



EMBEDDED FLOOR HEATING

Embedded floor heating systems incorporate heating within a concrete floor slab and use thermal mass to provide low-temperature, uniform heat over the entire floor area.

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There are two types of embedded floor heating systems – hydronic (using heated water) and electric.

A hydronic heating system consists of heated water pumped through continuous plastic pipework laid in the floor slab (see Figure 1). Water temperatures are generally between 40 and 60°C and the heating source may be electricity (including heat pumps and heat exchangers), gas, oil, solid fuel, solar or a combination of these.

An electric floor heating system consists of heating elements or cables embedded in the floor slab (see Figure 2).

Both pipework and heating elements are embedded 30–50 mm in the slab. Water pipes are spaced at 150–300 mm and electric cables at 50–350 mm. Both systems are laid over, and tied to, the steel reinforcing mesh. Floor temperatures may range between 20 and 29°C.

Many benefits

Benefits of embedded floor heating systems include:

- a 'self-regulation' of the heat transmission into the room
- no air movement or noise from air moving through ducts or fans
- no space in the room is taken by a heating system
- limited vertical temperature stratification, as low temperature radiant heating does not warm air
- less likelihood of condensation and mildew.

Self-regulation of heat

Heat transfer occurs from areas of higher temperature to areas of lower temperature. The greater the temperature difference,

the greater the heat flow. When the room temperature is less than that of the floor, heat will move from a heated floor slab to materials within the room. As the materials become warmer, the heat transfer rate will slow and eventually stop when a temperature equilibrium is reached. At this point there is no heat transfer from the slab, so no heat input is required.

This process of 'self-regulation' depends upon high levels of insulation in the floor slab and building envelope to ensure minimal heat loss from the building.

Slab needs to be well insulated

A building envelope must be designed to meet the requirements of the New Zealand Building Code Clause H1 *Energy efficiency*. If NZS 4218: 1996 *Energy efficiency – Housing and small building envelope* is used as the means of compliance to NZBC Clause H1, a heated floor slab must have a minimum R-value of R1.7 in all climate zones. However, the changes of 31 October 2007 to Clause

H1 increase the minimum R-value from R1.7 to R1.9.

Calculating the R-value for a floor slab takes into account the thermal resistance of the slab, the thermal conductivity of the soil beneath the slab, the length and width of the slab, and the width of the external walls of the building (which defines the length of least thermal resistance between the interior and exterior environments).

Rigid polystyrene insulation is typically used for underslab insulation. This is available in two forms – extruded (XPS) and expanded (EPS) polystyrene.

Perimeter insulation or a thermal break must be incorporated to limit the heat loss between the slab and foundation, and to maximise the insulation performance of the slab. BRANZ recommends the incorporation of a thermal break using H3.2, 140 × 45 mm timber inserts at the edge of the slab (see Figure 2). Wall construction using 140 mm wide bottom plates and framing, rather than 90 mm, and insulation, improves the thermal

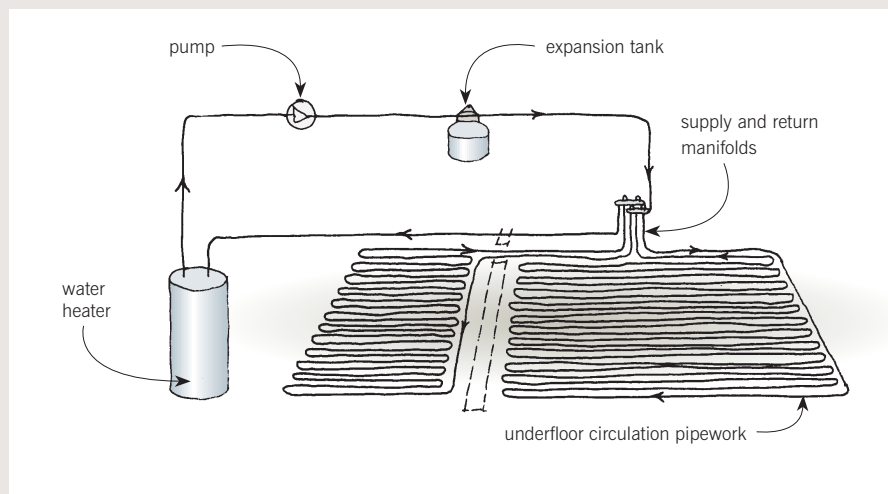


Figure 1: A hydronic floor heating system.

performance even further. This was described in *Build* 100 (June/July 2007, pages 32–33 and 103–105).

