MAXSlab & MAXRaft Thermal Performance

Compiled by Sustainable Engineering Ltd

Contents

Summary R-value Table

MAXRaft Products Summary R-value Table

		Area / Perimeter Ratio									
	Product	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.6	4
1	MAXSlab 300	2.77	2.99	3.22	3.38	3.54	3.7	3.86	4.02	4.49	4.81
2	MAXSlab 350	2.96	3.25	3.53	3.69	3.85	4.01	4.17	4.33	4.87	5.23
3	MAXSlab 400	2.89	3.17	3.45	3.65	3.84	4.04	4.23	4.43	4.92	5.25
4	MAXSlab 300 Brick Rebate	2.27	2.48	2.68	2.83	2.99	3.14	3.29	3.44	3.95	4.29
5	MAXRaft 320	1.86	1.97	2.07	2.16	2.25	2.33	2.42	2.5	2.74	2.9
6	MAXRaft 400	1.68	1.81	1.93	2.01	2.1	2.18	2.27	2.35	2.59	2.74
7	MAXRaft 320 Brick	1.62	1.73	1.85	1.93	2.02	2.11	2.2	2.29	2.53	2.69
8	MAXRaft 400 Brick	1.56	1.68	1.79	1.87	1.96	2.05	2.14	2.23	2.46	2.62
9	MAX85 305	1.46	1.54	1.62	1.7	1.77	1.85	1.92	2	2.21	2.36
10	MAX85 385	1.52	1.62	1.72	1.8	1.88	1.96	2.03	2.11	2.33	2.48
11	MAX85 305 Brick	1.3	1.39	1.47	1.55	1.62	1.7	1.78	1.85	2.06	2.21
12	MAX85 385 Brick	1.34	1.43	1.53	1.6	1.68	1.76	1.84	1.92	2.14	2.28
13	MAXRaft Plus+ 320 (50/50 POD)	2.38	2.54	2.7	2.86	3.02	3.18	3.35	3.51	3.81	4.02
14	MAXRaft Plus+ 400 (50/50 POD)	2.44	2.62	2.81	2.97	3.13	3.29	3.46	3.62	3.95	4.17
15	MAXRaft Plus+ 320 (SG POD)	2.5	2.67	2.84	3.01	3.19	3.36	3.53	3.7	4.03	4.25
16	MAXRaft Plus+ 400 (SG POD)	2.54	2.74	2.94	3.11	3.28	3.45	3.63	3.8	4.15	4.38
17	MAXRaft Plus+ 320 Brick	2.18	2.38	2.59	2.71	2.83	2.95	3.07	3.19	3.5	3.71
18	MAXRaft Plus+ 400 Brick	2.11	2.29	2.47	2.6	2.73	2.86	2.99	3.12	3.57	3.87

*R-value in red

Product	Suitability
MAXSlab	Good Ground, TC1, 300KPA
MAXRaft 320	200KPA, M Class soils
MAXRaft 400	TC2, H Class Soils
MAX85 305	TC1, 200KPA, M Class soils
MAX85 385	TC2, H Class Soils
MAXRaft Plus+320	200KPA, M Class soils
MAXRaft Plus+400	TC2, H Class Soils

MAXSlab

Designed on Good Ground

Heights

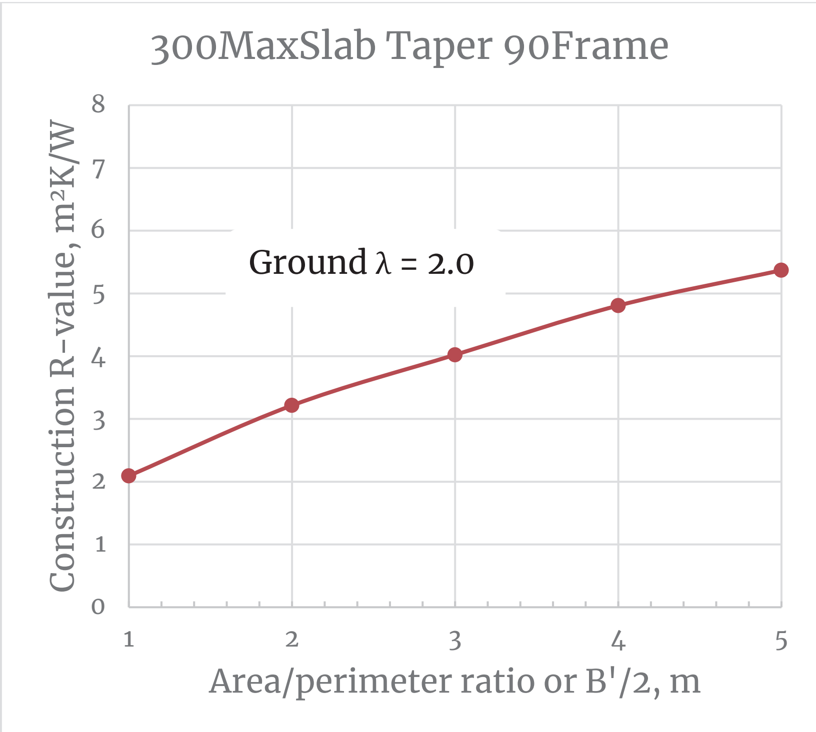
- 300mm / 320mm / 350mm / 400mm
- Bespoke options available

Key Features

- Superior R-values
- Suitable with UF Heating in most circumstances
- Suitable with 90mm/140mm/SIPS
- Site Specific Design
- Always Fully Insulated
- VH EPS perimeter & thickening insulation
- Solid sheets of insulation under slab (no ribs)
- Suitable with UF Heating
- Panel plan and pre-cut materials
- Minimum waste / Recycled polystyrene materials

MAXSlab 300mm for Good Ground (90mm frame)

Underfloor Heating Suitable

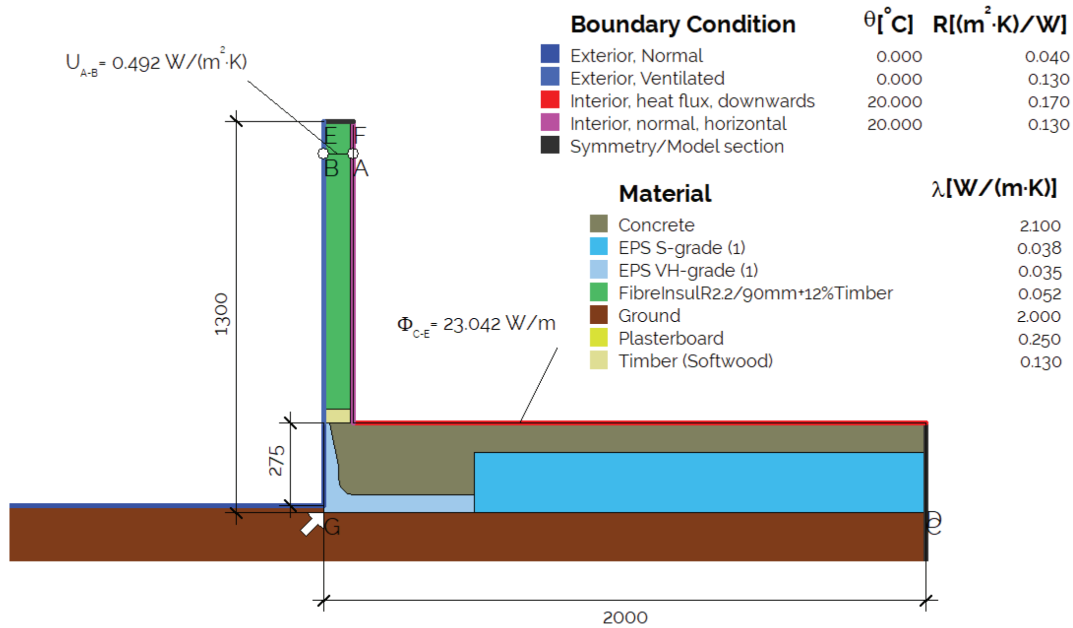


A/P, m	R-value, m^2K/W
1	**2.09**
1.6	2.77
1.8	2.99
2	**3.22**
2.2	3.38
2.4	3.54
2.6	3.70
2.8	3.86
3	**4.02**
3.2	4.18
3.4	4.34
3.6	4.49
3.8	4.65
4	**4.81**
5	**5.37**

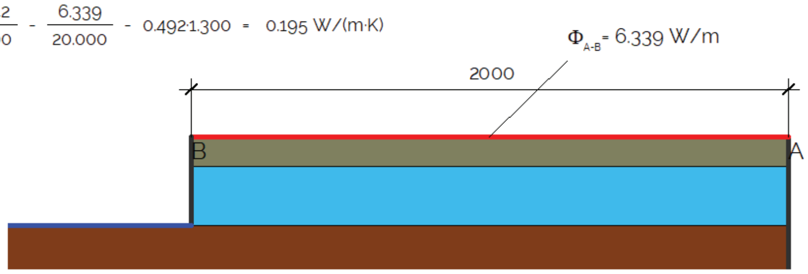
Note the above graph is for $slab\ area\ to\ perimeter\ ratio = A_{slab,internal} / P_{slab,internal}$ The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

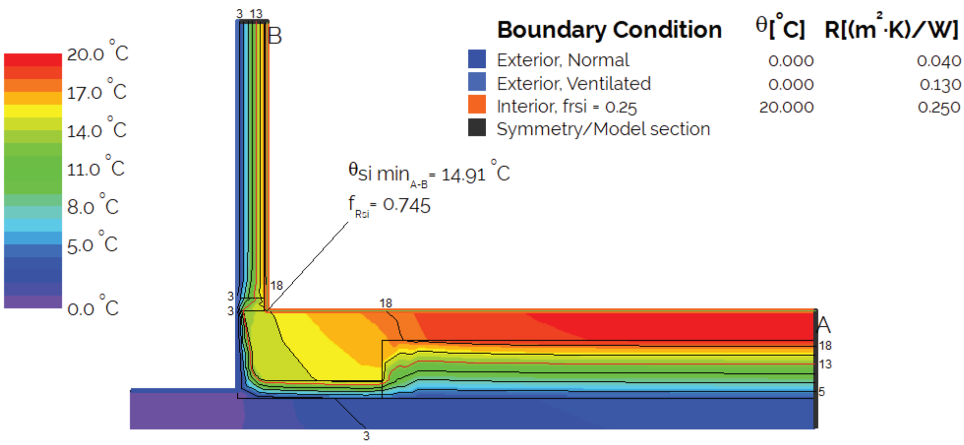
MAXSlab 300mm (90mm)

Good Ground



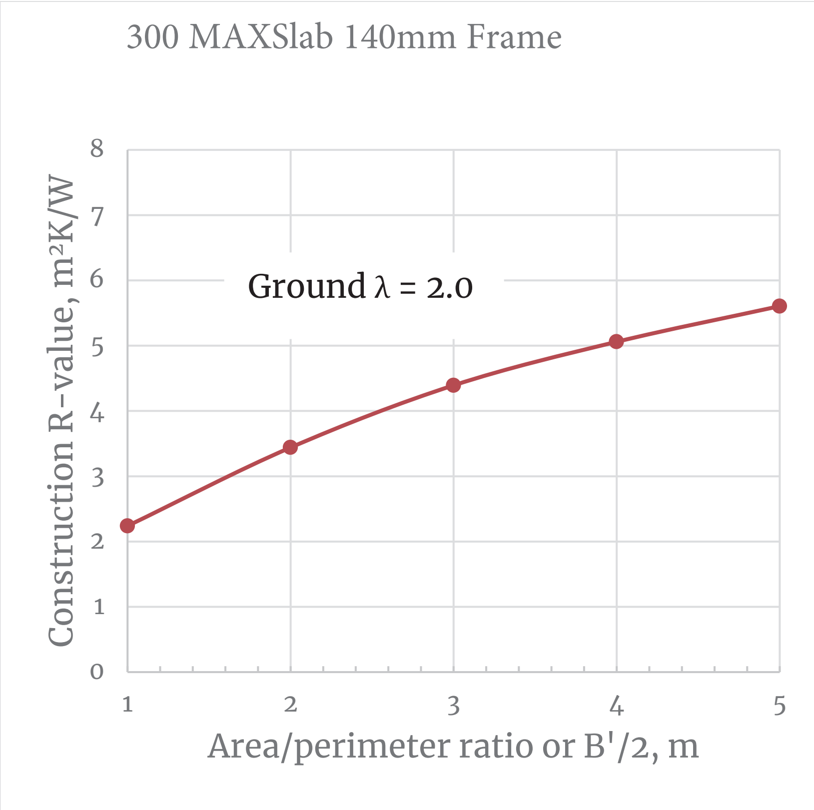
$$\Psi_{C\text{-}G\text{-}E} = \frac{23.042}{20.000} - \frac{6.339}{20.000} - 0.492 \cdot 1.300 = 0.195 \text{ W/(m·K)}$$





MAXSlab 300mm for Good Ground (140mm)

Underfloor Heating Suitable

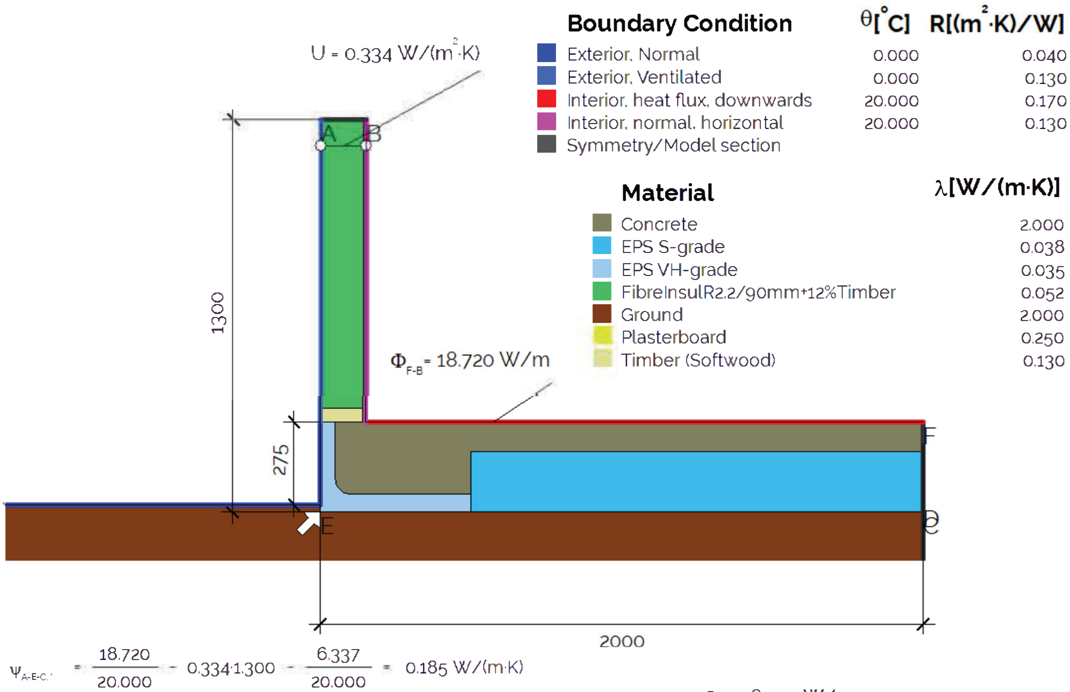


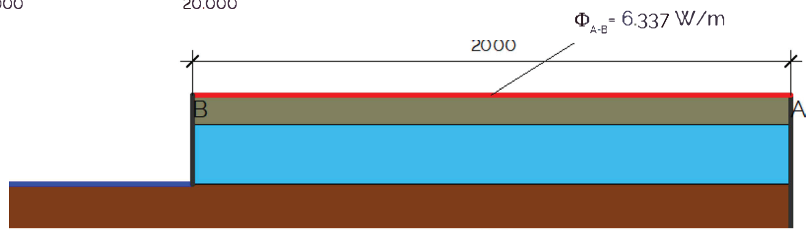
A/P, m	R-value, m²K/W
1	**2.24**
1.6	2.96
1.8	3.20
2	**3.44**
2.2	3.63
2.4	3.82
2.6	4.01
2.8	4.20
3	**4.39**
3.2	4.53
3.4	4.66
3.6	4.79
3.8	4.93
4	**5.06**
5	**5.61**

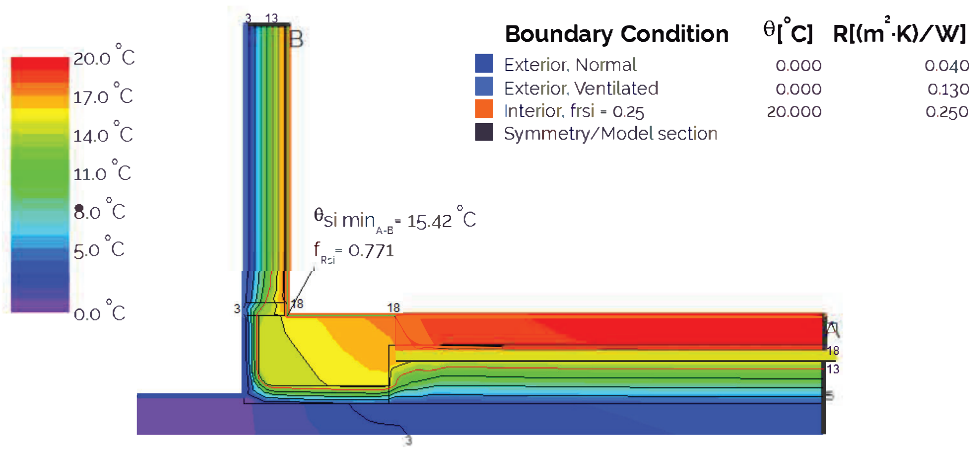
Note the above graph is for $slab\ area\ to\ perimeter\ ratio = Aslab{,}internal \ / \ Pslab{,}internal$ The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

MAXSlab 300mm (140mm)

