.22	-0.15
<b>Class SL</b>	<b>0.0407</b>	<b>3.168</b>	<b>3.37</b>	0.00
Class S	0.0394	3.273	3.47	0.11
Class M	0.0380	3.393	3.59	0.22
Class H	0.0365	3.531	3.73	0.36
Class VH	0.0349	3.692	3.89	0.52
	(W/m.K)	\ m <sup>2</sup> .K/W /		

**THERMAL INSULATION EVALUATION BY CALCULATION**

**175mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 125mm SL Grade EPS, 25mm Cement Render)  
(insulation path)**

**Calculation: 279.09s**

Evaluation for Summer, 36.0°C ambient air temperature, 24.0°C inside air temperature.

Wall Element (Insulation path)	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm	k at 23°C	Note
Outside air film:	0.040	<b>36.00</b>	35.85	35.92	0.15			1
12.5mm cement render:	0.010	35.85	35.81	35.83	0.04	12.5	1.3	4,5
Steel mesh:	0.000	35.81	35.81	35.81	0.00	0.0		3
12.5mm cement render:	0.010	35.81	35.78	35.79	0.04	12.5	1.3	4
<b>125mm SL Grade EPS</b>	<b>2.986</b>	35.78	24.52	30.15	11.25	125.0	0.0407	5
12.5mm cement render:	0.010	24.52	24.49	24.51	0.04	12.5	1.3	4
Steel mesh:	0.000	24.49	24.49	24.49	0.00	0.0		3
12.5mm cement render:	0.010	24.49	24.45	24.47	0.04	12.5	1.3	4,5
Indoor air film (unreflective surface):	<u>0.120</u>	24.45	<b>24.00</b>	24.23	<u>0.45</u>			2
<b>Total Thermal Resistance R<sub>Ti</sub> =</b>	<b>3.18</b>	m <sup>2</sup> .K/W		12.00		175		

**Corresponding Total Conductance (k<sub>Ti</sub>): 0.31 W/(m<sup>2</sup>.K)**

**NOTES:**

Calculated 16/6/09 22:19

Ref: 279\_B.xls

**Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings**

- AS/NZS 4859.1:2002/Amdt 1 2006, Clause K5(a)
- AS/NZS 4859.1:2002/Amdt 1 2006, Table K1
- 2007 AIRAH Technical Handbook pages 164-177
- Cement render conductivity estimated as k=1.3 W/(m.K) based on 2160 kg/m<sup>3</sup> density.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- SL Grade Expanded Polystyrene (EPS)  
Assumes k=0.0407 W/m.K for 23°C. R adjusted 0.39%/K in line with AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1  
For different EPS cores, see the table in "Conclusion".
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
- This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.EngAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 125mm SL Grade EPS, the SUMMER Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 36°-24° = 12K) is:

**R3.18 m<sup>2</sup>.K/W**

Signed:




Application results for various EPS grades  
(125mm, 30.2°C mean and 12K Δt)

EPS Grade	k at 23°C	EPS R	Total R	Added R value
Class L	0.0427	2.848	3.05	-0.14
<b>Class SL</b>	<b>0.0407</b>	<b>2.986</b>	<b>3.18</b>	0.00
Class S	0.0394	3.085	3.28	0.10
Class M	0.0380	3.198	3.40	0.21
Class H	0.0365	3.328	3.53	0.34
Class VH	0.0349	3.479	3.68	0.49
	(W/m.K)	\ m <sup>2</sup> .K/W /		

**THERMAL BRIDGING CALCULATION**

**175mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 125mm SL Grade EPS, 25mm Cement Render)**

**WINTER (heat flow out)**

Calc: **279.09w**

**SUMMER (heat flow in)**

**279.09s**

**Calc: 279.09B**

	Insul.	Frame	Insul.	Frame	
Thermal path area (sqm):	0.029990	0.000010	0.029990	0.000010	
Thermal path area ratio:	99.97%	0.03%	99.97%	0.03%	
	R (m <sup>2</sup> .K/W)		R (m <sup>2</sup> .K/W)		
Outside air film:	0.040		0.040		
12.5mm cement render:	0.010		0.010		R
12.5mm cement render:	0.010	-	0.010	-	
<b>125mm SL Grade EPS</b>	<b>3.168</b>	-	<b>2.986</b>	-	
<b>3.48mmØ x 250mm mild steel Z bar truss:</b>	-	<b>0.006</b>	-	<b>0.006</b>	
12.5mm cement render:	0.010	-	0.010	-	
12.5mm cement render:	0.010		0.010		R
Indoor air film (unreflective surface):	0.120		0.120		
Path Total R:	3.37	0.18	3.18	0.18	a
<b>Overall Total R:</b>	<b>R2.88</b>		<b>R2.74</b>		b
% reduction due to bridging:	14.5%		13.8%		=(a-b)/a*100%
<b>Added R due to EPS insulation:</b>	<b>R2.68</b>		<b>R2.55</b>		

