

# OVERALL “TOTAL R” (THERMALLY BRIDGED) THERMAL PERFORMANCE CALCULATIONS TO AS/NZS 4859 Parts 1 & 2:2018

The following calculations by James M Fricker Pty Ltd are based upon:

- a) AS/NZS 4859.1:2018 “Thermal insulation materials for buildings. Part 1: General criteria and technical provisions”,
- b) AS/NZS 4859.2:2018 “Thermal insulation materials for buildings. Part 2: Design”,
- c) the Australian Institute of Refrigeration Air-conditioning & Heating (AIRAH) Handbook (Edition 5, 2013), and (if necessary) the ASHRAE Fundamentals Handbook.

Initial results report Total R for each thermal path. These results are combined by area weighting and isothermal planes method to deduce **Overall Surface Total R**. This is per AS/NZS 4859.2:2018 Clause 4.3 – “A total resistance associated with a construction of materials, computed or measured over an area sufficient to be fully representative of the element of construction, and specified as a Total R-value, including surface film resistances and thermal bridging.”

Total R-values are based on product in-service conditions in accordance with AS/NZS 4859.2:2018 including the alteration of insulation Material R for temperature, and Air Space R for temperature and infrared emittance.

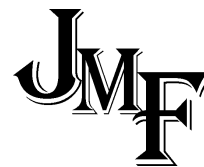
Each calculation result is subject to any specific notes and assumptions listed on the calculation.

If a construction differs from the described system, the thermal resistance may be different.

All calculations were done by James M Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus)



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SUMMARY OF RESULTS		Total R		Total U	
		"s"	"w"	"s"	"w"
JMF Calc.	<b>X-Plus WALL SYSTEMS</b>	Summer	Winter	Summer	Winter
<b>215w29Ax</b>	<b>115X-Plus WALL SYSTEM - (no insulation) 103mm concrete core</b>	<b>R0.28</b>	<b>R0.28</b>	<b>3.577</b>	<b>3.577</b>
<b>215w30xj</b>	<b>115X-PLUS WALL SYSTEM (internally insulated with R0.443 15mm FOILBOARD™) (furring channels at 400mm centres)</b>	<b>R1.36</b>	<b>R1.43</b>	<b>0.736</b>	<b>0.700</b>
<b>215w301xj</b>	<b>115X-PLUS WALL SYSTEM (internally insulated with R0.443 15mm FOILBOARD™) (furring channels at 600mm centres)</b>	<b>R1.38</b>	<b>R1.45</b>	<b>0.727</b>	<b>0.692</b>
<b>215w31x</b>	<b>RENDERED EXTERNALLY INSULATED 115X-PLUS WALL SYSTEM (R1.37 50MM H CLASS EPS)</b>	<b>R1.63</b>	<b>R1.71</b>	<b>0.612</b>	<b>0.586</b>
<b>215w311x</b>	<b>RENDERED EXTERNALLY INSULATED 115X-PLUS WALL SYSTEM (R1.79 50MM XPS)</b>	<b>R2.05</b>	<b>R2.12</b>	<b>0.488</b>	<b>0.471</b>
<b>215w32x</b>	<b>INTERNALLY R1.5 INSULATED 115X-PLUS WALL SYSTEM (furring channels at 400mm centres)</b>	<b>R1.45</b>	<b>R1.54</b>	<b>0.690</b>	<b>0.647</b>
<b>215w321x</b>	<b>INTERNALLY R1.5 INSULATED 115X-PLUS WALL SYSTEM (furring channels at 600mm centres)</b>	<b>R1.55</b>	<b>R1.64</b>	<b>0.647</b>	<b>0.608</b>

NOTES: The above shows Total R determinations based upon AS/NZS 4859 Parts 1&2:2018, Thermal insulation materials for buildings. The insulation thermal resistance is calculated for the Australian air temperature differences (winter: 18°-12°C = 6K, summer: 36°-24°C = 12K) per the standard.

Total Conductance (U) calculated by  $U=1/R$

See calculations for relevant assumptions and results for other thicknesses.

