Fact sheet

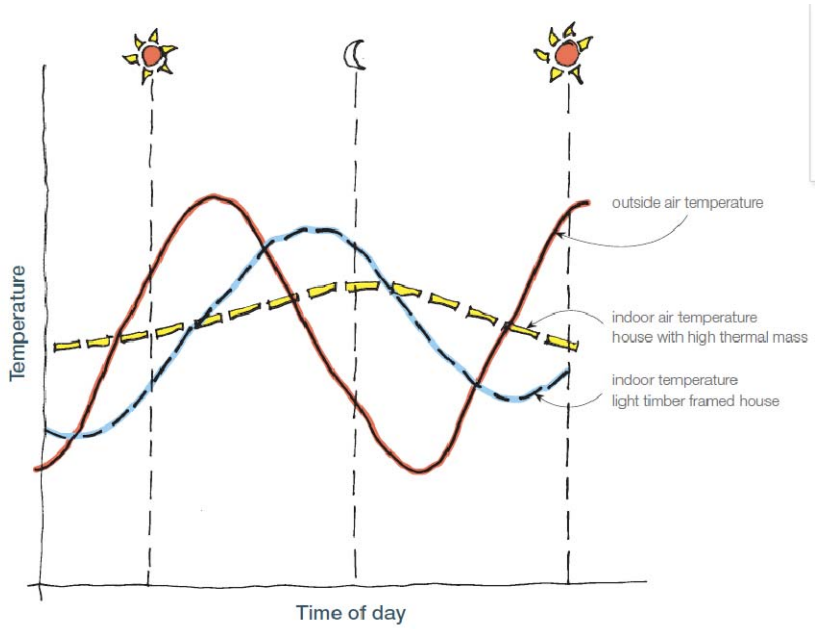
Thermal mass

In this Fact sheet:

- How can thermal mass be incorporated into a house
- Do's and don'ts of thermal mass

The term 'thermal mass' describes the ability of materials to absorb, store and release heat. The best thermal mass materials are those that are dense, such as concrete, brick or stone. They work by using a simple principle of physics: that heat moves from warmer areas to cooler areas. These materials absorb and store the heat from direct sunlight and heated indoor air. Then at night when the air temperature drops, the heat will radiate from the warmer thermal mass to the cooler air and other surfaces in the room. Meanwhile, in summer when the air temperature is warmer than the thermal mass, the floor or wall draws the warmth from the surrounding air, cooling the room.

By absorbing heat during warm parts of the day and radiating it out when it is colder, thermal mass acts to prevent large changes of indoor temperature as the outdoor temperatures rise or fall. It can help maintain uniform comfortable temperatures inside a home year round.



Source: www.level.co.nz

Because thermal mass is such a great conductor of heat, insulation is critical. Without insulation, thermal mass can make a home colder by moving the warmth from inside the home to the cooler air or ground outside.

How can thermal mass be incorporated into a house?

You can include thermal mass in a number of ways but the most typical is within a floor or wall. An insulated solid concrete slab on the ground is the most commonly found example of a thermal mass floor, although you can also use concrete blocks, bricks, rammed earth or stone. The surface can be polished or tiled but, because you need direct exposure to heat for thermal mass to work, it is best left un-carpeted. If you don't want the entire floor exposed, a strip of insulated thermal mass material along the sunny side of a room – for example, a metre or so wide - can also work well.

Brick, concrete, concrete block (including insulated and aerated types) and rammed earth can be used for walls if they catch the sun or are close to a radiant heat source (such as a wood or pellet burner).

There are other options including:

- a trombe wall - a north-facing heavy wall made of concrete or some other thermal mass material, located behind a layer of glass. The heat takes several hours to travel through the wall before it is released into the home's living areas in late afternoon or early evening as the temperature starts to fall.
- a conservatory – use thermal mass in the floor of a north-facing conservatory, or in the wall separating the conservatory from the main part of the home.
- a gabion basket - low wire or metal baskets containing rocks, placed behind glazing. Gabions can be used as internal window seats or feature walls.

Do's and don'ts of thermal mass

1. DO insulate the thermal mass to stop heat loss into the outside air and ground. For a concrete slab floor, insulate both underneath and around the slab edge with a minimum of 50mm 'S grade' expanded polystyrene (EPS) board. Install this over the damp proof membrane prior to the slab being poured. For a thermal mass wall with an external face (including into uninsulated garages), insulate the EXTERNAL surface to prevent heat loss and leave the INSIDE face exposed to the sun or heat (ideally without internal lining, although it can be plastered, painted or papered).

2. DO ensure your thermal mass floor or wall will be exposed to direct sunlight in winter - the north side of the house is generally best. Alternatively, you can use thermal mass near a wood burner, heater or other source of radiant heat.
3. DON'T use thermal mass in cold unheated areas, south-facing rooms, or away from the winter sun.
4. DO calculate the correct thickness for optimal performance. A good rule of thumb for New Zealand climates is that concrete slab floors should be 100-200mm thick for the best performance, while thermal mass walls should be 100–150mm thick. Too thick and the wall and floors will take too long to heat. Too thin and they won't store enough heat.
5. DON'T cover thermal mass floors as carpet, rugs, lino, cork or timber coverings will not let the heat through. However, you can cover areas of the floor which do not receive direct sunlight.
6. DO ensure all rooms which are heated through thermal mass are well insulated – we recommend insulating to above minimum Building Code levels.
7. DO ensure the house is designed to let through cool summer breezes and is shaded from hot summer sun to prevent the thermal mass absorbing and releasing too much heat in summer.
8. DO remember that concrete will not perform at its best until it has dried out. Drying time will vary depending on humidity and thickness. A 100mm thick slab can take four months to dry out (longer in winter), and thicker slabs will take longer.

Tips to take advantage of this free warmth

- Make sure the area where the sun warms the concrete is exposed to as much sun as possible.
- Do not cover the floor with carpets, rugs etc (or only cover parts of the floor that don't get the sun). