

# Firth New H1 report - 3Feb2022

Slab NZBC R-value and Passive  
House  $\Psi$  and fRSI

3 February 2022

Sustainable Engineering Ltd



# Summary

PSI and fRSI values are per PHI methodology,

Slab R-values are per the new NZBC H1 methodology.

Values between the calculated points can be interpolated.

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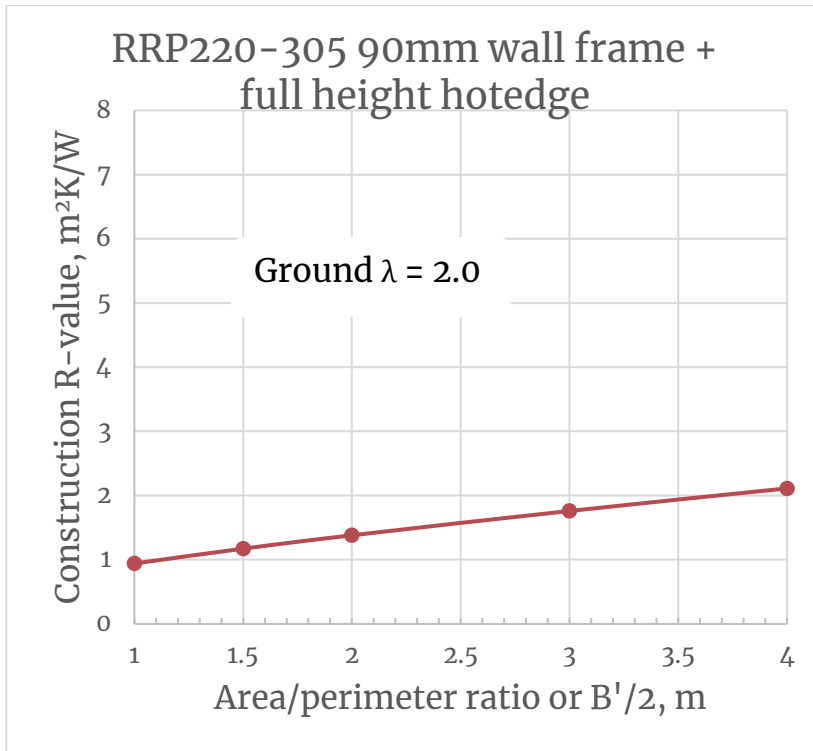
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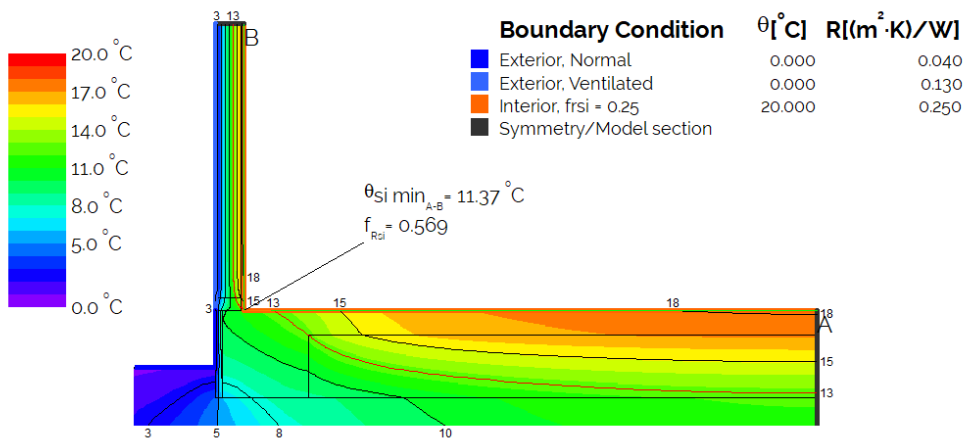
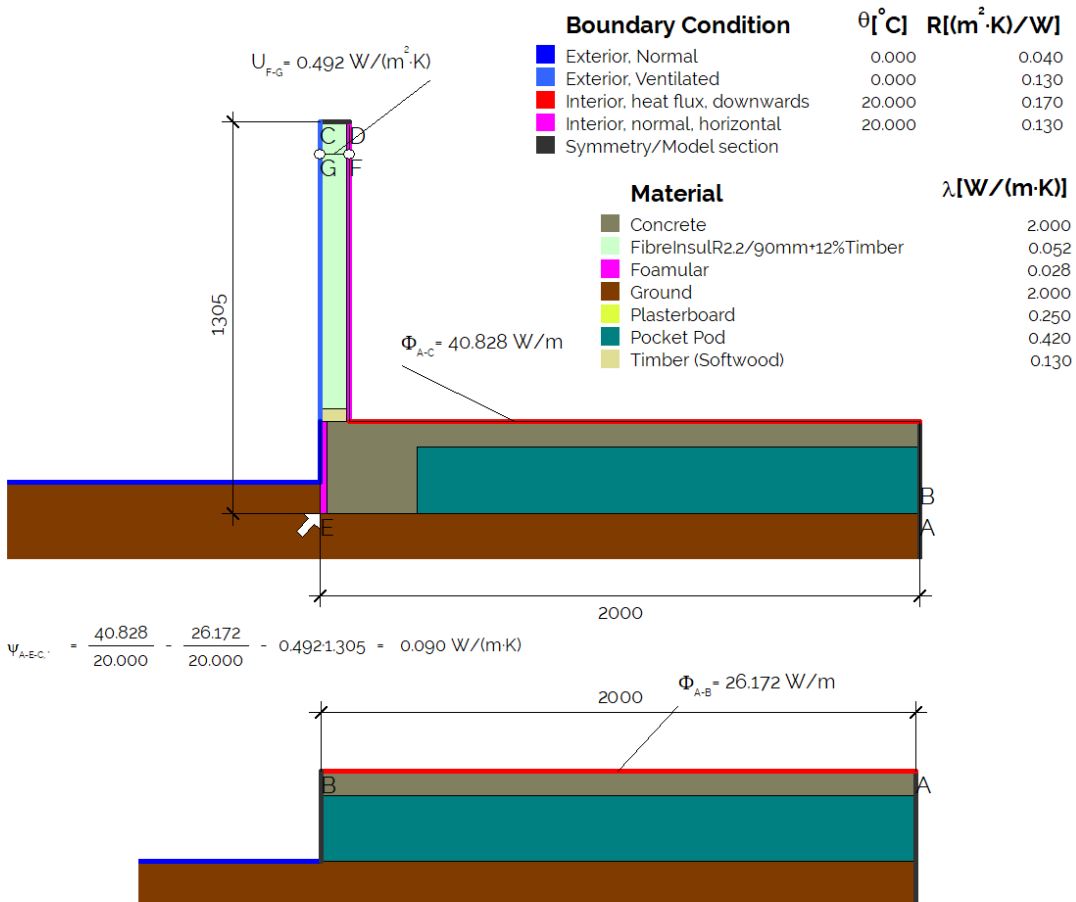
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**METHODOLOGY .....55**

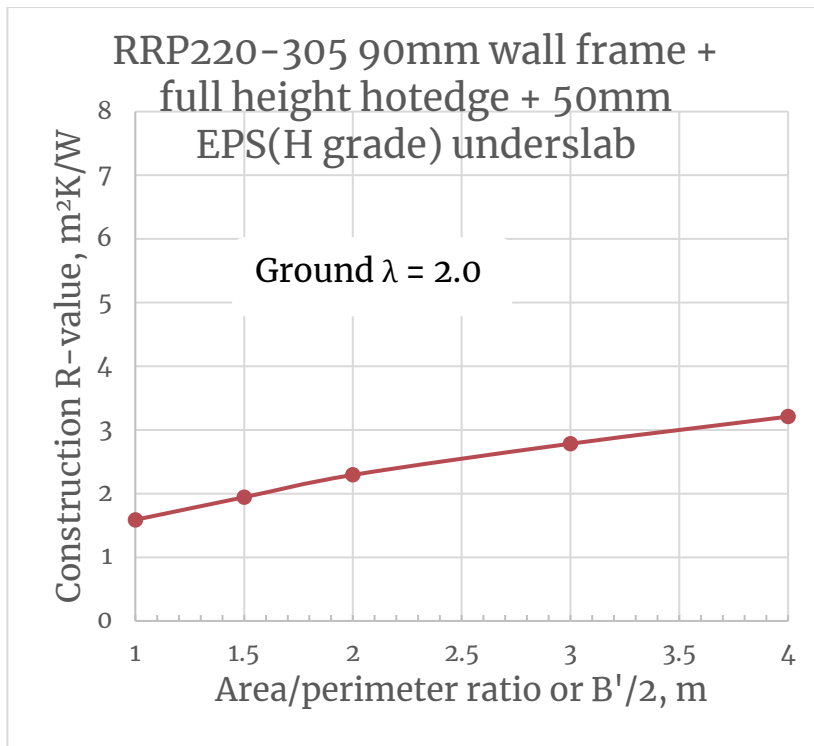
# RRPPod 220-305 90mm wall frame + full height hotedge



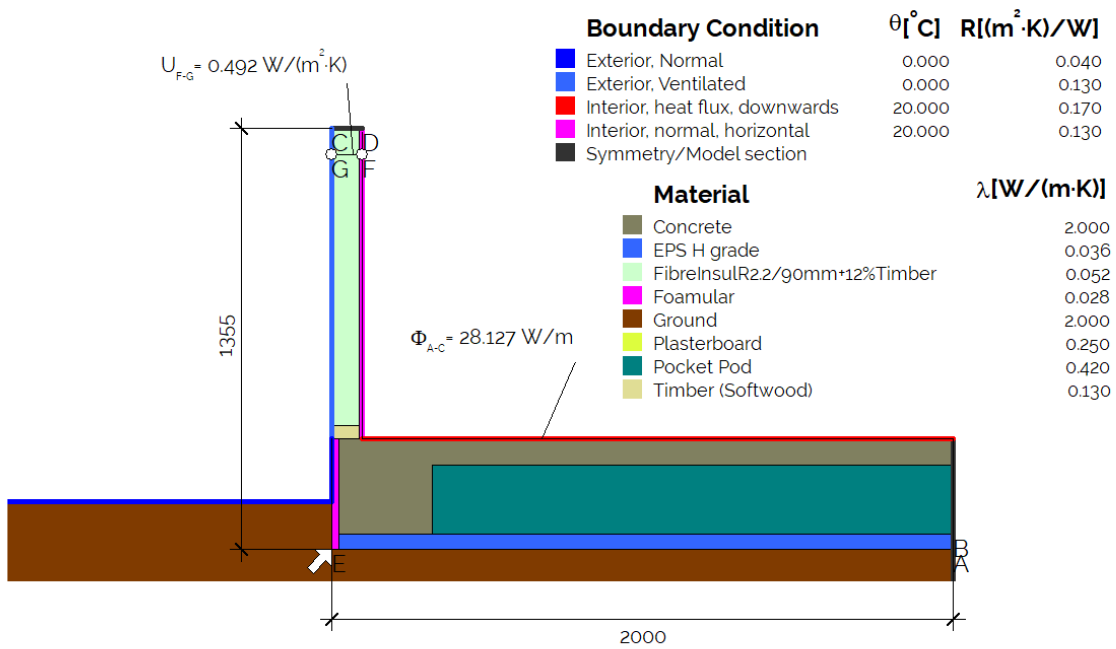
A/P, m	R-value, $m^2K/W$
1	0.94
1.5	1.17
2	1.38
3	1.76
4	2.11



# RRPPod 220-305 90mm wall frame + full height hotedge + 50mm EPS(H grade) underslab



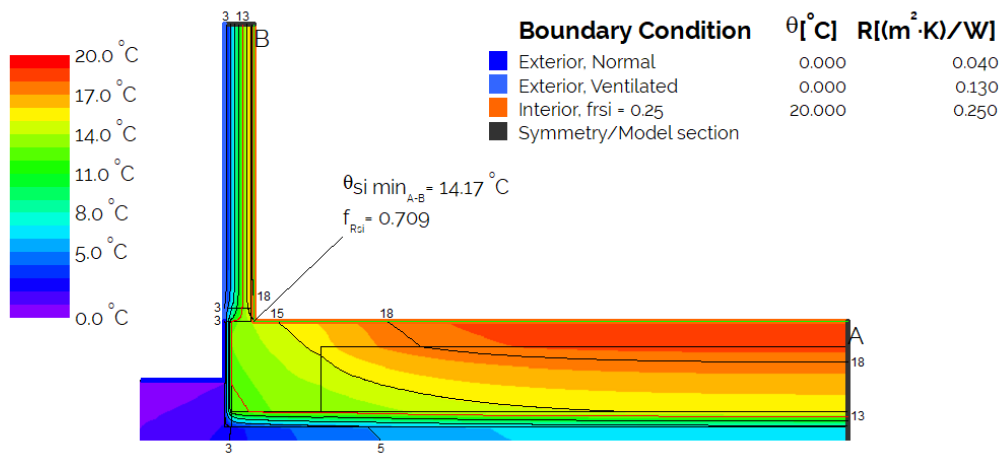
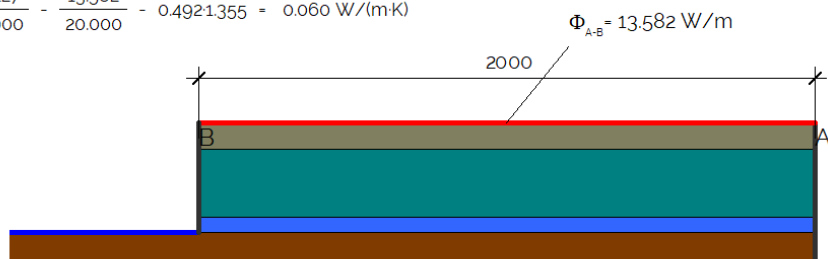
A/P, m	R-value, $m^2K/W$
1	1.59
1.5	1.94
2	2.29
3	2.78
4	3.21



Boundary Condition	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
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	$\lambda [W/(\text{m} \cdot \text{K})]$
Concrete	2.000
EPS H grade	0.036
FibreInsulR2.2/gomm+12%Timber	0.052
Foamular	0.028
Ground	2.000
Plasterboard	0.250
Pocket Pod	0.420
Timber (Softwood)	0.130

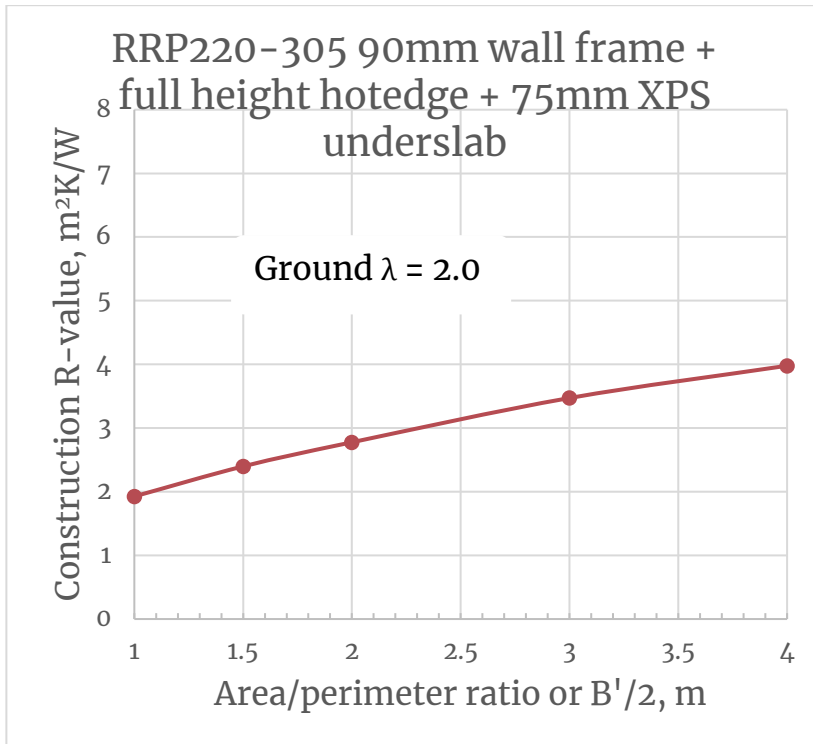
$$\psi_{A-E,C} = \frac{28.127}{20.000} - \frac{13.582}{20.000} - 0.492 \cdot 1355 = 0.060 \text{ W}/(\text{m} \cdot \text{K})$$



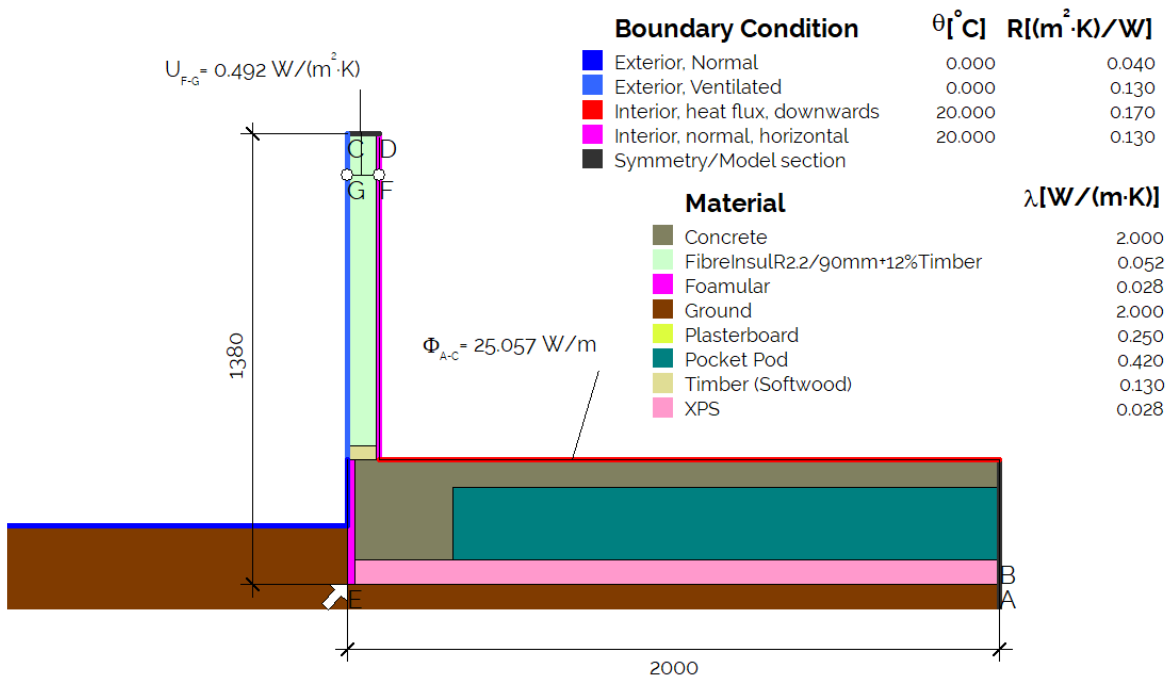
Boundary Condition	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		



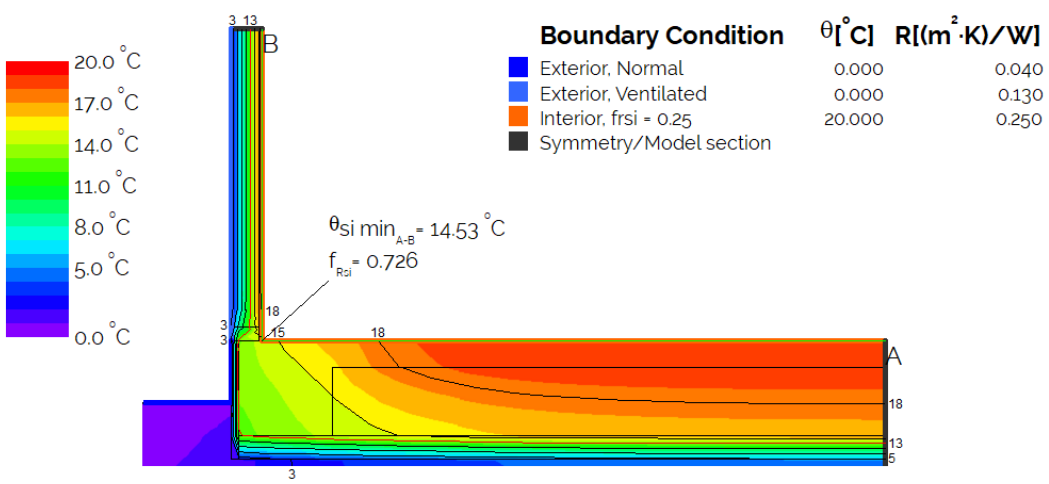
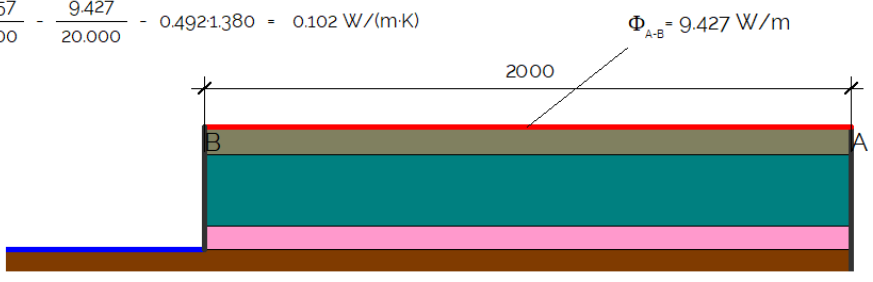
# RRPPod 220-305 90mm wall frame + full height hotedge + 75mm XPS underslab



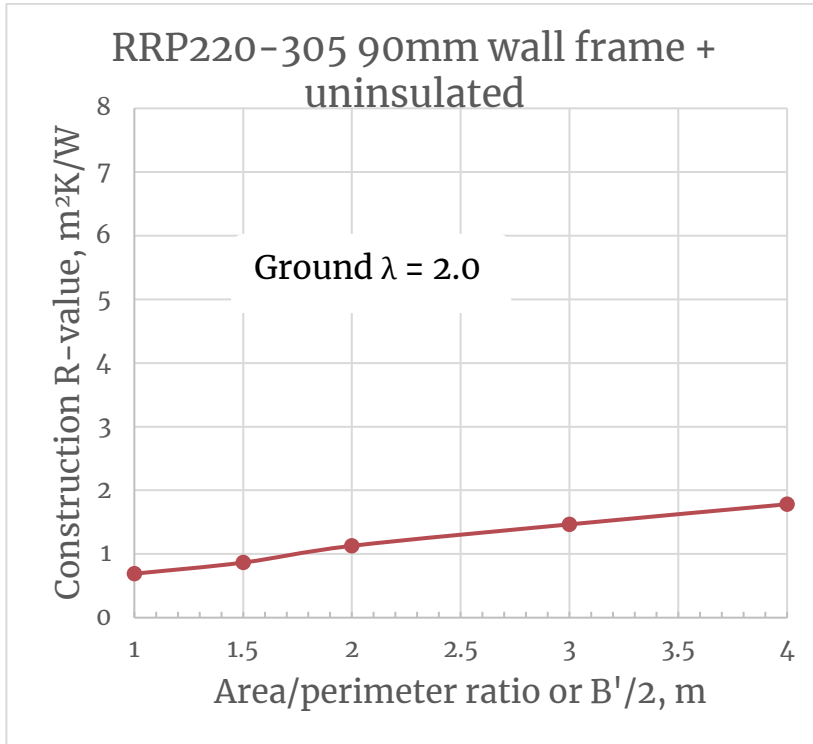
A/P, m	R-value, $m^2K/W$
1	1.93
1.5	2.40
2	2.78
3	3.47
4	3.98