Good Ground

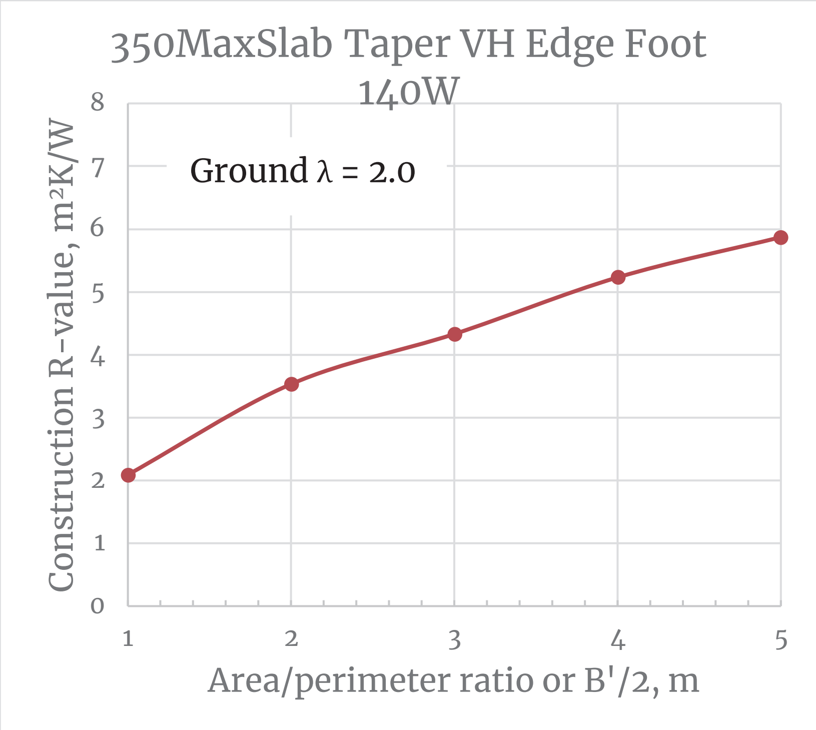






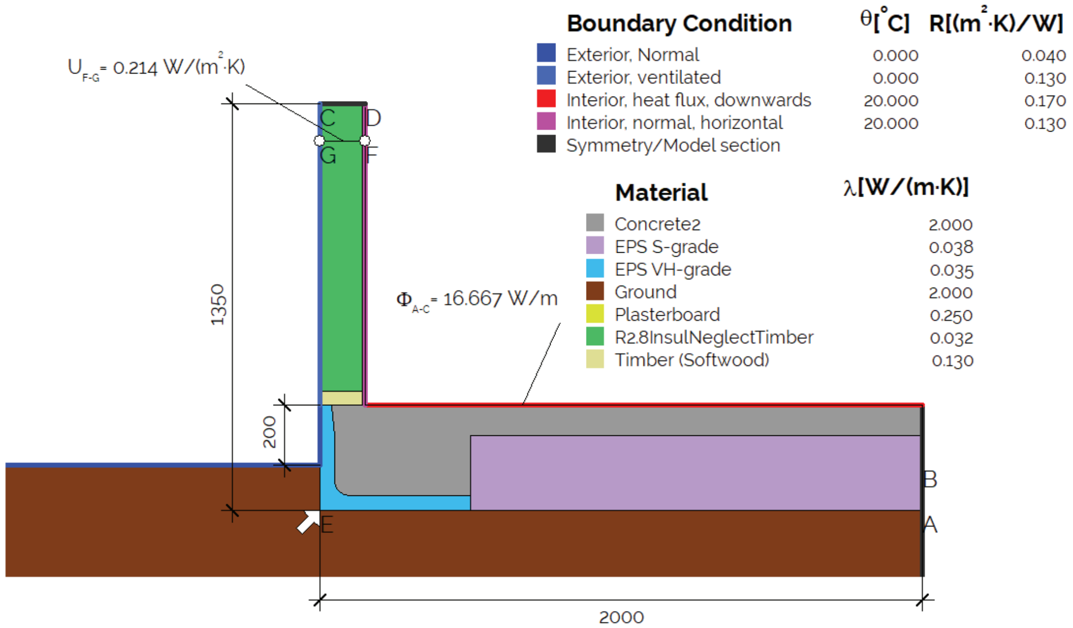
MAXSlab 350mm for Good Ground (140mm)

Underfloor Heating Suitable

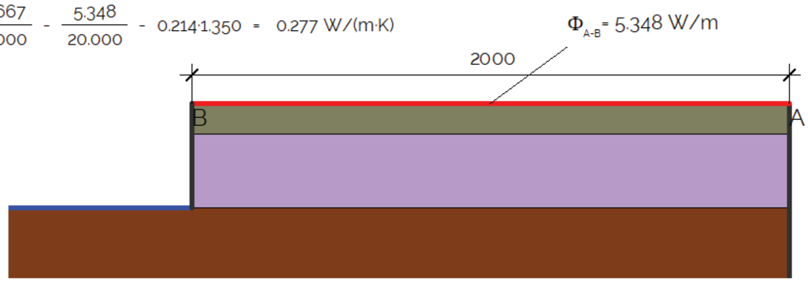


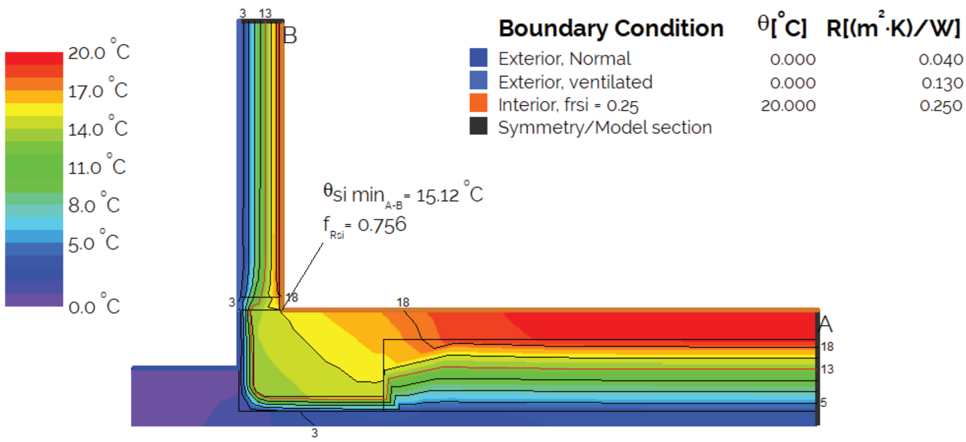
A/P, m	R-value, m²K/W
1	**2.09**
1.6	2.96
1.8	3.25
2	**3.53**
2.2	3.69
2.4	3.85
2.6	4.01
2.8	4.17
3	**4.33**
3.2	4.51
3.4	4.69
3.6	4.87
3.8	5.05
4	**5.23**
5	**5.87**

Note the above graph is for *slab area to perimeter ratio* = *Aslab,internal* / *Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.



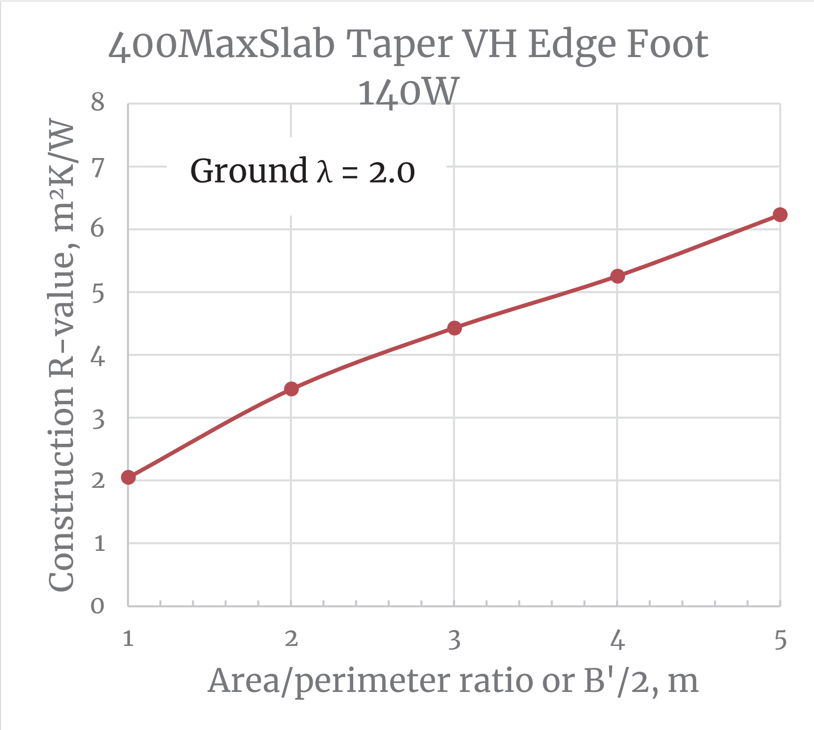
$$\Psi_{A-E-C} = \frac{16.667}{20.000} - \frac{5.348}{20.000} - 0.214 \cdot 1.350 = 0.277 \text{ W/(m·K)}$$





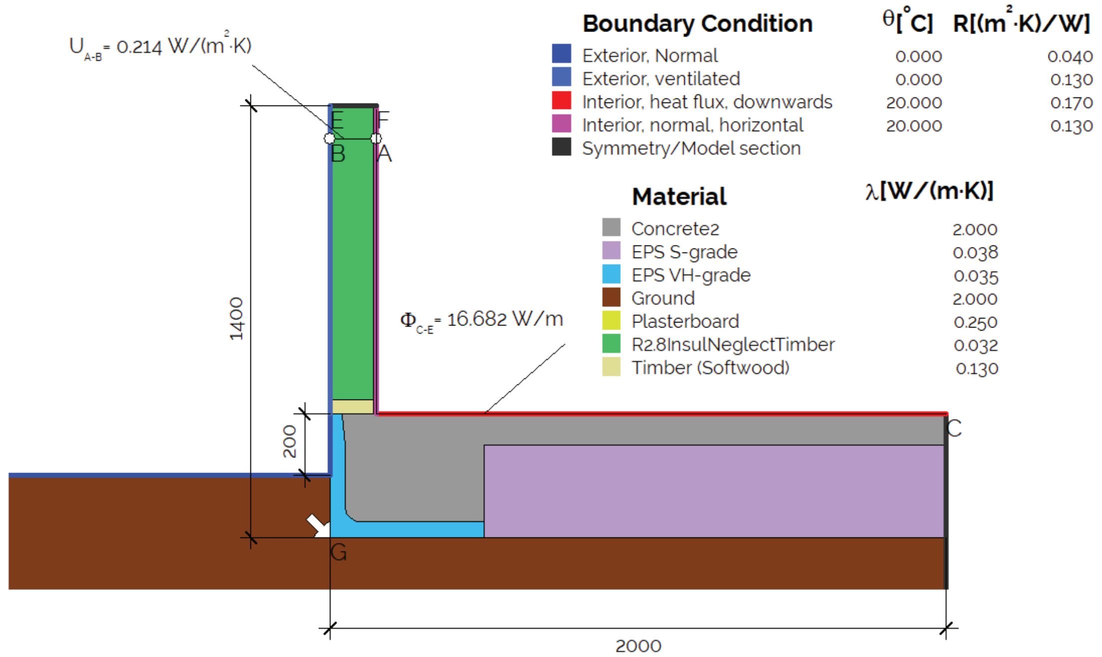
MAXSlab 400mm for Good Ground (140mm)

Underfloor Heating Suitable

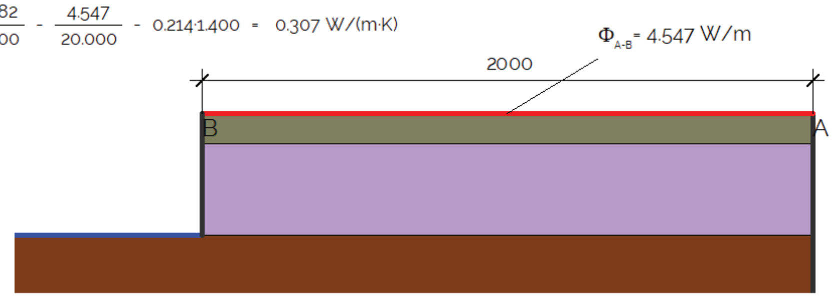


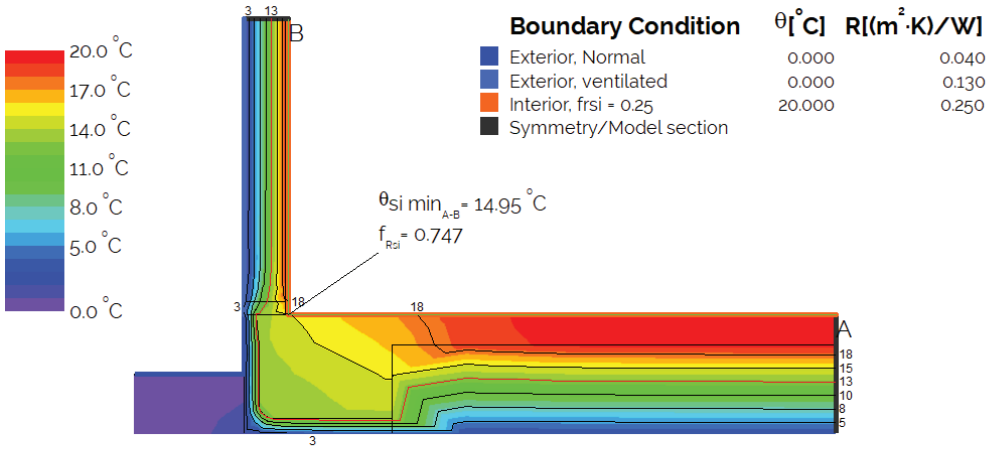
A/P, m	R-value, m²K/W
1	**2.05**
1.6	2.89
1.8	3.17
2	**3.45**
2.2	3.65
2.4	3.84
2.6	4.04
2.8	4.23
3	**4.43**
3.2	4.59
3.4	4.76
3.6	4.92
3.8	5.09
4	**5.25**
5	**6.23**

Note the above graph is for *slab area to perimeter ratio* = *Aslab,internal* / *Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.



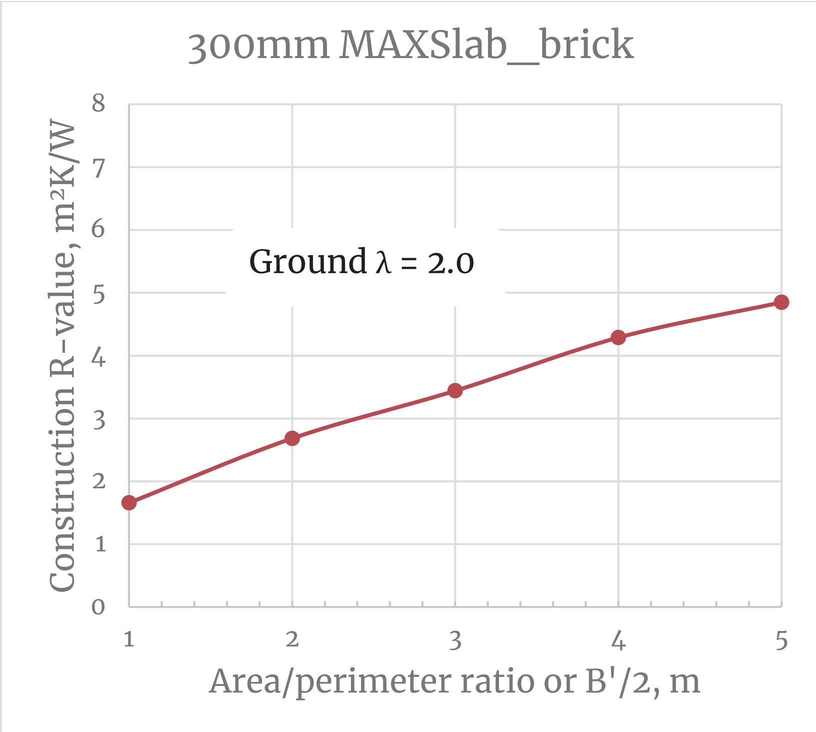
$$\Psi_{C-G-E} = \frac{16.682}{20.000} - \frac{4.547}{20.000} - 0.214 \cdot 1.400 = 0.307 \text{ W/(m·K)}$$





MAXRaft Floor System Thermal Performance

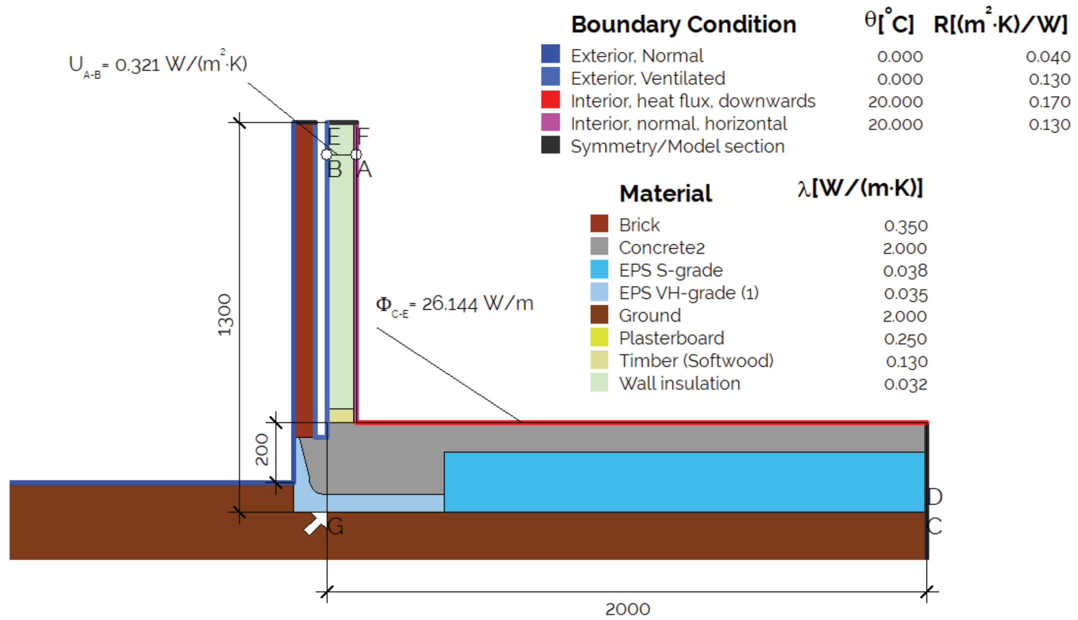
MAXSlab 300mm Brick* Rebate



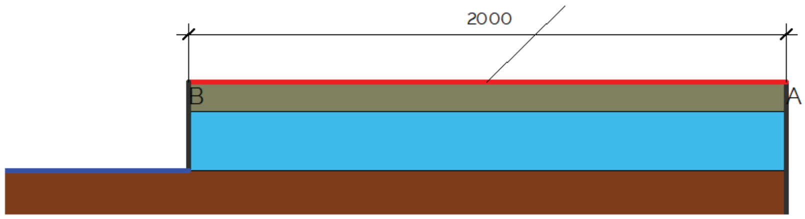
A/P, m	R-value, m^2K/W
1	**1.66**
1.6	2.27
1.8	2.48
2	**2.68**
2.2	2.83
2.4	2.99
2.6	3.14
2.8	3.29
3	**3.44**
3.2	3.61
3.4	3.78
3.6	3.95
3.8	4.12
4	**4.29**
5	**4.85**

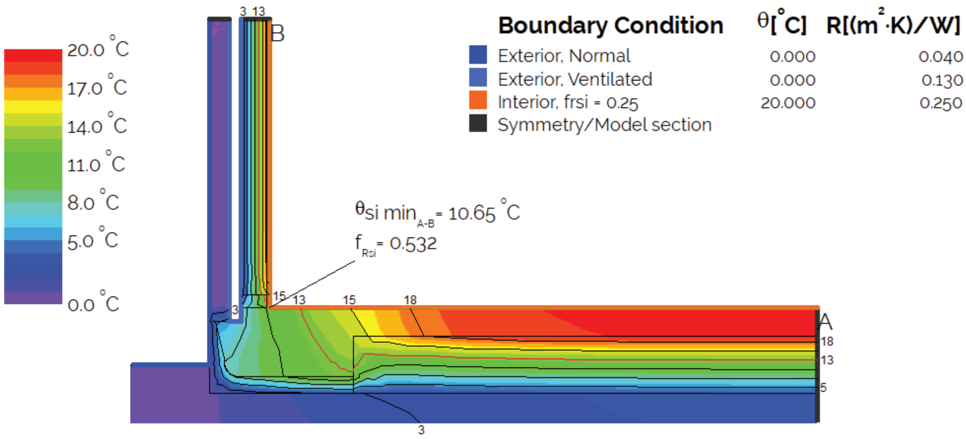
Note the above graph is for *slab area to perimeter ratio* = *Aslab,internal* / *Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

*if brick cladding to ground as per MAXSlab or MAXRaft alternative detail then use R-value shown in non-brick



$$\Psi_{C\text{-}G\text{-}E} = \frac{26.144}{20.000} - \frac{6.339}{20.000} - 0.321 \cdot 1.300 = 0.573 \text{ W/(m·K)}$$





Sustainable Engineering LTD

MAXRaft

MAXRaft slabs are designed on soft ground, TC2 or expansive soil sites.

