ARMADILLO ™ 500R

R-VALUE CALCULATION

Designed by www.cresco-group.com

For more information: www.armadillo-system.com

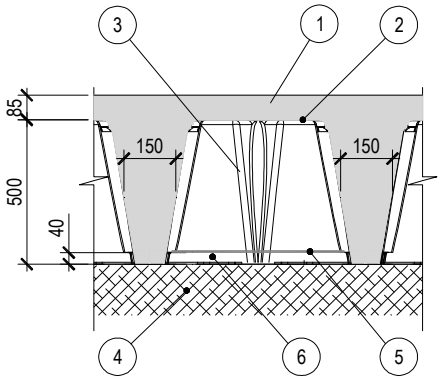
ARMADILLO™ 500R - R-Values according to the NZS 4218:2006

Wall Thickness mm	Floor Area Perimeter Ratio	ARMADILLO™ 500R R-Value (mK/W)	
		Thermal Base not installed	Thermal Base installed
100	1.5	1.32*	2.10
	2.5	1.76*	2.59
	3.5	2.16	3.05
	4.5	2.56	3.46
150	1.5	1.41*	2.18
	2.5	1.88*	2.71
	3.5	2.31	3.20
	4.5	2.73	3.63
200	1.5	1.48*	2.25
	2.5	1.97	2.80
	3.5	2.43	3.32
	4.5	2.87	3.77
300	1.5	1.60*	2.37
	2.5	2.13	2.96
	3.5	2.62	3.51
	4.5	3.09	3.99

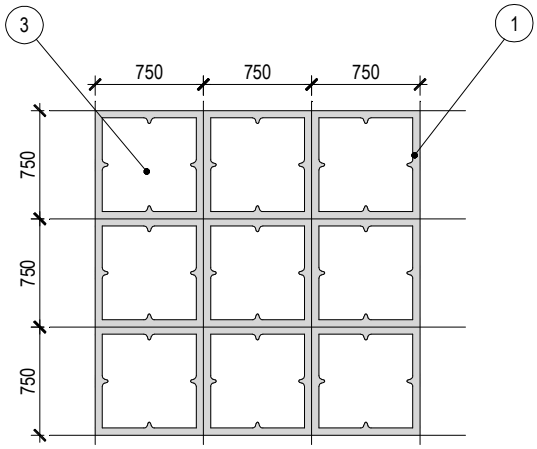
ARMADILLO™ 500R R-Values (with and without ARMADILLO™ Thermal Base installed). The ARMADILLO™ 500R that uses ARMADILLO™ pods 500C has the ARMADILLO™ Thermal Base included as a standard. (*) Configurations not compatible with in-floor heating.

R-VALUE FOR WALL 100 mm THICK AND A/p=3.5

GEOMETRY



1. Reinforced concrete
2. Cardboard
3. Main Air Cavity
4. Ground
5. Armadillo Thermal Base
6. Air Cavity



MATERIALS PROPERTIES

1. Concrete

$\lambda_1 = 1.6 \frac{W}{m\,K}$ — Thermal conductivity

$t_s = 85$ mm — Thickness of slab

$t_r = 585$ mm — Thickness of rib

2. Cardboard

$\lambda_2 = 0.21 \frac{W}{m\,K}$ — Thermal conductivity

$t_2 = 4$ mm — Thickness of cardboard

$\varepsilon_2 = 0.90$ — Carboard Emittance

3. Main Air Cavity

$T = 283K$ — Air Cavity Temperature

$d_A = 500$ mm — Cavity Thickness

$d_C = 460$ mm — Cavity Thickness (with pvc foam)

4. Ground

$\varepsilon_4 = 0.90$ Ground Emittance

5. Armadillo Thermal Base

$\lambda_5 = 0.07 \frac{W}{m\ K}$ Thermal conductivity

$t_5 = 6\ mm$ Thickness of Armadillo Thermal base

$\varepsilon_5 = 0.10$ Emittance

R-Values

$R_{1s} = \frac{t_s}{\lambda_1} = 0.053 \frac{m^2 K}{W}$ R-value for concrete slab