**NOTES:**

Calculated 28/7/09 15:40

Ref: 279\_B.xls

- The above estimates the resulting (overall) Total R from the two parallel heat paths -  
a. through the insulation      b. through the steel bar truss
- Overall resulting Total R calculated by Isothermal Planes Method per AS/NZS 4859.1:2002/Amdt 1/2006
- Reinforcing steel mesh within each whythe assumed to be relevant isothermal planes.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- Refer JMF calculations 140.71&w to AS/NZS 4859.1:2002/Amdt 1 2006 for assumptions.
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.EngAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 125mm SL Grade EPS, the WINTER overall Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 18°-12° = 6K) is:

**R2.88 m<sup>2</sup>.K/W after considering thermal bridging for this specific case.**

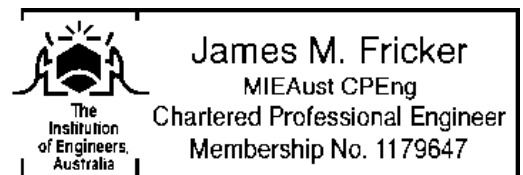
Similarly,

the SUMMER overall Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 36°-24° = 12K) is:

**R2.74 m<sup>2</sup>.K/W after considering thermal bridging for this specific case.**

Signed:

*James Fricker*



**Total R for other EPS grades**

EPS Grade	Winter	Summer
Class L	<b>R2.77</b>	<b>R2.64</b>
<b>Class SL</b>	<b>R2.88</b>	<b>R2.74</b>
Class S	<b>R2.95</b>	<b>R2.82</b>
Class M	<b>R3.04</b>	<b>R2.90</b>
Class H	<b>R3.13</b>	<b>R2.99</b>
Class VH	<b>R3.24</b>	<b>R3.10</b>

**THERMAL INSULATION EVALUATION BY CALCULATION**

**200mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 150mm SL Grade EPS, 25mm Cement Render)  
(insulation path)**

**Calculation: 279.10w**

Evaluation for Winter, 12.0°C ambient air temperature, 18.0°C inside air temperature.

Wall Element (Insulation path)	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm	k at 23°C	Note
Outside air film:	0.040	<b>12.00</b>	12.06	12.03	0.06			1
12.5mm cement render:	0.010	12.06	12.07	12.07	0.01	12.5	1.3	4,5
Steel mesh:	0.000	12.07	12.07	12.07	0.00	0.0		3
12.5mm cement render:	0.010	12.07	12.09	12.08	0.01	12.5	1.3	4
<b>150mm SL Grade EPS</b>	<b>3.801</b>	12.09	17.79	14.94	5.70	150.0	0.0407	5
12.5mm cement render:	0.010	17.79	17.81	17.80	0.01	12.5	1.3	4
Steel mesh:	0.000	17.81	17.81	17.81	0.00	0.0		3
12.5mm cement render:	0.010	17.81	17.82	17.81	0.01	12.5	1.3	4,5
Indoor air film (unreflective surface):	<u>0.120</u>	17.82	<b>18.00</b>	17.91	<u>0.18</u>			2
<b>Total Thermal Resistance R<sub>Ti</sub> =</b>	<b>4.00</b>	m <sup>2</sup> .K/W		6.00		200		
<b>Corresponding Total Conductance (k<sub>Ti</sub>):</b>	<b>0.25</b>	W/(m <sup>2</sup> .K)						

