# FLOOR SLABS WITH POLYSTYRENE PODS

**The BRANZ *House insulation guide* details the expected thermal performance for common construction options. It didn't include the thermal performance of floor slab systems with polystyrene pods, but recent modelling means this data is now available.**

**By Ian Cox-Smith,** BRANZ Building Physicist

There are a number of proprietary floor slab systems available that incorporate polystyrene pods or rafts laid out in a regular grid using spacers. The spacers enable the topping concrete to also form supporting beams between the polystyrene pods.

Although these systems typically use polystyrene with a thickness of 200 mm or more, the overall insulating impact of the expanded polystyrene (EPS) is considerably less than the EPS expected thermal resistance values. This is because the topping slab and edge beam provide a path for heat from the building to be carried to the outside edge of the slab.

There are ways to effectively insulate the edge of the slabs (see *Build* 109, December 2008/January 2009 pages 28–29 and the BRANZ *House insulation guide* pages 115–118), but these are not usually a standard part of the floor slab systems.

## Thermal resistance of pod systems modelled

For situations where heat flow through a building construct is mostly two dimensional (for example walls, floors and suspended floors), NZS 4214:2006 *Methods of determining the total thermal resistance of parts of buildings* can be used to calculate the R-value. Although NZS 4214 also contains formulae for calculating the R-value of traditional style floor slabs, formulae for pod-style floor systems are not included. Because the heat flow is three dimensional, special modelling is needed to determine the thermal resistance for the floor systems.

The main factor affecting the thermal resistance of floor systems is the ratio between the floor area and the total perimeter length of the floor (area/perimeter ratio). For example, a 10 m × 10 m slab has an area of 100 m$^2$, a perimeter length of 40 m and an area-to-perimeter ratio of 2.5. Other important factors are the:

- grade (conductivity) and thickness of the EPS
- conductivity of the soil
- thickness of exterior walls of the building above the slab.

Thicker walls mean that there is a longer heat flow path between the interior of the building and the outside edge of the slab so the thermal resistance is increased.

## R-values from modelling

Results of accurately modelling a typical pod floor system are shown in Table 1 and Figure 1. The assumptions used are that the:

- pods are 230 mm thick
- pods are made from grade 'S' EPS
- topping slab is 80 mm thick
- perimeter beam is 300 mm wide
- thermal conductivity of the soil is 1.2 W/mK.

It is also assumed that there is no additional insulation of the outside edge of the slab or a thermal break at the edge of the topping slab, reflecting standard practice.

## Pod system R-value increases with wall thickness

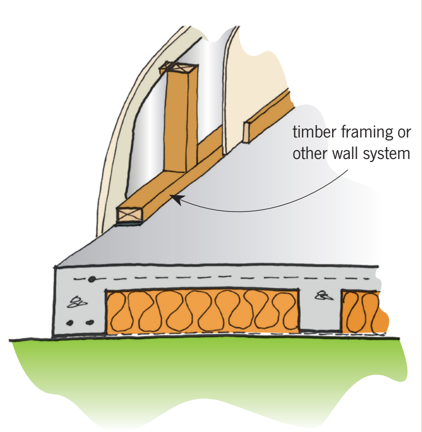
Comparing the chart opposite with the chart on page 114 of the BRANZ *House insulation guide* for a traditional slab-on-ground floor without insulation shows that the thermal resistances of the floors are similar for a building with 100 mm deep walls.