$R_{1r} = \frac{t_r}{\lambda_1} = 0.366 \frac{m^2 K}{W}$ R-value for concrete rib

$R_2 = \frac{t_2}{\lambda_2} = 0.019 \frac{m^2 K}{W}$ R-value for cardboard

$R_5 = \frac{t_5}{\lambda_5} = 0.086 \frac{m^2 K}{W}$ R-value for Armadillo Thermal Base

$R_6 = 0.19 \frac{m^2 K}{W}$ R value for air cavity, 40 mm, descending (see table E3 of NZS4214)

Surfaces

$r = 750\ mm$ Distance between Ribs

$s = 600\ mm$ Average lenght of slab

Based on a slab with one side 12 m long and with a Floor Area / Perimeter ratio of 3.5 we have:

$p_1 = 0.58$ Percentage of slab

$p_2 = 1 - p_1 = 0.42$ Percentage of ribs

Cavity R-Value without Armadillo Thermal Base

$\sigma = 5.67\ 10^{-8} \frac{W}{m^2\ K^4}$ Stefan-Boltzman Constant

$\varepsilon = \frac{1}{\frac{1}{\varepsilon_2} + \frac{1}{\varepsilon_4} - 1} = 0.818$ Effective Emittance

$h_a = \max\left[0.12\left(\frac{d_A}{m}\right)^{-0.44}, \frac{0.025m}{d_A}\right] \frac{W}{m^2 K} = 0.163 \frac{W}{m^2 K}$

$h_{r0} = 4\sigma T^3 = 5.14 \frac{W}{m^2 K}$

$h_r = \varepsilon\ h_{r0} = 4.206 \frac{W}{m^2 K}$

$$R_{3A} = \frac{1}{h_a + h_r} = 0.229 \frac{m^2K}{W}$$ Cavity R-Value

Cavity R-Value with Armadillo Thermal Base

$$\sigma = 5.67\ 10^{-8} \frac{W}{m^2 K^4}$$ Stefan-Boltzman Constant

$$\varepsilon = \frac{1}{\frac{1}{\varepsilon_2} + \frac{1}{\varepsilon_5} - 1} = 0.099$$ Effective Emittance

$$h_a = \max\left[0.12\left(\frac{d_C}{m}\right)^{-0.44}, \frac{0.025m}{d_C}\right] \frac{W}{m^2K} = 0.169 \frac{W}{m^2K} \qquad h_{r0} = 4\sigma T^3 = 5.14 \frac{W}{m^2K}$$

$$h_r = \varepsilon h_{r0} = 0.508 \frac{W}{m^2K}$$

$$R_{3B} = \frac{1}{h_a + h_r} = 1.477 \frac{m^2K}{W}$$ Cavity R-Value

System R-Values

The R-Value for the system is the weigthed average of the R-values of the part with the rib and of the part without ribs.

Without Armadillo Thermal Base $R_A = p_1 \left(R_{1s} + R_2 + R_{3A}\right) + p_2 R_{1r} = 0.328 \frac{m^2K}{W}$

With Armadillo Thermal Base $R_B = p_1 \left(R_{1s} + R_2 + R_{3B} + R_5 + R_6\right) + p_2 R_{1r} = 1.212 \frac{m^2K}{W}$

To have the R-value of the floor system, the R-value of the Room Air and of The Ground under the slab shall be added.

The R-value of the Room Air is $R_a = 0.09 \frac{m^2K}{W}$

The R-Value of the ground may be taken from Table E6 of NZS 3218:2006, and it depends on Floor Area/Perimeter Ratio and on perimeter wall thickness. For Ratio of 3.5 and a wall thickness of 100 mm, the R-Value is :

$$R_4 = 1.74 \frac{m^2K}{W}$$

The system R-Values are:

Without Armadillo Thermal Base $R_{As} = R_A + R_a + R_4 = 2.158 \frac{m^2K}{W}$

With Armadillo Thermal Base $R_{Bs} = R_B + R_a + R_4 = 3.042 \frac{m^2K}{W}$