**NOTES:**

Calculated 16/6/09 22:19

Ref: 279\_B.xls

**Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings**

- AS/NZS 4859.1:2002/Amdt 1 2006, Clause K5(a)
- AS/NZS 4859.1:2002/Amdt 1 2006, Table K1
- 2007 AIRAH Technical Handbook pages 164-177
- Cement render conductivity estimated as k=1.3 W/(m.K) based on 2160 kg/m<sup>3</sup> density.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- SL Grade Expanded Polystyrene (EPS)  
Assumes k=0.0407 W/m.K for 23°C. R adjusted 0.39%/K in line with AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1  
For different EPS cores, see the table in "Conclusion".
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
- This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.IEAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 150mm SL Grade EPS, the WINTER Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 18°-12° = 6K) is:

**R4.00 m<sup>2</sup>.K/W**

Signed:




Application results for various EPS grades  
(150mm, 14.9°C mean and 6K Δt)

EPS Grade	k at 23°C	EPS R	Total R	Added R value
Class L	0.0427	3.626	3.82	-0.18
<b>Class SL</b>	<b>0.0407</b>	<b>3.801</b>	<b>4.00</b>	0.00
Class S	0.0394	3.928	4.13	0.13
Class M	0.0380	4.071	4.27	0.27
Class H	0.0365	4.237	4.44	0.44
Class VH	0.0349	4.430	4.63	0.63
	(W/m.K)	\ m <sup>2</sup> .K/W /		

**THERMAL INSULATION EVALUATION BY CALCULATION**

**200mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 150mm SL Grade EPS, 25mm Cement Render)  
(insulation path)**

**Calculation: 279.10s**

Evaluation for Summer, 36.0°C ambient air temperature, 24.0°C inside air temperature.

Wall Element (Insulation path)	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm	k at 23°C	Note
Outside air film:	0.040	<b>36.00</b>	35.87	35.94	0.13			1
12.5mm cement render:	0.010	35.87	35.84	35.86	0.03	12.5	1.3	4,5
Steel mesh:	0.000	35.84	35.84	35.84	0.00	0.0		3
12.5mm cement render:	0.010	35.84	35.81	35.83	0.03	12.5	1.3	4
<b>150mm SL Grade EPS</b>	<b>3.583</b>	35.81	24.44	30.13	11.37	150.0	0.0407	5
12.5mm cement render:	0.010	24.44	24.41	24.43	0.03	12.5	1.3	4
Steel mesh:	0.000	24.41	24.41	24.41	0.00	0.0		3
12.5mm cement render:	0.010	24.41	24.38	24.40	0.03	12.5	1.3	4,5
Indoor air film (unreflective surface):	<u>0.120</u>	24.38	<b>24.00</b>	24.19	<u>0.38</u>			2
<b>Total Thermal Resistance R<sub>Ti</sub> =</b>	<b>3.78</b>	m <sup>2</sup> .K/W		12.00		200		

**Corresponding Total Conductance (k<sub>Ti</sub>): 0.26 W/(m<sup>2</sup>.K)**

**NOTES:**

Calculated 16/6/09 22:19

Ref: 279\_B.xls

**Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for the thermal insulation of buildings**

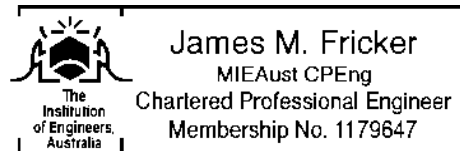
- AS/NZS 4859.1:2002/Amdt 1 2006, Clause K5(a)
- AS/NZS 4859.1:2002/Amdt 1 2006, Table K1
- 2007 AIRAH Technical Handbook pages 164-177
- Cement render conductivity estimated as k=1.3 W/(m.K) based on 2160 kg/m<sup>3</sup> density.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- SL Grade Expanded Polystyrene (EPS)  
Assumes k=0.0407 W/m.K for 23°C. R adjusted 0.39%/K in line with AS/NZS 4859.1:2002/Amdt 1 2006, Clause K3.1  
For different EPS cores, see the table in "Conclusion".
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- Thermal short-circuiting by frames is not considered here as evaluation is for the insulation path only.
- This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.EngAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 150mm SL Grade EPS, the SUMMER Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 36°-24° = 12K) is:

**R3.78 m<sup>2</sup>.K/W**

Signed:

Application results for various EPS grades  
(150mm, 30.1°C mean and 12K Δt)

EPS Grade	k at 23°C	EPS R	Total R	Added R value
Class L	0.0427	3.418	3.62	-0.16
<b>Class SL</b>	<b>0.0407</b>	<b>3.583</b>	<b>3.78</b>	0.00
Class S	0.0394	3.702	3.90	0.12
Class M	0.0380	3.838	4.04	0.25
Class H	0.0365	3.994	4.19	0.41
Class VH	0.0349	4.175	4.37	0.59
	(W/m.K)	m <sup>2</sup> .K/W		/