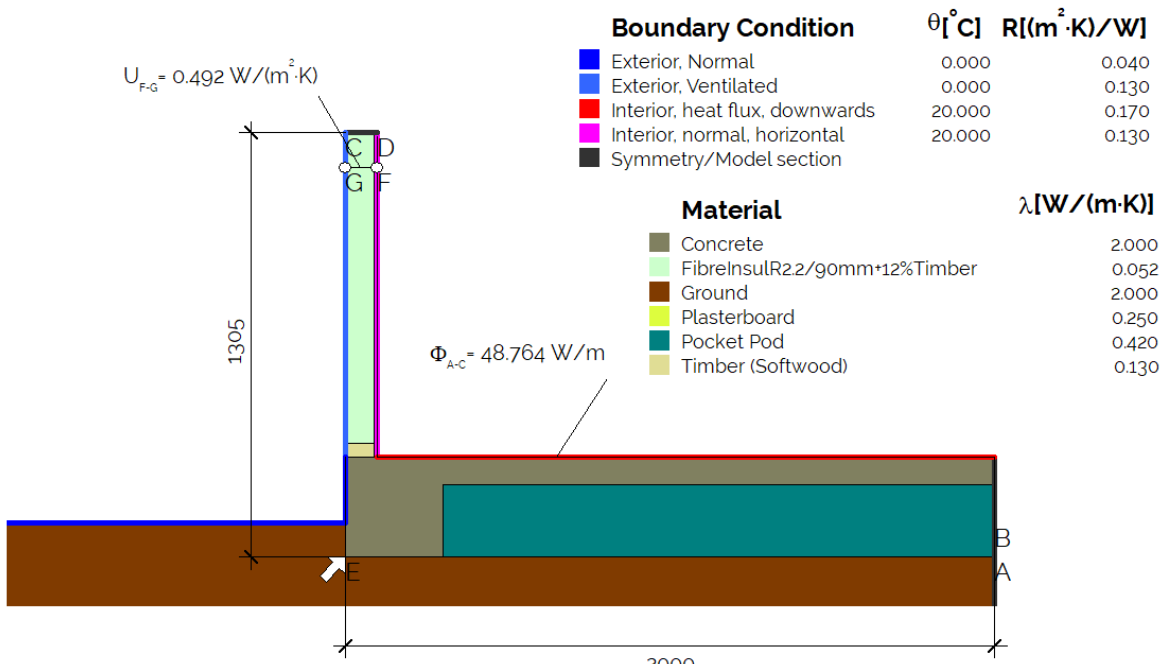
$$\psi_{A-E-C,1} = \frac{25.057}{20.000} - \frac{9.427}{20.000} - 0.492 \cdot 1.380 = 0.102 \text{ W}/(\text{m} \cdot \text{K})$$



# RRPPod 220-305 90mm wall frame + uninsulated



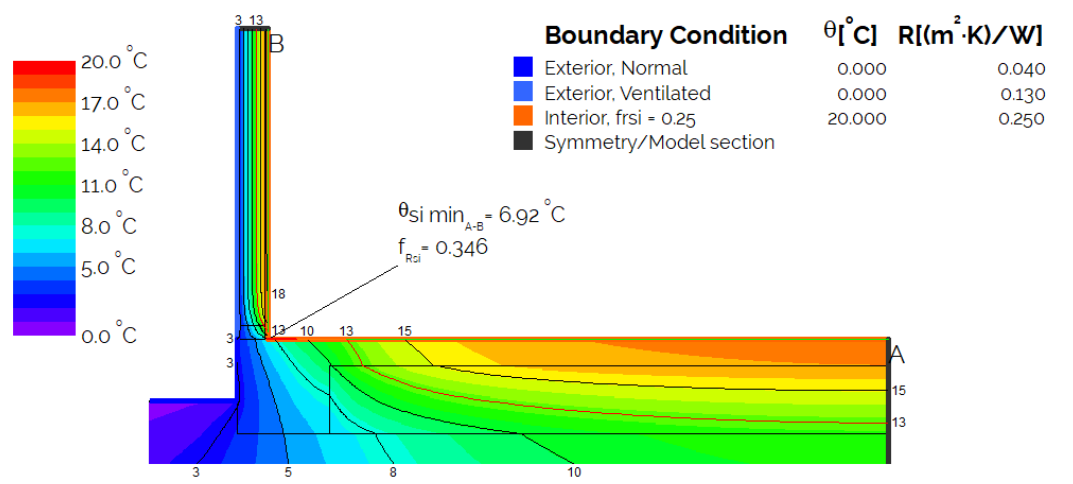
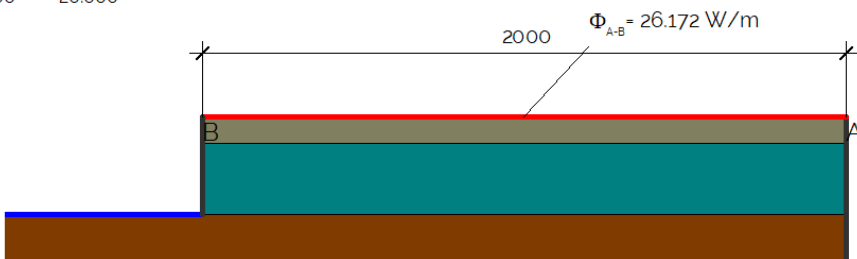
A/P, m	R-value, $m^2K/W$
1	0.69
1.5	0.87
2	1.13
3	1.47
4	1.78



Boundary Condition	$\theta$ [°C]	R [(m <sup>2</sup> ·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		

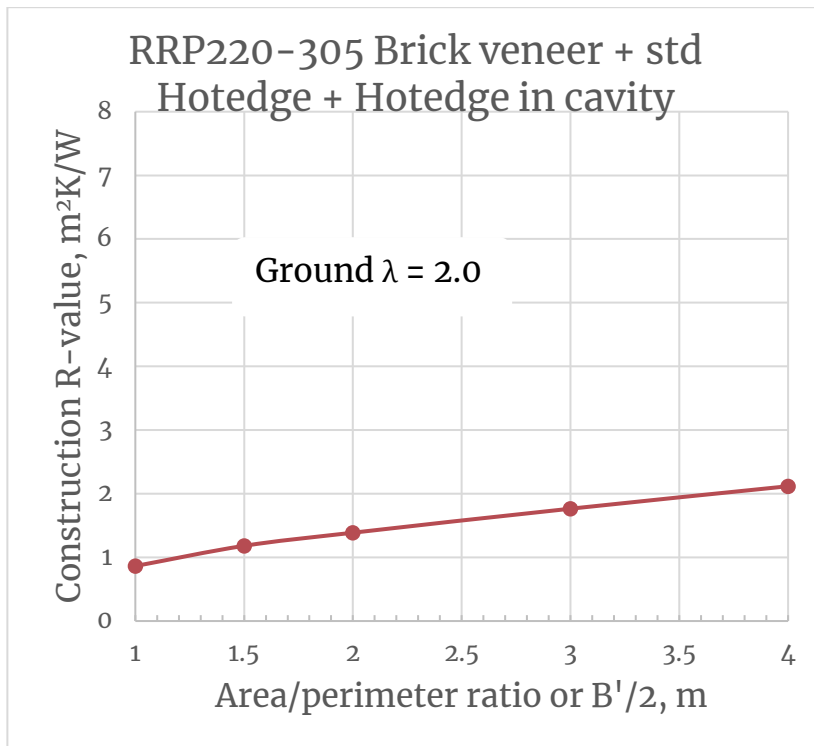
Material	$\lambda$ [W/(m·K)]
Concrete	2.000
FibreInsulR2.2/90mm+12%Timber	0.052
Ground	2.000
Plasterboard	0.250
Pocket Pod	0.420
Timber (Softwood)	0.130

$$v_{A-E-C} = \frac{48.764}{20.000} - \frac{26.172}{20.000} - 0.492 \cdot 1305 = 0.487 \text{ W/(m·K)}$$

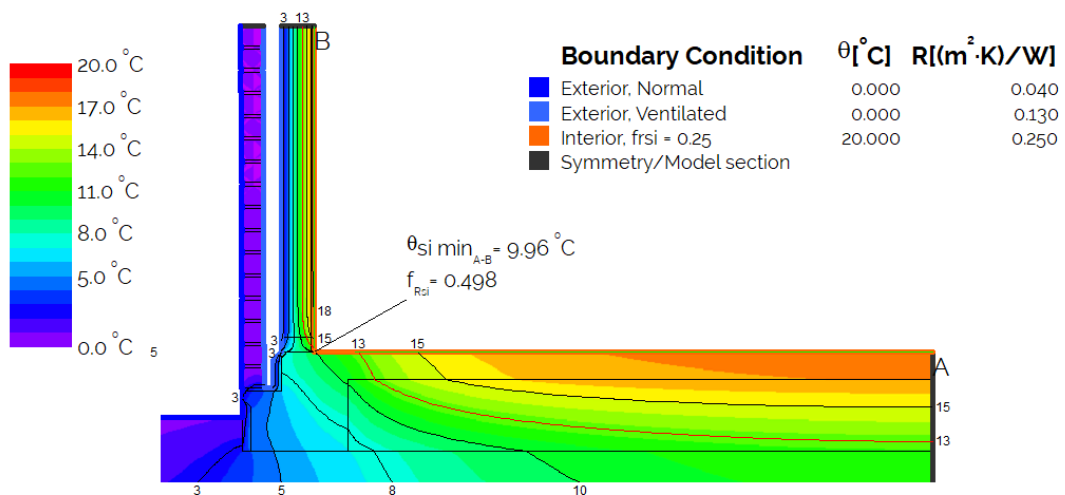
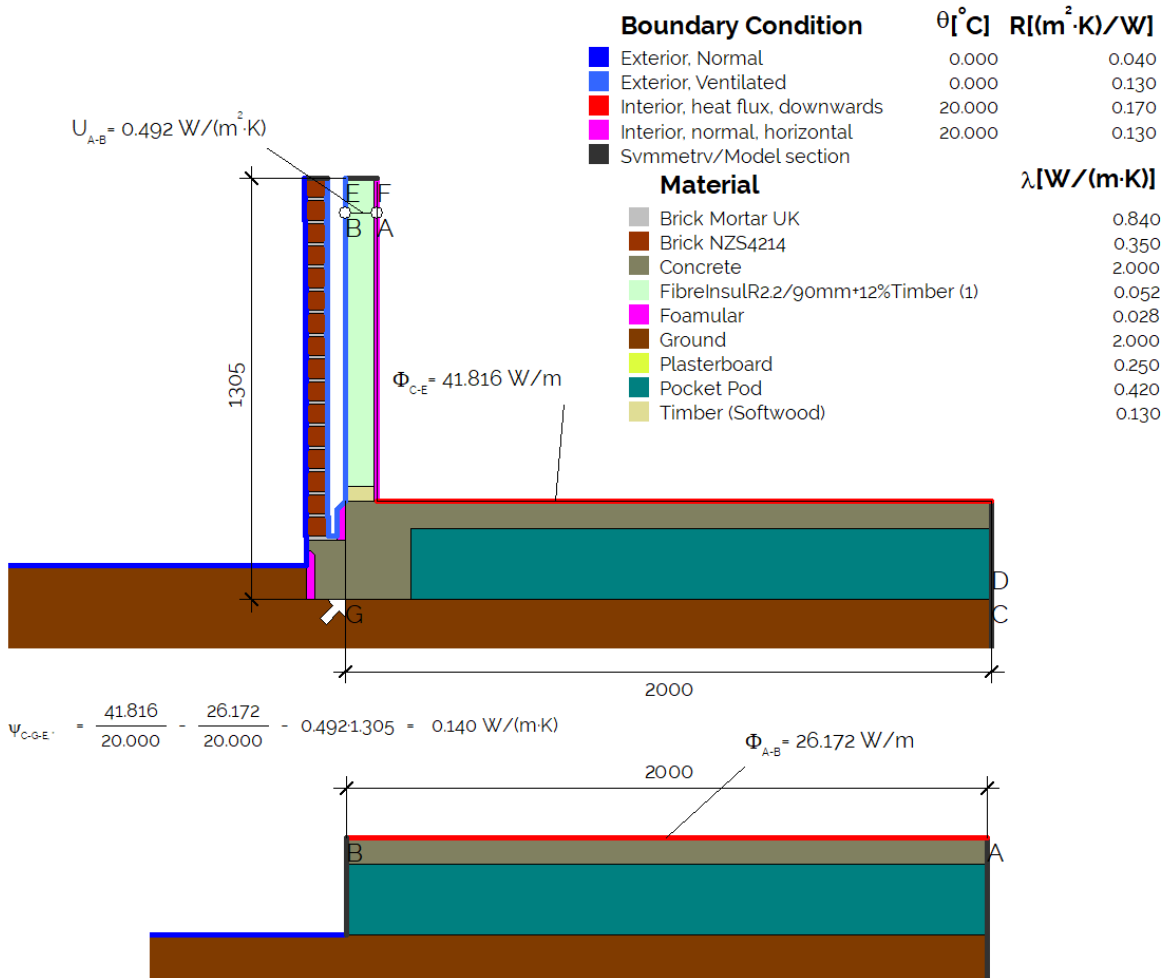


Boundary Condition	$\theta$ [°C]	R [(m <sup>2</sup> ·K)/W]
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		

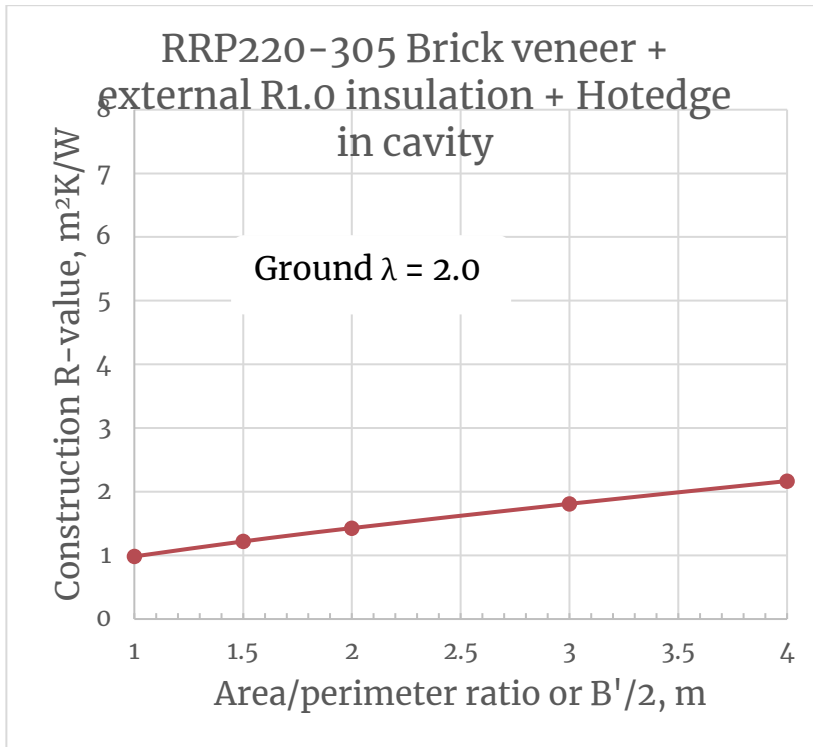
# RRPPod 220-305 Brick veneer + std Hotedge + Hotedge in cavity



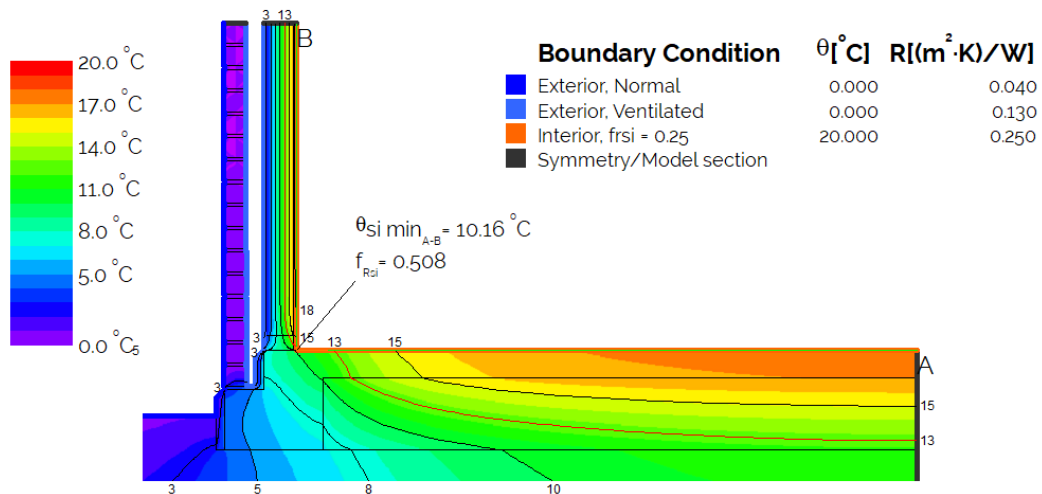
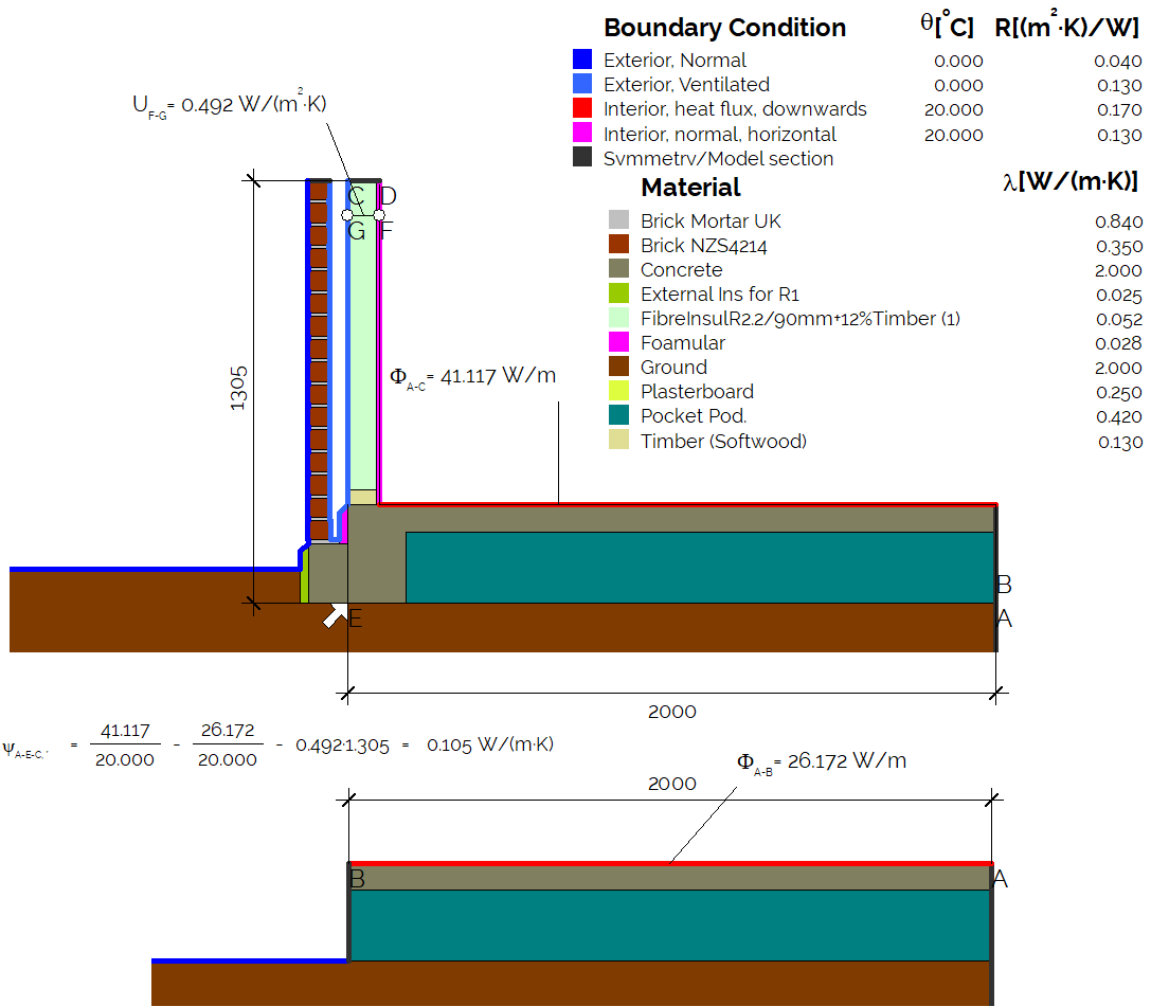
A/P, m	R-value, $m^2K/W$
1	0.86
1.5	1.18
2	1.39
3	1.76
4	2.12



# RRPPod 220-305 Brick veneer + external R1.0 insulation + Hotedge in cavity

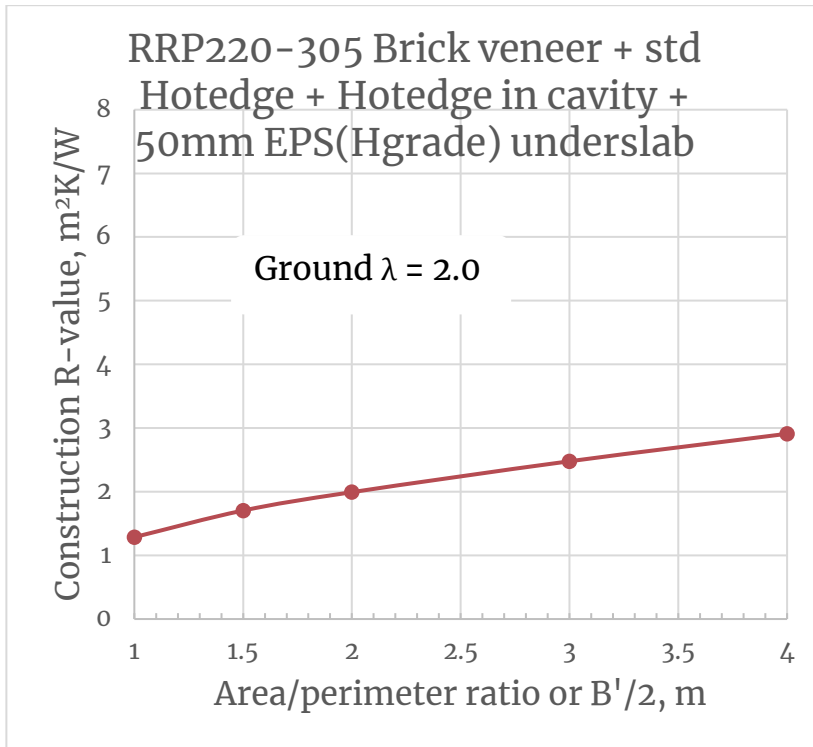


A/P, m	R-value, $m^2K/W$
1	0.98
1.5	1.22
2	1.43
3	1.81
4	2.17

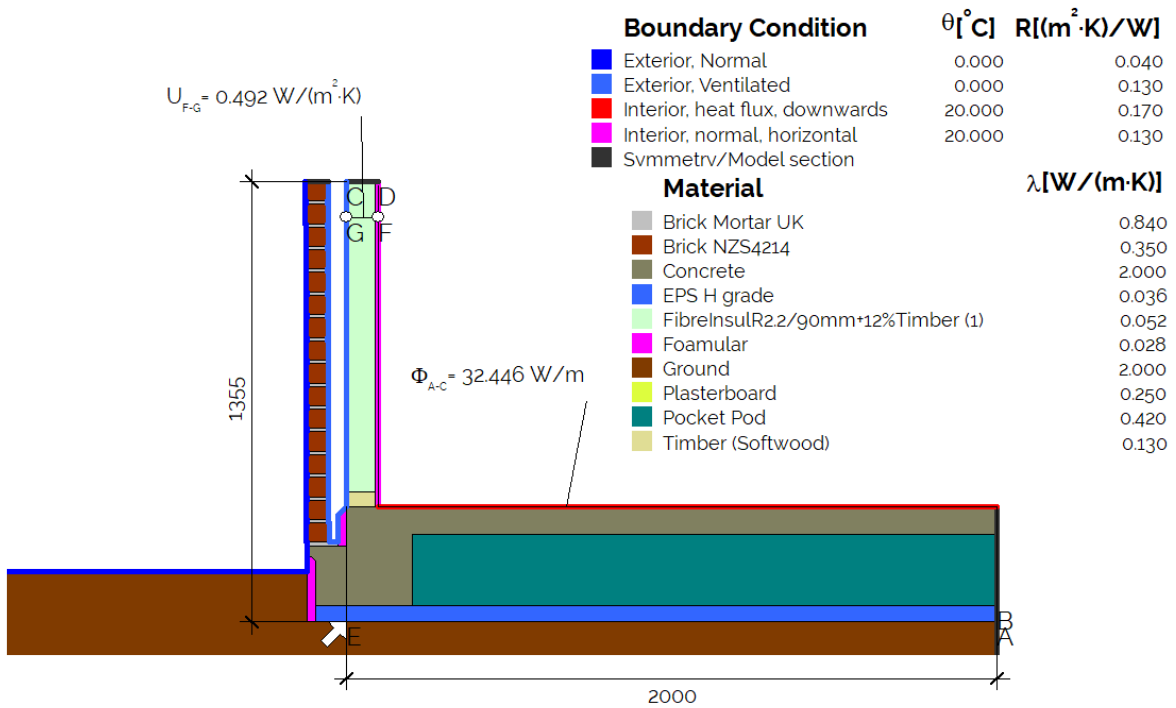




RRPPod 220-305 Brick veneer + std Hotedge +  
Hotedge in cavity + 50mm EPS(Hgrade) underslab