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Calculated on 27/2/20 15:20  
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**THERMAL INSULATION EVALUATION BY CALCULATION**

JMF Calc Ref

<b>215w29Ax</b>												<b>115X-Plus WALL SYSTEM - (no insulation) 103mm concrete core</b>											
JHI ref: Option A												<b>(i) Insulation path:- 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet</b>											
Insulation path wall area:												99.91%	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm
Outside air film												0.040	0.040	12.00	12.86	12.43	0.86	0.040	36.00	34.28	35.14	1.72	
6mm fibre cement sheet												0.024	0.024	12.86	13.37	13.12	0.52	0.024	34.28	33.25	33.77	1.03	6
103mm concrete core												0.072	0.072	13.37	14.91	14.14	1.54	0.072	33.25	30.18	31.72	3.07	103
6mm fibre cement sheet												0.024	0.024	14.91	15.42	15.17	0.52	0.024	30.18	29.15	29.67	1.03	6
Indoor still air film												0.120	0.120	15.42	18.00	16.71	2.58	0.120	29.15	24.00	26.58	5.15	115
<b>Overall Total Thermal Resistance</b>												<b>R<sub>T</sub> =</b>	<b>0.28</b>	<b>winter</b>			<b>0.28</b>	<b>summer</b>			<b>0.28</b>	<b>AVG</b>	

**NOTES:**

Calculated to AS4859.1&2:2018 on 25/2/20 18:24 215\_F52h.xls  
 The above estimates the resulting (overall) Total R for the X-Plus wall (metal spacers @ 350mm spacing).  
 Due to high conductivity of concrete, thermal bridging from spacers does not affect results.  
 Refer AS/NZS 4859.1&2:2018 for assumptions.  
 Indoor & outdoor air temperatures per AS/NZS 4859.2:2018, Clause 5.1  
 Calculated by James Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus)

**CONCLUSION:**

**For the bare X-Plus wall systems (no insulation),**

the WINTER & SUMMER overall Total R-values per AS4859.2:2018 are:

For the 115X-Plus Wall System, Total R is **R0.28** m<sup>2</sup>.K/W for 103mm concrete (115mm total wall thickness.)

Similarly,

For the 135X-Plus Wall System, Total R is **R0.29** m<sup>2</sup>.K/W for 123mm concrete (135mm total wall thickness.)

For the 150X-Plus Wall System, Total R is **R0.30** m<sup>2</sup>.K/W for 138mm concrete (150mm total wall thickness.)

For the 165X-Plus Wall System, Total R is **R0.31** m<sup>2</sup>.K/W for 153mm concrete (165mm total wall thickness.)

For the 200X-Plus Wall System, Total R is **R0.34** m<sup>2</sup>.K/W for 188mm concrete (200mm total wall thickness.)

For the 265X-Plus Wall System, Total R is **R0.38** m<sup>2</sup>.K/W for 253mm concrete (265mm total wall thickness.)

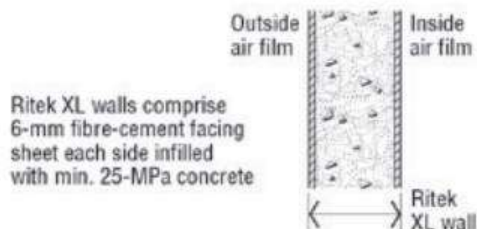
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**THERMAL INSULATION EVALUATION BY CALCULATION**

JMF Calc Ref

**215w30xj 115X-PLUS WALL SYSTEM (internally insulated with R0.443 15mm FOILBOARD™) (furring channels at 400mm centres)**

JHI ref: Option B

**(i) Insulation path:- 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet, R0.443 15mm Foilboard™, 35mm reflective air gap, 10mm plasterboard**

Insulation wall area:	93.00%	m².K/W	°C out	°C in	°C avg	Δt	m².K/W	°C out	°C in	°C avg	Δt	e1	e2	mm
Outside air film	0.040		12.00	12.16	12.08	0.16	0.040	36.00	35.66	35.83	0.34	cavity		
6mm fibre cement sheet	0.024		12.16	12.26	12.21	0.10	0.024	35.66	35.46	35.56	0.20			6
103mm concrete core	0.072		12.26	12.55	12.40	0.29	0.072	35.46	34.85	35.15	0.61			103
6mm fibre cement sheet	0.024		12.55	12.65	12.60	0.10	0.024	34.85	34.64	34.75	0.20			6
<b>(i) R0.443 15mm Foilboard™</b>	<b>0.462</b>		12.65	14.52	13.58	1.87	<b>0.424</b>	34.64	31.04	32.84	3.61			<b>15</b>
<b>35mm reflective air gap</b>	<b>0.679</b>		14.52	17.27	15.90	2.75	<b>0.649</b>	31.04	25.52	28.28	5.52	0.041	0.87	35
10mm plasterboard	0.059		17.27	17.51	17.39	0.24	0.059	25.52	25.02	25.27	0.50			10
Indoor still air film	0.120		17.51	18.00	17.76	0.49	0.120	25.02	24.00	24.51	1.02	0.87		175
<b>Insulation path, Total Thermal Resistance</b>	<b>R<sub>Ti</sub> = 1.480</b>		<b>winter</b>				<b>1.411</b>	<b>summer</b>						

