2.3 Thermal Performance/Passive Solar Design

Thermal Performance

Requirements for thermal performance of domestic dwellings are set out in NZS 4218:2009, *Thermal Insulation - Housing and Small Buildings*.

This standard is cited by MBIE as part of the acceptable solution within the New Zealand Building Code, Clause H1/AS1.

Concrete masonry construction R-values shall be determined by either the schedule, calculation or modelling method of the above standard.

Schedule Method

The schedule method shall only be used if the glazed area is ≤ 30% of the total wall area.

R-values are determined by Table 2 or Table 4. Table 2 requires R-values between 1.9 and 2.0 depending on the climate zone where the building is set. R-values required by Table 4 vary between 0.8 and 1.2 again in dependence on the buildings climate zone.

Table 2 can be used in any case. Table 4 can only be used if:

(a) the concrete masonry wall is openly exposed to the interior, and

(b) the density of the wall is ≥ 215 kg/m^2.

Comment: Fully filled, 150 mm concrete masonry walls are usually ≥ 215k g/m^2 but confirmation of the manufacturer is required for final assessment.

See NZS 4218, section 4.1 for further details.

Calculation Method

The calculation method shall only be used if the glazed area is ≤ 40% of the total wall area.
The advantage of this method over the schedule method is that a reduction of some building element's R-values can be compensated by increasing the R-values of other building elements.

For further details see NZS 4218, section 4.2.

Modelling Method

The modelling method can be used for any building but shall be used if the glazed area is larger than 40% of the total wall area.

The sum of the modelled and calculated heating and cooling load of the proposed building shall not exceed the reference building where R-values of Table 2 (or 4 if high mass) have been used.

The advantage again is that a reduction of some building element's R-values can be compensated by increasing the R-values of other building elements.

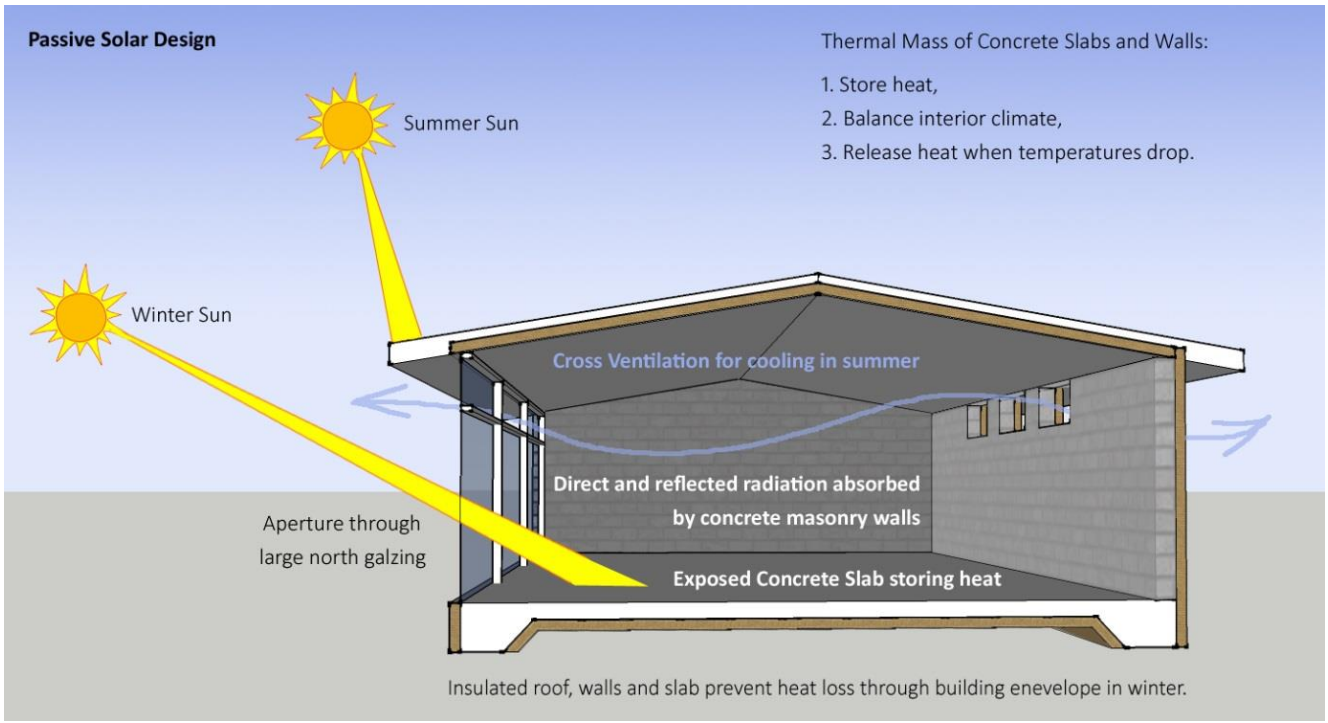
For further details see NZS 4218, section 4.3.

Passive Solar Design

The principles of passive solar design are:

1. Thermal mass
2. Large north glazing, no or minimal south glazing
3. Thermal insulation
4. Air sealage
5. External summer shading
6. Providing for cross ventilation

Image: *Cranko Architects using principles of passive solar design for a residence in Wellington.*



For further information see the 'Designing Comfortable Homes' Book, free download online at: www.CCANZ.org.nz/files/DCH_Book_WEB.pdf.

Principles of passive solar design as illustrated:

> *'Large glazing to the north to gain the sun's heating energy in winter plus roof overhangs to block the sun in the summer avoiding overheating are evident for passive solar design.*
>
> *Concrete masonry walls together with an exposed concrete slab capture direct and reflected radiant heat and balance the interior climate by cutting off daily peaks, highest and lowest temperatures.'*

Trombe Walls

The CCANZ *Concrete and Concrete Masonry Trombe Wall Information Bulletin* covers the design and application of Trombe walls which are passive solar building elements that, designed correctly, provide an effective way of conserving energy in buildings.

Trombe walls are sun-facing, solid concrete or concrete masonry walls that are separated from the outside by glass and an air space. They make full use of the low rising sun's energy during winter months by collecting this heat during the day and releasing it into the room behind over an extended period of time and during the night.

When the sun shines, energy comes through the glass and is stored in the wall's thermal mass. When the sun sets or is blocked and the temperature drops, the wall releases its heat into the room behind.

Trombe walls work in a similar way to a greenhouse, by trapping solar radiation. The solar heat's higher-energy ultraviolet radiation has a short wavelength and this passes through glass almost unhindered. When this radiation strikes a wall or slab, the energy is absorbed and then reemitted in the form of longer-wavelength infrared radiation. The infrared radiation does not pass through glass as easily, so the heat is trapped and builds up in the enclosed space.

This publication can be downloaded from http://www.nzcma.org.nz/document/279-32/IB96_Trombe_Walls.pdf