PASSIVE SOLAR DESIGN

ECO-DESIGN ADVISOR SERIES NO.4

TAPPING FREE ENERGY

Most of us have heard of the term passive solar design. Some of us may associate the idea with unconventional, fully self-sufficient homes, but in fact mainstream builders, architects and homeowners are increasingly embracing the concept. Passive solar design is all about harnessing and storing the energy of the sun for release overnight. Subsidiary features of good passive solar design are properly sized and positioned windows, the correct choice of glazing, passive ventilation and comprehensive insulation. (Glazing and insulation are dealt with in separate factsheets.)

A house design may incorporate some elements of passive solar design or it may go the whole way and bend every consideration to tapping the sun's energy. The choice is yours. But best of all, a passive solar designed house can be low-tech and no more expensive than standard construction. Free solar heat is an age-old benefit, and a house that correctly incorporates its principles will provide year-round comfort and enjoyment

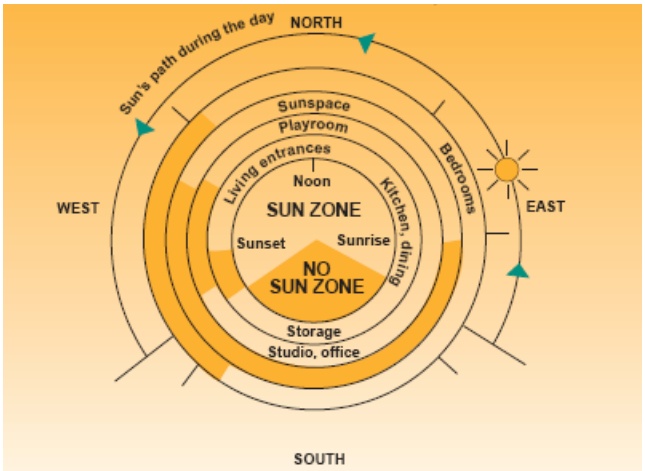
Face north

The first consideration is the position of the house in relation to the sun. A north-facing aspect is ideal. In the southern hemisphere, the sun travels in a northerly arc from east to west. The north side of the house should have the most windows and the biggest windows. Sun will pour through them for much of the day. The more elongated the house is along the east-west axis (stretched like a sausage, if you like), the better. The east and west walls should also have windows, not necessarily so big, to catch morning and afternoon sun. The south side should have only enough windows for ventilation purposes. It's the cold side.

If possible, position the house well clear of buildings and trees that will cast shadows and block valuable winter sun. Equally, consider planting deciduous trees closer to help prevent summer overheating. On the subject of overheating, eaves of the correct depth will block the worst of summer sun but let in winter sun. There are other options, too, such as louvers, shade sails, shutters and awnings.

Layout of rooms

The rooms on the north side should be the most used (living areas, in other words). The least used rooms (bathrooms, laundry, garage, guest bedroom) should go on the south side. Bedrooms and the kitchen are best on the east side (because they need early morning heating, and in the case of the kitchen, afternoon coolness). As an exercise, assess your existing home, or neighbours' or friends' homes, against this idea arrangement. One or two are sure to have a cozy garage for the car, but a cold lounge for the car's owners!

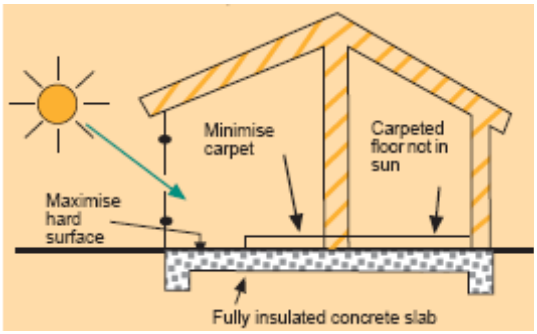


Ideal orientation of rooms for solar heating
Energy Efficiency and Conservation Authority, May 2000

This arrangement of rooms and windows around the different points of the compass is the optimum one, and when you have a big blank canvas, that is, plenty of flat, empty land, not especially difficult to accomplish. In compact, hilly urban settings, compromises and more complex arrangement of spaces will be necessary. The same goes if you are attempting to modify or extend an existing home. Nonetheless, it is worth the effort because your home will be warmer, lighter and altogether more pleasant to live in. And your power bills will be lower.

Thermal mass

So much for the ideal layout. The next concept to understand is thermal mass. Your design may be able to soak up every bit of winter sun, but without some way to store it, that heat will quickly dissipate. What you want is the slow release of stored heat over the course of the night. Enter thermal mass. This is the term for the ability of building materials to store the sun's energy.



Expose thermal mass to the sun
Energy Efficiency and Conservation Authority, May 2000

Four things determine thermal mass:

- **Type of material:** The thickness and density of materials, chiefly walls and flooring, will largely determine how well your house can be warmed by the sun. (A thickness of between 100 millimetres and 250 millimetres is best. As for density, think weight. Concrete and stone, for example, soak up large amounts of heat. For walls, bricks and concrete blocks are ideal. That stored heat lessens reliance on heating appliances. One Australian study found that a house with a concrete slab and insulated brick cavity walls had power bills 25 per cent lower than a timber-floored, brick veneer house of the same size.
- **Heat conductivity:** A concrete slab in a north-facing room can absorb and store lots of heat, provided it is uncovered (that is, no carpet, though ceramic and slate tiles are fine) and has an insulation layer underneath. (As a point of interest, adding a brick or stone feature in a place that will get direct sunlight has the same effect, releasing stored heat as the interior temperature drops.)
- **Length of exposure to sun:** A material with thermal mass needs between three and six hours' exposure to the sun's heat to work properly. Direct sunlight is twice as effective as diffuse light.
- **Colour:** The colour of the material (the darker the better – think how white surfaces reflect light and are cool, while black surfaces absorb light rapidly and heat up). White roofs are also beginning to be encouraged as it can lower the temperature in a building in summer. www.whiteroofs.org.nz

Warmer weather

Understandably, you might imagine that a house with so much thermal mass would overheat in summer. But the sun is higher in summer than winter, so the summer sun's rays do not penetrate as deeply or for as long into the house. Eaves and shading devices will provide extra protection. In addition, a good architect will ensure window sizes are matched to the thermal mass of the house, further minimising the chances of overheating. However, materials with thermal mass work in your favour even in summer. That's because they absorb heat in the air inside the home, providing a cooling effect during a hot day.

Passive ventilation measures are best worked in at the design stage. Examples are louvred windows, clerestorey windows and skylights (which add to solar gain as well as improving ventilation). Cross-ventilation is about the arrangement of doors and windows so as to allow the easy flow of air. Windows and doors should be located and open in the direction of the prevailing summer wind. This natural ventilation should ensure your need for fans and air-conditioning is minimal.

Simplicity

A last word about the design of your house: consider the day-to-day needs of your family rather than building for the occasional visit of friends and relatives. And keep the design simple. A complicated layout will be more expensive to build and probably to heat, too.

More information

For further information, contact the council's eco-design advisor on 570 6666 – a source of free, independent advice on how to include sustainable features in your building or renovation project

Useful links:

- Hutt City Council (www.huttcity.govt.nz)
- Eco-Design Advisor (www.ecodesignadvisor.org.nz)
- Smarter Homes (www.smarterhomes.org.nz)
- Sustainable building authority Level (www.level.org.nz)
- Energy Efficiency and Conservation Authority (www.eeca.govt.nz)
- Building Research Association of New Zealand (www.branz.co.nz)
- Ministry of Business, Innovation and Employment (www.dbh.govt.nz)