**(ii) Batten path:- 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet, R0.443 15mm Foilboard™, 28mm furring channel on Beta-Fix bracket, 10mm plasterboard**

Batten path wall area:	7.00%	m².K/W	°C out	°C in	°C avg	Δt	m².K/W	°C out	°C in	°C avg	Δt	e1	e2	mm
Outside air film	0.040		12.00	12.24	12.12	0.24	0.040	36.00	35.48	35.74	0.52	cavity		
6mm fibre cement sheet	0.024		12.24	12.38	12.31	0.14	0.024	35.48	35.17	35.33	0.31			6
103mm concrete core	0.072		12.38	12.81	12.60	0.43	0.072	35.17	34.24	34.71	0.93			103
6mm fibre cement sheet	0.024		12.81	12.96	12.89	0.14	0.024	34.24	33.93	34.09	0.31			6
<b>(i) R0.443 15mm Foilboard™</b>	<b>0.460</b>		12.96	15.72	14.34	2.76	<b>0.427</b>	33.93	28.39	31.16	5.54			<b>15</b>
<b>(ii) 28mm furring channel on Beta-Fix bracket</b>	<b>0.200</b>		15.72	16.92	16.32	1.20	<b>0.160</b>	28.39	26.32	27.36	2.07			35
10mm plasterboard	0.059		16.92	17.28	17.10	0.35	0.059	26.32	25.56	25.94	0.76			10
Indoor still air film	0.120		17.28	18.00	17.64	0.72	0.120	25.56	24.00	24.78	1.56	0.87		175
<b>Batten path, Total Thermal Resistance</b>	<b>R<sub>Tb</sub> = 0.999</b>		<b>winter</b>				<b>0.926</b>	<b>summer</b>						

The thermal path area proportions are used to deduce the following overall Total R from the R values above.

<b>Overall Total Thermal Resistance</b>	<b>R<sub>T</sub> = 1.43</b>	<b>winter</b>	<b>1.36</b>	<b>summer</b>	<b>1.39</b>	<b>AVG</b>
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**NOTES:**

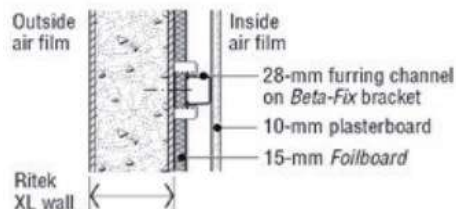
Calculated to AS4859.1&2:2018 on 27/2/20 15:20 215\_F52h.xls  
 The above estimates the overall Total R for the X-Plus wall (metal spacers in concrete @ 350mm spacing, furring channels at 400mm centres).  
 Due to high conductivity of concrete, thermal bridging from spacers does not affect results, but gaps between insulation do..  
 Assessment includes adjustment of insulation R based on temperature per 4859.2:2018 Clause 5.  
**R0.443 15mm Foilboard™ assumed conductivity k=0.0339 W/m-K @ 23°C**  
 Refer AS/NZS 4859:2018 for assumptions.  
 Indoor & outdoor air temperatures per AS/NZS 4859.2:2018, Clause 5.1  
 Calculated by James Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus)

**CONCLUSION:**

**For the internally insulated X-Plus walls (R0.443 15mm Foilboard™):**

the overall Total R-values per AS4859.2:2018 are:

		<b>winter</b>	<b>summer</b>	
115X-Plus Wall System		<b>R1.43</b>	<b>R1.36</b>	m².K/W
Similarly,				
135X-Plus Wall System		<b>R1.44</b>	<b>R1.37</b>	m².K/W
150X-Plus Wall System		<b>R1.45</b>	<b>R1.38</b>	m².K/W
165X-Plus Wall System		<b>R1.46</b>	<b>R1.39</b>	m².K/W
200X-Plus Wall System		<b>R1.49</b>	<b>R1.42</b>	m².K/W
265X-Plus Wall System		<b>R1.53</b>	<b>R1.46</b>	m².K/W



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**THERMAL INSULATION EVALUATION BY CALCULATION**

JMF Calc Ref

**215w301xj 115X-PLUS WALL SYSTEM (internally insulated with R0.443 15mm FOILBOARD™) (furring channels at 600mm centres)**

JHI ref: Option B

**(i) Insulation path:- 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet, R0.443 15mm Foilboard™, 35mm reflective air gap, 10mm plasterboard**

