STEPS TO GOOD INSULATION DESIGN

When it comes to insulation, designers should think optimum rather than minimum and make key decisions early in the design process.

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If insulation is an afterthought in your designs, it shouldn't be. By making insulation part of an integrated thermal design process you will achieve:

- reduced heating costs
- better heating performance
- better living environments
- future proofing
- comfortable and happy clients who will recommend you to others.

To get the best overall performance and the most cost-effective design, include thermal design early in the design process.

Integrated thermal design

The basic principles of good thermal design are:

- Insulate – use high levels of insulation to keep the heat in.
- Capture – capture solar energy through north facing windows.
- Store – use thermal mass (if feasible) to store heat.

An integrated thermal design achieves a good balance of insulation, glazing and thermal mass in the overall design. It is not just a matter of stuffing in a bit more insulation.

Tools such as the BRANZ thermal design tool ALF3 can be used to optimise the levels of insulation, glazing and thermal mass. More complex, specialist software packages are available, and some design practices specialise in passive design. There is plenty of good information available to help in the design process (see the Table).

Insulation choices

High levels of insulation are needed to keep the heat in. More than the Building Code Clause H1 *Energy efficiency* minimum may be required to optimise thermal design, so what are the priorities for doing better than the new H1 minimum levels?

FLOORS

The R1.3 H1 minimum can be improved on significantly to reduce heat losses and avoid a cold floor. Do better by using foil and lining (~R2.0) or bulk insulation in suspended floors (R2.5–R5.0), or use a thermal break and slab insulation for slab-on-ground floors (R2.0–R5.0), see *Build* 100 June/July 2007, pages 32–33.

WALLS

For framed walls choose the highest R-value insulation that will fit, rather than just trying to meet H1 minimums. Consider using 140 mm framing for even higher R-values. For solid masonry or timber, exterior insulation can give high R-values if H grade EPS or XPS polystyrene is used. Some wall types give higher R-values than others for the same amount of insulation – the choice of wall type and cladding will affect the R-value that is achievable (see the BRANZ *House insulation guide*).

GLAZING

Consider higher performance double glazing such as thermally broken frame, timber or pvc frame, low-e coating, argon fill, krypton fill or vacuum.

ROOF

It may not be worthwhile going much beyond the new H1 minimums unless other parts of the building have already been improved. Higher R-values are only readily achievable in pitched roofs, or skillion or low-slope roofs with deep framing (190+ mm) that have enough room for high R-value insulation products.

By using ALF, you can explore and understand the benefits of improving the insulation in each part of the building and choose where best to spend money on extra insulation.

Useful resources	Where to find them
Passive design principles	www.level.org.nz/passive-design/
	www.smarterhomes.org.nz/design/passive-heating
	www.energywise.org.nz/yourbuildingdes/using-the-sun.html
	www.eeca.govt.nz/eeca-library/renewable-energy/solar/fact-sheet/passive-solar-design-fact-sheet.pdf
Designing comfortable homes – free pdf or book for purchase	www.cca.org.nz/shop/downloads/A5Book.pdf
Level sustainable building series	www.branz.co.nz, see Bookshop
PAS 4244: 2003 *Insulation of lightweight-framed and solid-timber houses*	www.standards.co.nz
BRANZ *House insulation guide*	www.branz.co.nz, see Bookshop
ALF 3.2 – Annual loss factor software	www.branz.co.nz, see Resources and software

Glazing and solar gains

The sun can provide a lot of free energy for heating a house. To make the most of it, glazing should be orientated to the north (true north not compass north), and the amount of glazing in other directions kept to a practicable minimum. ALF can help here too, by determining how much glazing is enough, how much is too much, and by evaluating the benefits of higher performance glazing.

Excessive glazing (especially west facing) can cause overheating and glare in summer and excessive heat loss in winter. Good shading design is essential to allow the winter sun in to heat the house, yet keep out the summer sun to avoid overheating. However, not all sites have good sun or allow a good glazing orientation.

Thermal mass

Properly designed thermal mass can reduce the heating needs of a house and improve comfort in summer and winter. Thermal mass is most commonly an exposed concrete slab floor, or exposed masonry or concrete walls. This mass *must* be exposed to work properly – covering with carpet or lining interior walls makes thermal mass ineffective. Exposing an area of slab where it will be in direct sunlight in winter can store the heat for release later that day. Concrete slabs for heat storage should be well insulated and preferably of a dark colour.

Thermal mass walls should have the insulation on the exterior. Best results will be achieved with high levels of insulation that achieve wall R-values much higher than the H1 minimum, for example R1.5–R2.1.