Slab Height

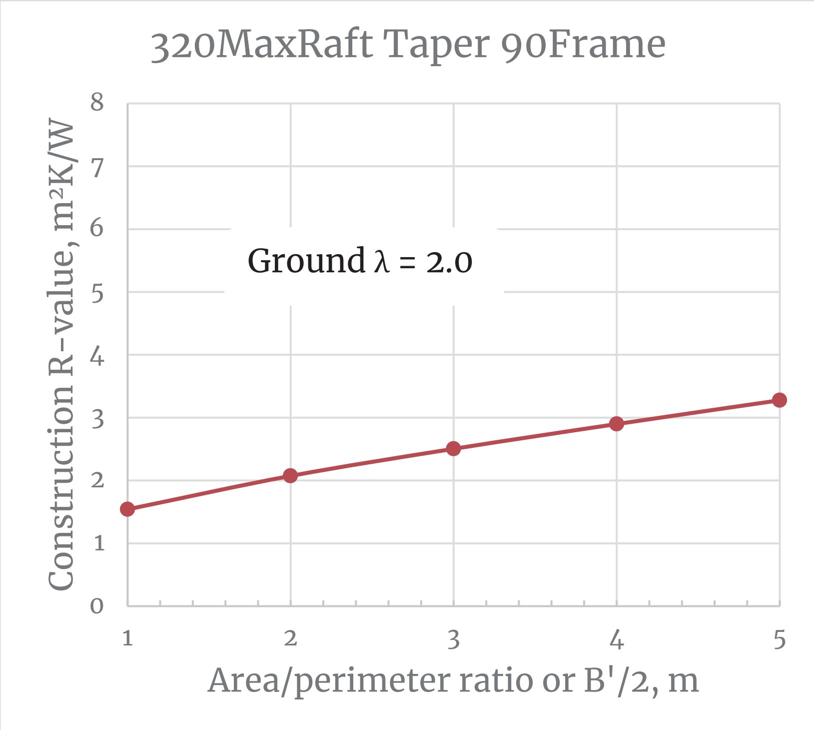
- 320mm / 340mm / 400mm / 420mm
- Bespoke heights available

Key Features

- Easily meets the building code
- Suitable with 90mm/140mm/SIPS
- Site specific design
- VH EPS perimeter & thickening insulation
- VH Insulation in ribs
- Panel plan and pre-cut materials including 220mm or 300mmPODS
- Minimum waste / Recycled polystyrene materials

MAXRaft 320

Soft Ground / TC2 / Expansive Soils

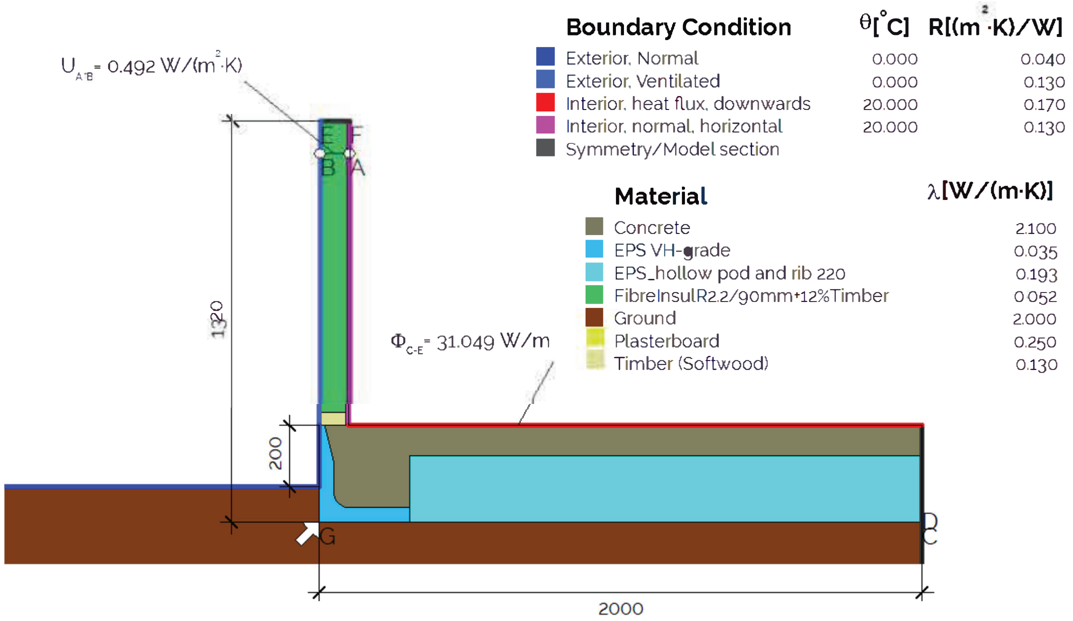


A/P, m	R-value, m^2K/W
1	**1.54**
1.6	1.86
1.8	1.97
2	**2.07**
2.2	2.16
2.4	2.25
2.6	2.33
2.8	2.42
3	**2.50**
3.2	2.58
3.4	2.66
3.6	2.74
3.8	2.82
4	**2.90**
5	**3.28**

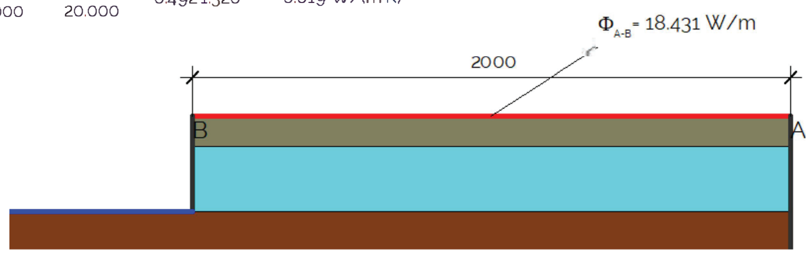
Note the above graph is for *slab area to perimeter ratio* = *Aslab*,*internal* / *Pslab*,*internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

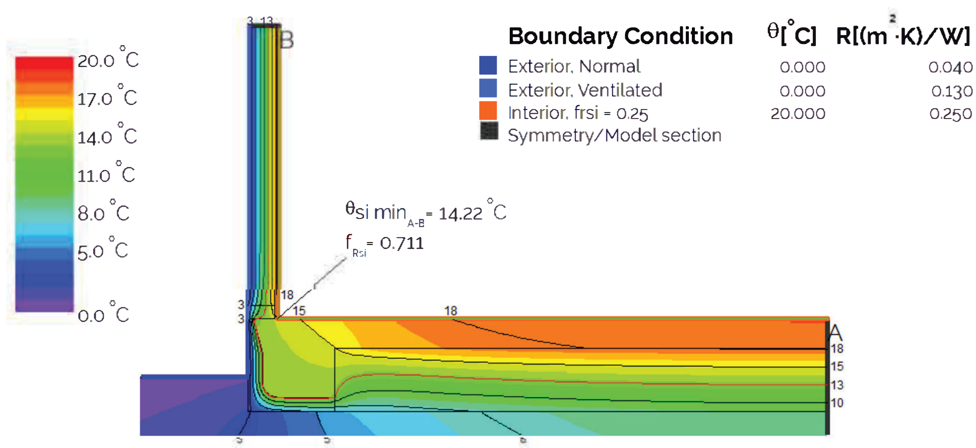
MAXRaft 320mm (90mm)

Soft soils / TC2 / Expansive



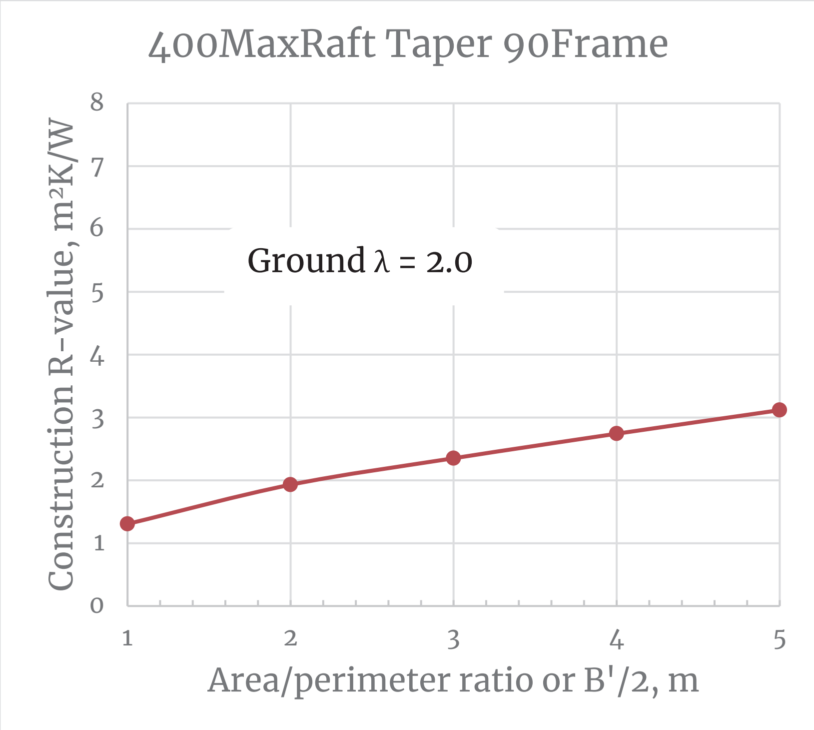
$$\Psi_{C-G-E} = \frac{31.049}{20.000} - \frac{18.431}{20.000} - 0.492 \cdot 1.320 = -0.019 \text{ W/(m·K)}$$





MAXRaft 400

Soft Soils / TC2 / Expansive Soils

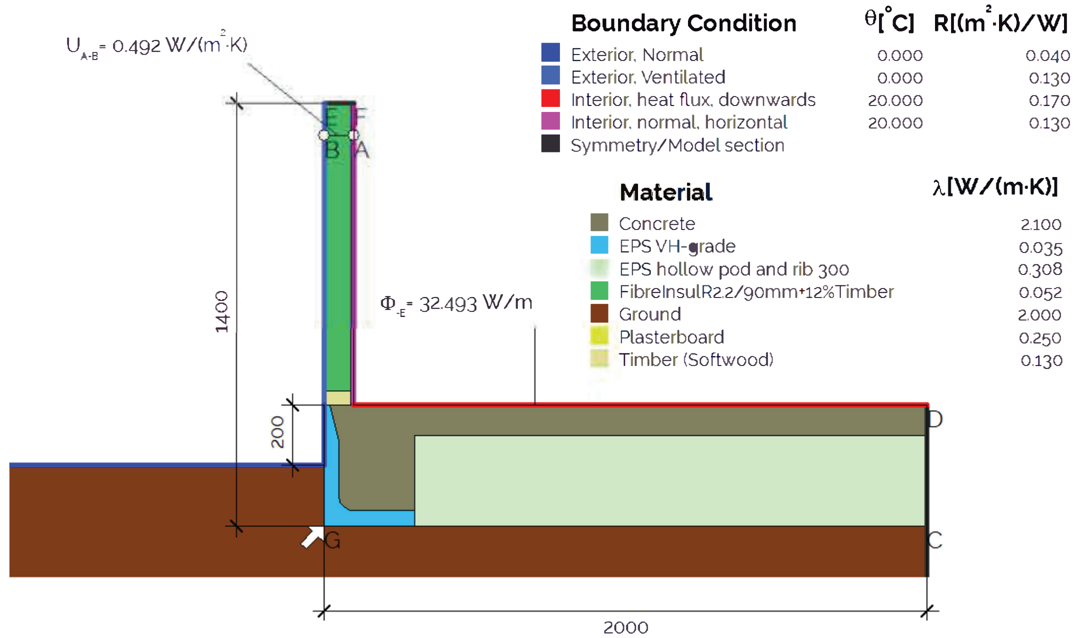


A/P, m	R-value, m²K/W
1	**1.31**
1.6	1.68
1.8	1.81
2	**1.93**
2.2	2.01
2.4	2.10
2.6	2.18
2.8	2.27
3	**2.35**
3.2	2.43
3.4	2.51
3.6	2.59
3.8	2.66
4	**2.74**
5	**3.12**

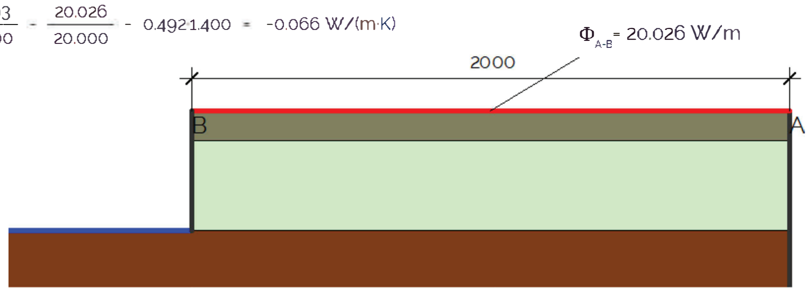
Note the above graph is for *slab area to perimeter ratio = Aslab,internal / Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

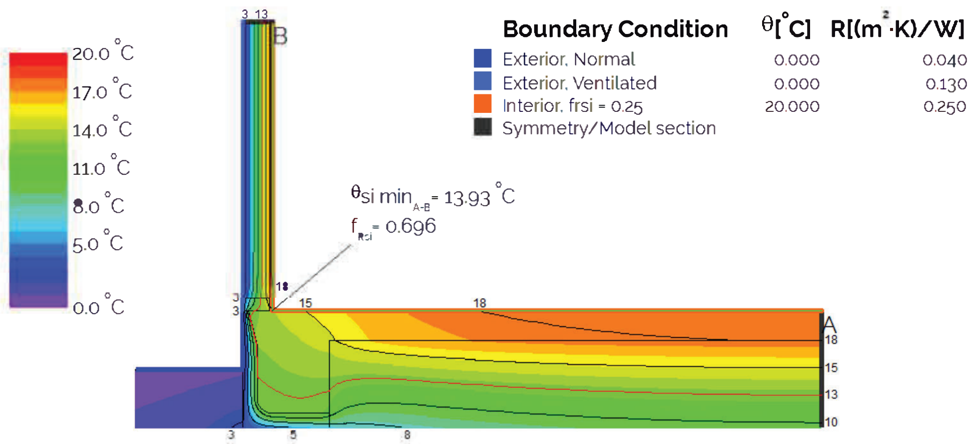
MAXRaft 400

Soft Soils / TC2 / Expansive Soils

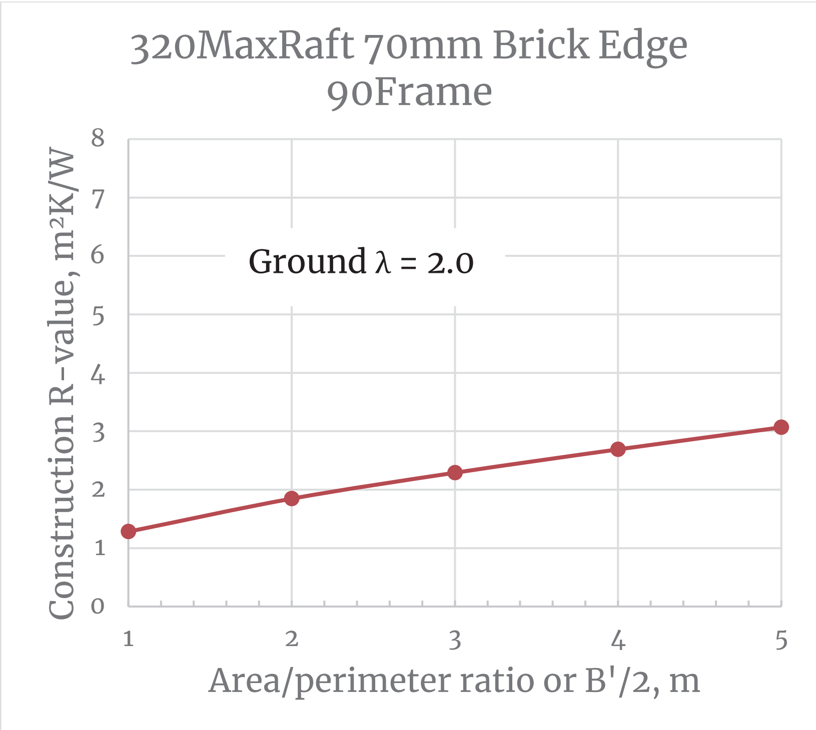


$$\Psi_{C-G-E} = \frac{32.493}{20.000} - \frac{20.026}{20.000} - 0.492 \cdot 1.400 = -0.066\ W/(m \cdot K)$$