Insulation wall area:	95.33%	m².K/W	°C out	°C in	°C avg	Δt	m².K/W	°C out	°C in	°C avg	Δt	e1	e2	mm
Outside air film	0.040		12.00	12.16	12.08	0.16	0.040	36.00	35.66	35.83	0.34	cavity		
6mm fibre cement sheet	0.024		12.16	12.26	12.21	0.10	0.024	35.66	35.46	35.56	0.20			6
103mm concrete core	0.072		12.26	12.55	12.40	0.29	0.072	35.46	34.85	35.15	0.61			103
6mm fibre cement sheet	0.024		12.55	12.65	12.60	0.10	0.024	34.85	34.64	34.75	0.20			6
<b>(i) R0.443 15mm Foilboard™</b>	<b>0.462</b>		12.65	14.52	13.58	1.87	<b>0.424</b>	34.64	31.04	32.84	3.61			<b>15</b>
<b>35mm reflective air gap</b>	<b>0.679</b>		14.52	17.27	15.90	2.75	<b>0.649</b>	31.04	25.52	28.28	5.52	0.041	0.87	35
10mm plasterboard	0.059		17.27	17.51	17.39	0.24	0.059	25.52	25.02	25.27	0.50			10
Indoor still air film	0.120		17.51	18.00	17.76	0.49	0.120	25.02	24.00	24.51	1.02	0.87		175
<b>Insulation path, Total Thermal Resistance</b>	<b>R<sub>Ti</sub> = 1.480</b>		<b>winter</b>				<b>1.411</b>	<b>summer</b>						

**(ii) Batten path:- 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet, R0.443 15mm Foilboard™, 28mm furring channel on Beta-Fix bracket, 10mm plasterboard**

Batten path wall area:	4.67%	m².K/W	°C out	°C in	°C avg	Δt	m².K/W	°C out	°C in	°C avg	Δt	e1	e2	mm
Outside air film	0.040		12.00	12.24	12.12	0.24	0.040	36.00	35.48	35.74	0.52	cavity		
6mm fibre cement sheet	0.024		12.24	12.38	12.31	0.14	0.024	35.48	35.17	35.33	0.31			6
103mm concrete core	0.072		12.38	12.81	12.60	0.43	0.072	35.17	34.24	34.71	0.93			103
6mm fibre cement sheet	0.024		12.81	12.96	12.89	0.14	0.024	34.24	33.93	34.09	0.31			6
<b>(i) R0.443 15mm Foilboard™</b>	<b>0.460</b>		12.96	15.72	14.34	2.76	<b>0.427</b>	33.93	28.39	31.16	5.54			<b>15</b>
<b>(ii) 28mm furring channel on Beta-Fix bracket</b>	<b>0.200</b>		15.72	16.92	16.32	1.20	<b>0.160</b>	28.39	26.32	27.36	2.07			35
10mm plasterboard	0.059		16.92	17.28	17.10	0.35	0.059	26.32	25.56	25.94	0.76			10
Indoor still air film	0.120		17.28	18.00	17.64	0.72	0.120	25.56	24.00	24.78	1.56	0.87		175
<b>Batten path, Total Thermal Resistance</b>	<b>R<sub>Tb</sub> = 0.999</b>		<b>winter</b>				<b>0.926</b>	<b>summer</b>						

The thermal path area proportions are used to deduce the following overall Total R from the R values above.

<b>Overall Total Thermal Resistance</b>	<b>R<sub>T</sub> = 1.45</b>	<b>winter</b>	<b>1.38</b>	<b>summer</b>	<b>1.41</b>	<b>AVG</b>
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**NOTES:**

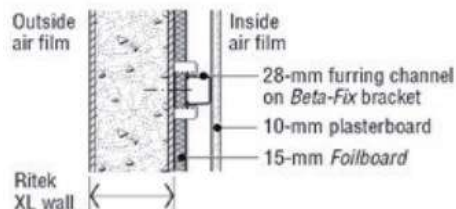
Calculated to AS4859.1&2:2018 on 27/2/20 15:20 215\_F52h.xls  
 The above estimates the overall Total R for the X-Plus wall (metal spacers in concrete @ 350mm spacing, furring channels at 600mm centres).  
 Due to high conductivity of concrete, thermal bridging from spacers does not affect results, but gaps between insulation do..  
 Assessment includes adjustment of insulation R based on temperature per 4859.2:2018 Clause 5.  
**R0.443 15mm Foilboard™ assumed conductivity k=0.0339 W/m.K @ 23°C**  
 Refer AS/NZS 4859:2018 for assumptions.  
 Indoor & outdoor air temperatures per AS/NZS 4859.2:2018, Clause 5.1  
 Calculated by James Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus)

**CONCLUSION:**

**For the internally insulated X-Plus walls (R0.443 15mm Foilboard™):**

the overall Total R-values per AS4859.2:2018 are:

		<b>winter</b>	<b>summer</b>	
115X-Plus Wall System		<b>R1.45</b>	<b>R1.38</b>	m².K/W
Similarly,				
135X-Plus Wall System		<b>R1.46</b>	<b>R1.39</b>	m².K/W
150X-Plus Wall System		<b>R1.47</b>	<b>R1.40</b>	m².K/W
165X-Plus Wall System		<b>R1.48</b>	<b>R1.41</b>	m².K/W
200X-Plus Wall System		<b>R1.50</b>	<b>R1.43</b>	m².K/W
265X-Plus Wall System		<b>R1.55</b>	<b>R1.48</b>	m².K/W



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**THERMAL INSULATION EVALUATION BY CALCULATION**

JMF Calc Ref

215w31x RENDERED EXTERNALLY INSULATED 115X-PLUS WALL SYSTEM (R1.37 50MM H CLASS EPS)												
JHI ref: Option C 2mm texture coat, 8mm render coat, 50mm H Class EPS insulation, 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet												
Whole wall area:	100%	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm
Outside air film		0.040	12.00	12.14	12.07	0.14	0.040	36.00	35.71	35.85	0.29	
2mm texture coat		0.004	12.14	12.15	12.15	0.01	0.004	35.71	35.68	35.69	0.03	2
8mm render coat		0.015	12.15	12.21	12.18	0.05	0.015	35.68	35.57	35.62	0.11	8
<b>50mm H Class EPS insulation</b>		<b>1.409</b>	12.21	<b>17.16</b>	14.68	4.95	<b>1.335</b>	35.57	25.76	30.66	9.81	<b>50</b>
6mm fibre cement sheet		0.024	17.16	17.24	17.20	0.08	0.024	25.76	25.58	25.67	0.18	6
103mm concrete core		0.072	17.24	17.49	17.37	0.25	0.072	25.58	25.06	25.32	0.53	103
6mm fibre cement sheet		0.024	17.49	17.58	17.54	0.08	0.024	25.06	24.88	24.97	0.18	6
Indoor still air film		0.120	17.58	18.00	17.79	0.42	0.120	24.88	24.00	24.44	0.88	175
<b>Insulation path, Total Thermal Resistance R<sub>Ti</sub> = 1.707 winter</b>							<b>1.634 summer</b>					
<b>Overall Total Thermal Resistance R<sub>T</sub> = 1.71 winter</b>							<b>1.63 summer</b>		<b>1.67 AVG</b>			

**NOTES:**

Calculated to AS4859.1&2:2018 on 25/2/20 18:24 215\_F52h.xls  
 The above estimates the resulting (overall) Total R for the X-Plus wall (metal spacers @ 350mm spacing).  
 Due to high conductivity of concrete, thermal bridging from spacers does not affect results.  
 Assessment includes adjustment of insulation R based on temperature per 4859.2:2018 Clause 5.  
**50mm H Class EPS insulation assumed conductivity k=0.0365 W/m·K @ 23°C**  
 Refer AS/NZS 4859:2018 for assumptions.  
 Indoor & outdoor air temperatures per AS/NZS 4859.2:2018, Clause 5.1  
 Calculated by James Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus)

**CONCLUSION:**

**For the rendered externally insulated X-Plus walls (50mm H Class EPS insulation):**

the overall Total R-values per AS4859.2:2018 are:

115X-Plus Wall System **winter R1.71 summer R1.63** m<sup>2</sup>.K/W

Similarly,

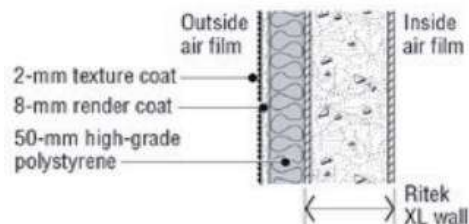
135X-Plus Wall System **R1.72 R1.65** m<sup>2</sup>.K/W