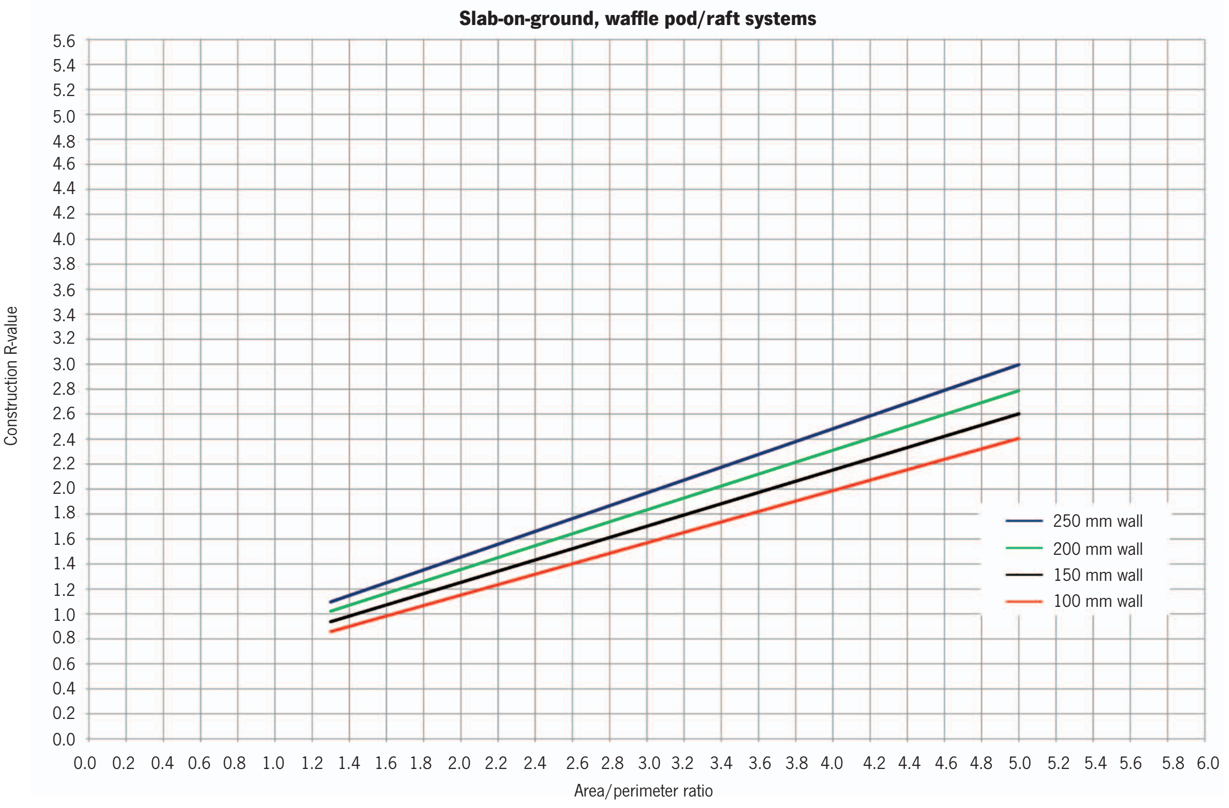
However, once the thickness of the walls is increased, the thermal resistance of the pod floor system becomes increasingly better than that of the traditional slab system. For a 250 mm deep wall, the pod system R-value is about 20% higher than the R-value of a traditional floor.

## Adjust for soil conditions

As with the floor slab examples in the BRANZ *House insulation guide*, the results can be adjusted to take into account the thermal conductivity of the soil. For dry sandy loam, multiply the R-value by 1.2, and for wet or saturated clay or areas with a high water table, multiply the R-value by 0.8.

| Construction | Area-to-perimeter ratio | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1.3 | 1.9 | 2.2 | 2.5 | 2.8 | 3.1 | 4.0 |
| | Total construction R-value | | | | | | |
| 250 mm wall | 1.1 | 1.4 | 1.5 | 1.7 | 1.8 | 2.0 | 2.4 |
| 200 mm wall | 1.0 | 1.3 | 1.4 | 1.5 | 1.7 | 1.8 | 2.3 |
| 150 mm wall | 0.9 | 1.2 | 1.3 | 1.4 | 1.6 | 1.7 | 2.1 |
| 100 mm wall | 0.8 | 1.1 | 1.2 | 1.3 | 1.4 | 1.6 | 1.9 |




Slab-on-ground, waffle pod/raft systems
Construction R-value
Area/perimeter ratio
250 mm wall
200 mm wall
150 mm wall
100 mm wall