MAXRaft 320mm Brick* Rebate

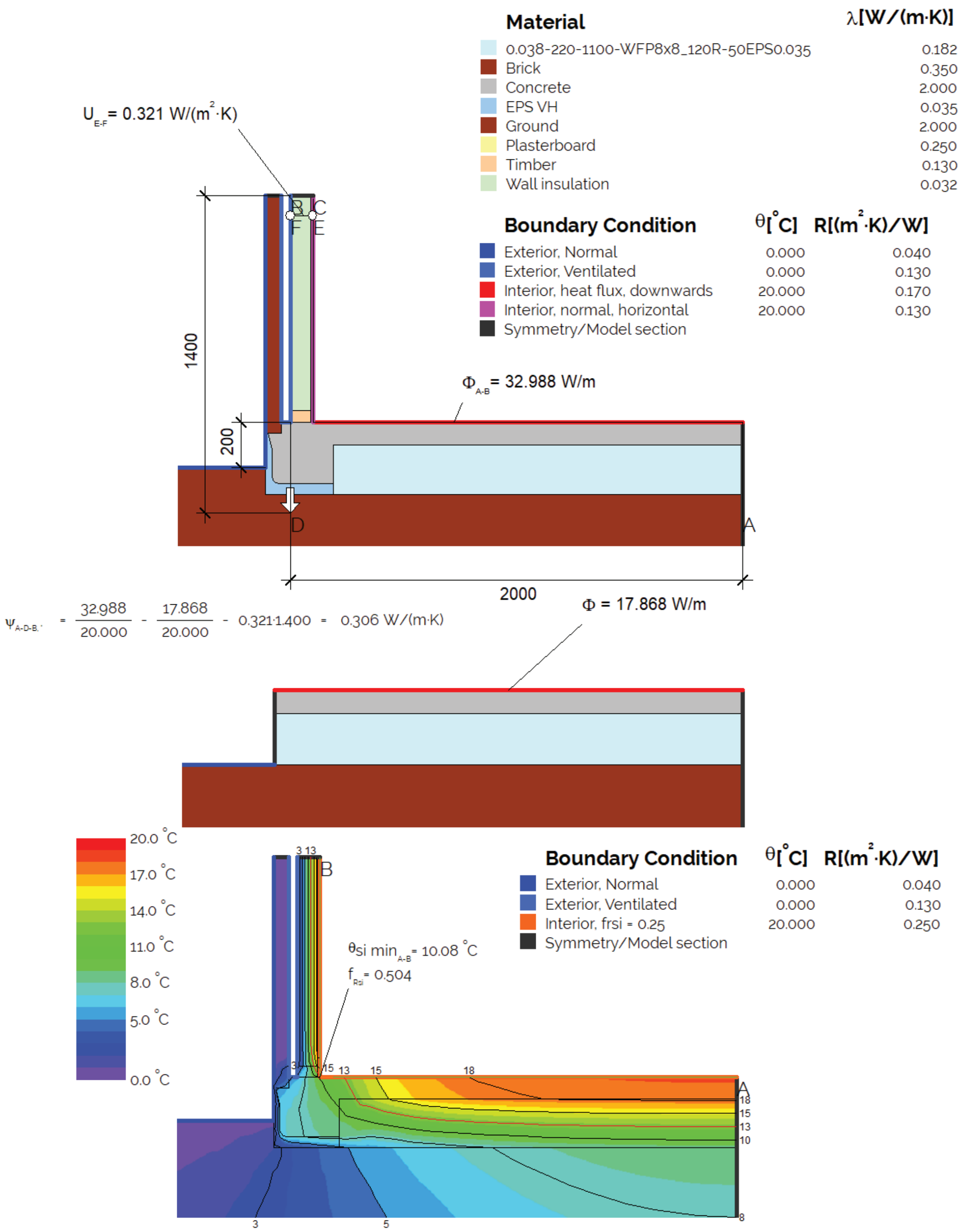


A/P, m	R-value, m²K/W
1	**1.28**
1.6	1.62
1.8	1.73
2	**1.85**
2.2	1.93
2.4	2.02
2.6	2.11
2.8	2.20
3	**2.29**
3.2	2.37
3.4	2.45
3.6	2.53
3.8	2.61
4	**2.69**
5	**3.07**

Note the above graph is for *slab area to perimeter ratio* = *Aslab*,*internal* / *Pslab*,*internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

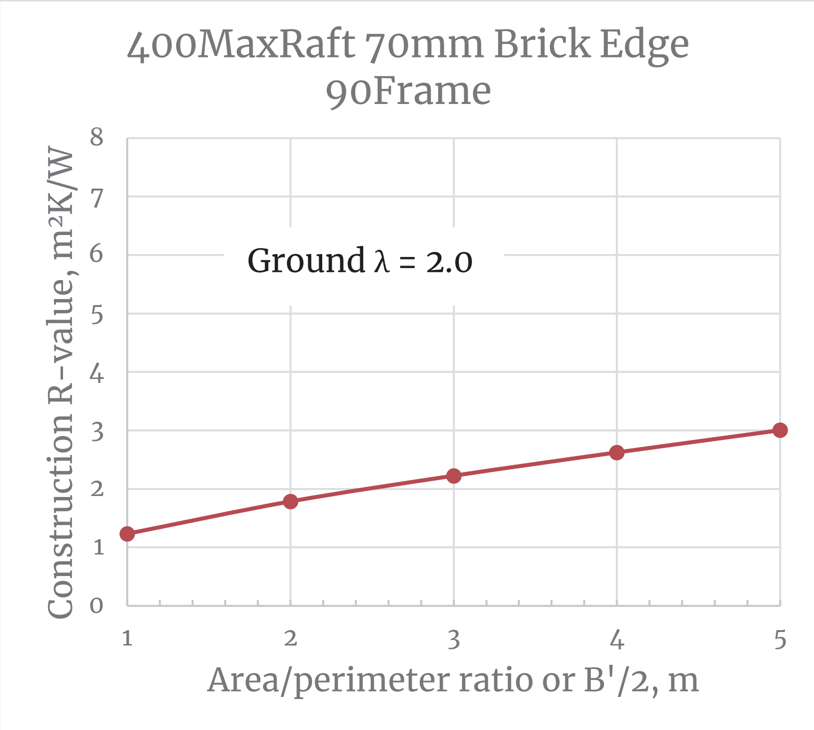
*if brick cladding to ground as per MAXSlab or MAXRaft alternative detail then use R-value shown in non-brick

MAXRaft 320mm Brick* Rebate



*if brick cladding to ground as per MAXSlab or MAXRaft alternative detail then use R-value shown in non-brick

MAXRaft 400mm Brick* rebate



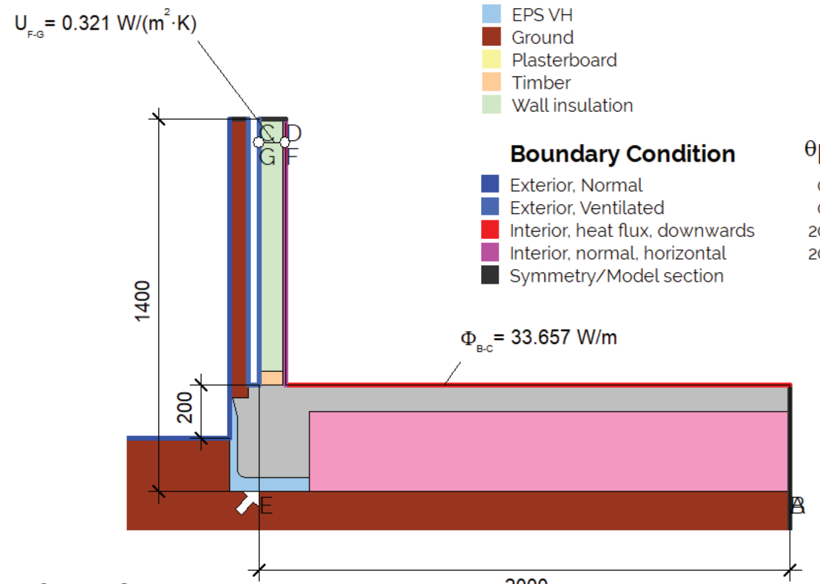
A/P, m	R-value, m²K/W
1	**1.23**
1.6	1.56
1.8	1.68
2	**1.79**
2.2	1.87
2.4	1.96
2.6	2.05
2.8	2.14
3	**2.23**
3.2	2.31
3.4	2.39
3.6	2.46
3.8	2.54
4	**2.62**
5	**3.00**

Note the above graph is for *slab area to perimeter ratio* = *Aslab,internal* / *Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

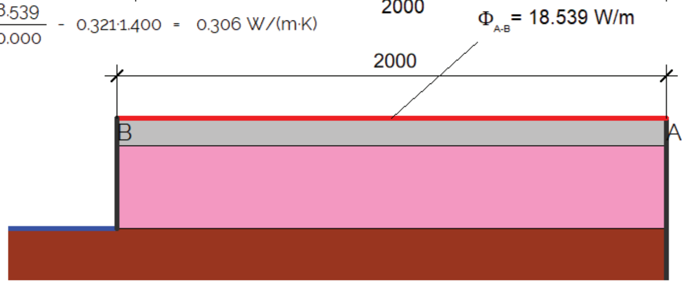
*if brick cladding to ground as per MAXSlab or MAXRaft alternative detail then use R-value shown in non-brick

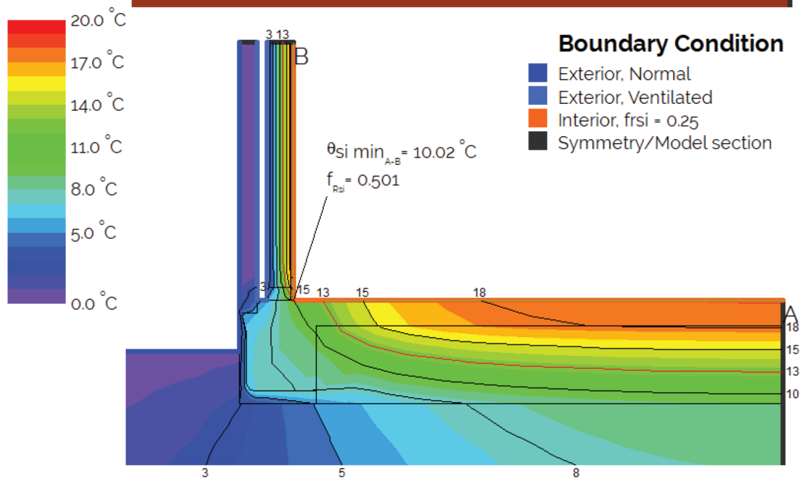
Material	λ[W/(m·K)]
0.038-300-1100-WFP8x8_120R-50EPS0.035	0.265
Brick	0.350
Concrete	2.000
EPS VH	0.035
Ground	2.000
Plasterboard	0.250
Timber	0.130
Wall insulation	0.032

Boundary Condition	θ[°C]	R[(m²·K)/W]
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, heat flux, downwards	20.000	0.170
Interior, normal, horizontal	20.000	0.130
Symmetry/Model section		



$$\Psi_{A-E-C} = \frac{33.657}{20.000} - \frac{18.539}{20.000} - 0.321 \cdot 1.400 = 0.306 \ W/(m \cdot K)$$





Boundary Condition	θ[°C]	R[(m²·K)/W]
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		

MAX85

Can be designed for good or soft ground. Utilises the MAXRaft perimeter insulation to create a thermal break around the slab.

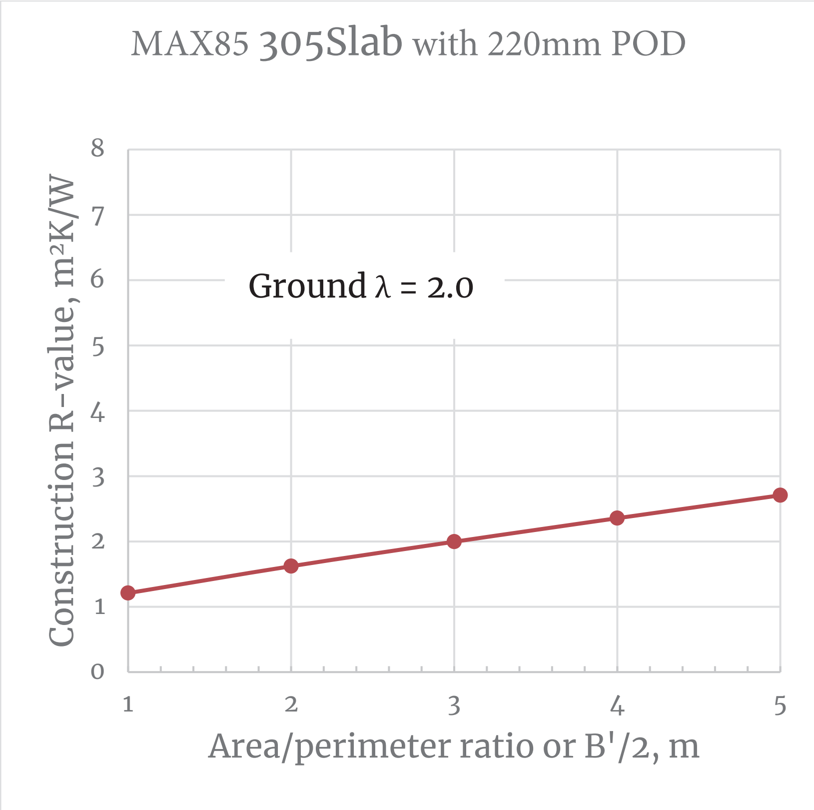
Heights

- 305mm / 385mm
- Bespoke options available

Key Features

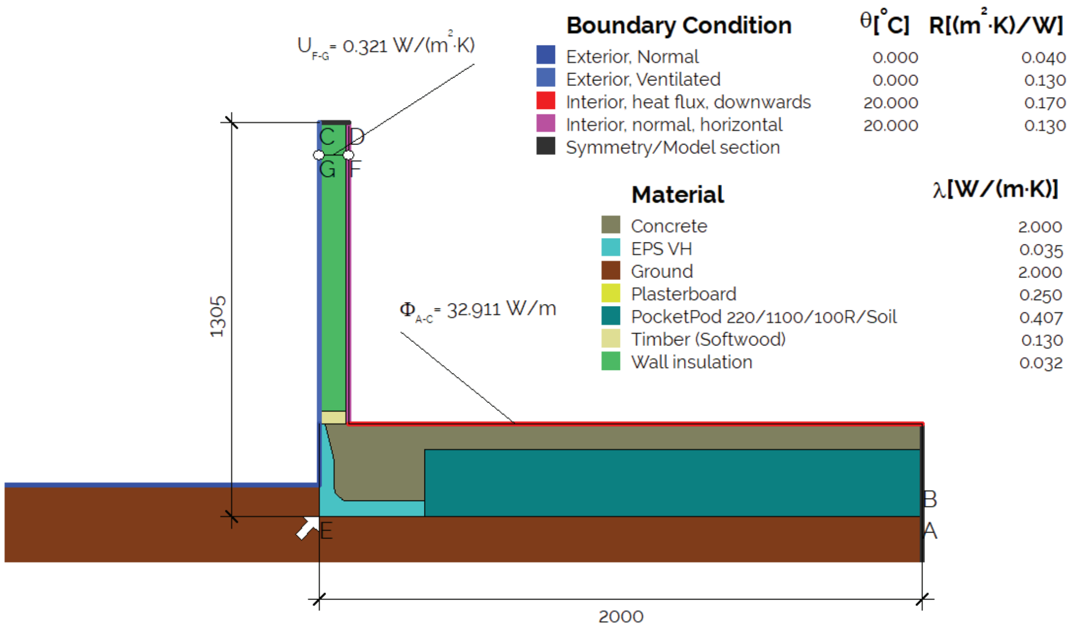
- Designed to meet the requirements of the building code in most instances
- Typically designed with an 85mm slab
- Site specific design
- Suitable with 90mm/140mm/SIPS
- VH EPS perimeter insulation
- Panel plan and pre-cut materials including 220mm or 300mmPODS
- Minimum waste / Recycled polystyrene materials

MAX85 305mm

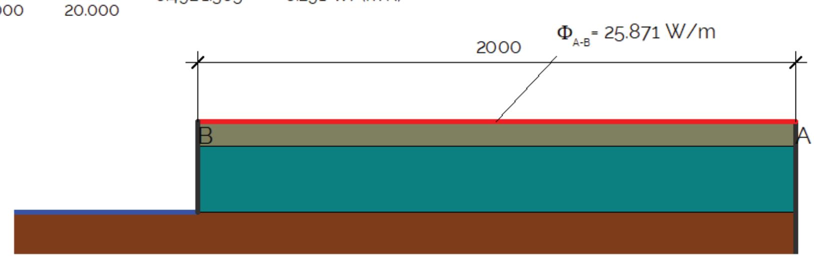


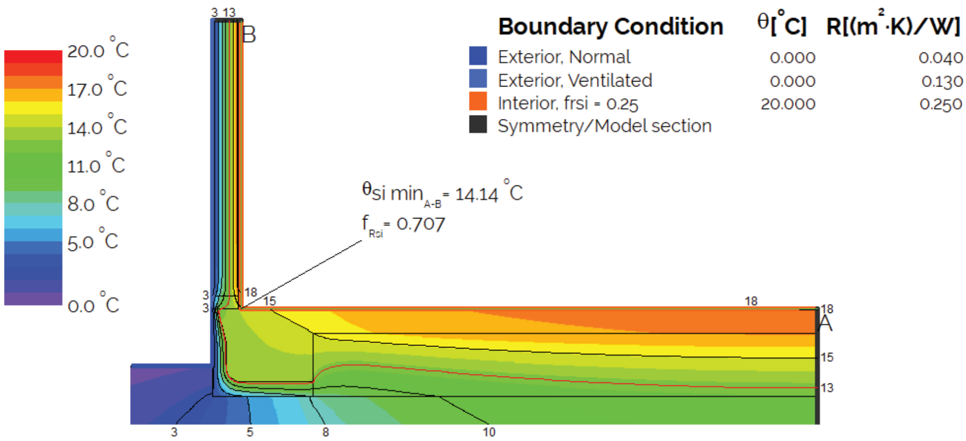
A/P, m	R-value, m^2K/W
1	**1.21**
1.6	1.46
1.8	1.54
2	**1.62**
2.2	1.70
2.4	1.77
2.6	1.85
2.8	1.92
3	**2.00**
3.2	2.07
3.4	2.14
3.6	2.21
3.8	2.28
4	**2.36**
5	**2.71**

Note the above graph is for *slab area to perimeter ratio* = *Aslab,internal* / *Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

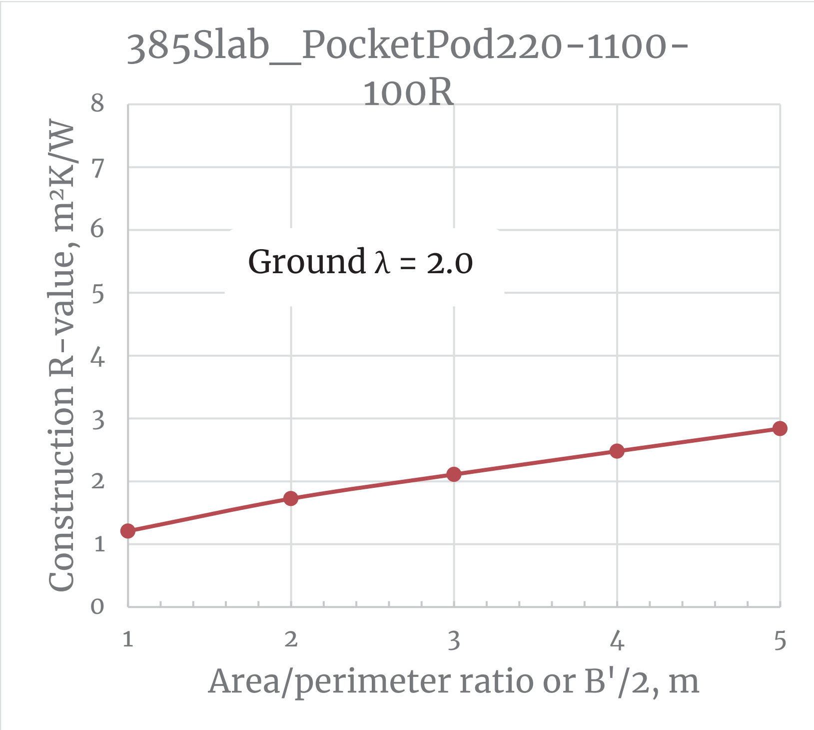


$$\Psi_{A\text{-}E\text{-}C} = \frac{32.911}{20.000} - \frac{25.871}{20.000} - 0.492 \cdot 1.305 = -0.291 \text{ W/(m·K)}$$





