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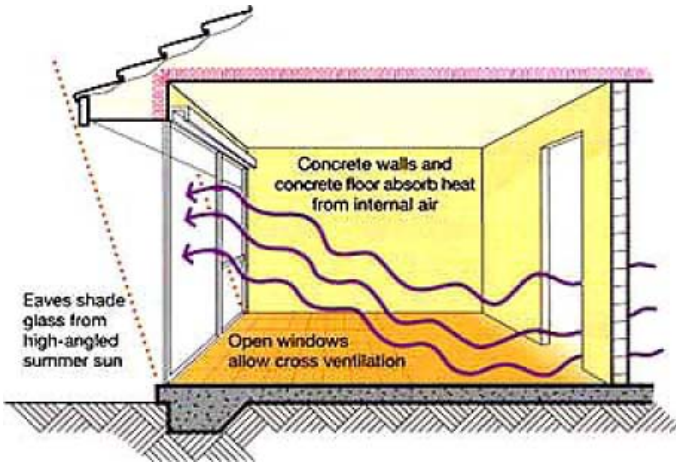
Residential Construction Thermal Performance

Research work undertaken by the Cement and Concrete Association of New Zealand into the benefits of building a house from concrete is now complete and is the culmination of three distinct stages of work that was started in 1997. The work has confirmed that high mass construction is well suited to local conditions. Housing designs with expansive areas of glazing provide a key ingredient for deriving maximum benefit from thermal mass, i.e., high levels of thermal gain. The findings of the research can be summarised as follows:

- The amount of glazing, and its orientation to the sun, has a significant effect on the performance of a home.
- The concrete building used 15.5% less energy than the identical timber one for similar comfort conditions.
- The concrete house was more comfortable when a large window was fitted, the timber home overheated significantly.
- The concrete home was more than 5P^{oP}C cooler than ambient on a 30P^{oP}C day, while the temperature inside the timber home approximated the outside temperature.
- Overnight, the timber home was on average, 1 degree cooler than the concrete one.
- The minimum temperatures for the concrete and timber buildings were 15.6P^{oP}C and 12.8P^{oP}C respectively.
- The timber home required four times the shading needed by the concrete home (to control overheating).

Concrete has an inherent capacity (related to its mass) to absorb and store thermal energy. This quality is referred to as 'thermal mass'. Quite simply, concrete will absorb thermal energy, store it, and release it when the internal home temperature drops below that of the concrete. This buffering effect means that the intermittent nature of heat sources such as space heaters and the sun becomes less apparent - temperature fluctuations are reduced and a more comfortable home is the result.



Summer

In summer, energy from direct sun and from warm circulating air is absorbed by the cooler concrete mass thus reducing the air temperature within the home. As the air temperature decreases in the evening, stored energy within the concrete mass re-radiates - providing consistent comfortable temperatures within the home. This cooling effect of thermal mass is especially beneficial in very warm climates. Eaves should be designed to shade windows from high angled summer sun and there should be sufficient opening windows to allow cross ventilation.

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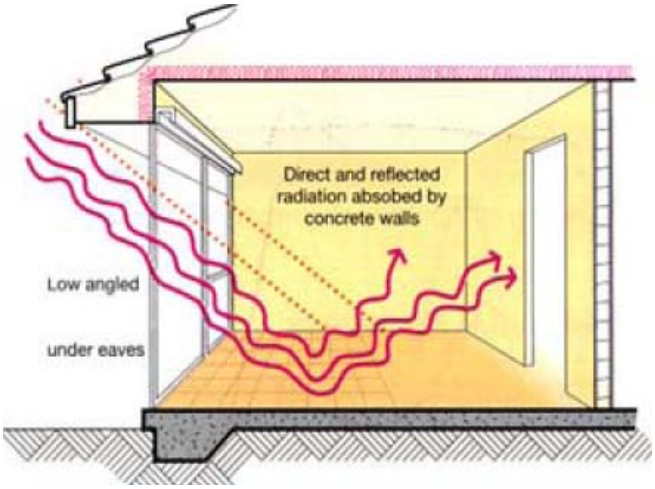
Winter

Capturing the free energy of the sun is relatively simple with a concrete home. This energy is most efficiently captured if the sun shines directly onto existing concrete surfaces, although reflected radiation will also be absorbed by concrete surfaces not directly exposed to sunlight. Convection and conduction also play a part. Solar gain can be achieved by maximising the glazing that faces north (± 20° off north is best) and using low insulation floor covering such as tiles on a concrete slab. Carpet will insulate the concrete floor slab, which reduces its ability to absorb solar energy. Likewise plasterboard lining on concrete walls will reduce solar gain compared to hardwall plaster. Eaves and verandas should not prevent winter sun penetrating the glazing.



Thermal Performance Information courtesy of Cement and Concrete Association of New Zealand.

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