150X-Plus Wall System **R1.73 R1.66** m<sup>2</sup>.K/W

165X-Plus Wall System **R1.74 R1.67** m<sup>2</sup>.K/W

200X-Plus Wall System **R1.77 R1.69** m<sup>2</sup>.K/W

265X-Plus Wall System **R1.81 R1.74** m<sup>2</sup>.K/W



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**THERMAL INSULATION EVALUATION BY CALCULATION**

JMF Calc Ref

215w311x RENDERED EXTERNALLY INSULATED 115X-PLUS WALL SYSTEM (R1.79 50MM XPS)													
JHI ref: Option D 2mm texture coat, 8mm render coat, 50mm XPS insulation, 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet													
Whole wall area:		100%	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm
Outside air film			0.040	12.00	12.11	12.06	0.11	0.040	36.00	35.77	35.88	0.23	
2mm texture coat			0.004	12.11	12.12	12.12	0.01	0.004	35.77	35.74	35.75	0.02	2
8mm render coat			0.015	12.12	12.17	12.15	0.04	0.015	35.74	35.65	35.70	0.09	8
<b>50mm XPS insulation</b>			<b>1.826</b>	12.17	<b>17.32</b>	14.75	5.16	<b>1.750</b>	35.65	25.40	30.53	10.25	<b>50</b>
6mm fibre cement sheet			0.024	17.32	17.39	17.36	0.07	0.024	25.40	25.26	25.33	0.14	6
103mm concrete core			0.072	17.39	17.59	17.49	0.20	0.072	25.26	24.84	25.05	0.42	103
6mm fibre cement sheet			0.024	17.59	17.66	17.63	0.07	0.024	24.84	24.70	24.77	0.14	6
Indoor still air film			0.120	17.66	18.00	17.83	0.34	0.120	24.70	24.00	24.35	0.70	175
<b>Insulation path, Total Thermal Resistance</b>			<b>R<sub>Ti</sub> = 2.125</b>	<b>winter</b>				<b>2.048</b>	<b>summer</b>				
<b>Overall Total Thermal Resistance</b>			<b>R<sub>T</sub> = 2.12</b>	<b>winter</b>				<b>2.05</b>	<b>summer</b>		<b>2.09</b>		<b>AVG</b>

**NOTES:**

Calculated to AS4859.1&2:2018 on 25/2/20 18:24 215\_F52h.xls  
 The above estimates the resulting (overall) Total R for the X-Plus wall (metal spacers @ 350mm spacing).  
 Due to high conductivity of concrete, thermal bridging from spacers does not affect results.  
 Assessment includes adjustment of insulation R based on temperature per 4859.2:2018 Clause 5.  
**50mm 32kg/m<sup>3</sup> XPS insulation assumed conductivity k=0.0280 W/m-K @ 23°C**  
 Refer AS/NZS 4859:2018 for assumptions.  
 Indoor & outdoor air temperatures per AS/NZS 4859.2:2018, Clause 5.1  
 Calculated by James Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus)

**CONCLUSION:**

**For the rendered externally insulated X-Plus walls (50mm XPS insulation):**

the overall Total R-values per AS4859.2:2018 are:

115X-Plus Wall System **winter R2.12** **summer R2.05** m<sup>2</sup>.K/W

Similarly,

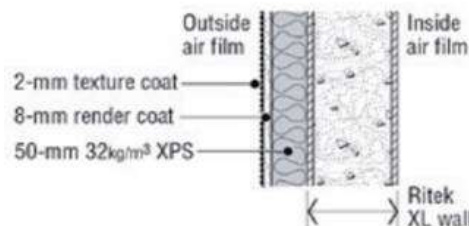
135X-Plus Wall System **R2.14** **R2.06** m<sup>2</sup>.K/W

150X-Plus Wall System **R2.15** **R2.07** m<sup>2</sup>.K/W

165X-Plus Wall System **R2.16** **R2.08** m<sup>2</sup>.K/W

200X-Plus Wall System **R2.18** **R2.11** m<sup>2</sup>.K/W

265X-Plus Wall System **R2.23** **R2.15** m<sup>2</sup>.K/W



Signed:

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**THERMAL INSULATION EVALUATION BY CALCULATION**

JMF Calc Ref

**215w32x INTERNALLY R1.5 INSULATED 115X-PLUS WALL SYSTEM (furring channels at 400mm centres)**

JHI ref: Option E

**(i) Insulation path:- 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet, R1.5 50mm insulation batt, 10mm plasterboard**

Insulation wall area:	93.00%	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm
Outside air film		0.040	12.00	12.13	12.06	0.13	0.040	36.00	35.73	35.87	0.27	
6mm fibre cement sheet		0.024	12.13	12.20	12.16	0.08	0.024	35.73	35.57	35.65	0.16	6
103mm concrete core		0.072	12.20	12.43	12.32	0.23	0.072	35.57	35.09	35.33	0.48	103
6mm fibre cement sheet		0.024	12.43	12.51	12.47	0.08	0.024	35.09	34.93	35.01	0.16	6
<b>(i) R1.5 50mm insulation batt</b>		<b>1.553</b>	12.51	17.43	14.97	4.93	<b>1.455</b>	34.93	25.20	30.07	9.74	<b>50</b>
10mm plasterboard		0.059	17.43	17.62	17.53	0.19	0.059	25.20	24.80	25.00	0.39	10
Indoor still air film		0.120	17.62	18.00	17.81	0.38	0.120	24.80	24.00	24.40	0.80	175
<b>Insulation path, Total Thermal Resistance R<sub>Ti</sub> =</b>		<b>1.891</b>	<b>winter</b>				<b>1.794</b>	<b>summer</b>				