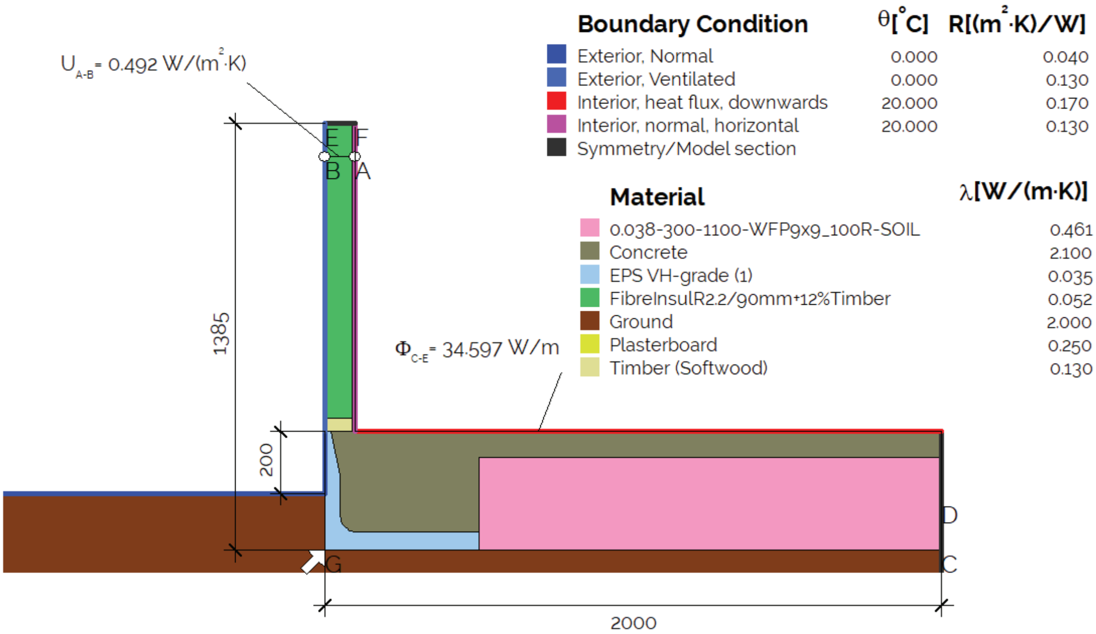
MAX85 385mm



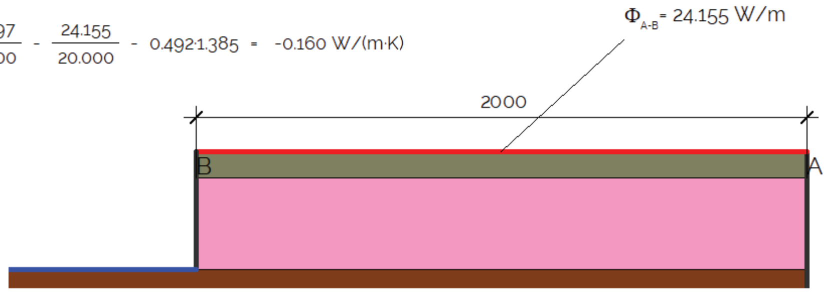
A/P, m	R-value, m²K/W
1	**1.21**
1.6	1.52
1.8	1.62
2	**1.72**
2.2	1.80
2.4	1.88
2.6	1.96
2.8	2.03
3	**2.11**
3.2	2.18
3.4	2.26
3.6	2.33
3.8	2.41
4	**2.48**
5	**2.84**

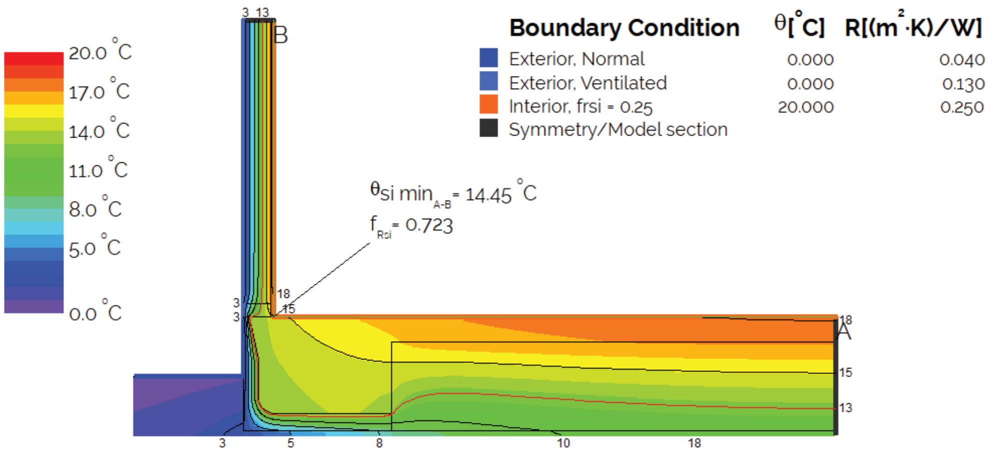
Note the above graph is for *slab area to perimeter ratio* = *Aslab,internal* / *Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 i place of R1.33). Slab R-values were calculated without any additional slab thickenings.

*if brick cladding to ground as per MAXSlab or MAXRaft alternative detail then use R-value shown in non-brick

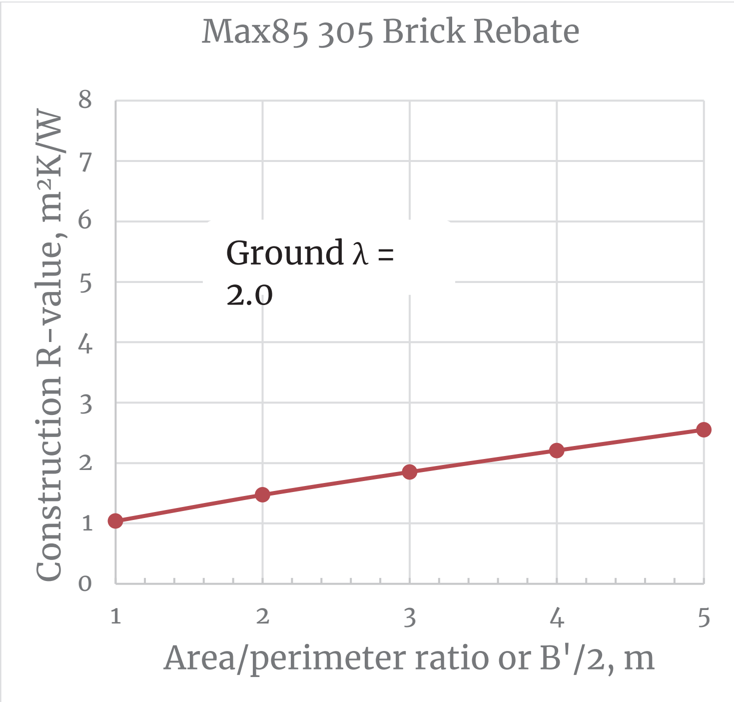


$$\Psi_{C\text{-}G\text{-}E} = \frac{34.597}{20.000} - \frac{24.155}{20.000} - 0.492 \cdot 1.385 = -0.160\ \text{W/(m·K)}$$





MAX85 305mm Brick* Rebate

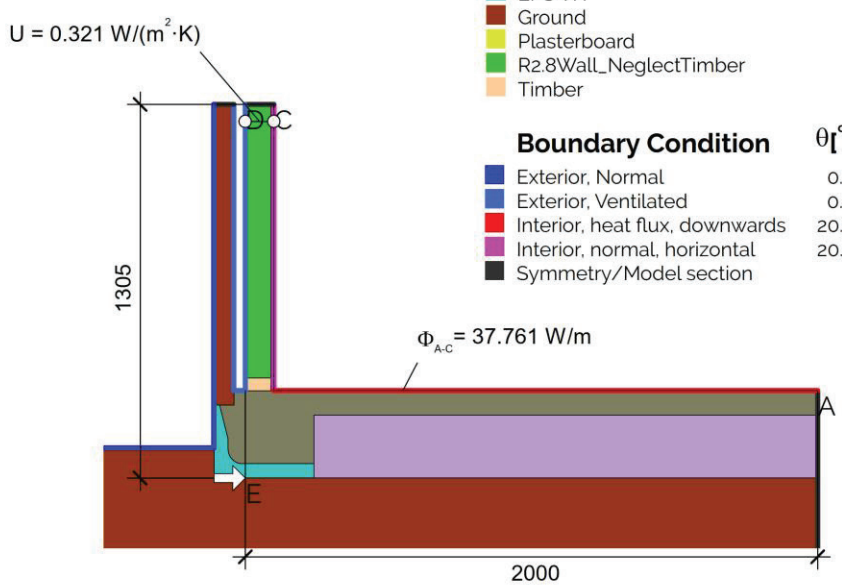


A/P, m	R-value, m^2K/W
1	**1.04**
1.6	1.30
1.8	1.39
2	**1.47**
2.2	1.55
2.4	1.62
2.6	1.70
2.8	1.78
3	**1.85**
3.2	1.92
3.4	1.99
3.6	2.06
3.8	2.14
4	**2.21**
5	**2.55**

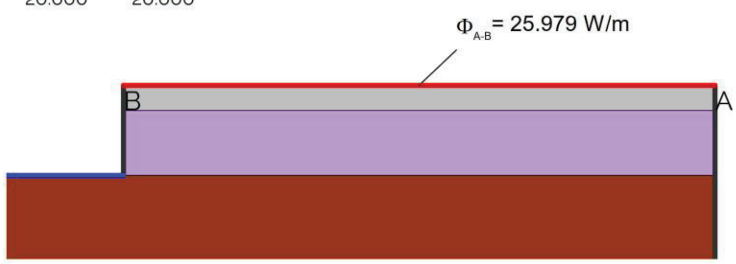
Note the above graph is for *slab area to perimeter ratio = Aslab,internal / Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

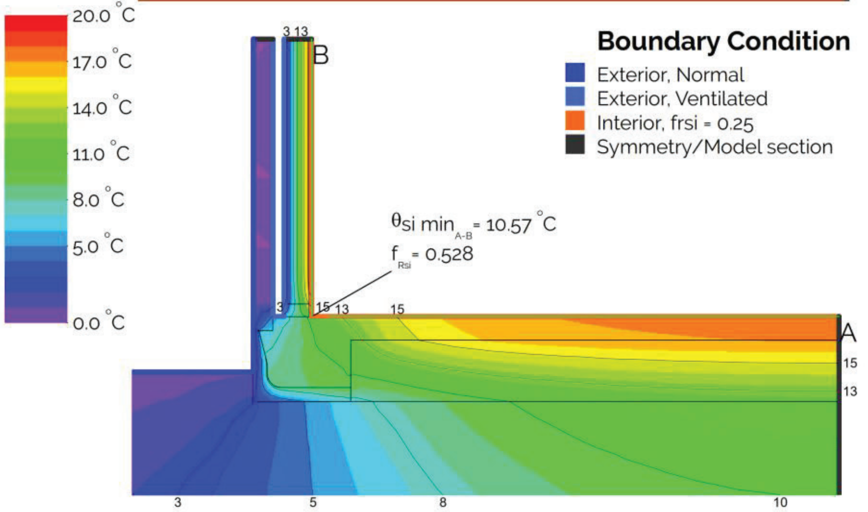
Material	λ[W/(m·K)]
85SL_0.038-220-1100-WFP9x9_100R-SOIL	0.407
Brick	0.350
Concrete	2.000
EPS VH	0.035
Ground	2.000
Plasterboard	0.250
R2.8Wall_NeglectTimber	0.032
Timber	0.130

Boundary Condition	θ[°C]	R[(m²·K)/W]
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, heat flux, downwards	20.000	0.170
Interior, normal, horizontal	20.000	0.130
Symmetry/Model section		



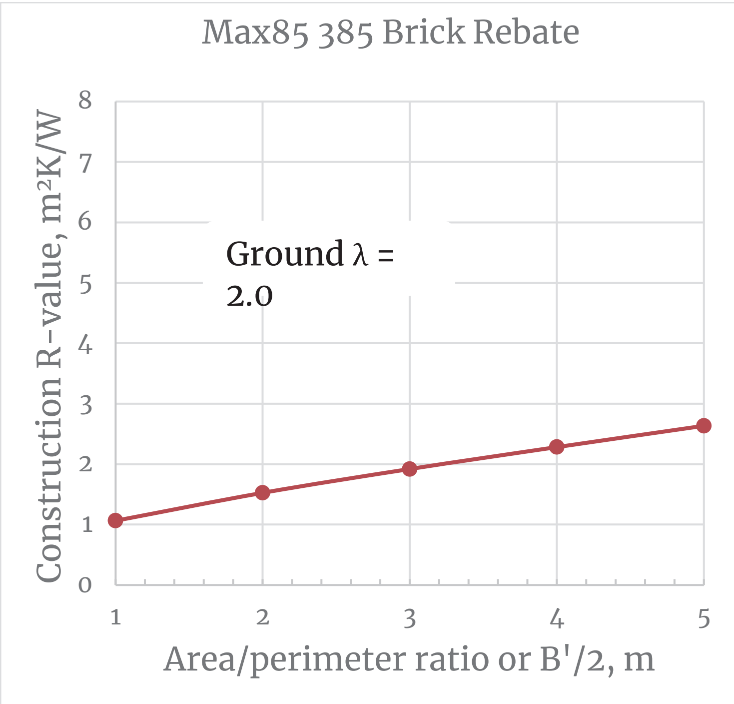
$$\psi_{A\text{-}E\text{-}C,'} = \frac{37.761}{20.000} - \frac{25.979}{20.000} - 0.321 \cdot 1.305 = 0.170\ W/(m \cdot K)$$





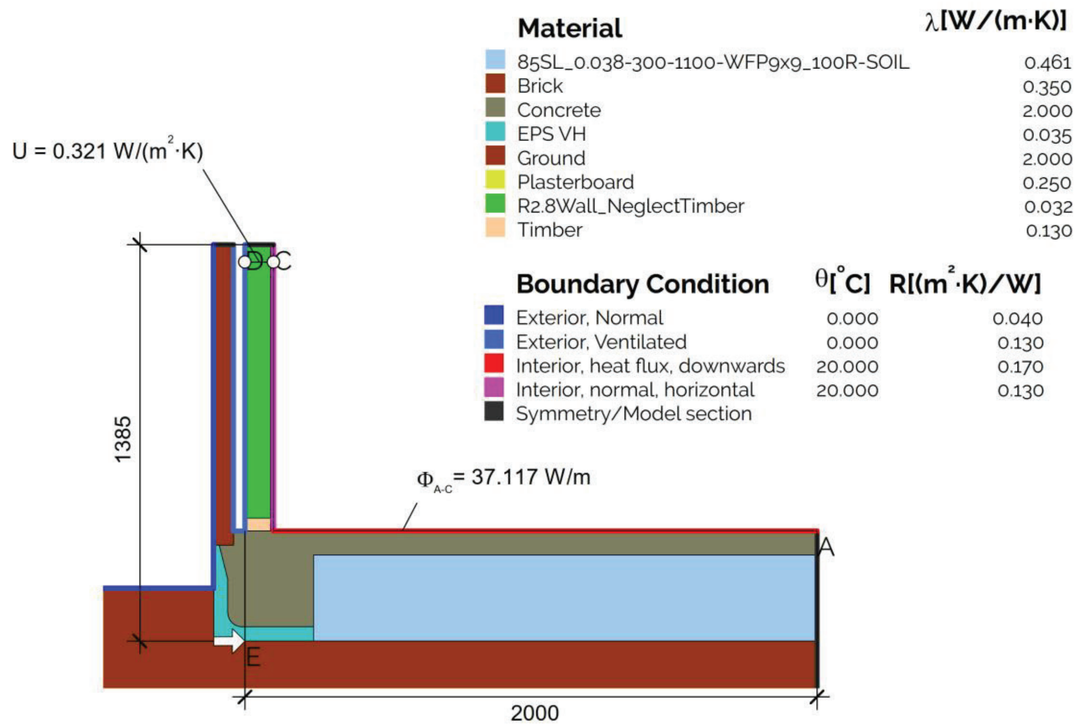
Boundary Condition	θ[°C]	R[(m²·K)/W]
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		

MAX85 385mm Brick* Rebate

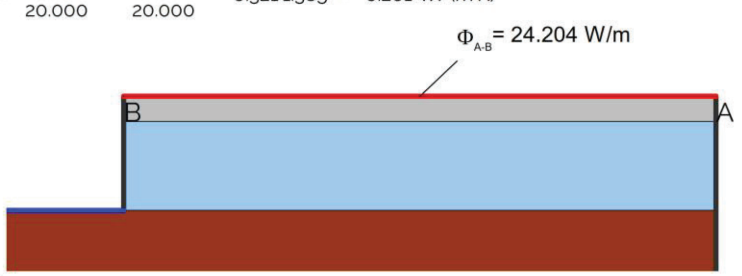


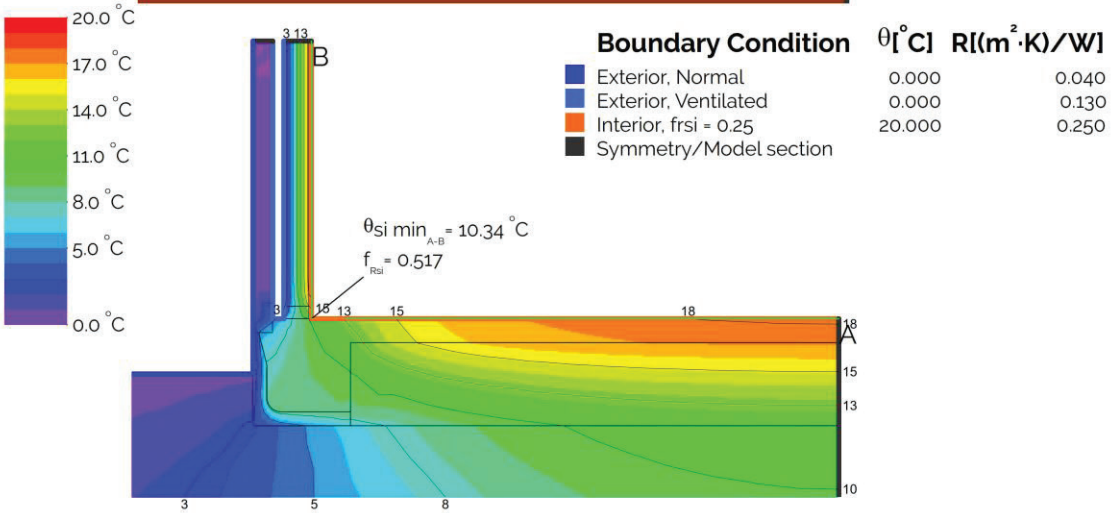
A/P, m	R-value, m²K/W
1	**1.06**
1.6	1.34
1.8	1.43
2	**1.53**
2.2	1.60
2.4	1.68
2.6	1.76
2.8	1.84
3	**1.92**
3.2	1.99
3.4	2.06
3.6	2.14
3.8	2.21
4	**2.28**
5	**2.63**

Note the above graph is for *slab area to perimeter ratio = Aslab,internal / Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.



$$\psi_{A\text{-}E\text{-}C'} = \frac{37.117}{20.000} - \frac{24.204}{20.000} - 0.321 \cdot 1.385 = 0.201\ W/(m \cdot K)$$





MAXRaft Plus+

Enhanced version of a standard MAXRaft with Solid Insulation between ribs to work with Underfloor Heating requirements on soft soils, TC2, piles and expansive soils.