A/P, m	R-value, m <sup>2</sup> K/W
1	1.29
1.5	1.70
2	1.99
3	2.48
4	2.91

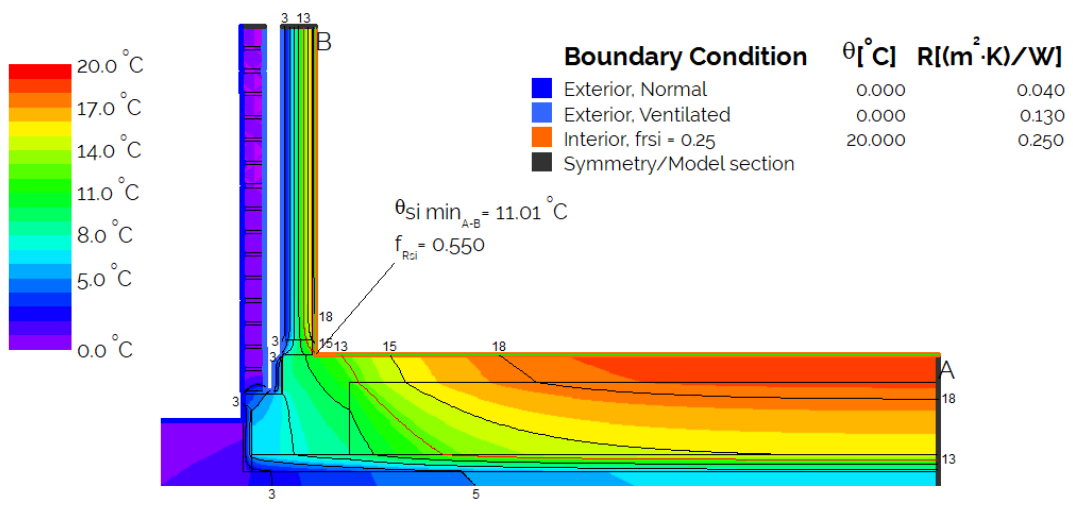
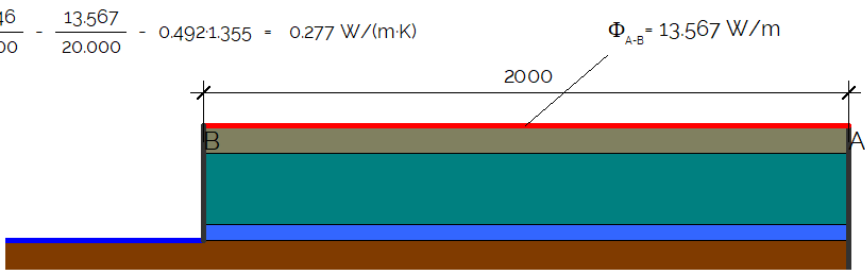


Boundary Condition	$\theta [^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, heat flux, downwards	20.000	0.170
Interior, normal, horizontal	20.000	0.130
Symmetry/Model section		

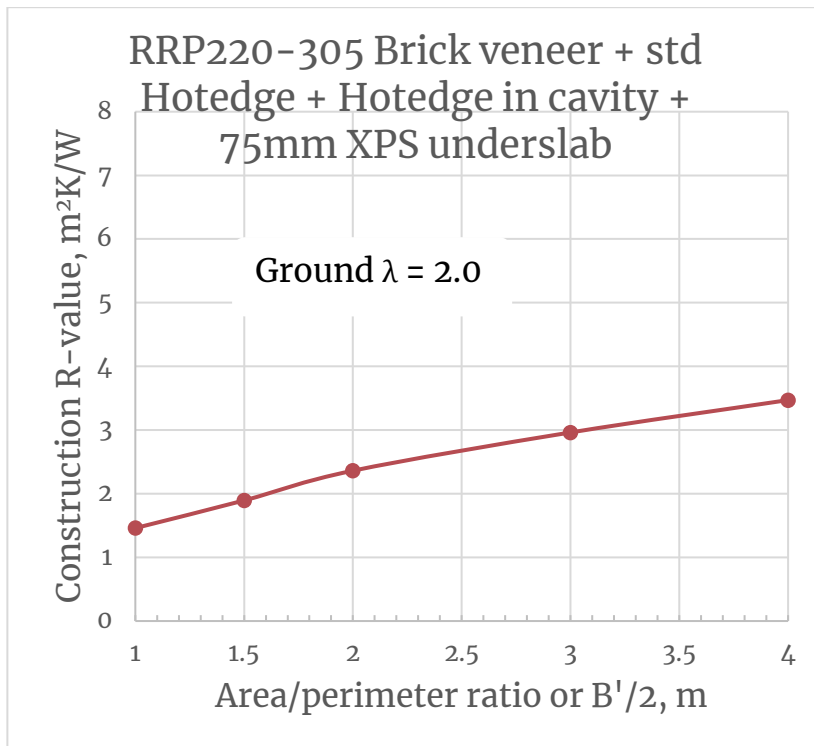
  

Material	$\lambda [W/(\text{m} \cdot \text{K})]$
Brick Mortar UK	0.840
Brick NZS4214	0.350
Concrete	2.000
EPS H grade	0.036
FibreInsulR2.2/90mm+12%Timber (1)	0.052
Foamular	0.028
Ground	2.000
Plasterboard	0.250
Pocket Pod	0.420
Timber (Softwood)	0.130

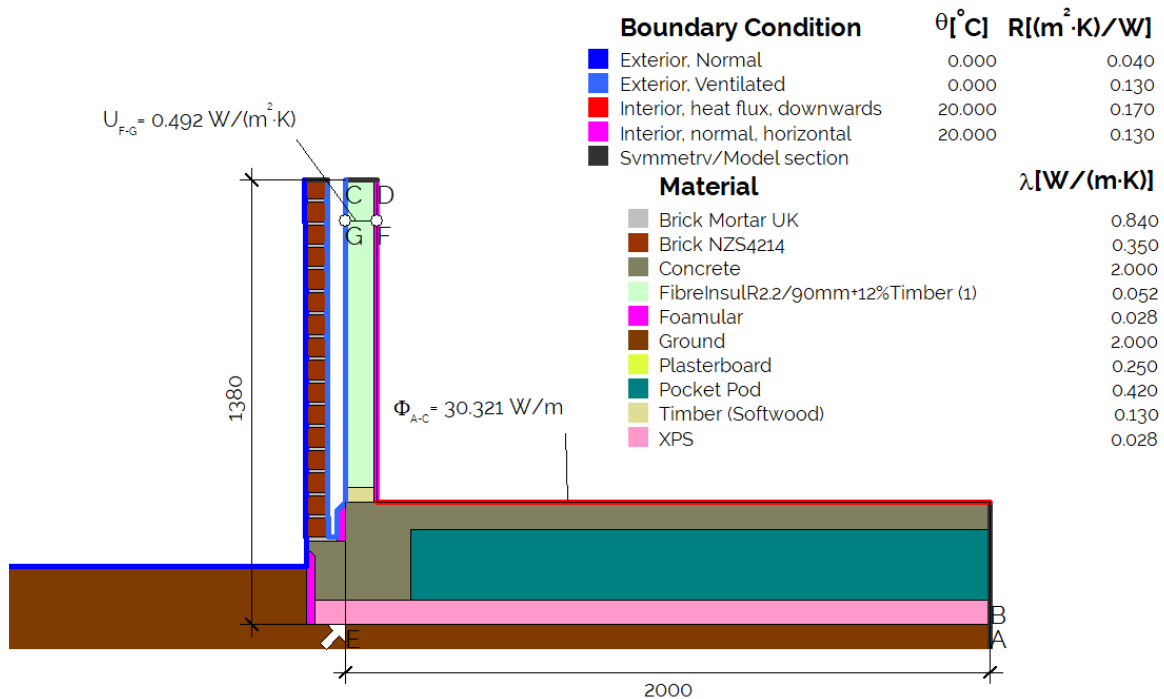
$$v_{A-E-C} = \frac{32.446}{20.000} - \frac{13.567}{20.000} - 0.492 \cdot 1.355 = 0.277 \text{ W}/(\text{m} \cdot \text{K})$$



# RRPPod 220-305 Brick veneer + std Hotedge + Hotedge in cavity + 75mm XPS underslab



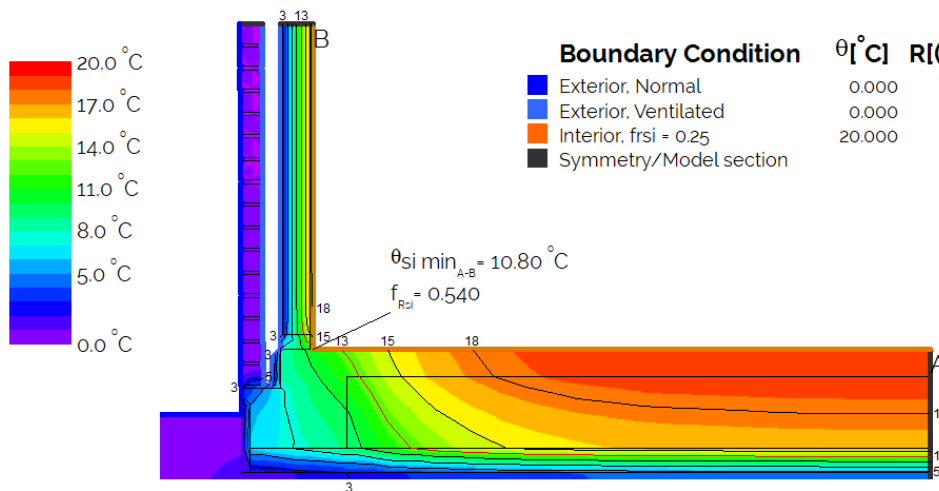
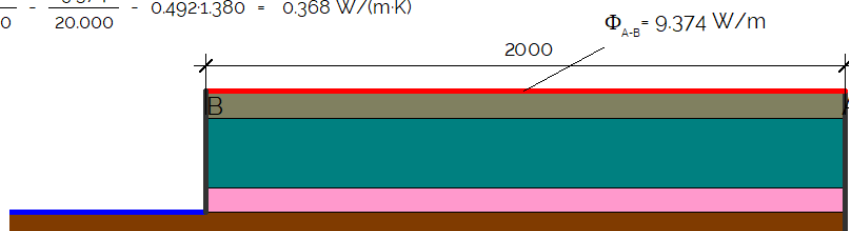
A/P, m	R-value, $m^2K/W$
1	1.46
1.5	1.89
2	2.36
3	2.96
4	3.47



Boundary Condition	$\theta [^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
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		

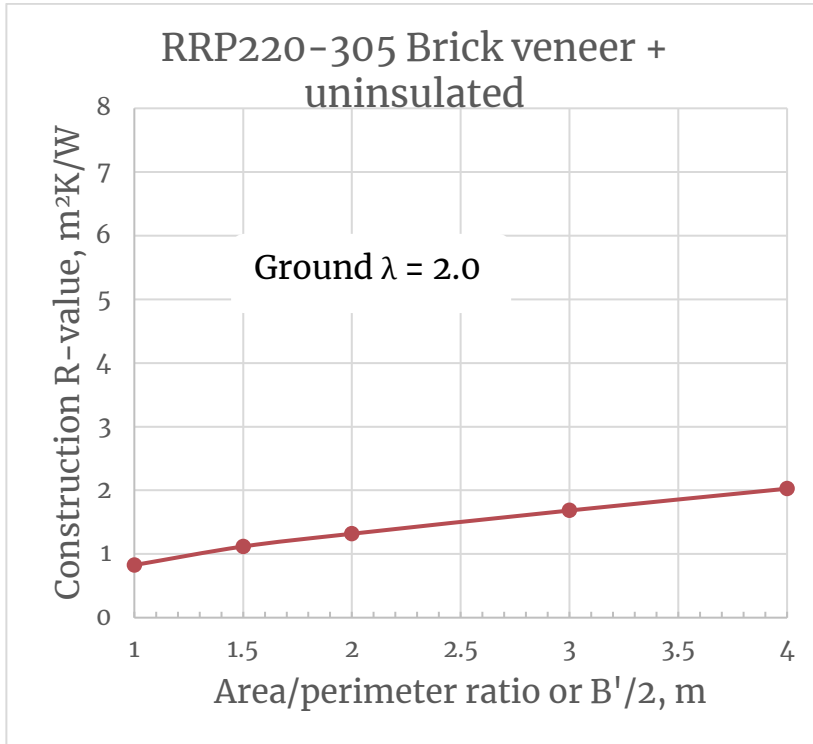
Material	$\lambda [W/(\text{m} \cdot \text{K})]$
Brick Mortar UK	0.840
Brick NZS4214	0.350
Concrete	2.000
FibreInsulR2.2/90mm+12%Timber (1)	0.052
Foamular	0.028
Ground	2.000
Plasterboard	0.250
Pocket Pod	0.420
Timber (Softwood)	0.130
XPS	0.028

$$\psi_{A-E-C} = \frac{30.321}{20.000} - \frac{9.374}{20.000} - 0.492 \cdot 1380 = 0.368 \text{ W}/(\text{m} \cdot \text{K})$$

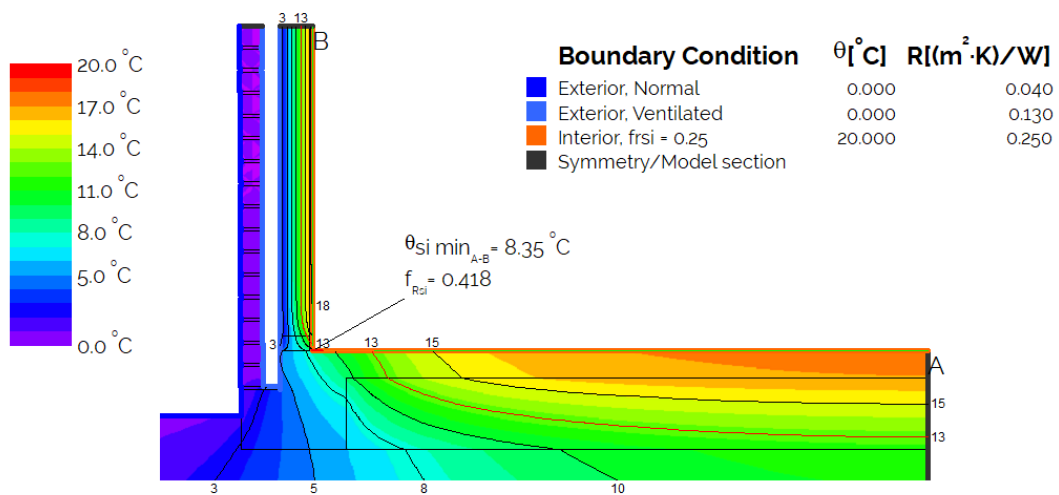
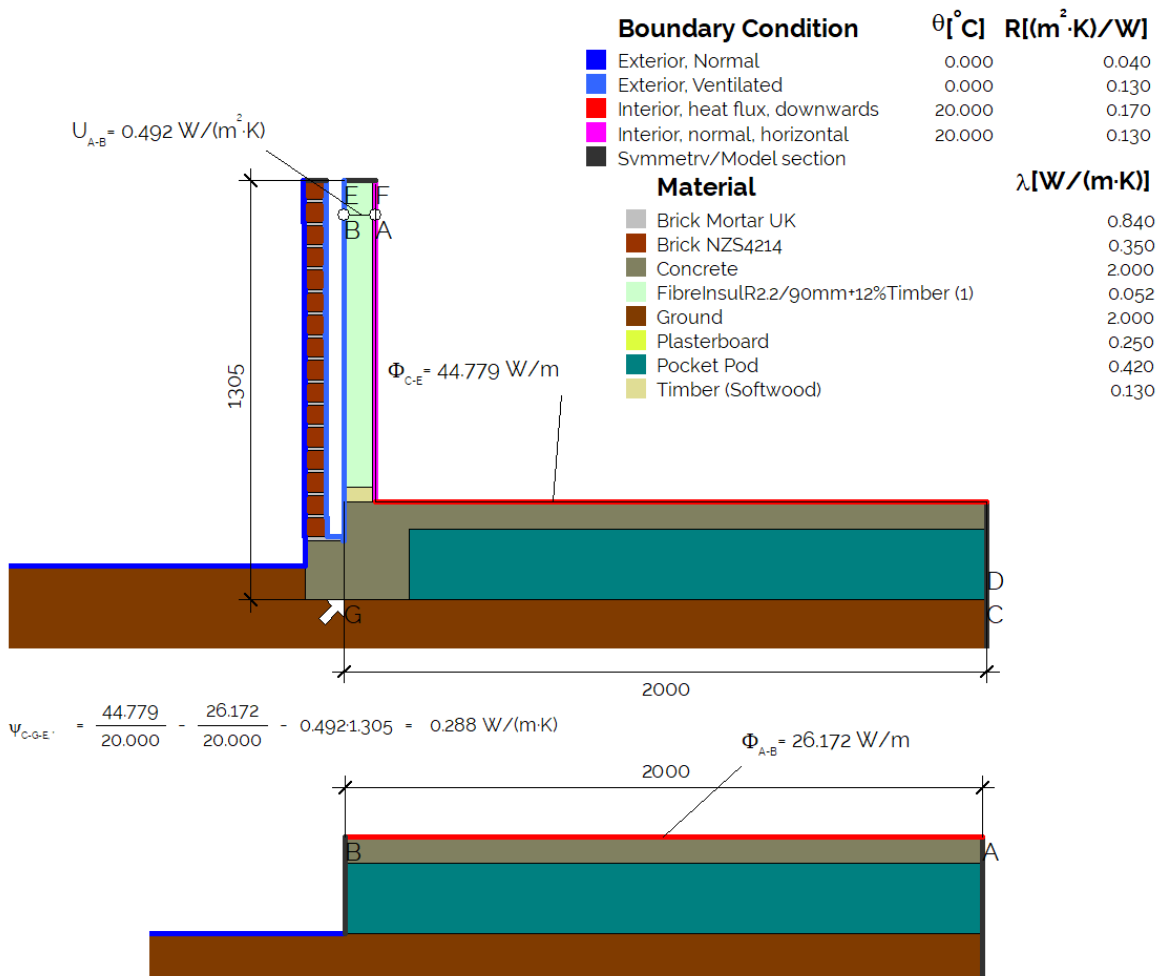


Boundary Condition	$\theta [^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		

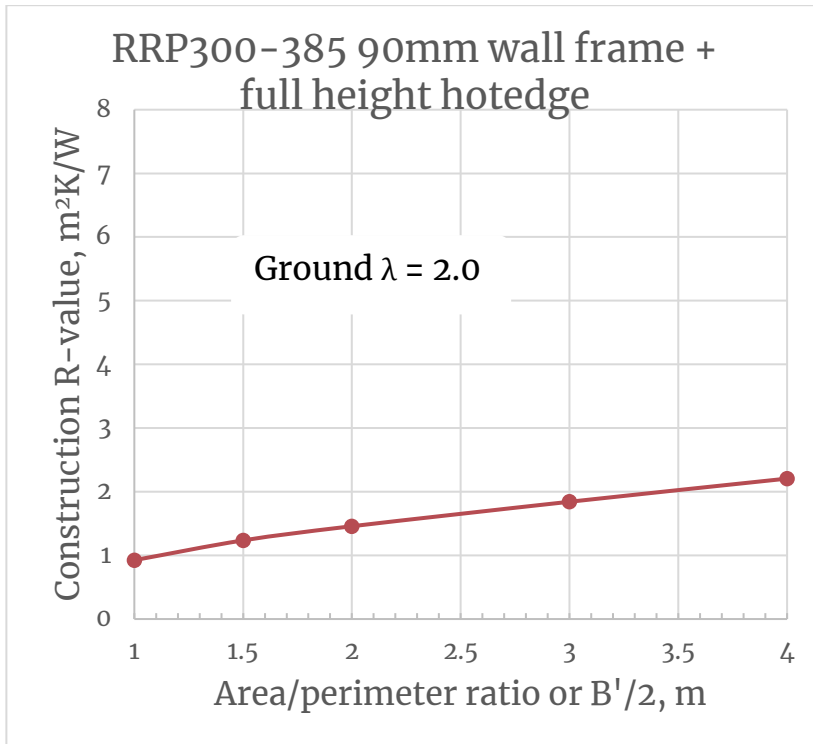
# RRPPod 220-305 Brick veneer + uninsulated



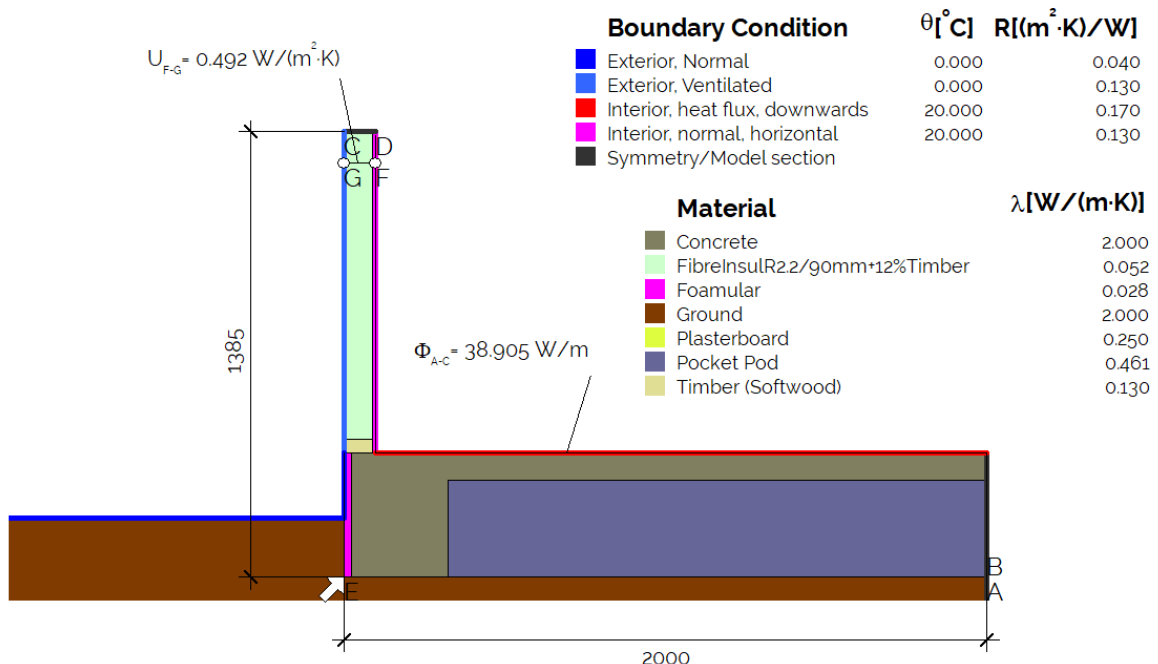
A/P, m	R-value, $m^2K/W$
1	0.83
1.5	1.12
2	1.32
3	1.68
4	2.03