**(ii) Batten path:- 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet, 28mm furring channel on 22mm Beta-Fix bracket, 10mm plasterboard**

Batten path wall area:	7.00%	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm
Outside air film		0.040	12.00	12.45	12.22	0.45	0.040	36.00	35.04	35.52	0.96	
6mm fibre cement sheet		0.024	12.45	12.71	12.58	0.27	0.024	35.04	34.46	34.75	0.58	6
103mm concrete core		0.072	12.71	13.51	13.11	0.80	0.072	34.46	32.74	33.60	1.72	103
6mm fibre cement sheet		0.024	13.51	13.78	13.64	0.27	0.024	32.74	32.16	32.45	0.58	6
<b>(ii) 28mm furring channel on 22mm Beta-Fix bracket</b>		<b>0.200</b>	13.78	16.01	14.89	2.23	<b>0.160</b>	32.16	28.31	30.23	3.85	<b>50</b>
10mm plasterboard		0.059	16.01	16.66	16.33	0.66	0.059	28.31	26.89	27.60	1.42	10
Indoor still air film		0.120	16.66	18.00	17.33	1.34	0.120	26.89	24.00	25.44	2.89	175
<b>Batten path, Total Thermal Resistance R<sub>Tb</sub> =</b>		<b>0.539</b>	<b>winter</b>				<b>0.499</b>	<b>summer</b>				

The thermal path area proportions are used to deduce the following overall Total R from the R values above.

<b>Overall Total Thermal Resistance R<sub>T</sub> =</b>	<b>1.54</b>	<b>winter</b>	<b>1.45</b>	<b>summer</b>	<b>1.50</b>	<b>AVG</b>
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**NOTES:**

Calculated to AS4859.1&2:2018 on 25/2/20 18:24 215\_F52h.xls  
 The above estimates the overall Total R for the X-Plus wall (metal spacers in concrete @ 350mm spacing, furring channels at 400mm centres).  
 Due to high conductivity of concrete, thermal bridging from spacers does not affect results, but gaps between insulation batts do..  
 Assessment includes adjustment of insulation R based on temperature per 4859.2:2018 Clause 5.  
**R1.5 50mm insulation batt assumed conductivity k=0.0333 W/m.K @ 23°C**  
 Refer AS/NZS 4859:2018 for assumptions.  
 Indoor & outdoor air temperatures per AS/NZS 4859.2:2018, Clause 5.1  
 Calculated by James Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus)

**CONCLUSION:**

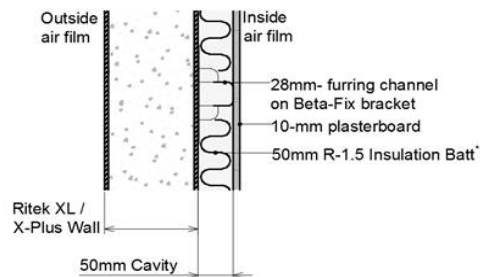
**For the internally R1.5 insulated X-Plus walls (R1.5 50mm insulation batt):**

the overall Total R-values per AS4859.2:2018 are:

	<b>winter</b>	<b>summer</b>	
115X-Plus Wall System	<b>R1.54</b>	<b>R1.45</b>	m <sup>2</sup> .K/W

Similarly,

135X-Plus Wall System	<b>R1.56</b>	<b>R1.46</b>	m <sup>2</sup> .K/W
150X-Plus Wall System	<b>R1.57</b>	<b>R1.47</b>	m <sup>2</sup> .K/W
165X-Plus Wall System	<b>R1.58</b>	<b>R1.48</b>	m <sup>2</sup> .K/W
200X-Plus Wall System	<b>R1.60</b>	<b>R1.51</b>	m <sup>2</sup> .K/W
265X-Plus Wall System	<b>R1.65</b>	<b>R1.55</b>	m <sup>2</sup> .K/W



Signed: *James Fricker*



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**THERMAL INSULATION EVALUATION BY CALCULATION**

JMF Calc Ref

**215w321x INTERNALLY R1.5 INSULATED 115X-PLUS WALL SYSTEM**  
(furring channels at 600mm centres)

JHI ref: Option E

**(i) Insulation path:- 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet, R1.5 50mm insulation batt, 10mm plasterboard**