Slab Height

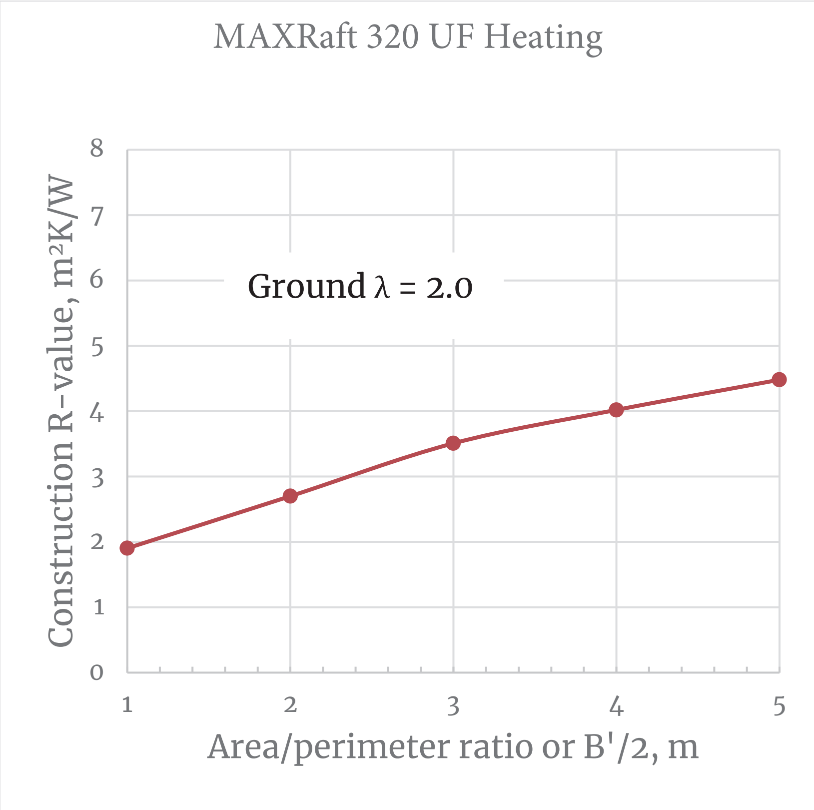
- 300mm / 320mm / 350mm / 400mm
- Bespoke options available

Key Features

- Designed to meet the requirements of UF Heating in most instances
- Suitable with 90mm/140mm/SIPS
- VH EPS perimeter & thickening insulation
- SOLID EPS Insulation replaces traditional waffle PODS
- VH Insulation in ribs
- Site Specific design
- Panel plan and pre-cut materials including 220mm or 300mmPODS
- Minimum waste / Recycled polystyrene materials

MAXRaft Plus+ 320

Soft Soils / TC2 / Expansive Soils

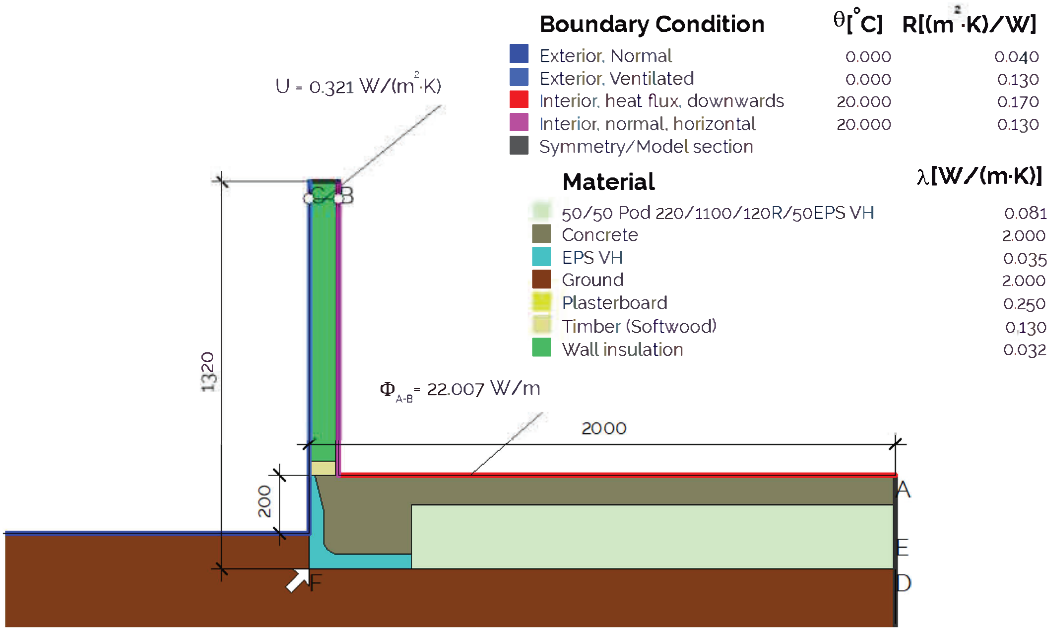


A/P, m	R-value, m^2K/W
1	**1.90**
1.6	2.38
1.8	2.54
2	**2.70**
2.2	2.86
2.4	3.02
2.6	3.18
2.8	3.35
3	**3.51**
3.2	3.61
3.4	3.71
3.6	3.81
3.8	3.92
4	**4.02**
5	**4.48**

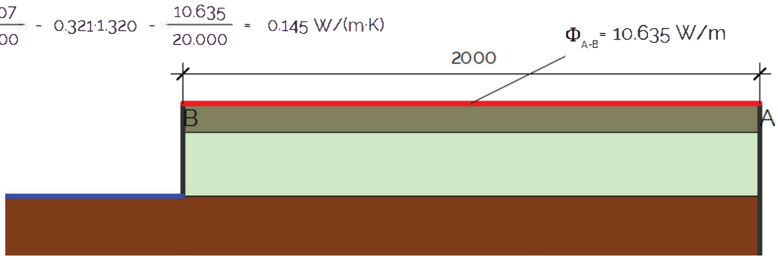
Note the above graph is for *slab area to perimeter ratio = Aslab,internal / Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

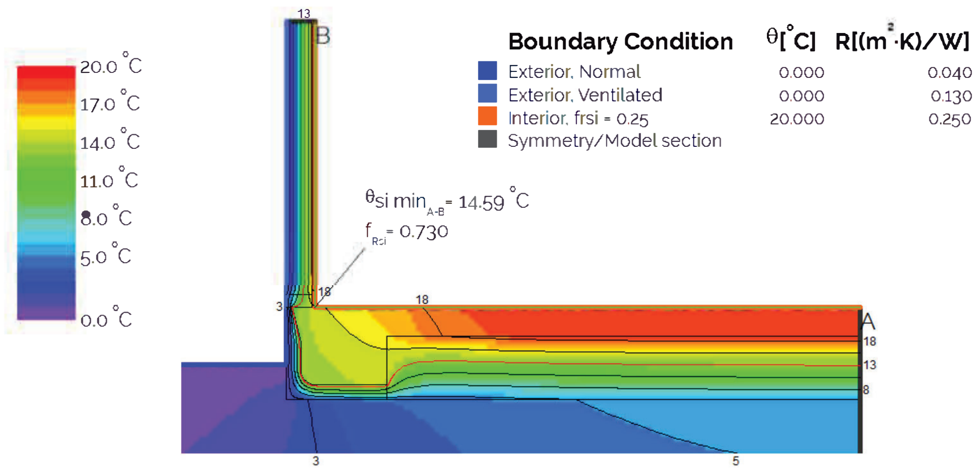
MAXRaft Plus+ 320

Soft Soils / TC2 / Expansive Soils



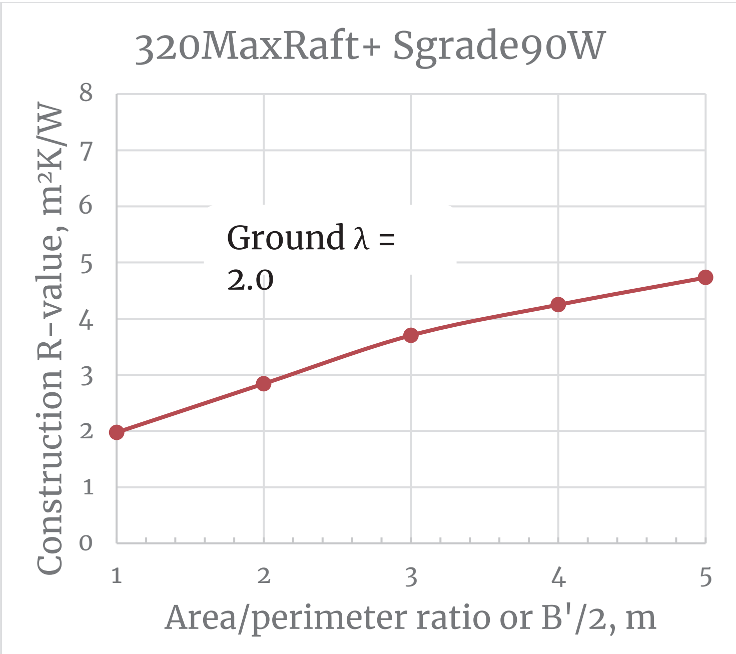
$$\Psi_{C-F-D} = \frac{22.007}{20.000} - 0.321 \cdot 1.320 - \frac{10.635}{20.000} = 0.145\ W/(m \cdot K)$$





MAXRaft Plus+ 320

S-grade POD 90mm Wall

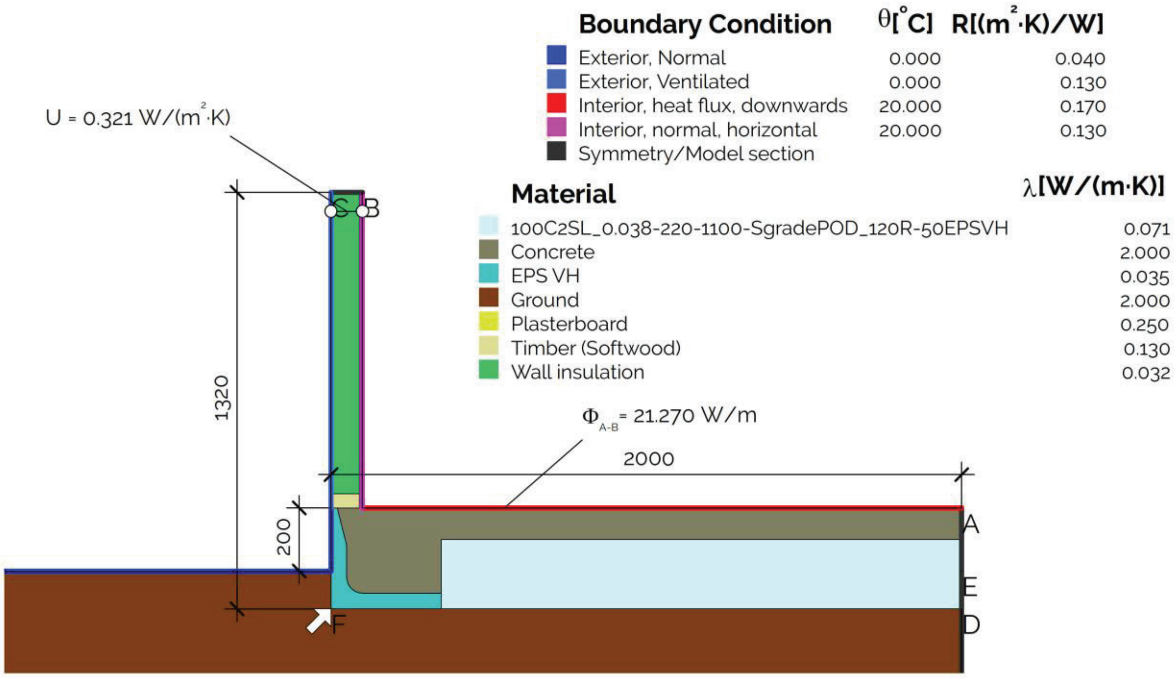


A/P, m	R-value, m²K/W
1	**1.97**
1.6	2.50
1.8	2.67
2	**2.84**
2.2	3.01
2.4	3.19
2.6	3.36
2.8	3.53
3	**3.70**
3.2	3.81
3.4	3.92
3.6	4.03
3.8	4.14
4	**4.25**
5	**4.73**

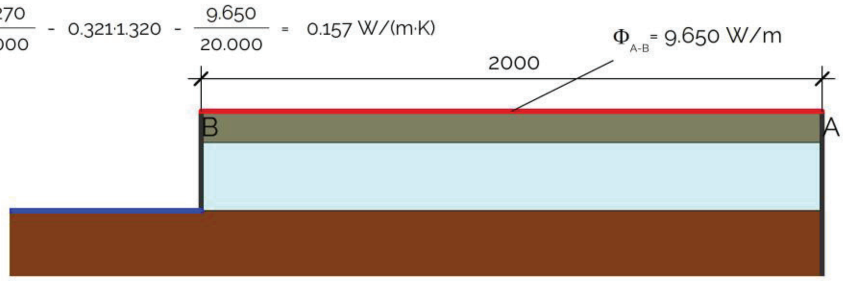
Note the above graph is for *slab area to perimeter ratio* = *Aslab*,*internal* / *Pslab*,*internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

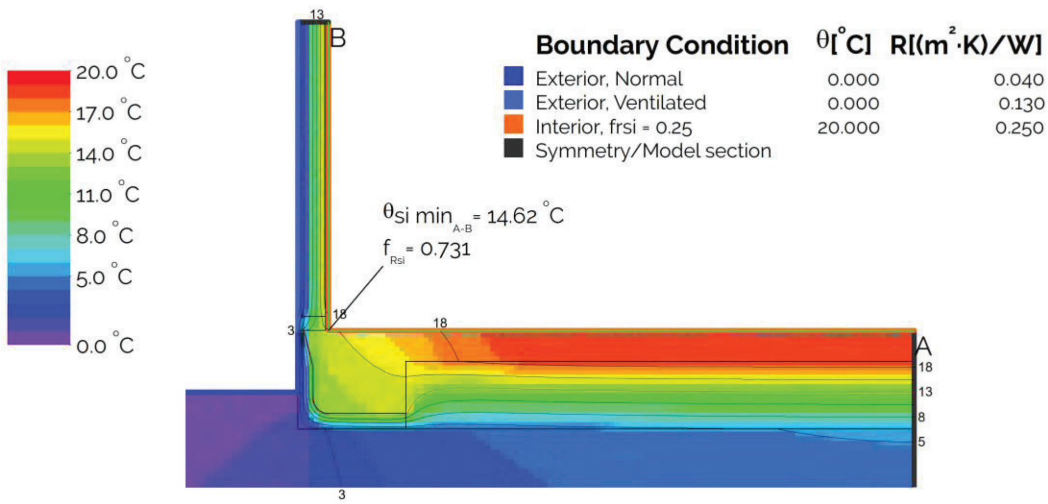
MAXRaft Plus+ 320

S-grade POD 90mm Wall



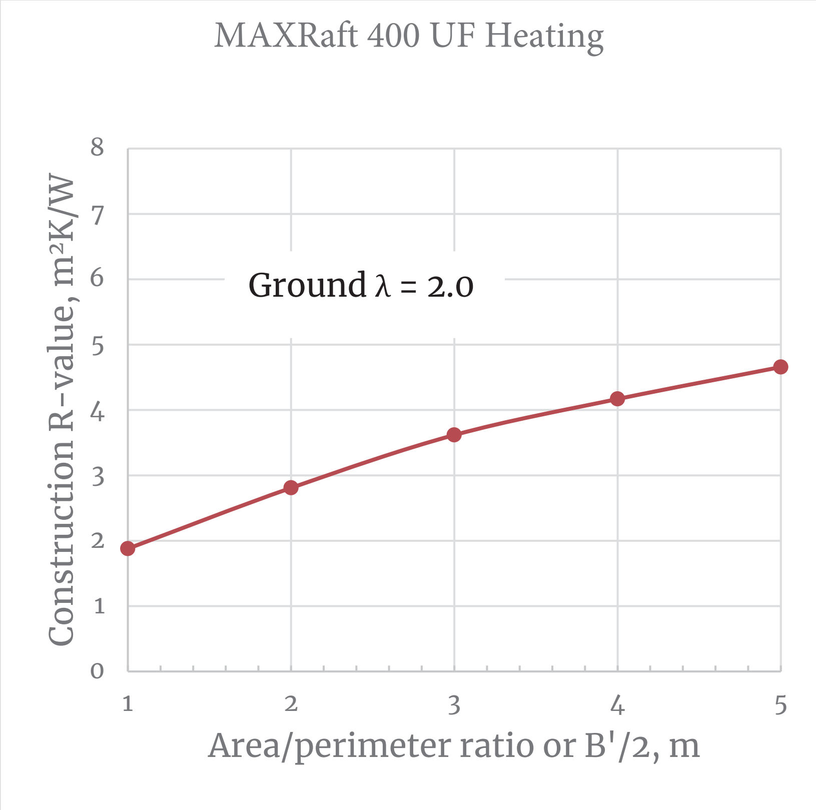
$$\psi_{C\text{-}F\text{-}D,\cdot} = \frac{21.270}{20.000} - 0.321 \cdot 1.320 - \frac{9.650}{20.000} = 0.157 \text{ W/(m·K)}$$