Energy efficient

Underfloor heating systems are low temperature systems. They are efficient heat generators, requiring less heat input than other heating systems. Hydronic systems are particularly suited for underfloor heating. The water temperature is generally controlled by thermostat, but solar-heated water will require the water flow to be controlled once the maximum temperature is reached.

Additional efficiency can be achieved by designing the building to maximise direct solar gain onto the floor.

Floor coverings have an impact

Floor coverings affect and reduce the rate of efficiency of a floor heating system according to their thermal resistance. A concrete finish and ceramic or slate tiles provide little thermal resistance (insulation) to the floor, but coverings such as carpet, cork, linoleum, vinyl and timber will all reduce the heat output rate.

Retrofitting sometimes possible

Embedded floor heating systems are most commonly installed in new concrete floors.

Retrofitting is often not a practical option and can only be done where a lightweight topping slab can be placed over an existing slab. The existing structure must be checked for:

- structural adequacy of the slab
- adequacy of existing insulation or, if required, whether it is possible to increase the insulation
- adequate floor-to-ceiling height after the overpour and additional insulation is added.

Electric floor heating systems may provide a good heating solution for building additions where extending an existing, or installing a new, hydronic system would be impractical.

Other flooring, other systems

Floor heating systems are available for other floor types, such as timber floors. However, these are not embedded floor heating systems and do not provide the thermal mass heat storage of embedded systems covered in this article.

For more information see the recently released BRANZ Bulletin 491 Embedded floor heating. ■

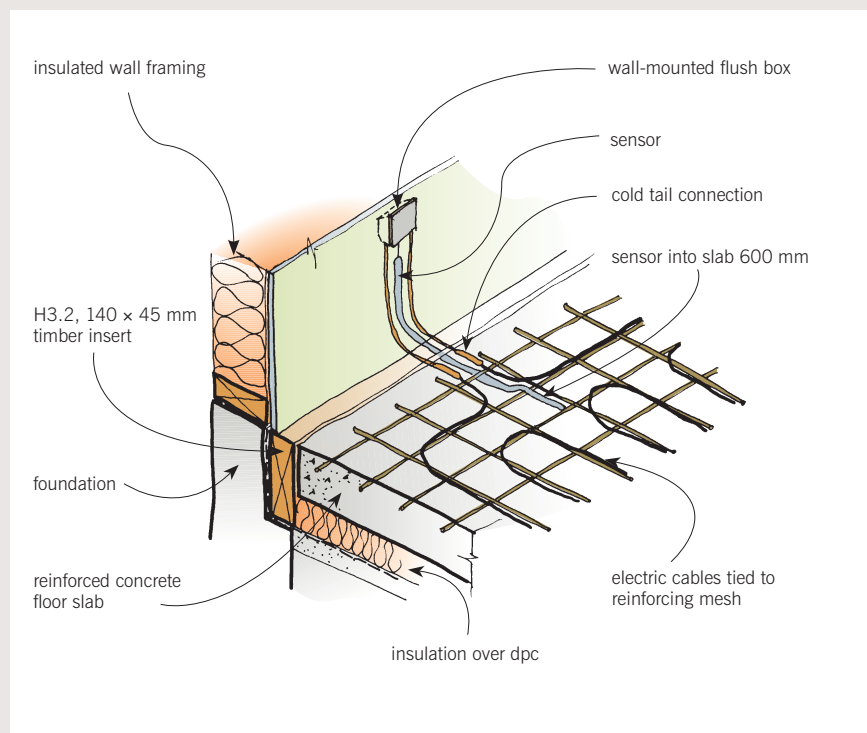


Figure 2: Electric floor heating system with embedded temperature sensor.