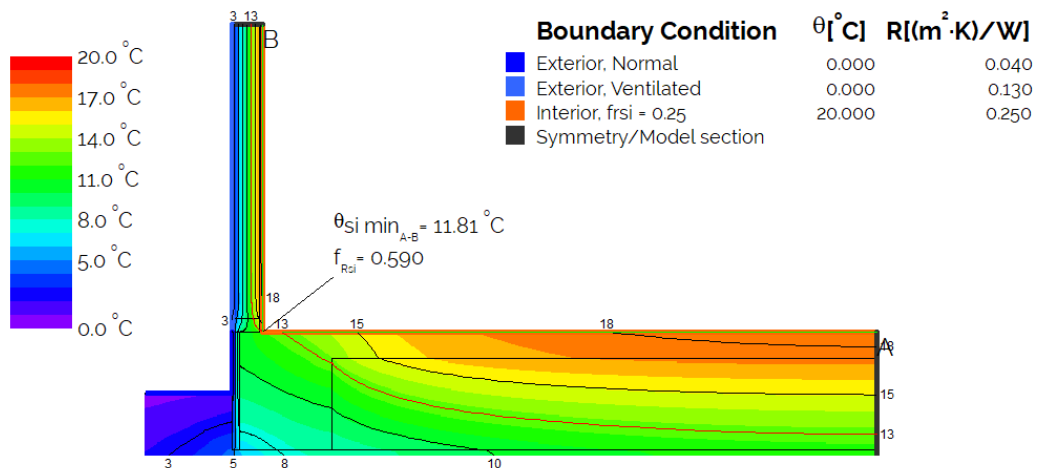
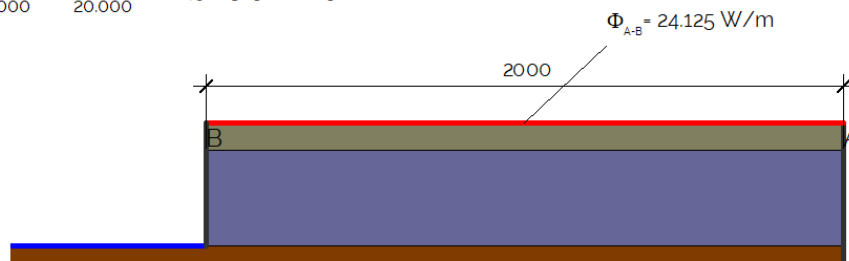
# RRPPod 300-385 90mm wall frame + full height hotedge



A/P, m	R-value, $m^2K/W$
1	0.93
1.5	1.24
2	1.46
3	1.84
4	2.21

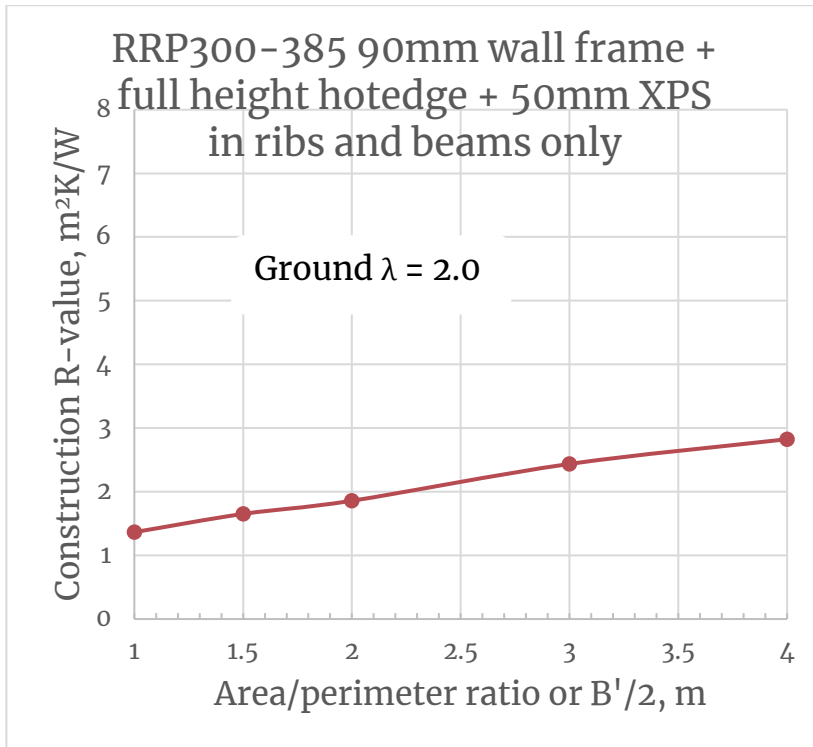


$$\Psi_{A-E-C} = \frac{38.905}{20.000} - \frac{24.125}{20.000} - 0.492 \cdot 1.385 = 0.057 \text{ W}/(\text{m} \cdot \text{K})$$

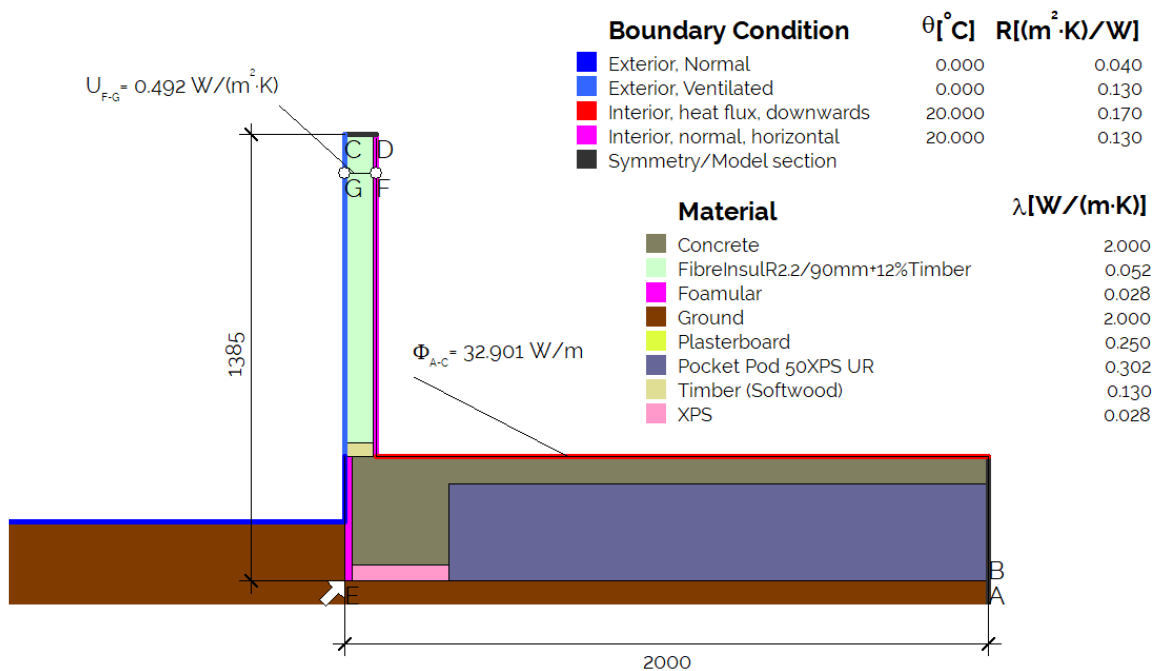




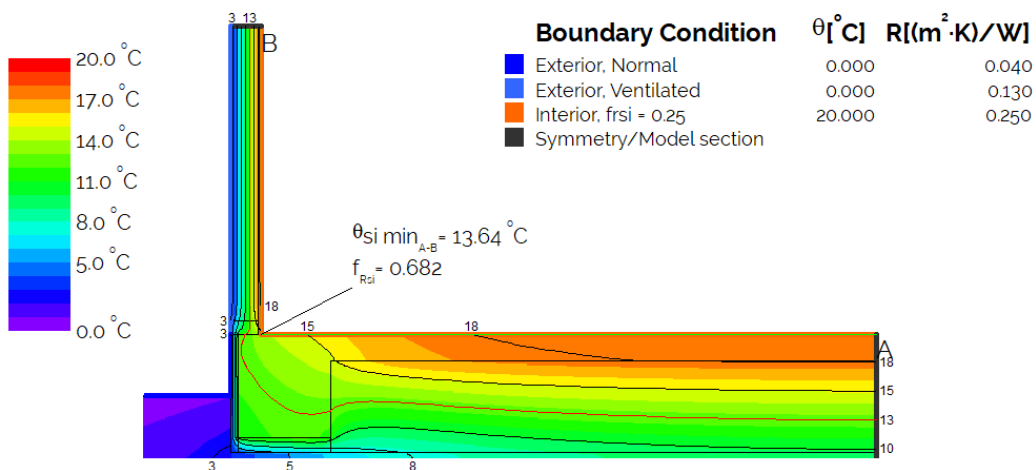
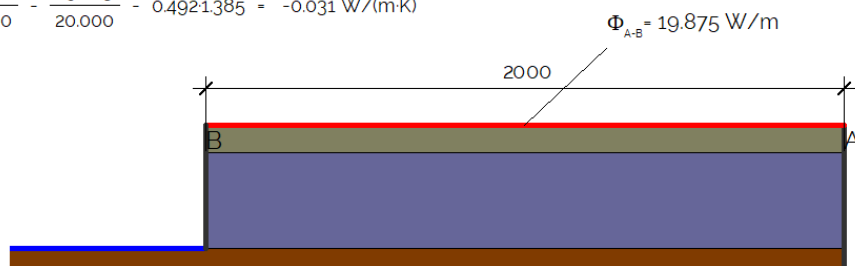
# RRPPod 300-385 90mm wall frame + full height hotedge + 50mm XPS in ribs and beams only



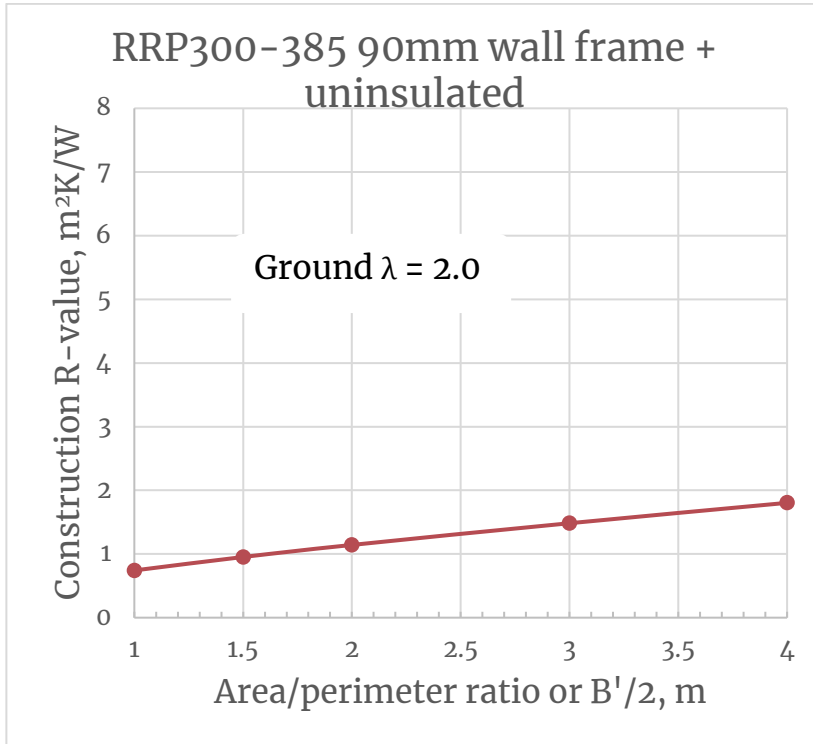
A/P, m	R-value, $m^2K/W$
1	1.36
1.5	1.65
2	1.86
3	2.44
4	2.82



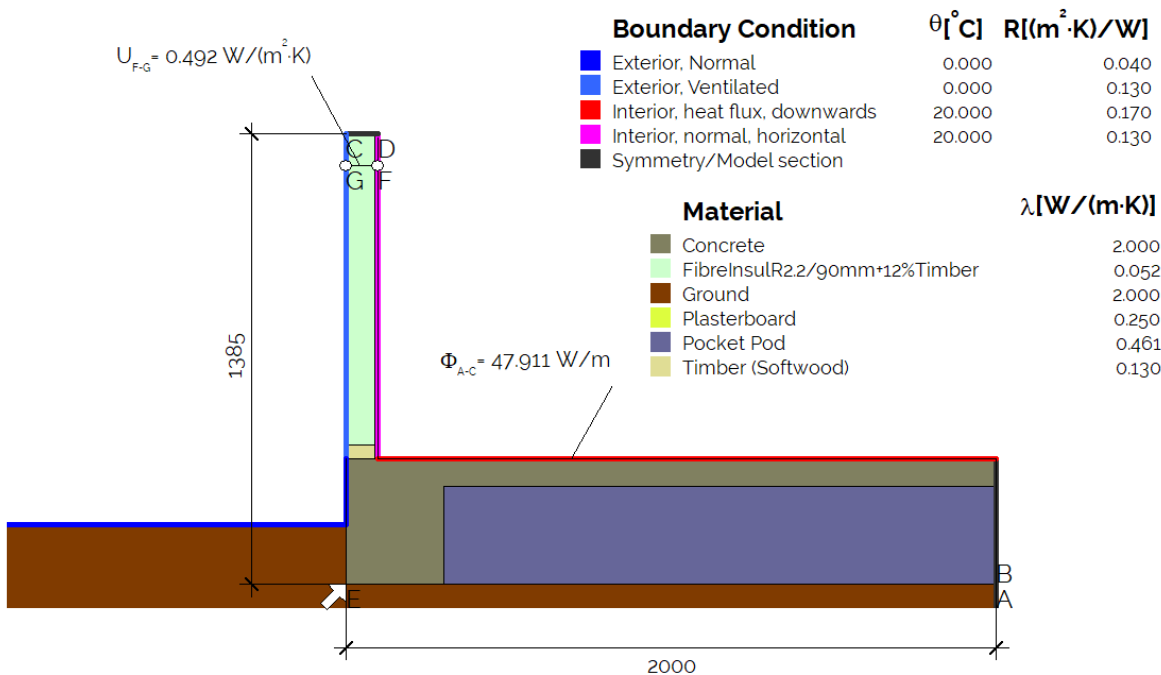
$$\psi_{A-E,C} = \frac{32.901}{20.000} - \frac{19.875}{20.000} - 0.492 \cdot 1.385 = -0.031 \text{ W}/(\text{m} \cdot \text{K})$$



# RRPPod 300-385 90mm wall frame + uninsulated



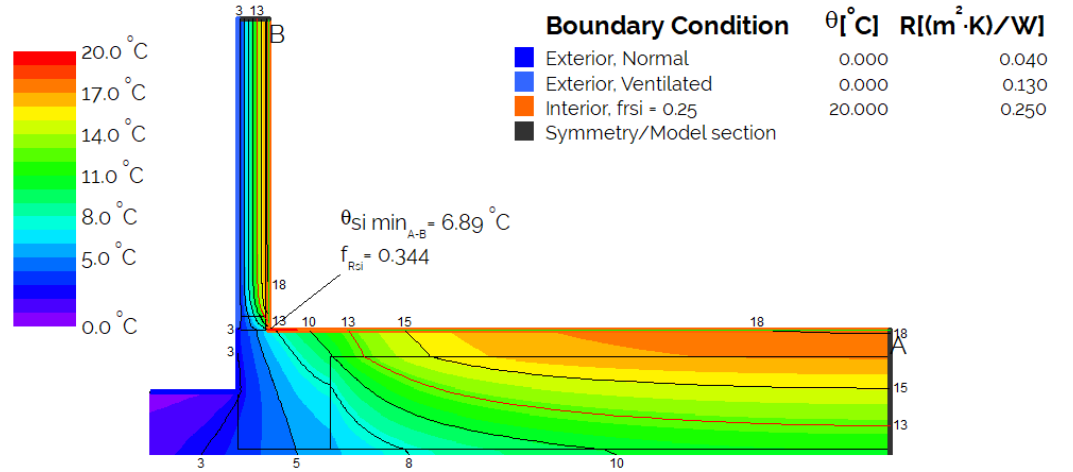
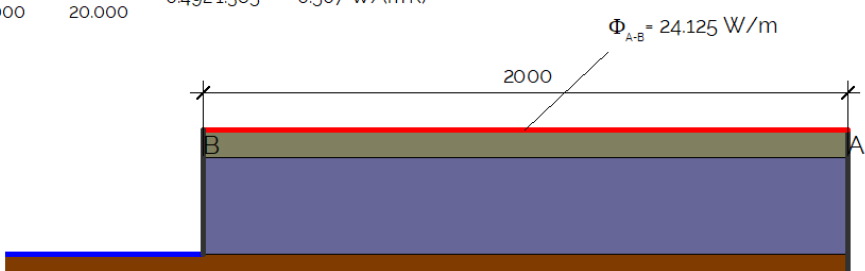
A/P, m	R-value, $m^2K/W$
1	0.74
1.5	0.95
2	1.14
3	1.48
4	1.80



Boundary Condition	$\theta [^{\circ}\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$
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		

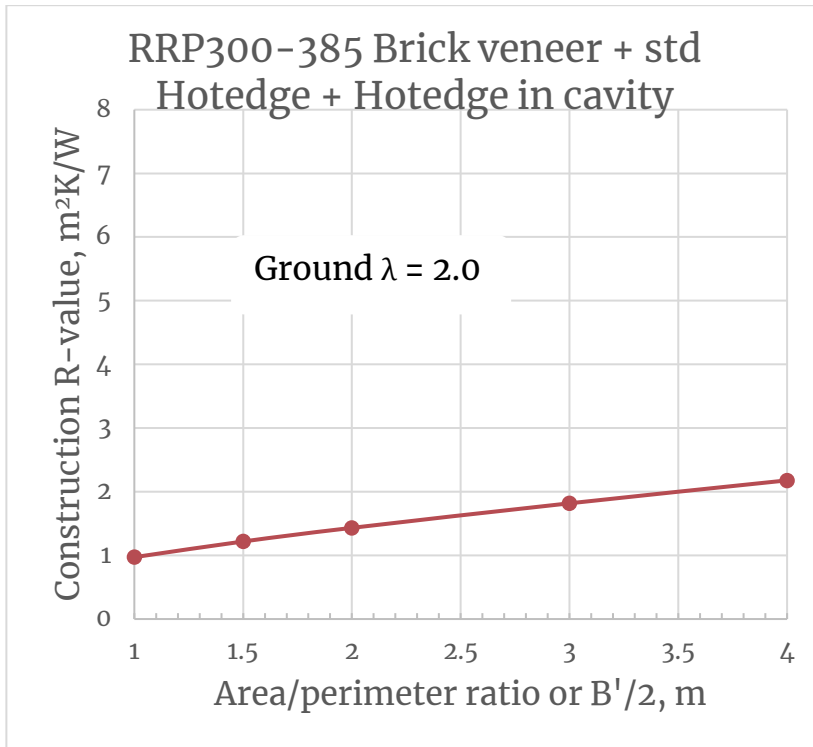
Material	$\lambda[\text{W}/(\text{m} \cdot \text{K})]$
Concrete	2.000
FibreInsulR2.2/90mm+12%Timber	0.052
Ground	2.000
Plasterboard	0.250
Pocket Pod	0.461
Timber (Softwood)	0.130

$$\psi_{A-E,C} = \frac{47.911}{20.000} - \frac{24.125}{20.000} - 0.492 \cdot 1385 = 0.507 \text{ W}/(\text{m} \cdot \text{K})$$

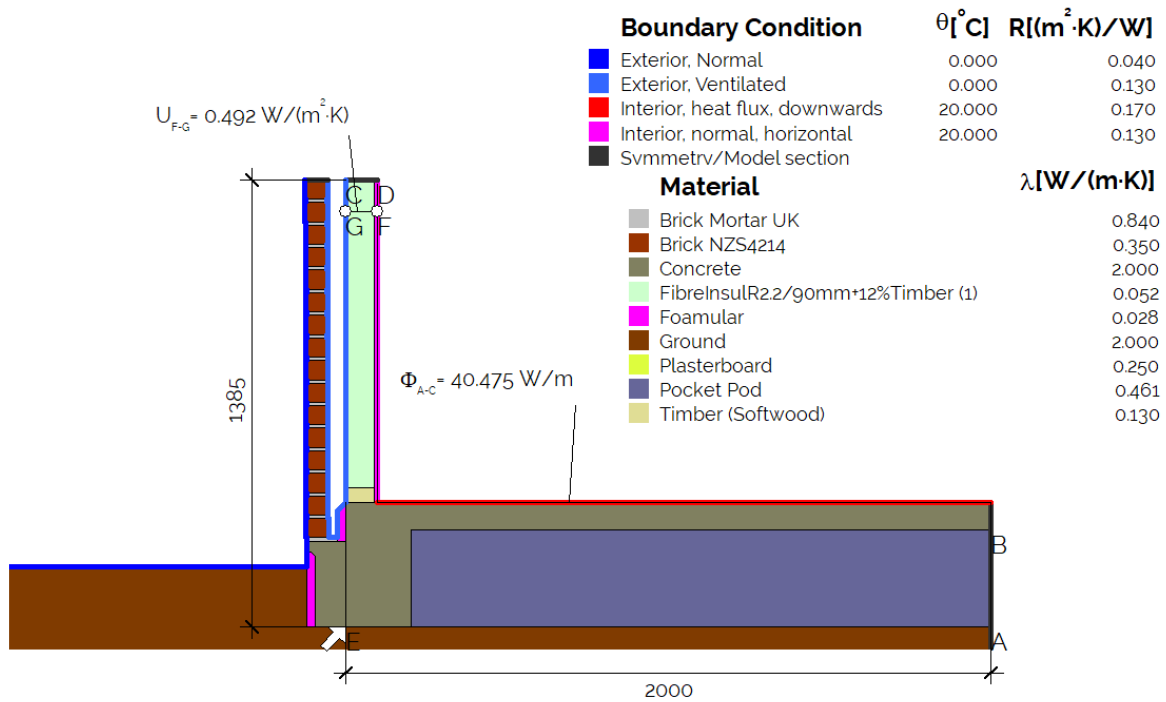


Boundary Condition	$\theta [^{\circ}\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		

# RRPPod 300-385 Brick veneer + std Hotedge + Hotedge in cavity



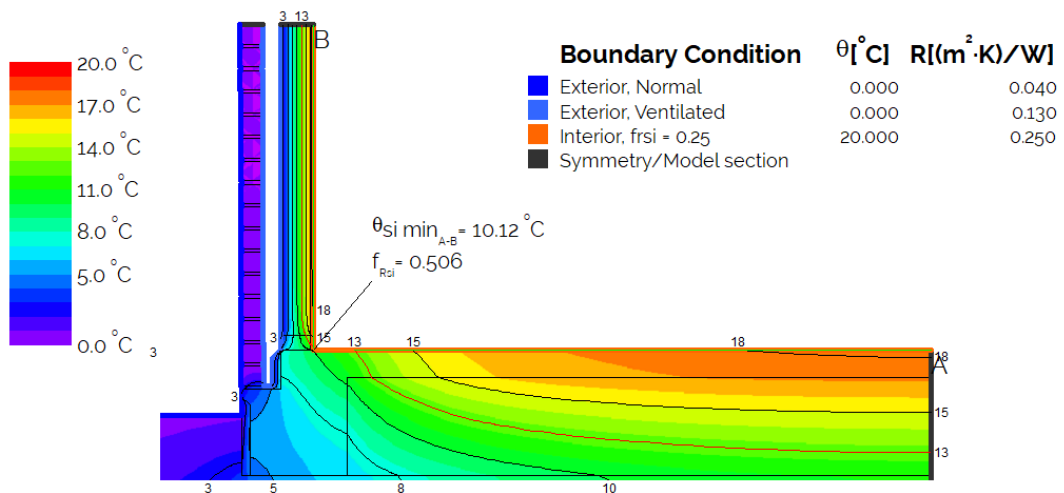
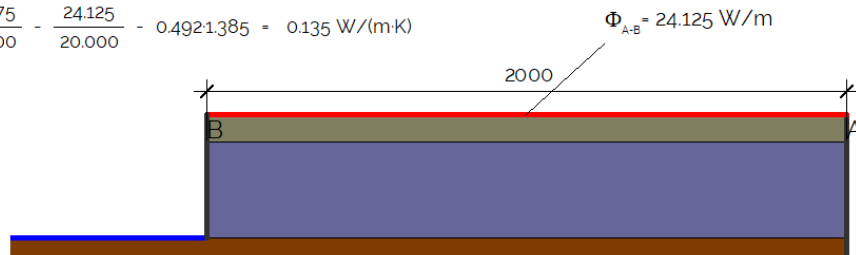
A/P, m	R-value, $m^2K/W$
1	0.97
1.5	1.22
2	1.43
3	1.82
4	2.18