MAXRaft Plus+ 400

Soft Soils / TC2 / Expansive Soils

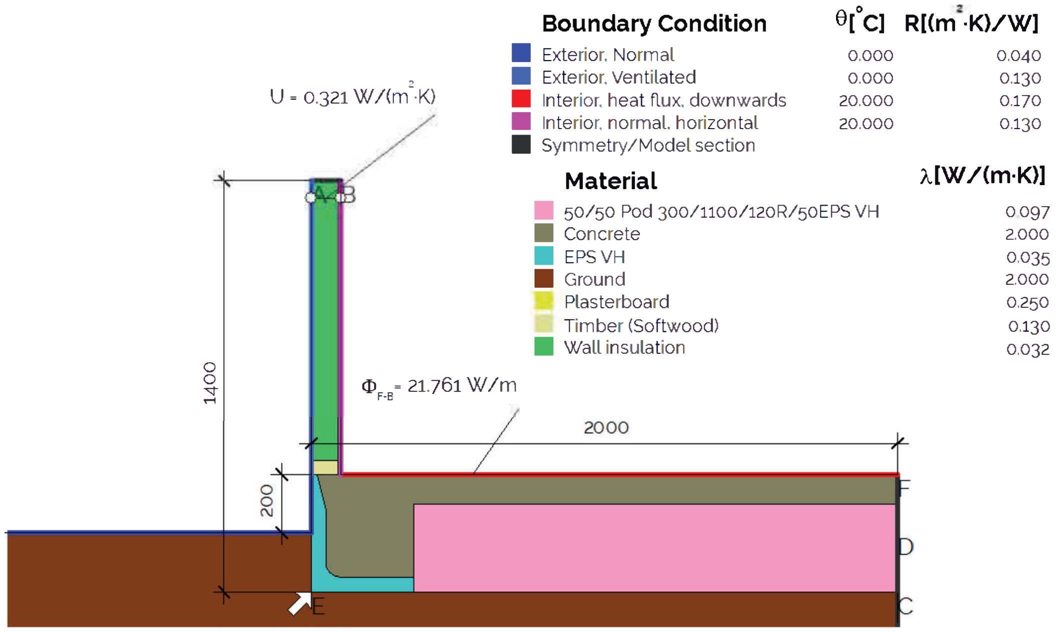


A/P, m	R-value, m²K/W
1	**1.88**
1.6	2.44
1.8	2.62
2	**2.81**
2.2	2.97
2.4	3.13
2.6	3.29
2.8	3.46
3	**3.62**
3.2	3.73
3.4	3.84
3.6	3.95
3.8	4.06
4	**4.17**
5	**4.66**

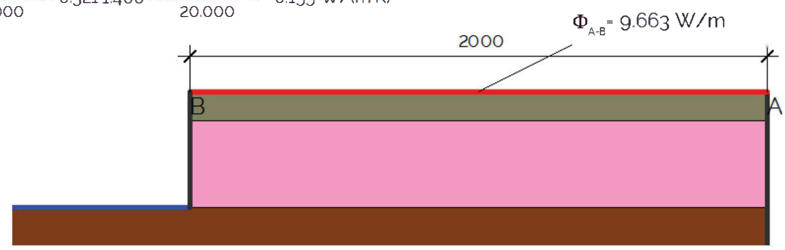
Note the above graph is for *slab area to perimeter ratio* = *Aslab,internal* / *Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

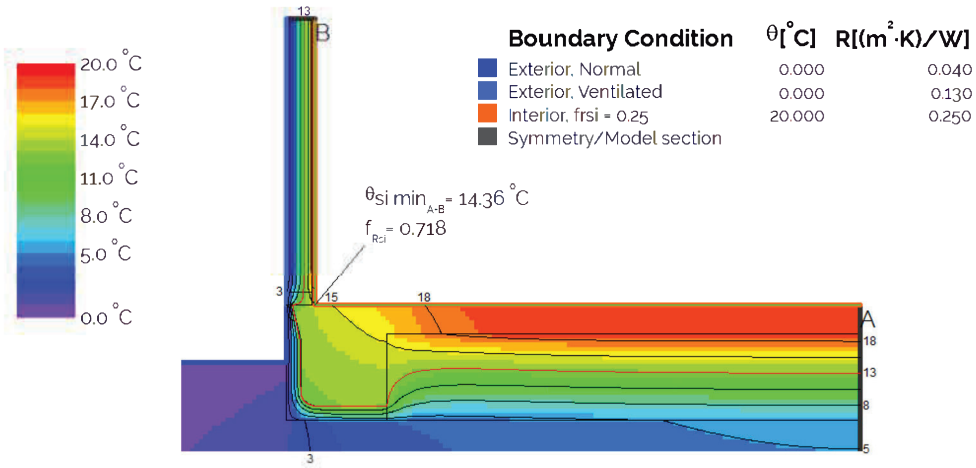
MAXRaft Plus+ 400

Soft Soils / TC2 / Expansive Soils



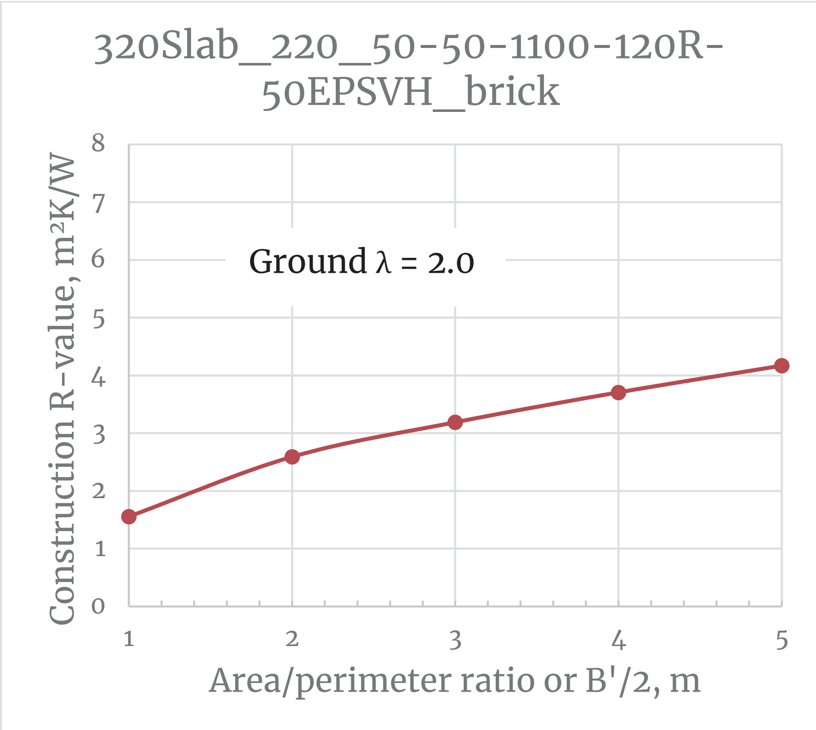
$$\Psi_{A-E-C} = \frac{21.761}{20.000} - 0.321 \cdot 1.400 - \frac{9.663}{20.000} = 0.155\ W/(m \cdot K)$$





MAXRaft Plus+ 320mm

Solid POD with Brick Rebate



A/P, m	R-value, m²K/W
1	**1.56**
1.6	2.18
1.8	2.38
2	**2.59**
2.2	2.71
2.4	2.83
2.6	2.95
2.8	3.07
3	**3.19**
3.2	3.29
3.4	3.40
3.6	3.50
3.8	3.60
4	**3.71**
5	**4.17**

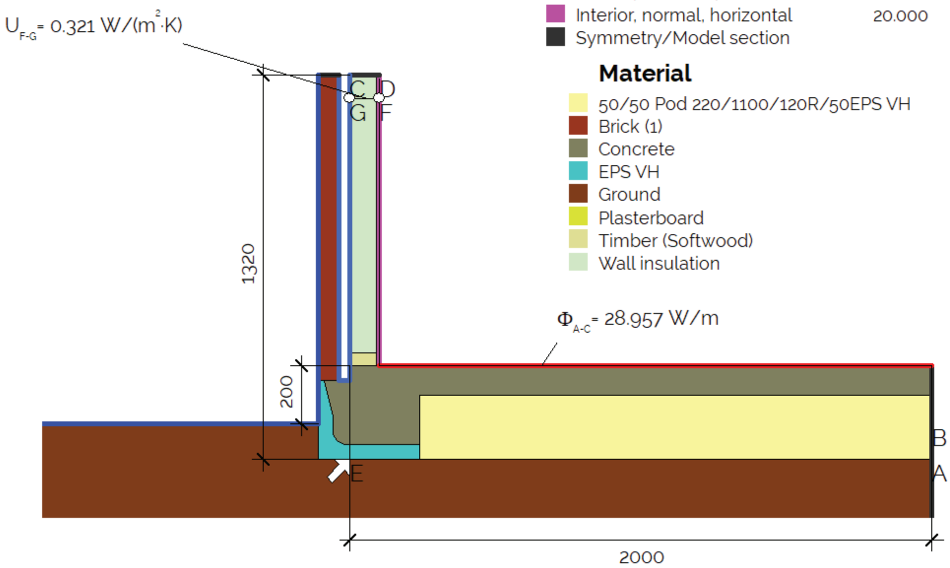
Note the above graph is for *slab area to perimeter ratio* = *Aslab*,*internal* / *Pslab*,*internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

MAXRaft Plus+ 320mm

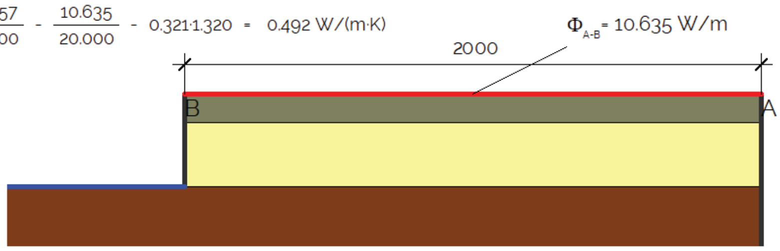
Solid POD with Brick Rebate

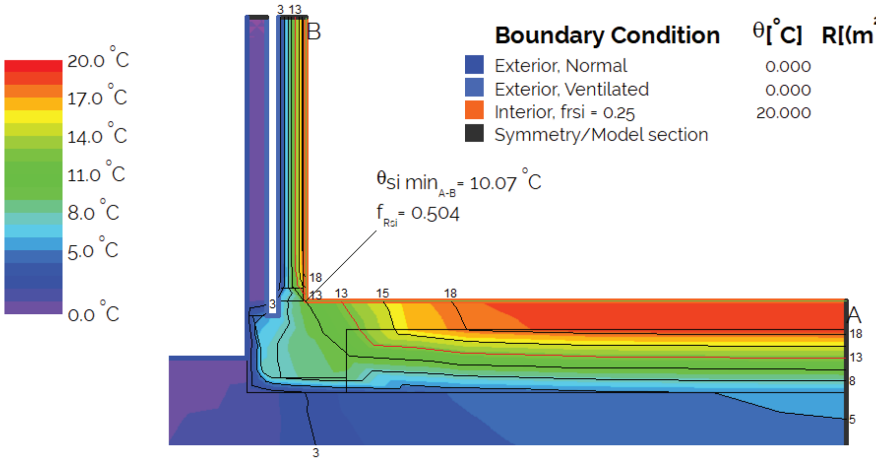
Boundary Condition	θ[°C]	R[(m²·K)/W]
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, heat flux, downwards	20.000	0.170
Interior, normal, horizontal	20.000	0.130
Symmetry/Model section		

Material	λ[W/(m·K)]
50/50 Pod 220/1100/120R/50EPS VH	0.081
Brick (1)	0.350
Concrete	2.000
EPS VH	0.035
Ground	2.000
Plasterboard	0.250
Timber (Softwood)	0.130
Wall insulation	0.032



$$\Psi_{A\text{-}E\text{-}C'} = \frac{28.957}{20.000} - \frac{10.635}{20.000} - 0.321 \cdot 1.320 = 0.492\ W/(m \cdot K)$$

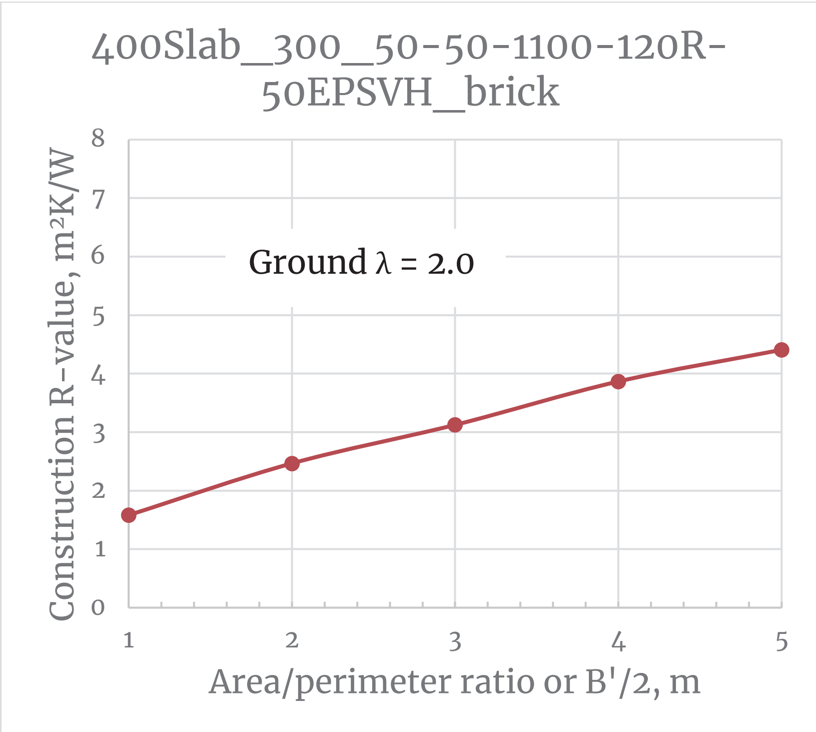




Boundary Condition	θ[°C]	R[(m²·K)/W]
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		

MAXRaft Plus+ 400mm

Solid POD with Brick Rebate

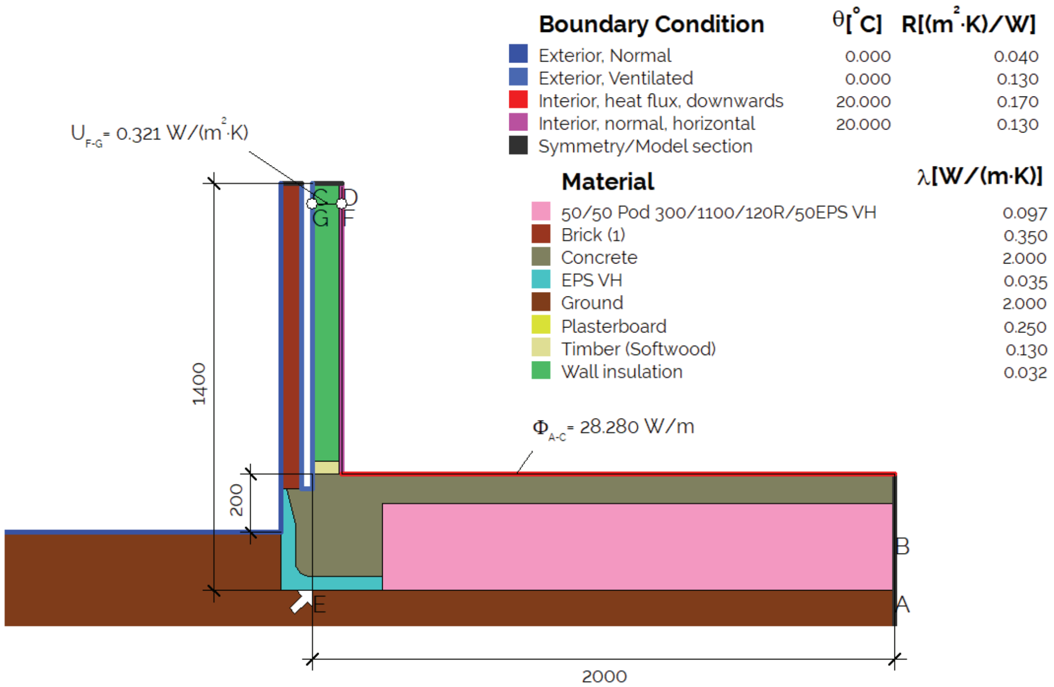


A/P, m	R-value, m^2K/W
1	**1.58**
1.6	2.11
1.8	2.29
2	**2.47**
2.2	2.60
2.4	2.73
2.6	2.86
2.8	2.99
3	**3.12**
3.2	3.27
3.4	3.42
3.6	3.57
3.8	3.72
4	**3.87**
5	**4.41**

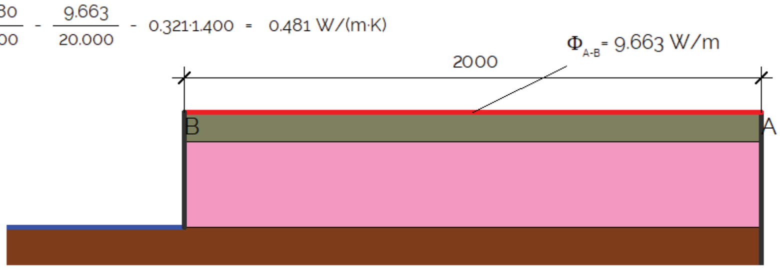
Note the above graph is for *slab area to perimeter ratio* = $A_{slab,internal}$ / $P_{slab,internal}$ The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.