Insulation wall area:	95.33%	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm
Outside air film		0.040	12.00	12.13	12.06	0.13	0.040	36.00	35.73	35.87	0.27	
6mm fibre cement sheet		0.024	12.13	12.20	12.16	0.08	0.024	35.73	35.57	35.65	0.16	6
103mm concrete core		0.072	12.20	12.43	12.32	0.23	0.072	35.57	35.09	35.33	0.48	103
6mm fibre cement sheet		0.024	12.43	12.51	12.47	0.08	0.024	35.09	34.93	35.01	0.16	6
<b>(i) R1.5 50mm insulation batt</b>		<b>1.553</b>	12.51	17.43	14.97	4.93	<b>1.455</b>	34.93	25.20	30.07	9.74	<b>50</b>
10mm plasterboard		0.059	17.43	17.62	17.53	0.19	0.059	25.20	24.80	25.00	0.39	10
Indoor still air film		0.120	17.62	18.00	17.81	0.38	0.120	24.80	24.00	24.40	0.80	175
<b>Insulation path, Total Thermal Resistance</b>		<b>R<sub>Ti</sub> = 1.891</b>	<b>winter</b>				<b>1.794</b>	<b>summer</b>				

**(ii) Batten path:- 6mm fibre cement sheet, 103mm concrete core, 6mm fibre cement sheet, 28mm furring channel on 22mm Beta-Fix bracket, 10mm plasterboard**

Batten path wall area:	4.67%	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	m <sup>2</sup> .K/W	°C out	°C in	°C avg	Δt	mm
Outside air film		0.040	12.00	12.45	12.22	0.45	0.040	36.00	35.04	35.52	0.96	
6mm fibre cement sheet		0.024	12.45	12.71	12.58	0.27	0.024	35.04	34.46	34.75	0.58	6
103mm concrete core		0.072	12.71	13.51	13.11	0.80	0.072	34.46	32.74	33.60	1.72	103
6mm fibre cement sheet		0.024	13.51	13.78	13.64	0.27	0.024	32.74	32.16	32.45	0.58	6
<b>(ii) 28mm furring channel on 22mm Beta-Fix bracket</b>		<b>0.200</b>	13.78	16.01	14.89	2.23	<b>0.160</b>	32.16	28.31	30.23	3.85	50
10mm plasterboard		0.059	16.01	16.66	16.33	0.66	0.059	28.31	26.89	27.60	1.42	10
Indoor still air film		0.120	16.66	18.00	17.33	1.34	0.120	26.89	24.00	25.44	2.89	175
<b>Batten path, Total Thermal Resistance</b>		<b>R<sub>Tb</sub> = 0.539</b>	<b>winter</b>				<b>0.499</b>	<b>summer</b>				

The thermal path area proportions are used to deduce the following overall Total R from the R values above.

<b>Overall Total Thermal Resistance</b>	<b>R<sub>T</sub> = 1.64</b>	<b>winter</b>	<b>1.55</b>	<b>summer</b>	<b>1.59</b>	<b>AVG</b>
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**NOTES:**

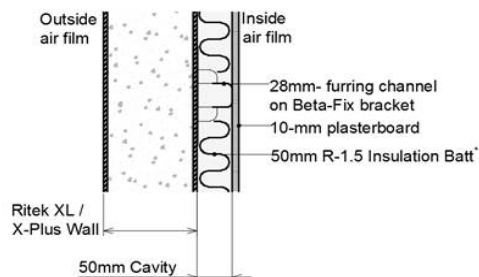
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 The above estimates the overall Total R for the X-Plus wall (metal spacers in concrete @ 350mm spacing, furring channels at 600mm centres).  
 Due to high conductivity of concrete, thermal bridging from spacers does not affect results, but gaps between insulation batts do..  
 Assessment includes adjustment of insulation R based on temperature per 4859.2:2018 Clause 5.  
**R1.5 50mm insulation batt assumed conductivity k=0.0333 W/m.K @ 23°C**  
 Refer AS/NZS 4859:2018 for assumptions.  
 Indoor & outdoor air temperatures per AS/NZS 4859.2:2018, Clause 5.1  
 Calculated by James Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus)

**CONCLUSION:**

**For the internally R1.5 insulated X-Plus walls (R1.5 50mm insulation batt):**

the overall Total R-values per AS4859.2:2018 are:

	<b>winter</b>	<b>summer</b>	
115X-Plus Wall System	<b>R1.64</b>	<b>R1.55</b>	m <sup>2</sup> .K/W
Similarly,			
135X-Plus Wall System	<b>R1.66</b>	<b>R1.56</b>	m <sup>2</sup> .K/W
150X-Plus Wall System	<b>R1.67</b>	<b>R1.57</b>	m <sup>2</sup> .K/W
165X-Plus Wall System	<b>R1.68</b>	<b>R1.58</b>	m <sup>2</sup> .K/W
200X-Plus Wall System	<b>R1.70</b>	<b>R1.61</b>	m <sup>2</sup> .K/W
265X-Plus Wall System	<b>R1.75</b>	<b>R1.65</b>	m <sup>2</sup> .K/W



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