Boundary Condition	$\theta [^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
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		

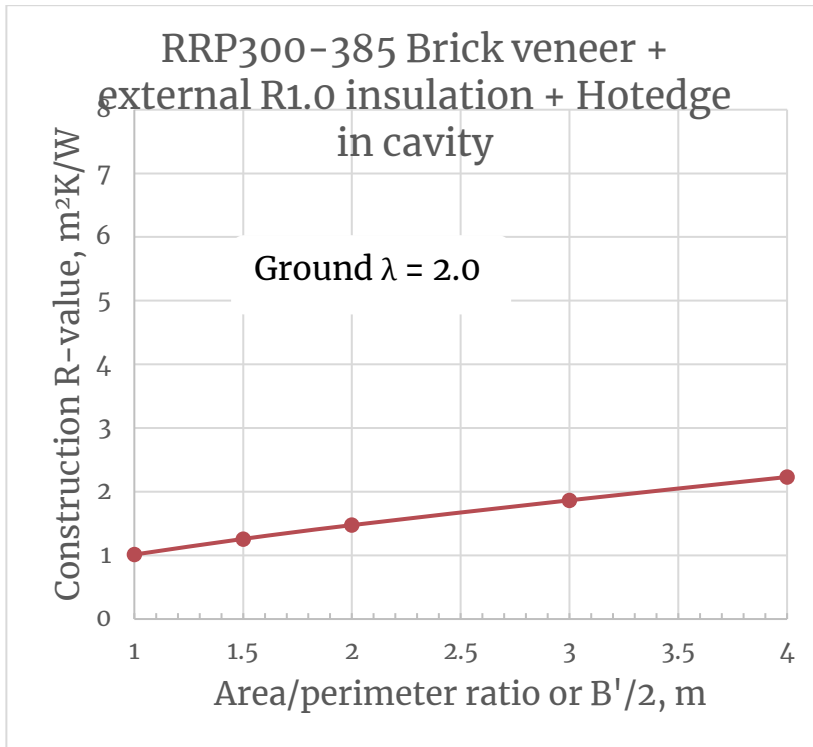
Material	$\lambda [W/(\text{m} \cdot \text{K})]$
Brick Mortar UK	0.840
Brick NZS4214	0.350
Concrete	2.000
FibreinsulR2.2/90mm+12%Timber (1)	0.052
Foamular	0.028
Ground	2.000
Plasterboard	0.250
Pocket Pod	0.461
Timber (Softwood)	0.130

$$\Psi_{A-E-C} = \frac{40.475}{20.000} - \frac{24.125}{20.000} - 0.492 \cdot 1385 = 0.135 \text{ W}/(\text{m} \cdot \text{K})$$

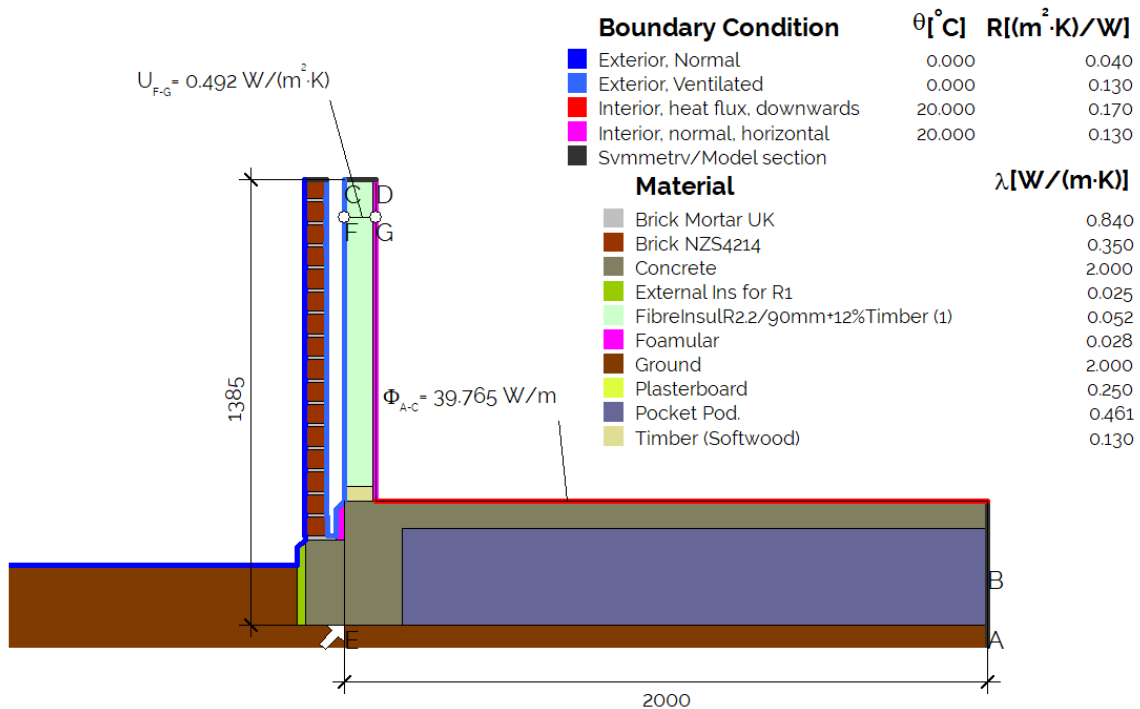


Boundary Condition	$\theta [^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		

# RRPPod 300-385 Brick veneer + external R1.0 insulation + Hotedge in cavity



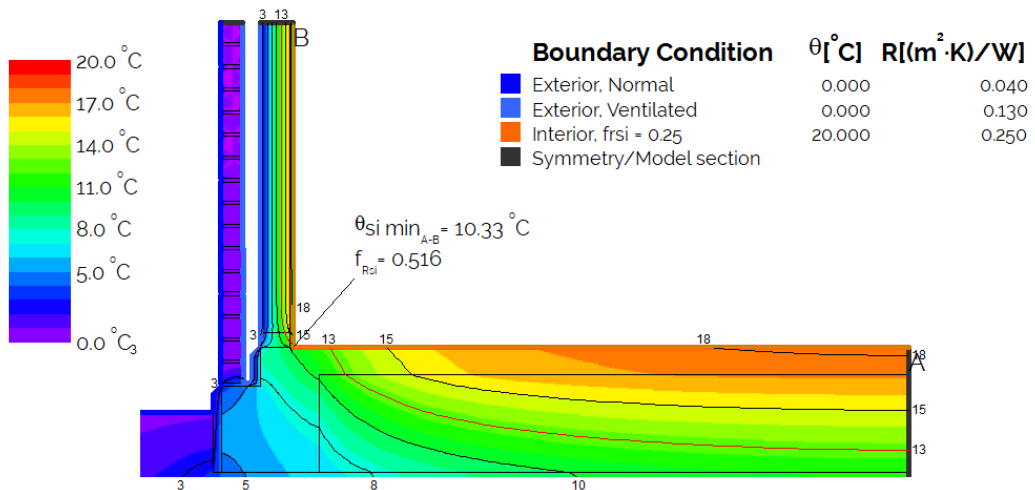
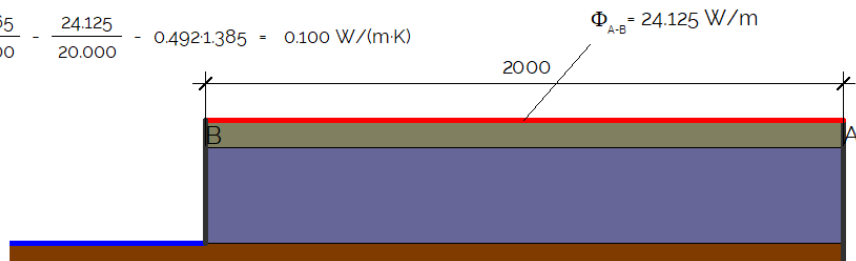
A/P, m	R-value, $m^2K/W$
1	1.01
1.5	1.26
2	1.48
3	1.87
4	2.23



Boundary Condition	$\theta [^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
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		

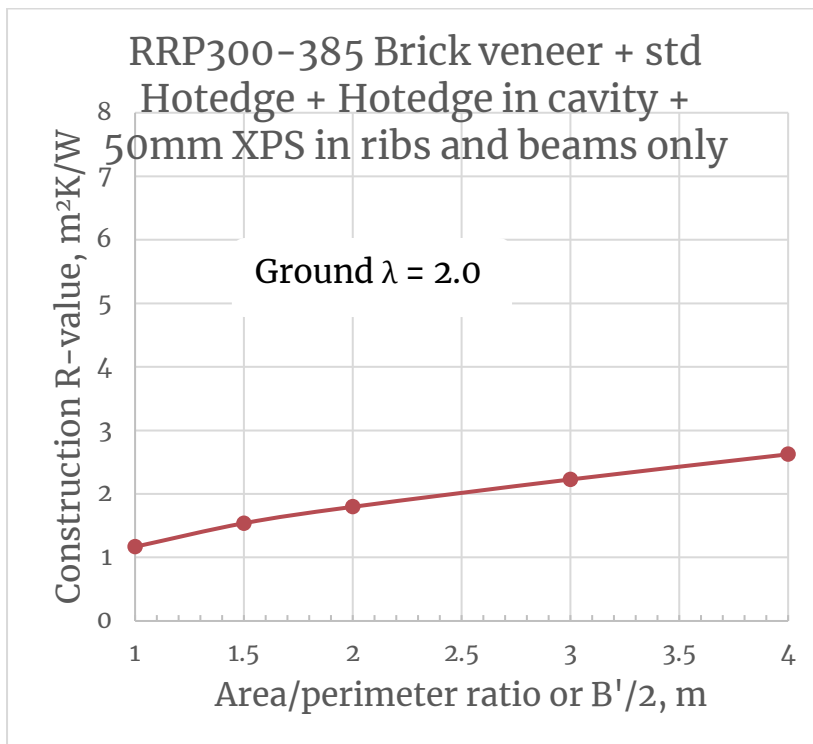
Material	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$
Brick Mortar UK	0.840
Brick NZS4214	0.350
Concrete	2.000
External Ins for R1	0.025
FibreInsulR2.2/90mm+12%Timber (1)	0.052
Foamular	0.028
Ground	2.000
Plasterboard	0.250
Pocket Pod.	0.461
Timber (Softwood)	0.130

$$\Psi_{A-E-C} = \frac{39.765}{20.000} - \frac{24.125}{20.000} - 0.492 \cdot 1.385 = 0.100 \text{ W}/(\text{m} \cdot \text{K})$$

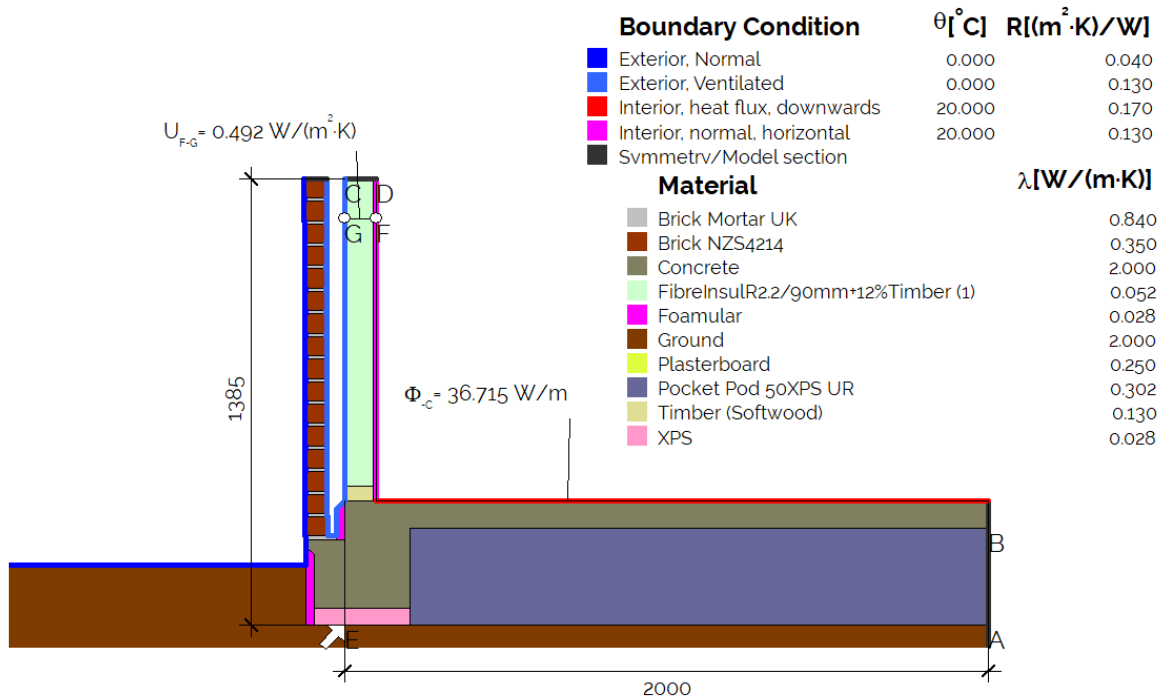




# RRPPod 300-385 Brick veneer + std Hotedge + Hotedge in cavity + 50mm XPS in ribs and beams only



A/P, m	R-value, $m^2K/W$
1	1.17
1.5	1.54
2	1.80
3	2.23
4	2.62

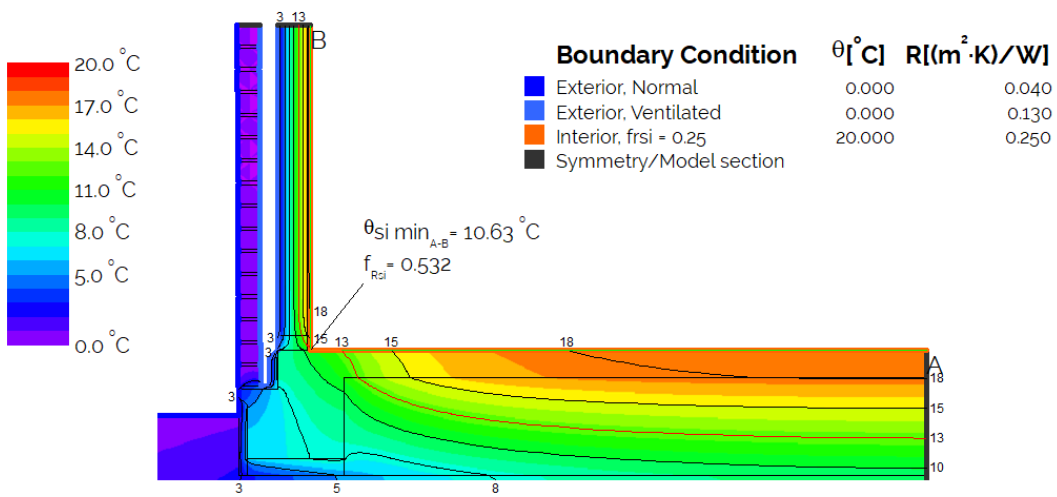
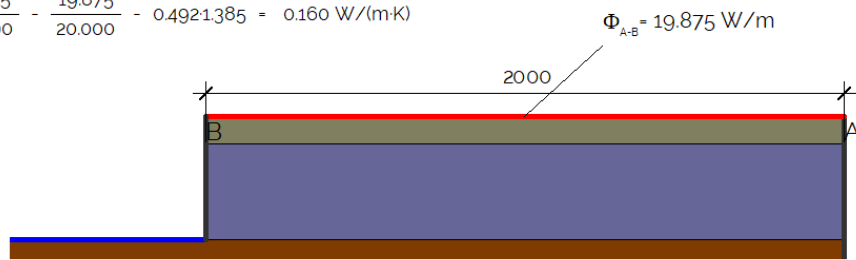


Boundary Condition	$\theta [^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, heat flux, downwards	20.000	0.170
Interior, normal, horizontal	20.000	0.130
Symmetry/Model section		

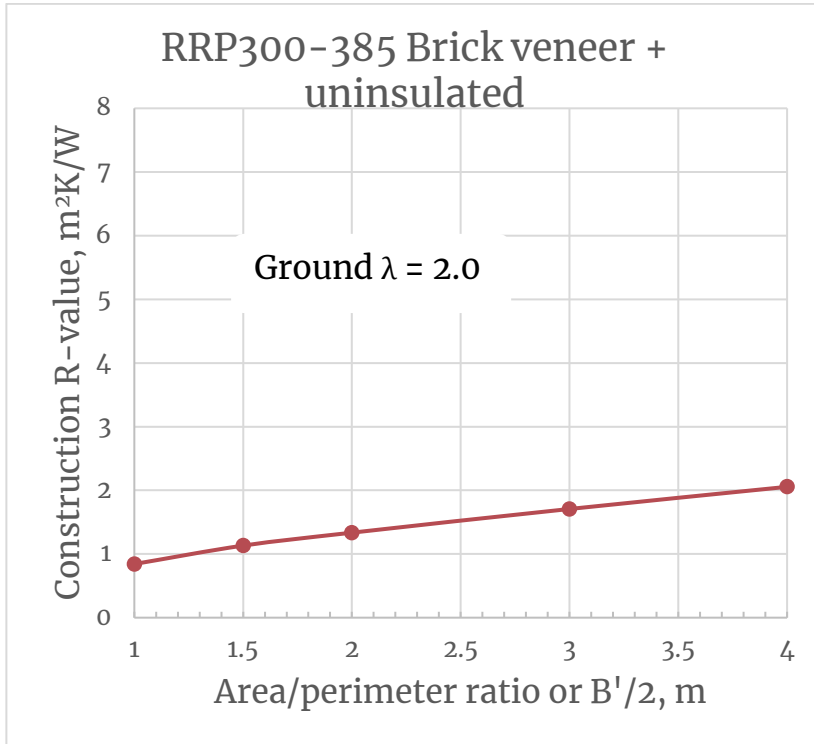
  

Material	$\lambda[\text{W}/(\text{m} \cdot \text{K})]$
Brick Mortar UK	0.840
Brick NZS4214	0.350
Concrete	2.000
FibreInsulR2.2/90mm+12%Timber (1)	0.052
Foamular	0.028
Ground	2.000
Plasterboard	0.250
Pocket Pod 50XPS UR	0.302
Timber (Softwood)	0.130
XPS	0.028

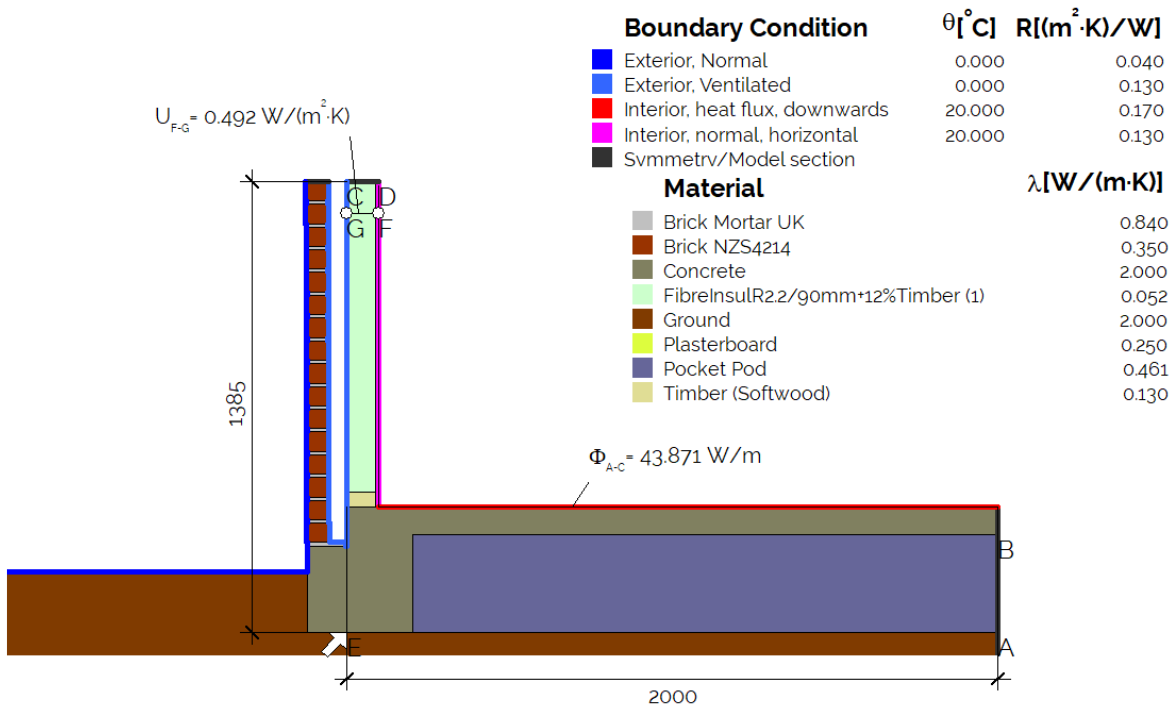
$$\Psi_{A-E-c} = \frac{36.715}{20.000} - \frac{19.875}{20.000} - 0.492 \cdot 1.385 = 0.160 \text{ W}/(\text{m} \cdot \text{K})$$



# RRPPod 300-385 Brick veneer + uninsulated



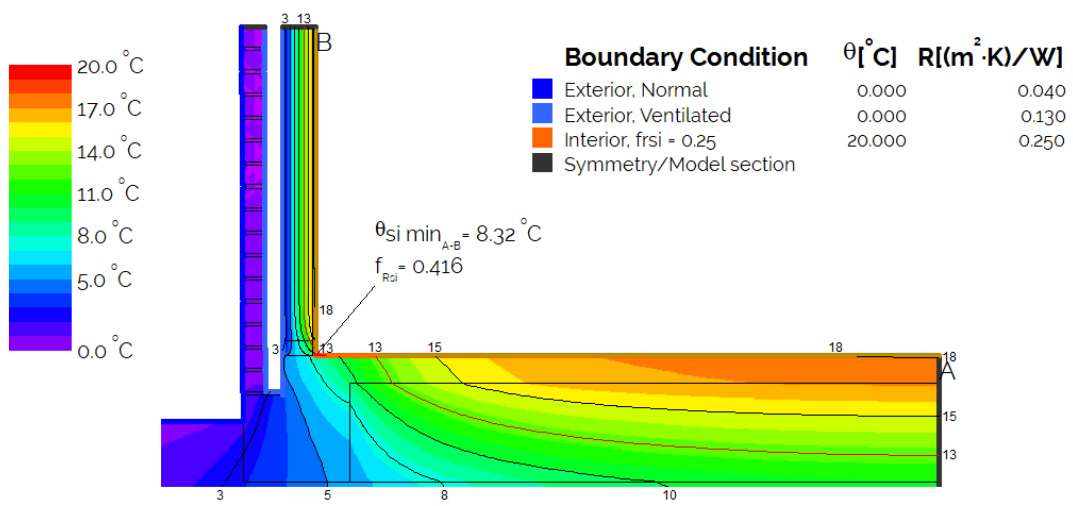
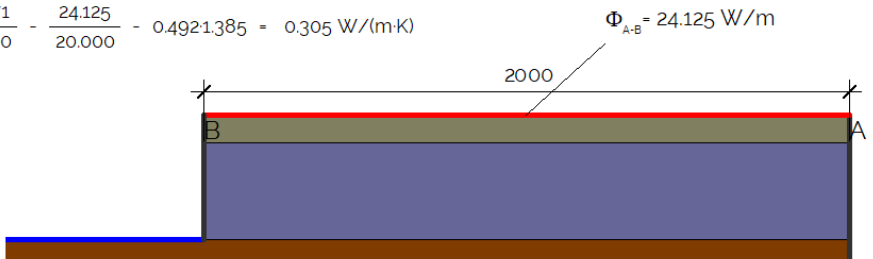
A/P, m	R-value, $m^2K/W$
1	0.84
1.5	1.13
2	1.33
3	1.71
4	2.05