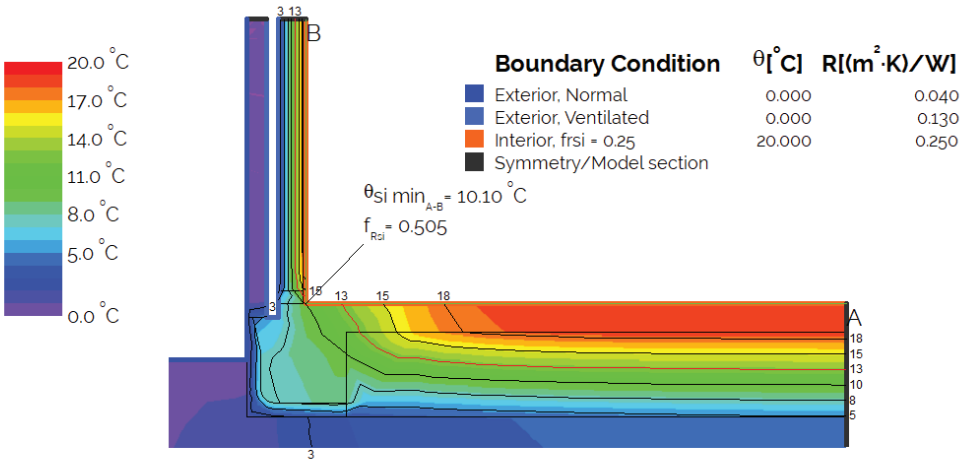
MAXRaft Plus+ 400mm

Solid POD with Brick Rebate



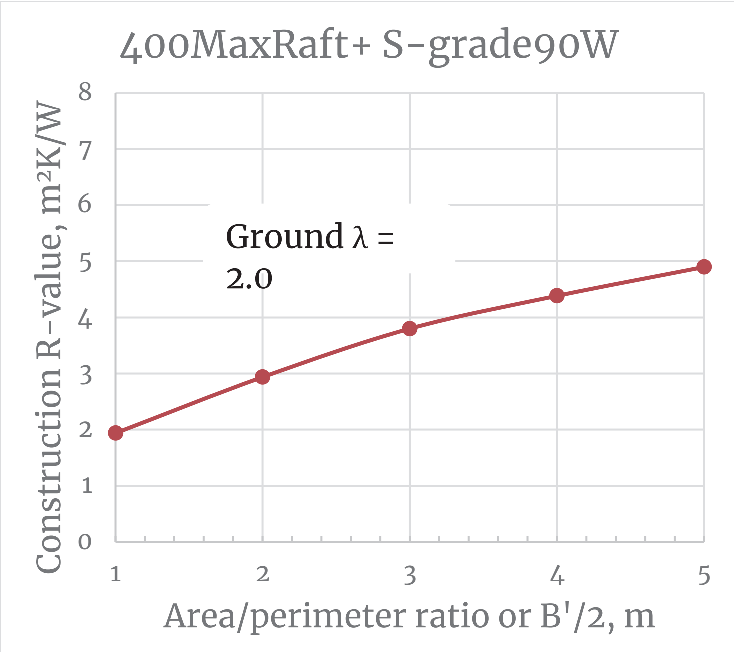
$$\Psi_{A\text{-}E\text{-}C} = \frac{28.280}{20.000} - \frac{9.663}{20.000} - 0.321 \cdot 1.400 = 0.481\ W/(m \cdot K)$$





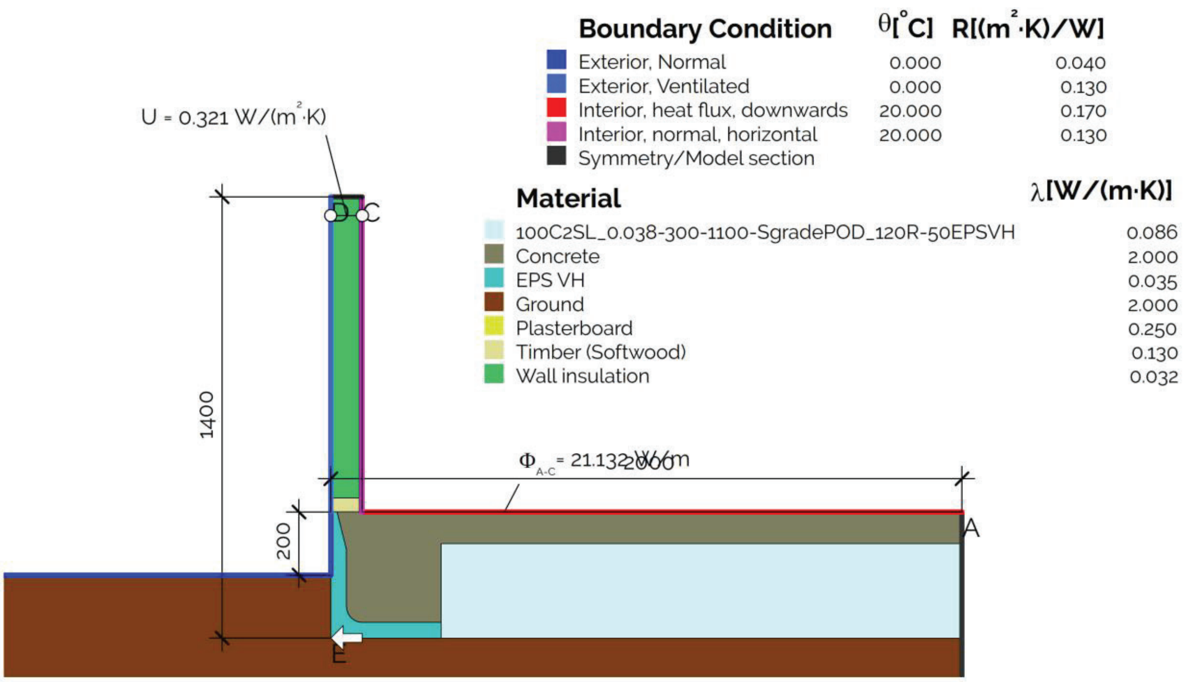
MAXRaft Plus+ 400

S-grade POD 90mm Wall

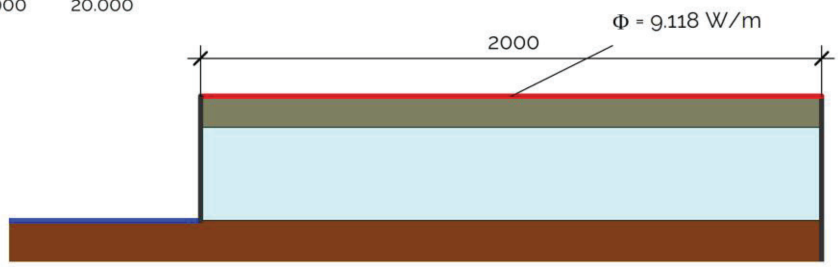


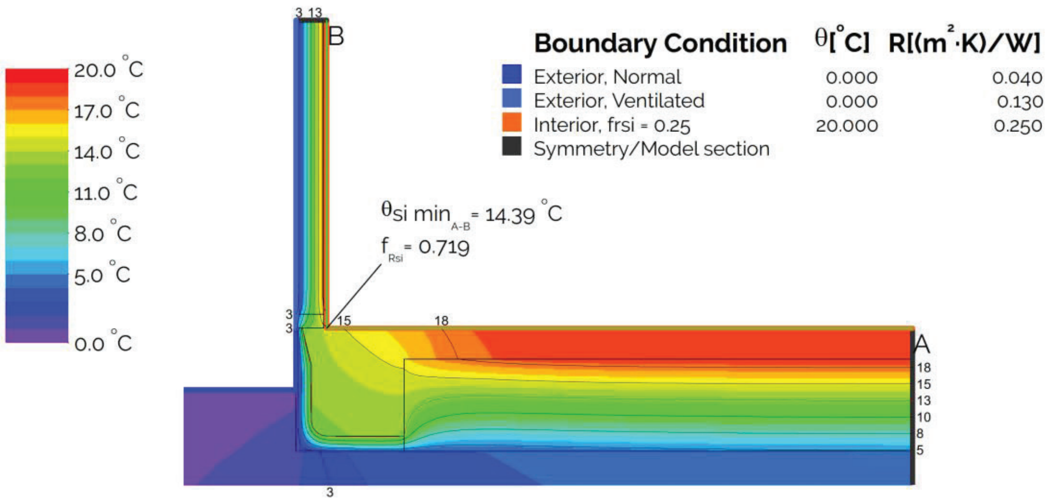
A/P, m	R-value, m²K/W
1	**1.94**
1.6	2.54
1.8	2.74
2	**2.94**
2.2	3.11
2.4	3.28
2.6	3.45
2.8	3.63
3	**3.80**
3.2	3.92
3.4	4.03
3.6	4.15
3.8	4.27
4	**4.38**
5	**4.90**

Note the above graph is for *slab area to perimeter ratio* = *Aslab,internal* / *Pslab,internal* The results are provided to two decimal places to help with Interpolation but the accuracy only justifies a single decimal place (ie R1.3 in place of R1.33). Slab R-values were calculated without any additional slab thickenings.



$$\Psi_{A\text{-}E\text{-}C} = \frac{21.132}{20.000} - \frac{9.118}{20.000} - 0.321 \cdot 1.400 = 0.151 \text{ W/(m·K)}$$





Methodology

NZBC R-VALUES

NZBC calculations are per the NZBC H1 standard Verification Method H1/VM1 Appendix F, effective 29Nov2021, summarized here:

Using internal slab dimensions in accordance with Equation 1 from this standard.

Equation 1: *slab area to perimeter ratio = Aslab, internal / Pslab, internal*

where:

Aslab,internal is the area of the slab-on-ground floor that is part of the thermal envelope, measured between the interior surfaces of the walls that form the thermal envelope (m2) and

Pslab,internal is the perimeter of the slab-on-ground floor that is part of the thermal envelope, measured along the interior surfaces of the walls that form the thermal envelope, including the length of any wall(s) between conditioned and unconditioned spaces (m).

To convert from interior to exterior A/P ratio use the equation from H1/AS1 (5^{th} edition, Nov2021) equation F1 and F2.

This is done using a two-dimensional numerical calculation in accordance with ISO 13370 Section 5.2b), a geometrical model in accordance with ISO 10211 Sections 7.3, 12.4.1 and 12.4.2 shall be used.

$$\frac{A_{slab,internal}}{P_{slab,internal}} = \frac{A_{slab,external}}{P_{slab,external}} - \frac{wall\ thickness}{2}$$

The model shall have a floor width equal to half the characteristic dimension of the floor.

COMMENT: 1. The characteristic dimension of the floor (B, see ISO 13370) equals the area of the floor divided by half the perimeter of the floor and should be determined using internal dimensions. 2. A two-dimensional geometrical model with a floor width equal to half the characteristic dimension of the floor represents a floor that is infinitely long and has a width equal to the characteristic dimension of the floor, as required by ISO 13370 Section 5.2 b).

F.1.2.5 The calculation shall use the default values for the thermal properties of the ground from ISO 13370 Table7 category 2. For other materials, thermal conductivity values from ISO 10456 shall be used and, for materials used below ground level, reflect the moisture and temperature conditions of the application. Values of surface resistance shall conform to ISO 13370 Section 6.4.3.

Note: Soil or Ground thermal conductivity = 2 W/(mK). The remaining thermal conductivities are shown in the results.

F.1.2.6 The construction R-value of the slab-on-ground floor shall be calculated according to Equation F.1.

Equation F.1: *Rfloor = 1/U*

where:

U is the temperature-specific heat flux through the internal floor surface of the two- or three-dimensional geometrical model, with the internal floor surface extending from the internal surface of the external wall to the cut-off plane of the floor (W/(m2 ·K)), determined by a numerical calculation as per F.1.2.1 to F.1.2.5.

Slab thickenings

Note that the H1/AS1 (5^{th} edition, Nov2021) calculations do not include slab thickenings in the R-value calculations. The methodology that has been selected would mean that every slab containing a slab thickening would need a custom two-dimensional or three-dimensional numerical calculation to take the slab thickenings into account. Given this and absent a clarification from MBIE we believe that slab thickenings can be neglected for NZBC H1 compliance. If H1/VM1 or VM2 is being used to demonstrate code compliance, the slab thickenings should be considered the same way in both the reference and proposed models.

Although we believe that the slab thickenings should be neglected for NZBC compliance we do not think this is good practice or to be recommended for high performance buildings. Slab thickenings can be a significant fraction of the slab area (we have seen over 30% of a slab area thickened) and this can significantly impact the building's performance. This is like the way the actual timber fraction in a wall can be much larger than is assumed in the NZBC H1/AS1 requirements and the result - overprediction performance is the same. In Passive House or NZGBC Homestar V5 models the slab thickenings must be considered either by using an area based different slab construction (U-value) for the area of the slab that is thickened or by using a PSI value for the specific slab thickening times the length of the thickening (this is the more accurate approach).

Hollow foundation pods (eg Expol Tuff Pods)

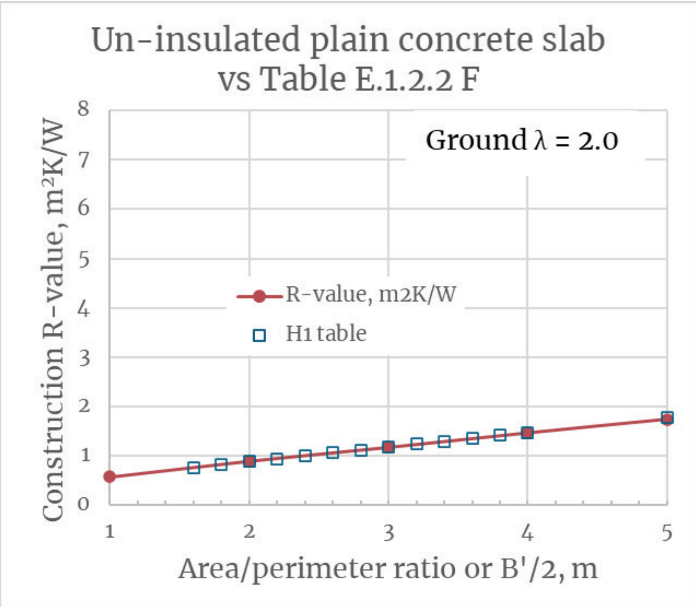
This analysis assumes the pods are un-cut. In practice the air pocket molded EPS pods and other hollow pods are cut which allows concrete to flow into the hollow pockets. This increases the amount of concrete thermal bridging through the slab and can lower the slab thermal resistance. Using similar logic to the above on slab thickenings we believe that this impact can be neglected for NZBC H1 compliance.

Wet sites and impacts on slab performance

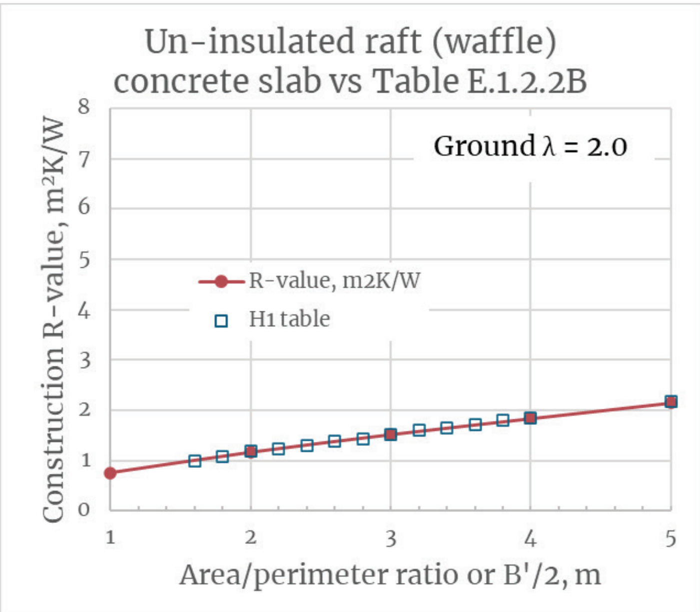
Slab performance has been calculated assuming a well-drained site. Sites with water tables that are high enough to have the under-slab insulation wet should consider a raised foundation as the thermal performance of the insulation will potentially be reduced by immersion in water.

The below two graphs compare our Implementation of the H1 methodology compared to the BRANZ calculated table values in H1/AS1. They agree to within less than 2%. The small variation is from different finite element meshing routines. The results are given to two decimal places to help with interpolation, but the accuracy only justifies a single decimal place and we'd recommend tables provided to designers show only a single decimal place (ie R1.33 show as R1.3).

NZBC R-values for an un-insulated plain concrete slab



NZBC R-values for an un-insulated raft (waffle) concrete slab

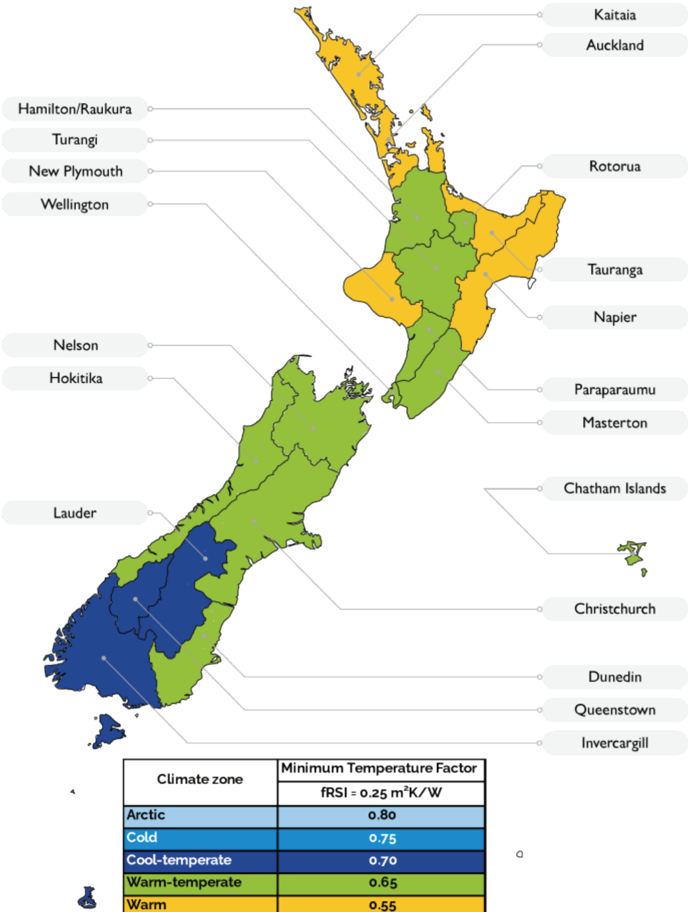


Both examples for 90mm stud + 10mm gypsum wall board or 100mm wall.

PASSIVE HOUSE Ψ AND FRSI

Slab Passive House calculations of Ψ are in accordance with ISO10211:2017 with Passive House Institute (PHI) modifications and fRSI criteria. These use EXTERNAL DIMENSIONS and the heat loss at the sill plate (which should not be neglected) is included in this Ψ calculation. NZBC has no official requirements for a particular fRSI value but NZGBC Homestar V5 does have requirements Intended to parallel the Passive House requirements. In PHPP10 these will be calculated via a moisture balance for each specific building to allow lower fRSI values to be used as less conservative criteria are appropriate with more detailed knowledge of the building ventilation rates, loads, and heating setpoints.

FRSI REQUIREMENTS FOR NZ REGIONS FOR PASSIVE HOUSE



Climate zone	Minimum Temperature Factor fRSI = 0.25 m²K/W
Arctic	0.80
Cold	0.75
Cool-temperate	0.70
Warm-temperate	0.65
Warm	0.55
Hot	-
Very hot	-

Figure 1: This map shows the three different fRSI zones at the weather station altitudes. The climate zone and thus the fRSI requirements also vary with altitude as the average temperatures typically drop by 0.6C per 100m of elevation gain. In general these zones can be used without considering the elevation change. Illustration: Sustainable Engineering Ltd. fRSI requirements from [PHI Passive House Standard Building Criteria](#).