**THERMAL BRIDGING CALCULATION**

**200mm SL Volcan Wall Structural Concrete Insulated Panels  
(25mm Cement Render, 150mm SL Grade EPS, 25mm Cement Render)**

**WINTER (heat flow out)**

Calc: **279.10w**

**SUMMER (heat flow in)**

**279.10s**

**Calc: 279.10B**

	Insul.	Frame	Insul.	Frame	
Thermal path area (sqm):	0.029990	0.000010	0.029990	0.000010	
Thermal path area ratio:	99.97%	0.03%	99.97%	0.03%	
	R (m <sup>2</sup> .K/W)		R (m <sup>2</sup> .K/W)		
Outside air film:	0.040		0.040		
12.5mm cement render:	0.010		0.010		R
12.5mm cement render:	0.010	-	0.010	-	
<b>150mm SL Grade EPS</b>	<b>3.801</b>	-	<b>3.583</b>	-	
<b>3.48mmØ x 266mm mild steel Z bar truss:</b>	-	<b>0.006</b>	-	<b>0.006</b>	
12.5mm cement render:	0.010	-	0.010	-	
12.5mm cement render:	0.010		0.010		R
Indoor air film (unreflective surface):	0.120		0.120		
Path Total R:	4.00	0.19	3.78	0.19	a
<b>Overall Total R:</b>	<b>R3.35</b>		<b>R3.20</b>		b
% reduction due to bridging:	16.2%		15.4%		=(a-b)/a*100%
<b>Added R due to EPS insulation:</b>	<b>R3.15</b>		<b>R3.00</b>		

**NOTES:**

Calculated 28/7/09 15:40

Ref: 279\_B.xls

- The above estimates the resulting (overall) Total R from the two parallel heat paths -  
a. though the insulation      b. through the steel bar truss
- Overall resulting Total R calculated by Isothermal Planes Method per AS/NZS 4859.1:2002/Amdt 1/2006
- Reinforcing steel mesh within each whythe assumed to be relevant isothermal planes.
- The addition of 10mm Perlite Render would increase Total R by 0.11m<sup>2</sup>.K/W.  
The addition of 10mm Poly Render would increase Total R by 0.03m<sup>2</sup>.K/W.  
The addition of 10mm Cement Render would increase Total R by 0.02m<sup>2</sup>.K/W
- Refer JMF calculations 140.71&w to AS/NZS 4859.1:2002/Amdt 1 2006 for assumptions.
- Indoor & outdoor air temperatures per AS/NZS 4859.1:2002/Amdt 1, Clause K3.1
- For insulation product labelling to AS/NZS 4859.1:2002, this calculation requires an endorsement from a recognised laboratory per Section 4.3 of the standard.
- Calculated by James Fricker, M.AIRAH, M.EngAust, CPEng.

**CONCLUSION:**

For the insulation path in the above wall arrangement with 150mm SL Grade EPS, the WINTER overall Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 18°-12° = 6K) is:

**R3.35 m<sup>2</sup>.KW after considering thermal bridging for this specific case.**

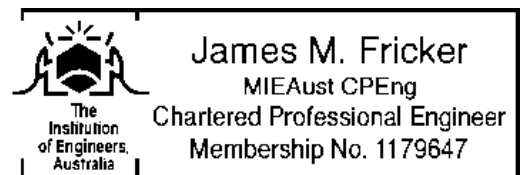
Similarly,

the SUMMER overall Total R-value per AS4859.1:2002/Amdt 1 2006, Clause K3.1 (air Δt of 36°-24° = 12K) is:

**R3.20 m<sup>2</sup>.KW after considering thermal bridging for this specific case.**

Signed:

*James Fricker*



**Total R for other EPS grades**

EPS Grade	Winter	Summer
Class L	<b>R3.23</b>	<b>R3.08</b>
<b>Class SL</b>	<b>R3.35</b>	<b>R3.20</b>
Class S	<b>R3.44</b>	<b>R3.28</b>
Class M	<b>R3.53</b>	<b>R3.38</b>
Class H	<b>R3.64</b>	<b>R3.48</b>
Class VH	<b>R3.77</b>	<b>R3.60</b>