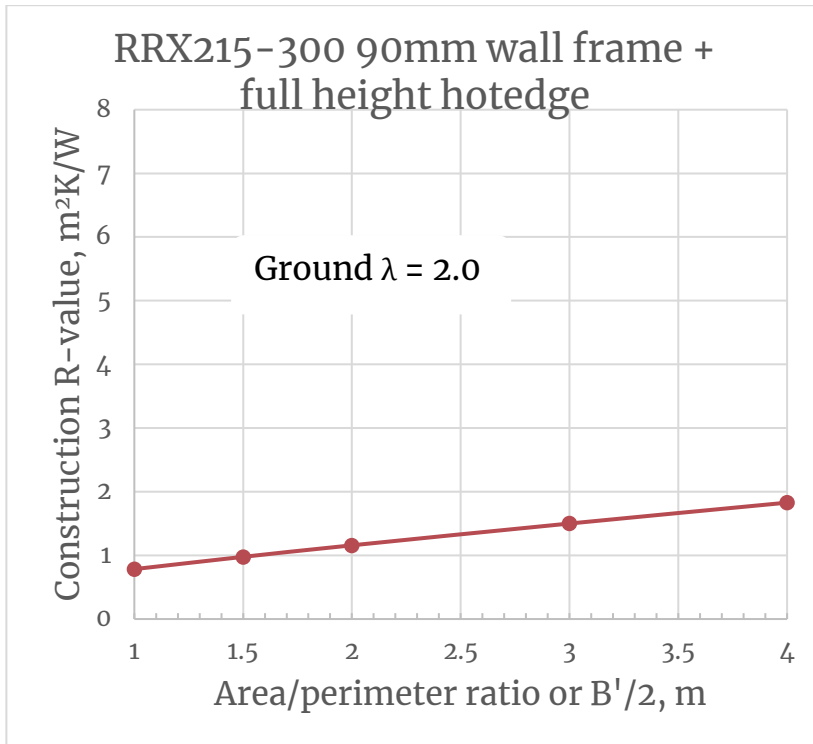
Boundary Condition	$\theta [^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, heat flux, downwards	20.000	0.170
Interior, normal, horizontal	20.000	0.130
Symmetry/Model section		

Material	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$
Brick Mortar UK	0.840
Brick NZS4214	0.350
Concrete	2.000
FibreInsulR2.2/gomm+12%Timber (1)	0.052
Ground	2.000
Plasterboard	0.250
Pocket Pod	0.461
Timber (Softwood)	0.130

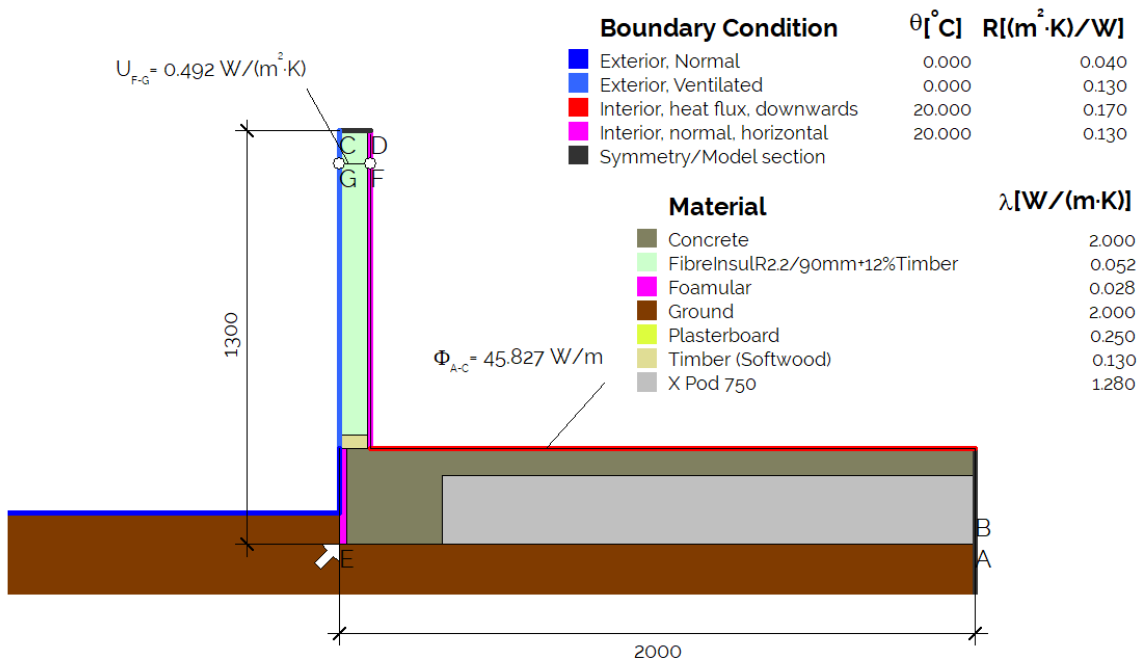
$$\Psi_{A-E-C} = \frac{43.871}{20.000} - \frac{24.125}{20.000} - 0.492 \cdot 1385 = 0.305 \text{ W}/(\text{m} \cdot \text{K})$$



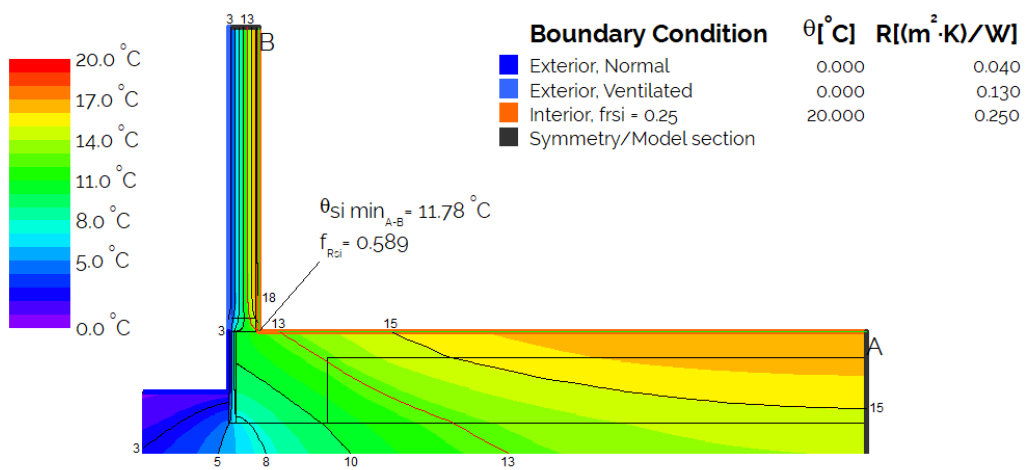
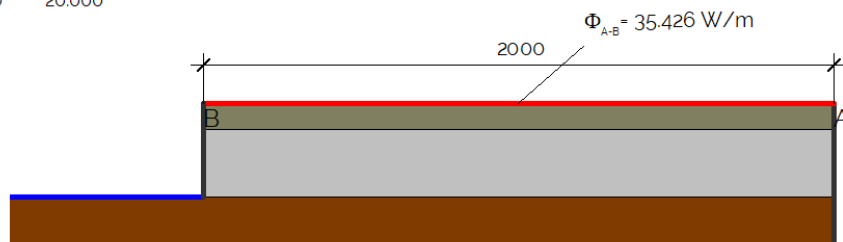
# RRXPod 215-300 90mm wall frame + full height hotedge



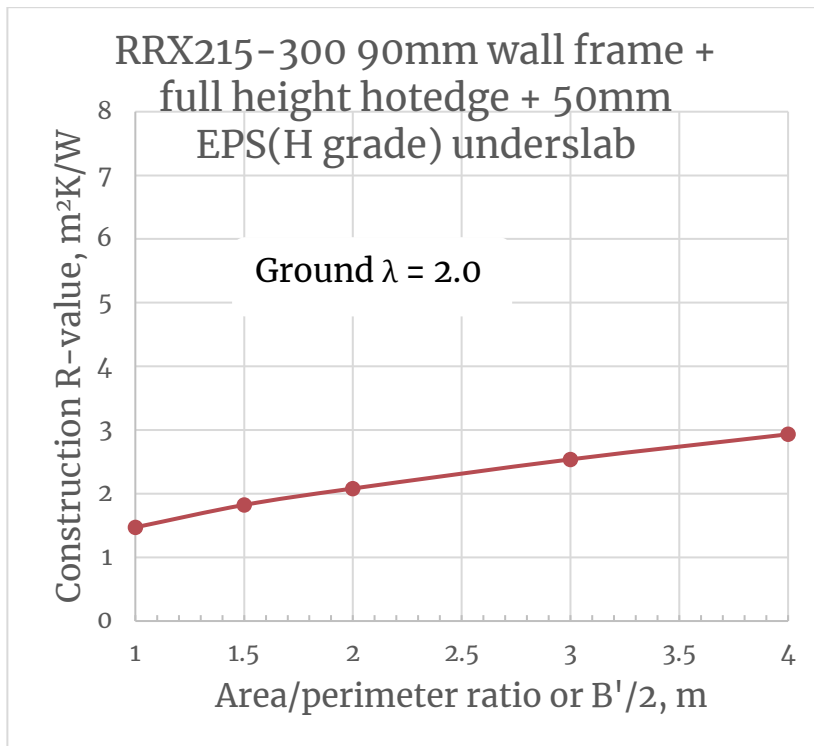
A/P, m	R-value, $m^2K/W$
1	0.78
1.5	0.98
2	1.16
3	1.50
4	1.83



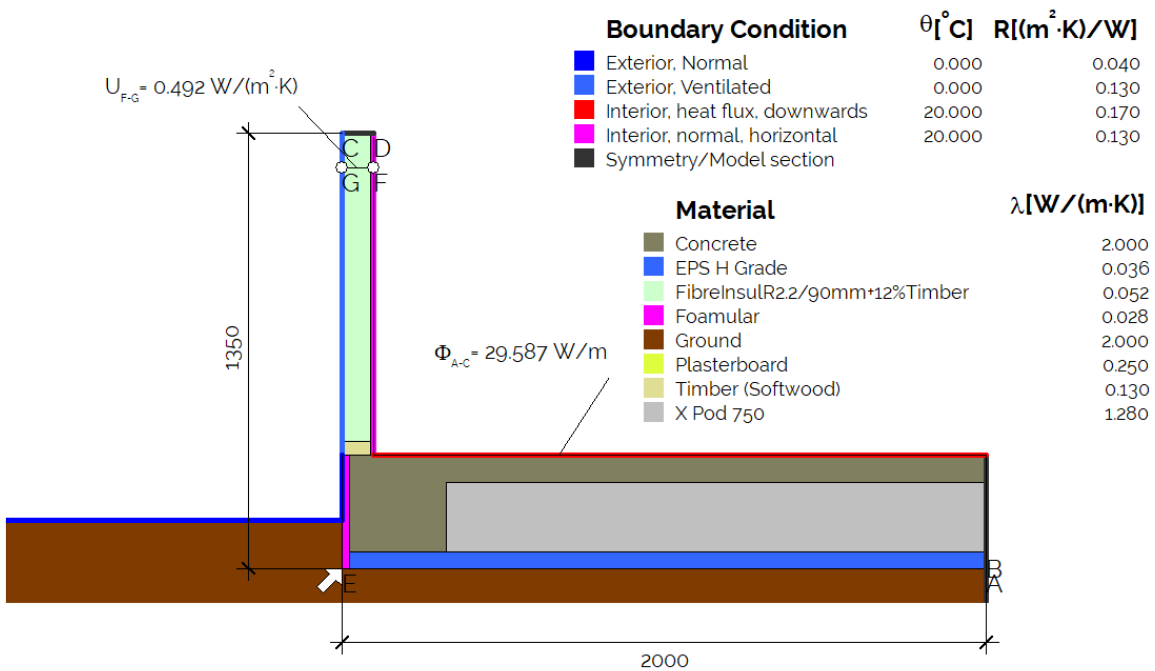
$$\psi_{A-E,C} = \frac{45.827}{20.000} - \frac{35.426}{20.000} - 0.492 \cdot 1.300 = -0.120 \text{ W/(m} \cdot \text{K)}$$



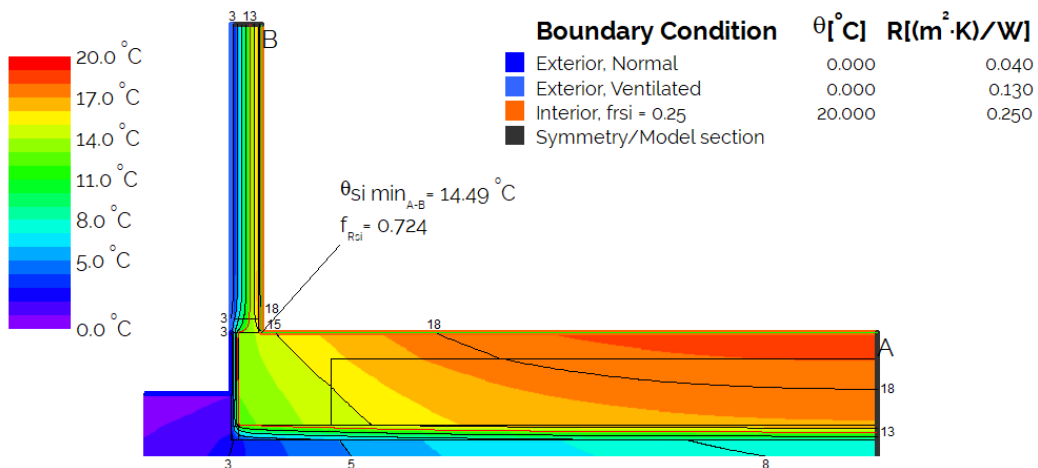
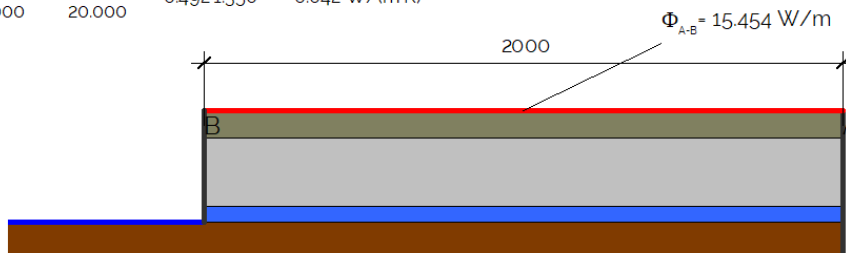
# RRXPod 215-300 90mm wall frame + full height hotedge + 50mm EPS(H grade) underslab



A/P, m	R-value, $m^2K/W$
1	1.47
1.5	1.82
2	2.08
3	2.54
4	2.93

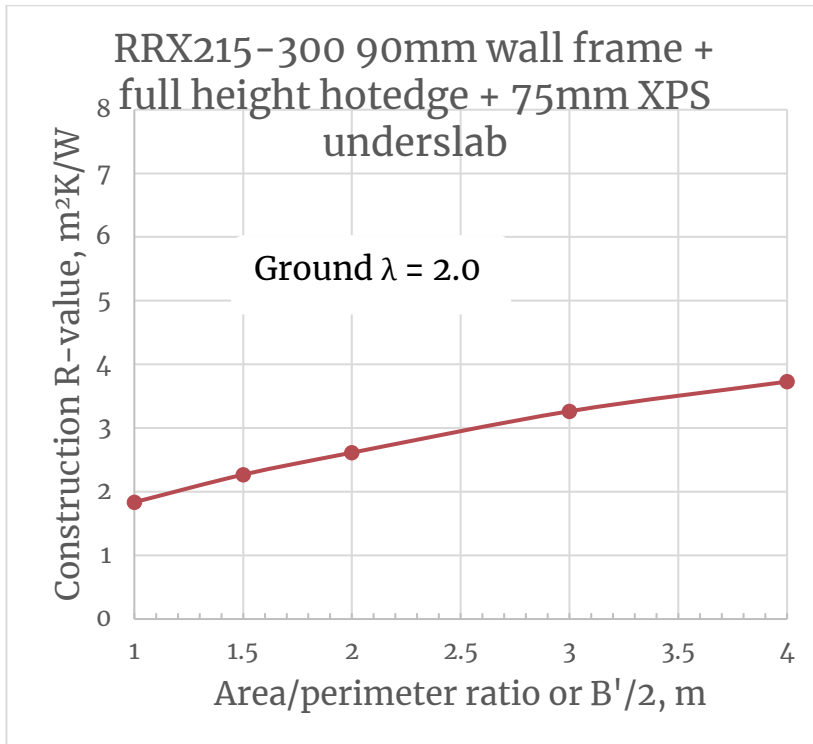


$$\Psi_{A-E-C} = \frac{29.587}{20.000} - \frac{15.454}{20.000} - 0.492 \cdot 1.350 = 0.042 \text{ W/(m·K)}$$

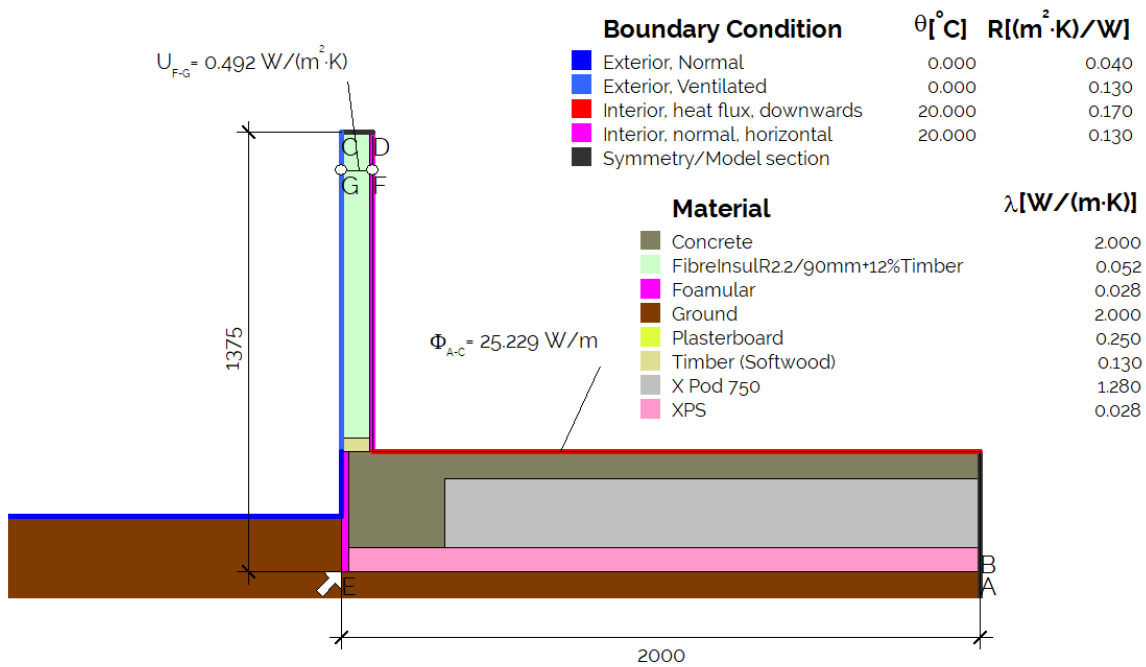




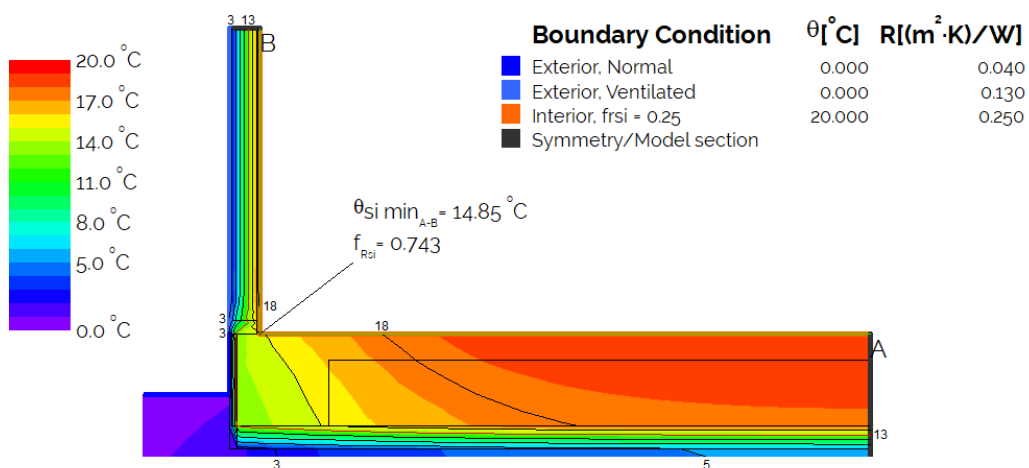
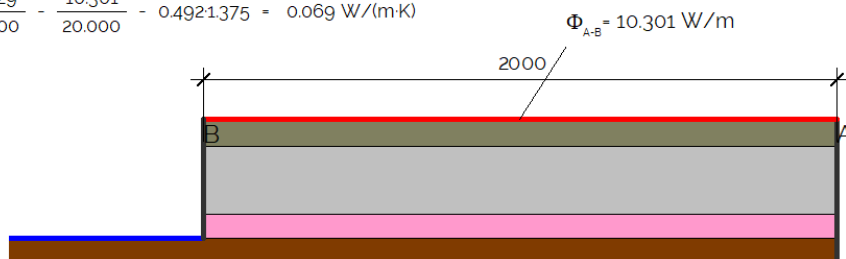
# RRX215-300 90mm wall frame + full height hotedge + 75mm XPS underslab



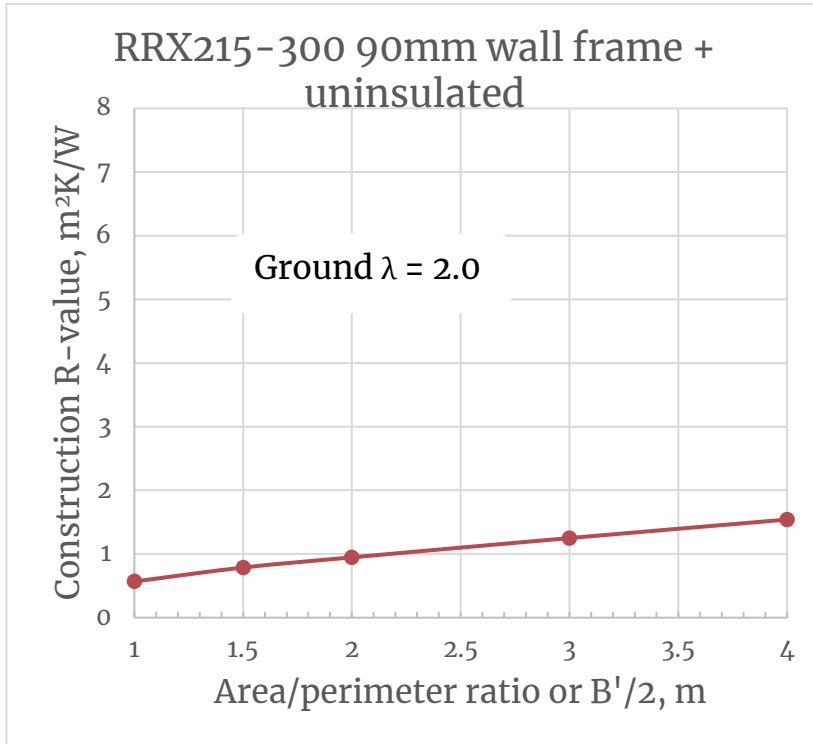
A/P, m	R-value, $m^2K/W$
1	1.84
1.5	2.27
2	2.61
3	3.26
4	3.73



