



## **VOIDFORM RAFT FLOOR SLAB INSULATION CALCULATION**

This calculation is based off NZS4214:2006 and the Building Research Association of New Zealand's publication "Calculating R-Values Using the Isothermal Planes Method". This method is very similar to the ASHRAE Handbook of Fundamentals (American Society of Heating, Refrigeration, Air conditioning, Engineers) but includes several additional items concerning contact resistance and heat transfer processes.

It is slightly difficult to give a total R-value for the slab as the ground thermal mass has a large influence on the measured R-value. What these calculations show is the increase in performance between a 100mm concrete slab-on-ground, contrasted with a standard Voidform raft floor slab using 225mm deep pods, and a Voidform slab using 300mm deep pods. The number chosen for the conventional slab on ground R-Value is a conservative value.

This calculation determines the R-Value through a central part of the Voidform slab. Issues such as multipliers for edge insulated slab-on-ground floors, wall thickness, and depth of water table are essentially the same for all types of construction, hence are not discussed here, and will need to be taken into account depending on the actual shape of the slab to be constructed.

### **Conventional Slab Calculation:**

The standard uninsulated 100mm concrete slab on ground in New Zealand is assigned a minimum R-Value of 1.3 in NZS 4218. Of this the concrete contributes 0.06. This is calculated by the equation:

$$R = \frac{t}{k} \text{ where } t = \text{thickness of concrete} = 100\text{mm}$$

$$k = \text{thermal conductivity} = 1.6 \text{ W/m}^\circ\text{C}$$

$$R = 0.06$$

This leaves approximately  $1.24 \text{ m}^2\text{C/W}$  provided by the foundation materials below the slab.

### **Voidform 225 Pod Raft Floor Slab Calculation:**

Symbols	$f_c$	=	fraction of floor slab made up by concrete ribs
	$f_p$	=	fraction of floor slab made up by polystyrene
	$R_c$	=	Thermal resistance of concrete
	$R_p$	=	Thermal resistance of polystyrene
	$R_b$	=	Combined thermal resistance across ribs and polystyrene

Combined thermal resistance  $R_b$  is given by:

$$R_b = \frac{1}{\left(\frac{f_c}{R_c} + \frac{f_p}{R_p}\right)}$$

As we have 100mm wide ribs and 1090mm square polystyrene pods:

$$\begin{aligned} f_c &= (1190^2 - 1090^2)/1190^2 = 0.161 \\ f_p &= 1 - f_c = 0.839 \\ R_c &= 0.225/1.6 = 0.140 \\ R_p &= 1.357 \end{aligned}$$

Therefore:

$$R_b = \frac{1}{\left(\frac{0.161}{0.140} + \frac{0.839}{1.357}\right)} = 0.566$$

Now we need to add the 85mm concrete topping over the polystyrene pods. This is calculated to be  $0.085/1.6 = 0.053$ , giving us a total R-Value for the Voidform floor slab of:

$$R_{\text{Voidform}} = 0.619$$

Taking the previous assumption that an R-Value of 1.24 is obtained from the ground immediately beneath the slab, we can make the following comparison:

$$\text{Conventional slab R value} = 1.24 + 0.06 = 1.3$$

$$\text{Voidform Raft Floor Slab R Value} = 1.24 + 0.619 = 1.859$$

This shows that the Voidform Raft Floor Slab using a 225mm deep pod has a 43% better insulation value than a conventional slab on ground.

### **Voidform 300 Pod Raft Floor Slab Calculation:**

Symbols	$f_c$	=	fraction of floor slab made up by concrete ribs
	$f_p$	=	fraction of floor slab made up by polystyrene
	$R_c$	=	Thermal resistance of concrete
	$R_p$	=	Thermal resistance of polystyrene
	$R_b$	=	Combined thermal resistance across ribs and polystyrene

Combined thermal resistance  $R_b$  is given by:

$$R_b = \frac{1}{\left(\frac{f_c}{R_c} + \frac{f_p}{R_p}\right)}$$

As we have 100mm wide ribs and 1090mm square polystyrene pods:

$$f_c = (1190^2 - 1090^2)/1190^2 = 0.161$$

$$f_p = 1 - f_c = 0.839$$

$$R_c = 0.300/1.6 = 0.188$$

$$R_p = 1.371$$

Therefore:

$$R_b = \frac{1}{\left(\frac{0.161}{0.188} + \frac{0.839}{1.371}\right)} = 0.681$$

Now we need to add the 85mm concrete topping over the polystyrene pods. This is calculated to be  $0.085/1.6 = 0.053$ , giving us a total R-Value for the Voidform floor slab of:

$$R_{\text{Voidform}} = 0.734$$

Taking the previous assumption that an R-Value of 1.24 is obtained from the ground immediately beneath the slab, we can make the following comparison:

$$\text{Conventional slab R value} = 1.24 + 0.06 = 1.3$$

$$\text{Voidform Raft Floor Slab R Value} = 1.24 + 0.734 = 1.972$$

This shows that the Voidform Raft Floor Slab using 300mm deep pods has a 51% better insulation value than a conventional slab on ground.