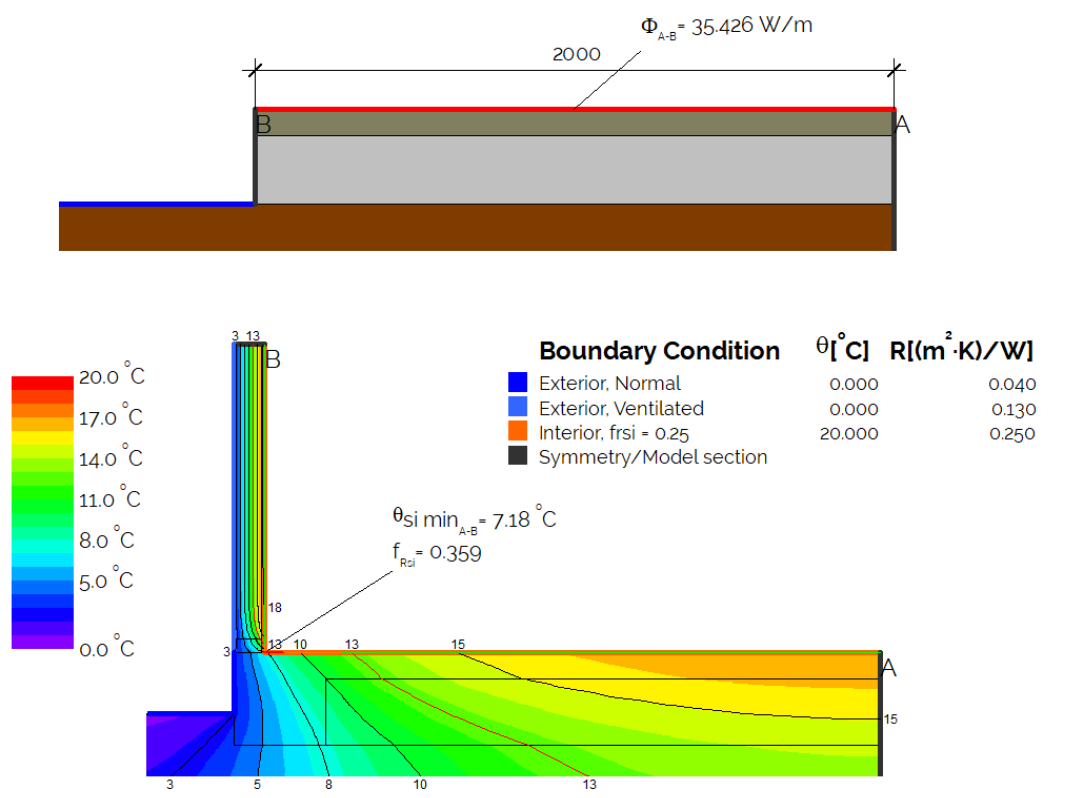
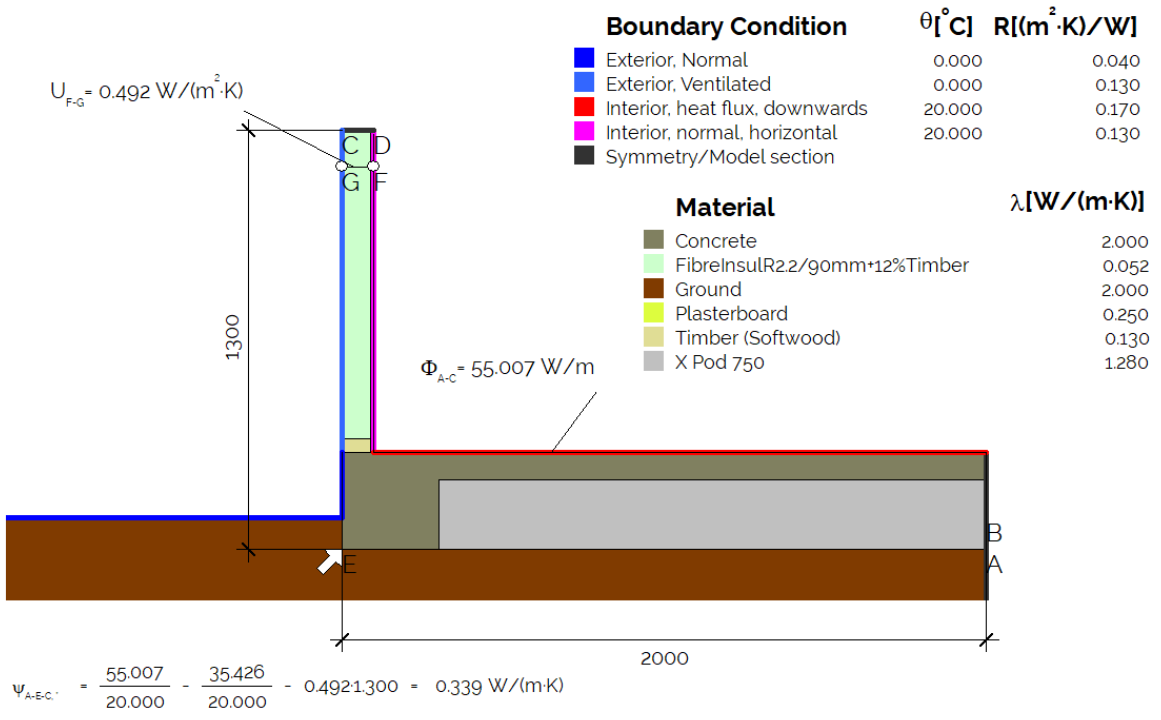
$$\psi_{A-E-C} = \frac{25.229}{20.000} - \frac{10.301}{20.000} - 0.492 \cdot 1375 = 0.069 \text{ W}/(m \cdot K)$$



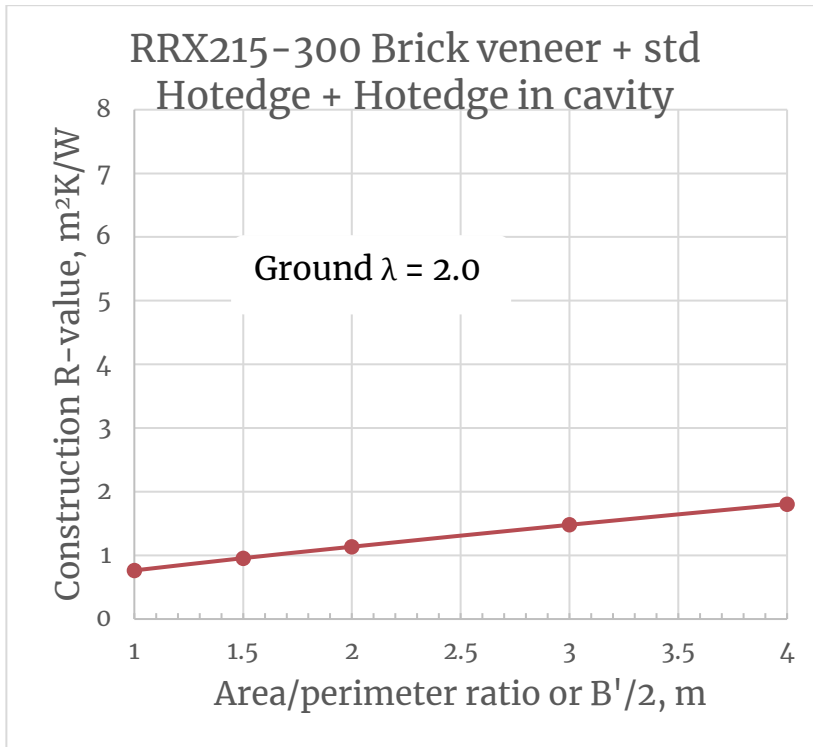
# RRXPod 215-300 90mm wall frame + uninsulated



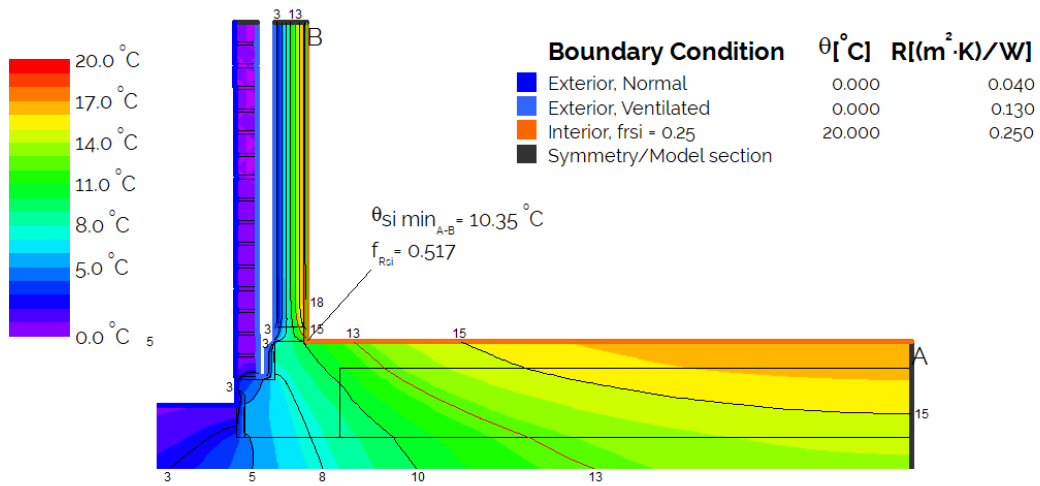
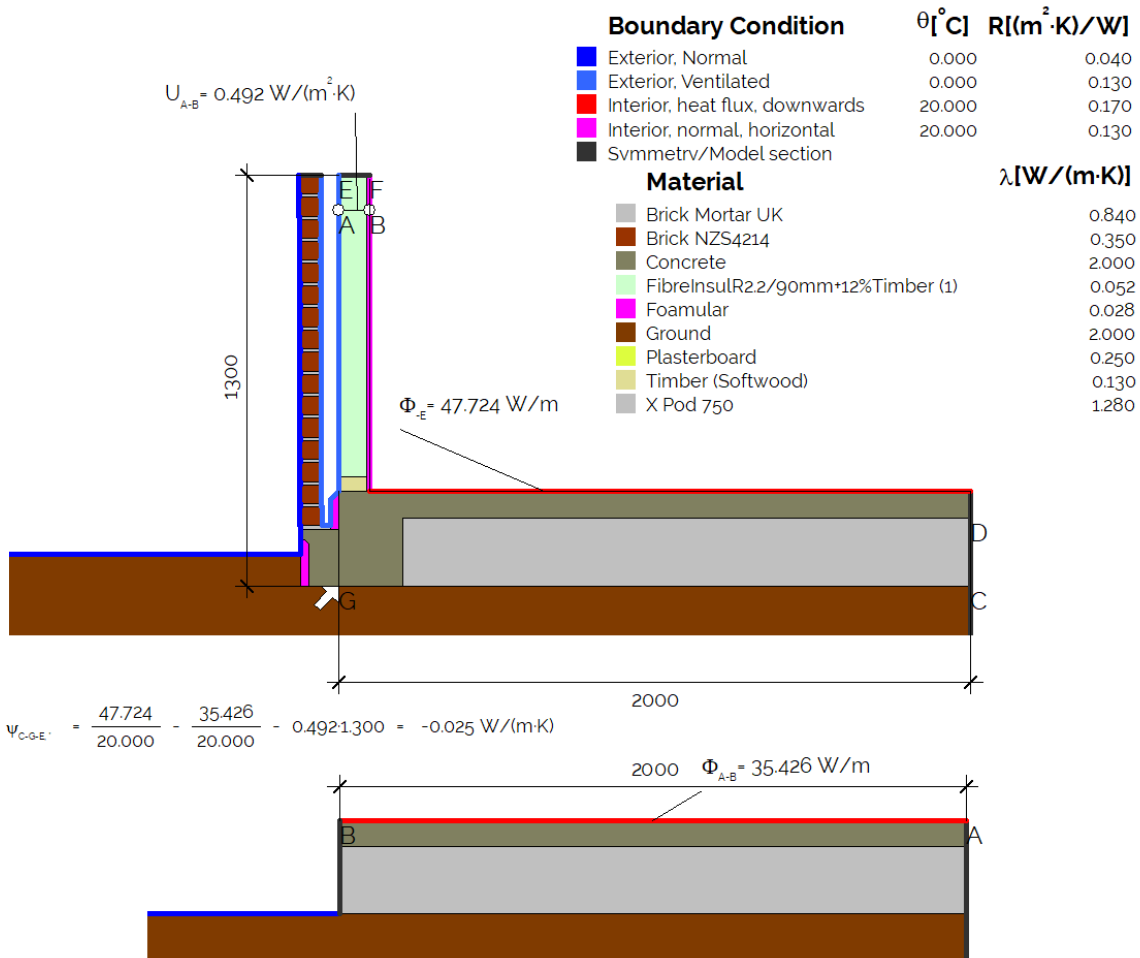
A/P, m	R-value, $m^2K/W$
1	0.57
1.5	0.79
2	0.95
3	1.25
4	1.54



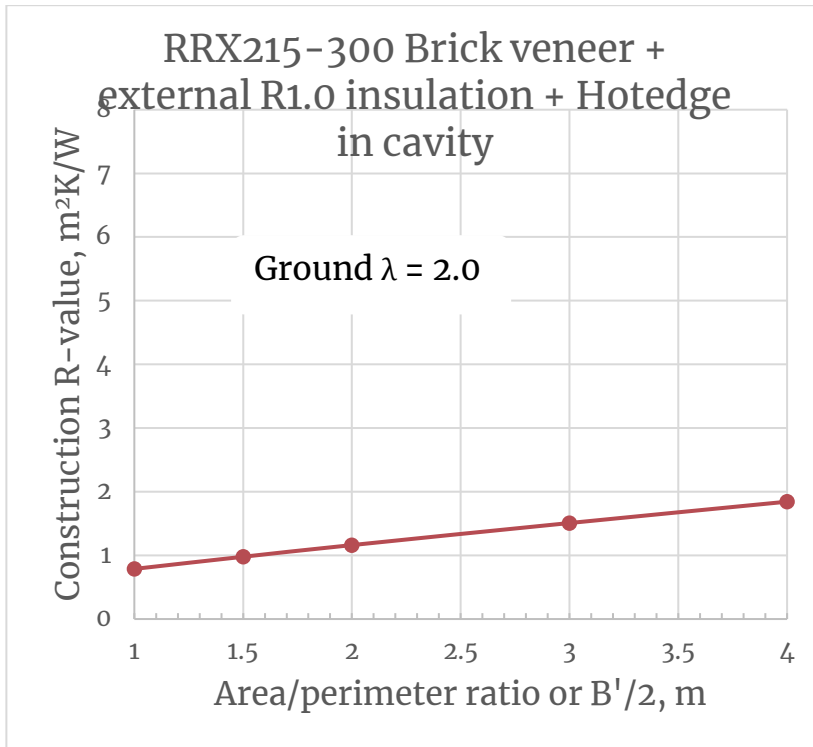
# RRXPod 215-300 Brick veneer + std Hotedge + Hotedge in cavity



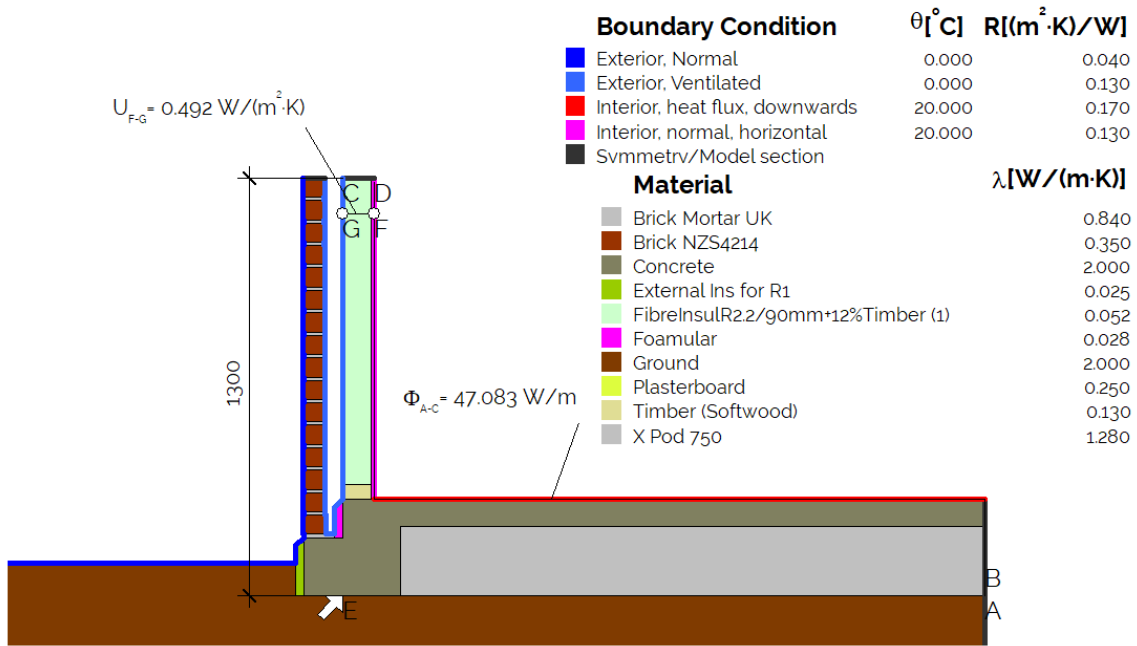
A/P, m	R-value, $m^2K/W$
1	0.76
1.5	0.96
2	1.14
3	1.48
4	1.81



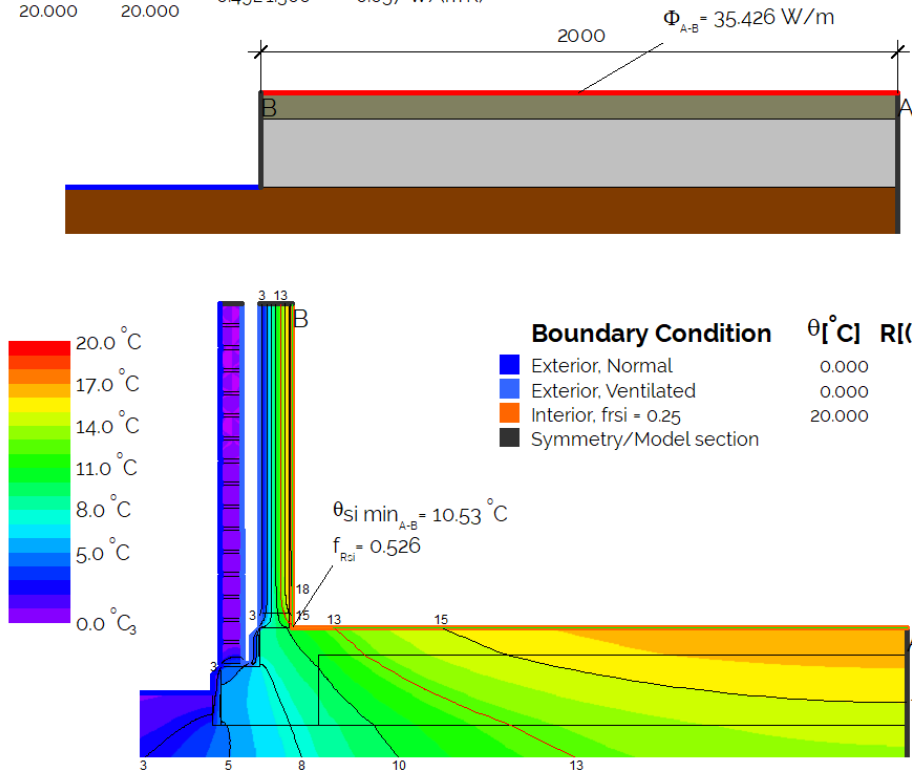
# RRXPod 215-300 Brick veneer + external R1.0 insulation + Hotedge in cavity



A/P, m	R-value, $m^2K/W$
1	0.79
1.5	0.98
2	1.16
3	1.51
4	1.84

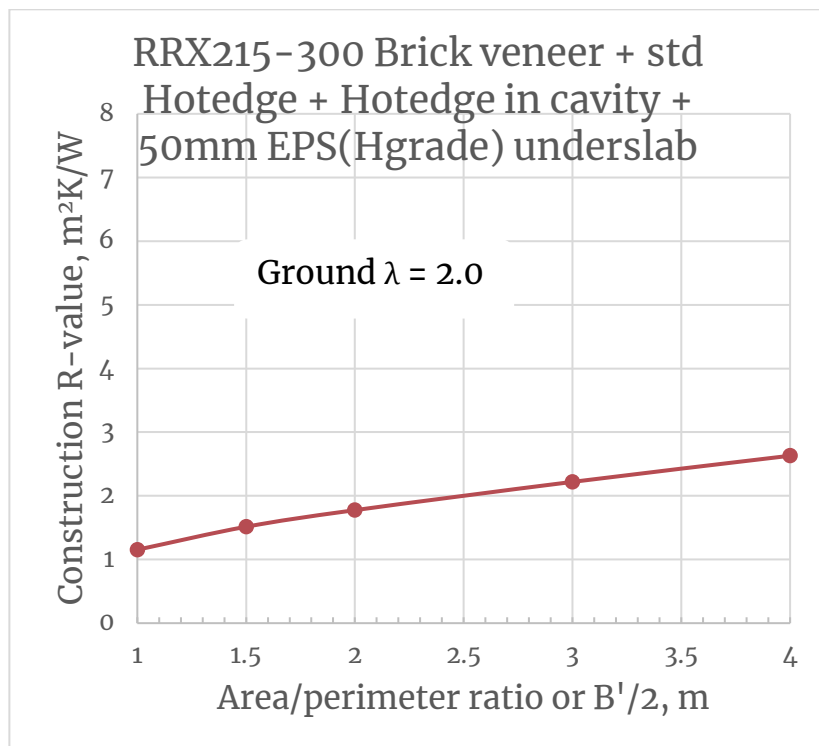


$$\psi_{A-E,C} = \frac{47.083}{20.000} - \frac{35.426}{20.000} - 0.492 \cdot 1.300 = -0.057 \text{ W}/(\text{m} \cdot \text{K})$$

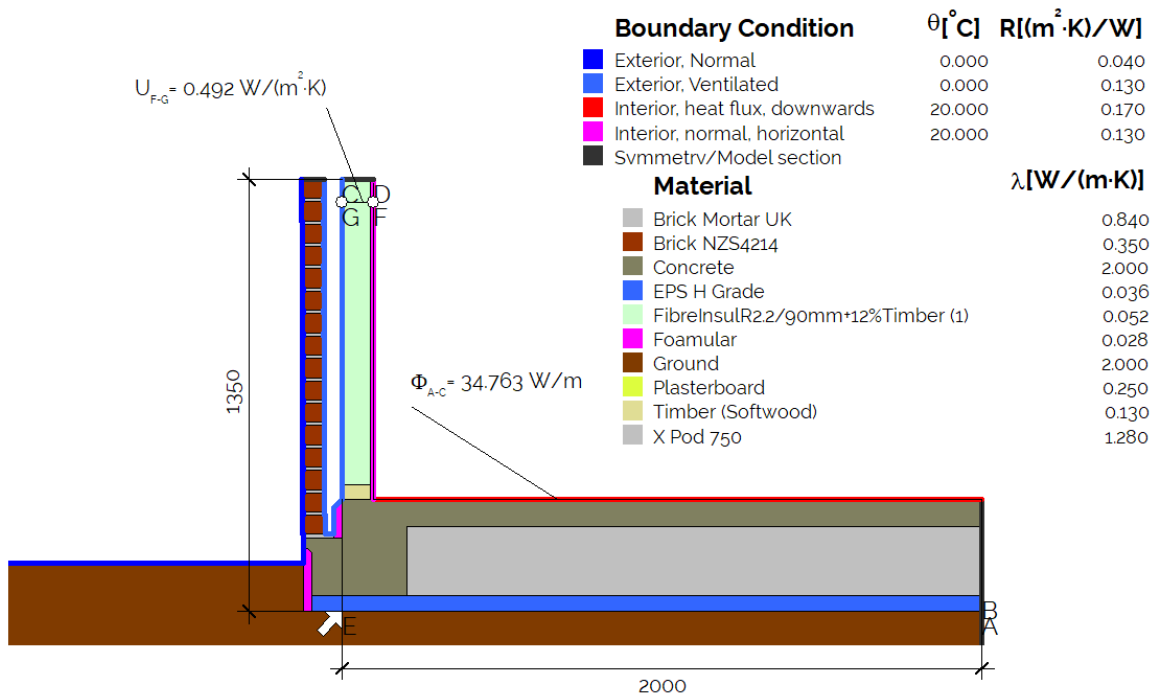




# RRXPod 215-300 Brick veneer + std Hotedge + Hotedge in cavity + 50mm EPS(Hgrade) underslab



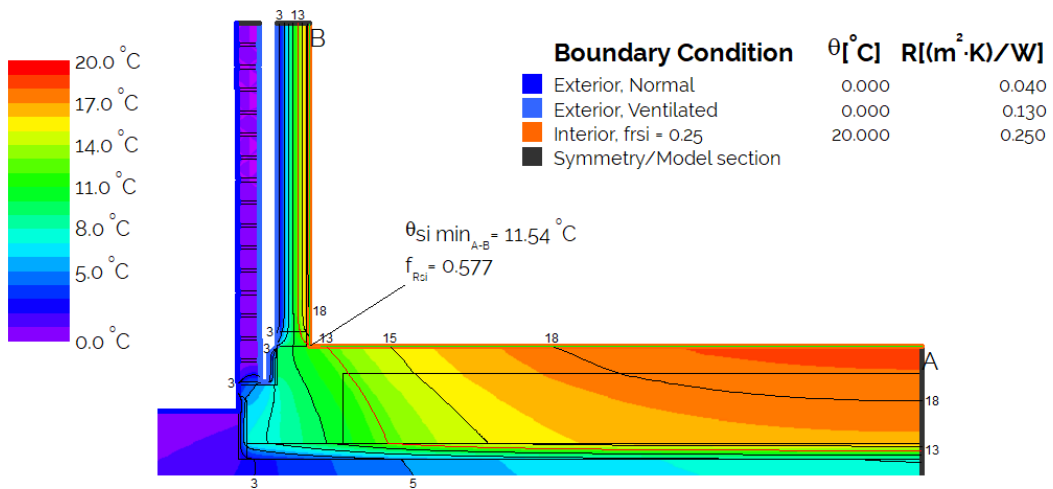
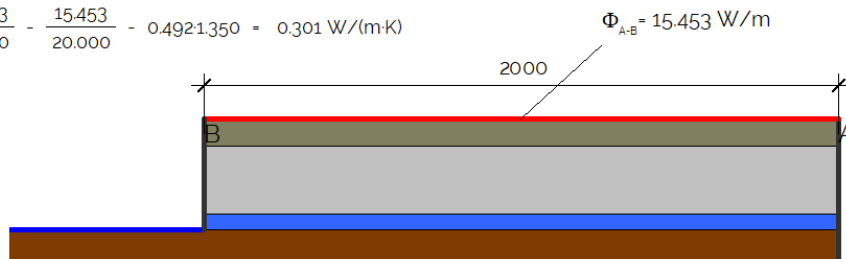
A/P, m	R-value, $m^2K/W$
1	1.15
1.5	1.51
2	1.77
3	2.22
4	2.63



Boundary Condition	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
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		

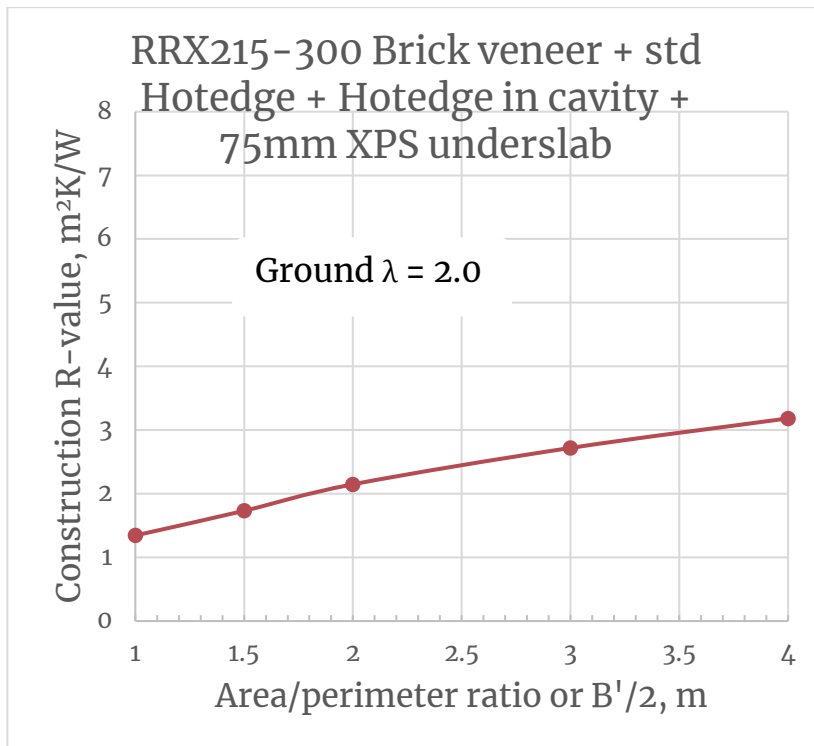
Material	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$
Brick Mortar UK	0.840
Brick NZS4214	0.350
Concrete	2.000
EPS H Grade	0.036
FibreInsulR2.2/90mm+12%Timber (1)	0.052
Foamular	0.028
Ground	2.000
Plasterboard	0.250
Timber (Softwood)	0.130
X Pod 750	1.280

$$\psi_{A-E-C} = \frac{34.763}{20.000} - \frac{15.453}{20.000} - 0.492 \cdot 1350 = 0.301 \text{ W}/(\text{m} \cdot \text{K})$$

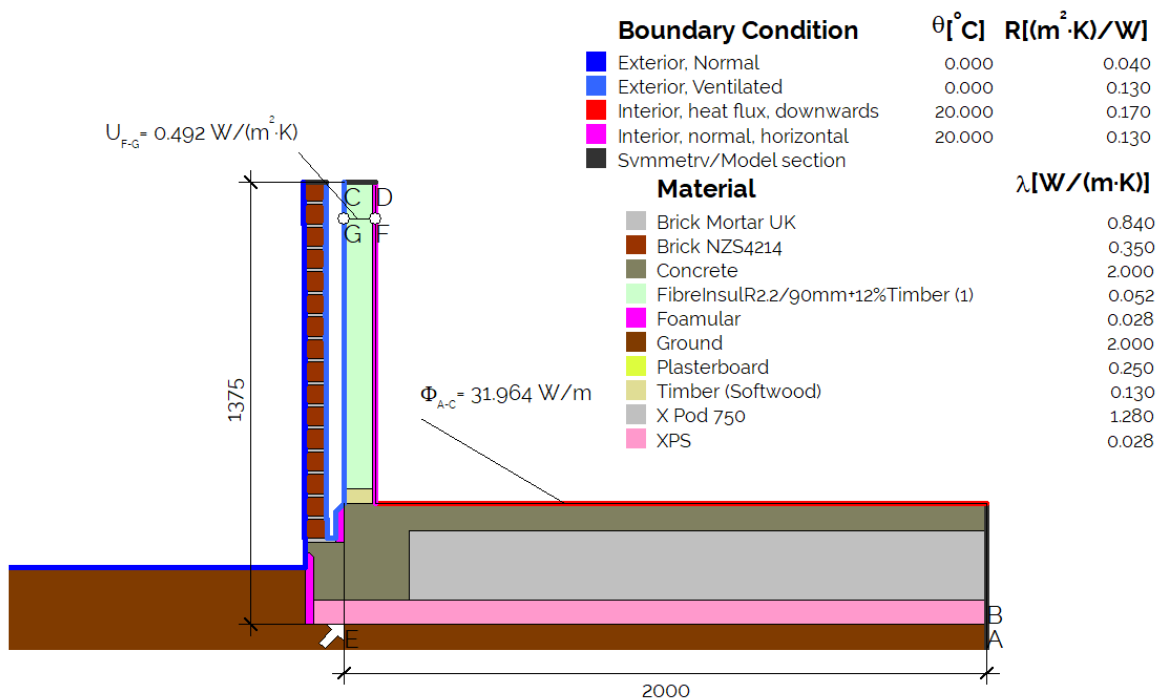


Boundary Condition	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		

# RRXPod 215-300 Brick veneer + std Hotedge + Hotedge in cavity + 75mm XPS underslab



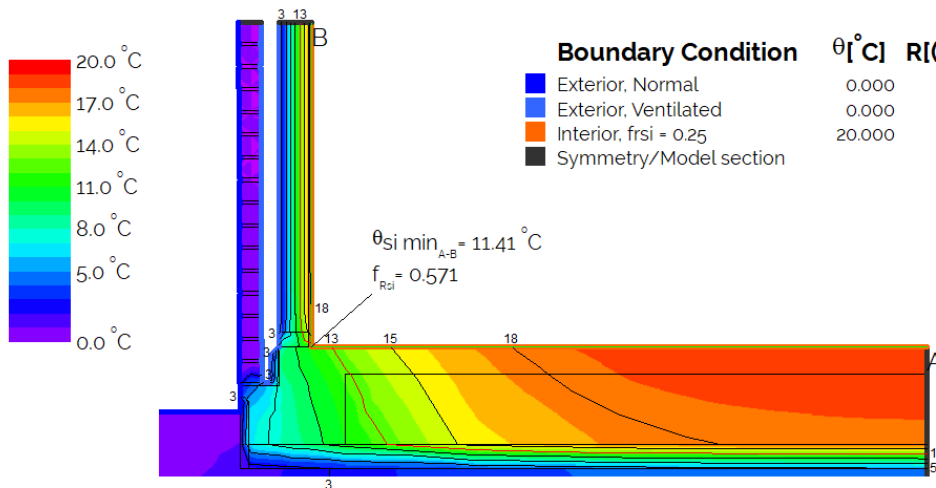
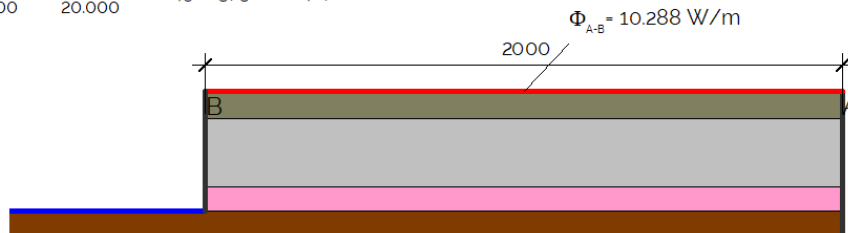
A/P, m	R-value, m <sup>2</sup> K/W
1	1.34
1.5	1.73
2	2.15
3	2.72
4	3.18



Boundary Condition	$\theta [^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
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		

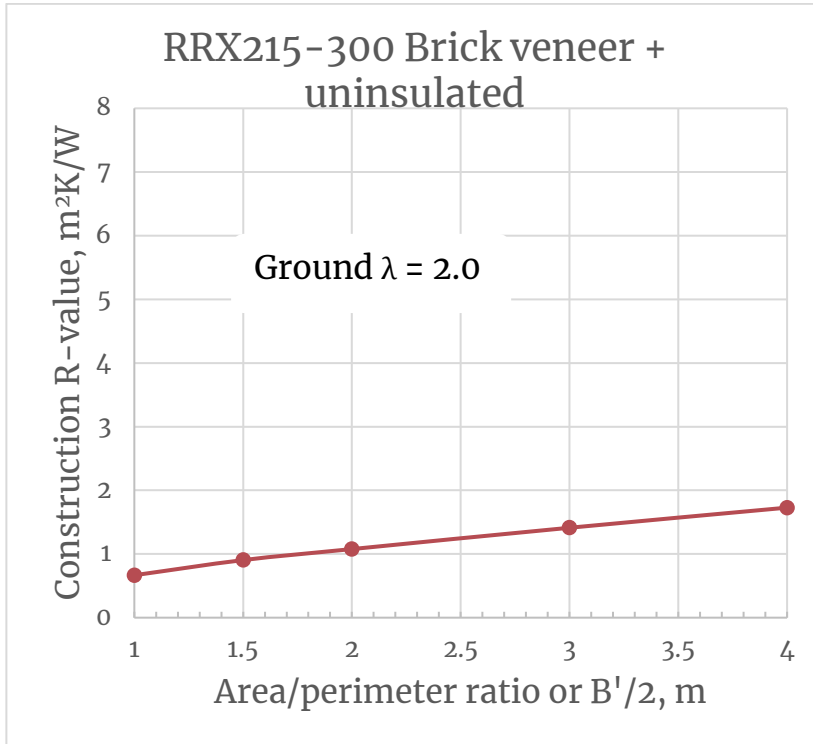
Material	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$
Brick Mortar UK	0.840
Brick NZS4214	0.350
Concrete	2.000
FibreInsulR2.2/90mm+12%Timber (1)	0.052
Foamular	0.028
Ground	2.000
Plasterboard	0.250
Timber (Softwood)	0.130
X Pod 750	1.280
XPS	0.028

$$\psi_{A-E-C} = \frac{31.964}{20.000} - \frac{10.288}{20.000} - 0.492 \cdot 1.375 = 0.407 \text{ W}/(\text{m} \cdot \text{K})$$

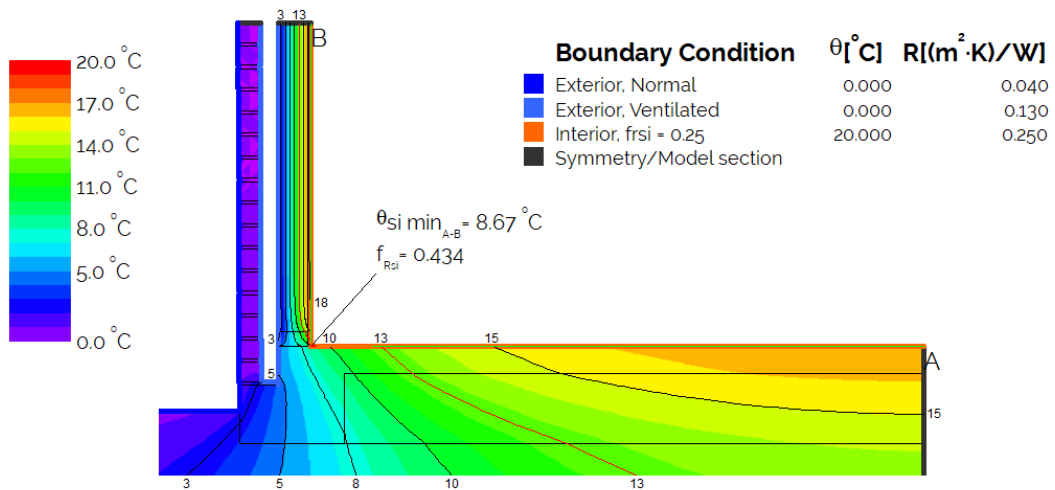
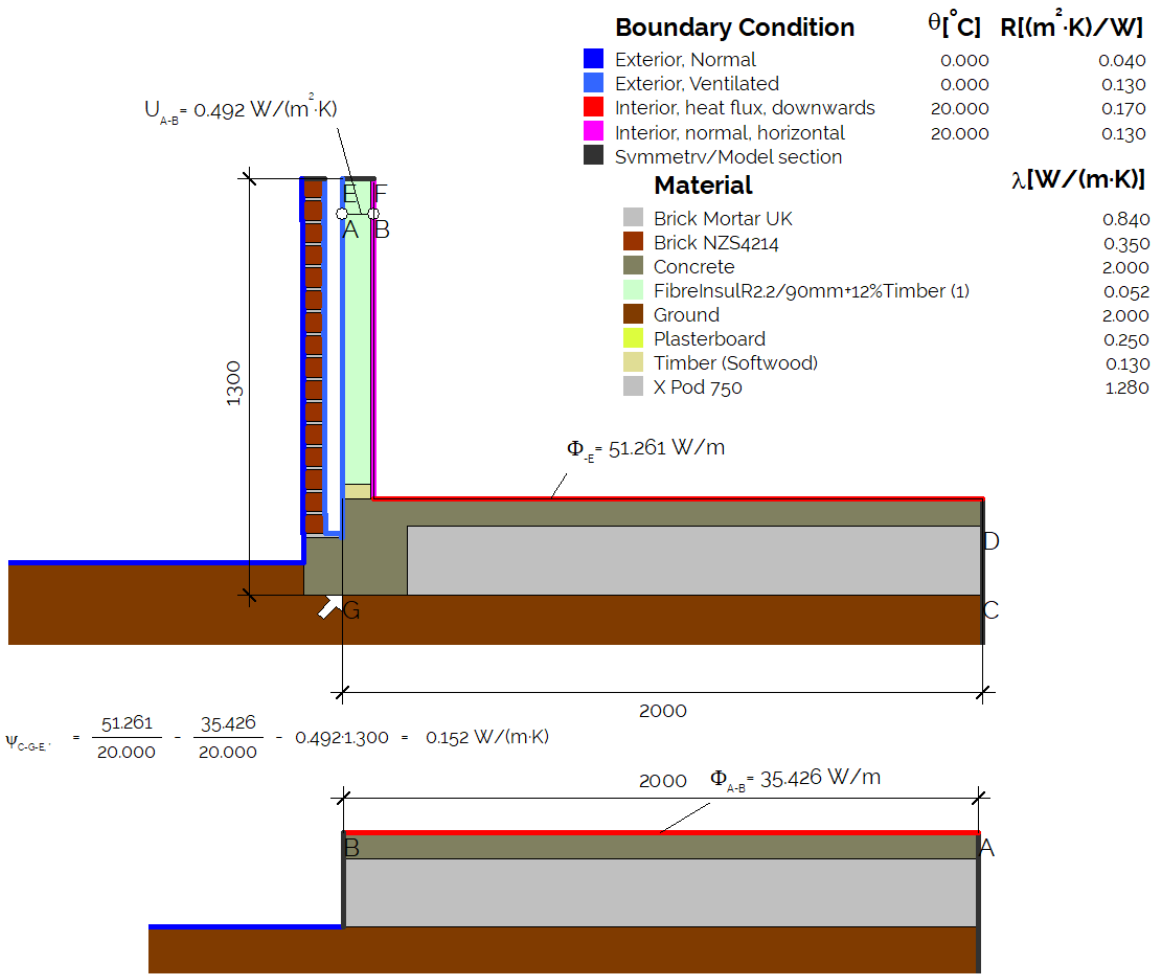


Boundary Condition	$\theta [^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
Exterior, Normal	0.000	0.040
Exterior, Ventilated	0.000	0.130
Interior, frsi = 0.25	20.000	0.250
Symmetry/Model section		

# RRXPod 215-300 Brick veneer + uninsulated



A/P, m	R-value, $m^2K/W$
1	0.67
1.5	0.90
2	1.08
3	1.41
4	1.73



# 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* =  $A_{slab,internal} / P_{slab,internal}$

where:

$A_{slab,internal}$  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 (m<sup>2</sup>) and

$P_{slab,internal}$  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).

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. 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 Table 7 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.

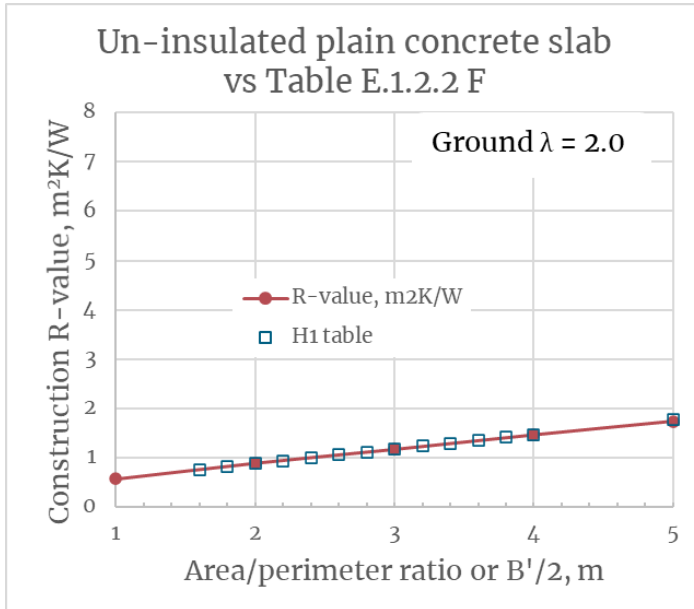
Equation F.1:  $R_{floor} = 1/U$

where:

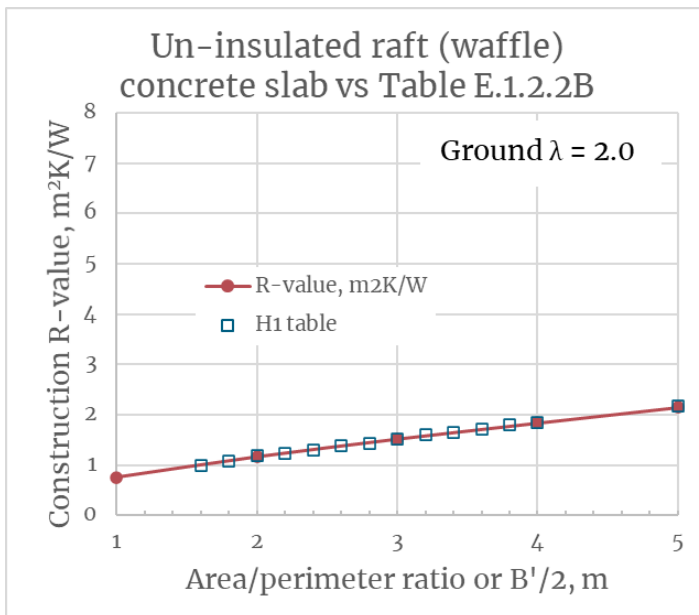
U is the temperature-specific heat flux through the internal floor surface of the two- or three-dimensional geometrical model, with the internal floor surface extending from the internal surface of the external wall to the cut-off plane of the floor (W/(m<sup>2</sup> · K)), determined by a numerical calculation as per F.1.2.1 to F.1.2.5.

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 $\Psi$ AND fRSI

Slab Passive House calculations of  $\Psi$  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  $\Psi$  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

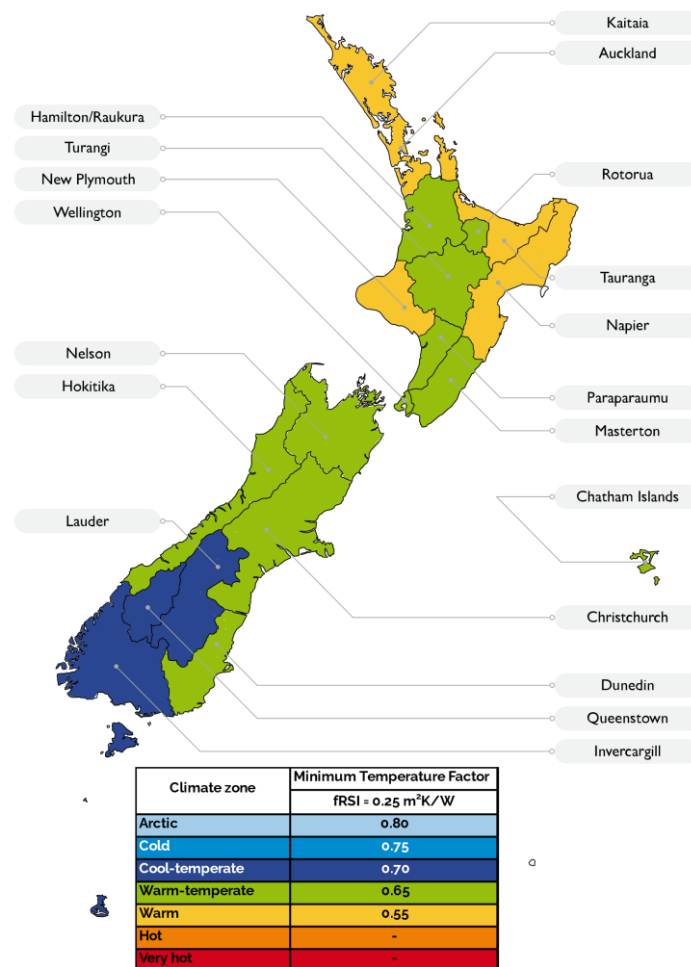


Figure 1: This map shows the three different fRSI zones at the weather station altitudes. The climate zone and thus the fRSI requirements also vary with altitude as the average temperatures typically drop by 0.6C per 100m of elevation gain. In general these zones can be used without considering the elevation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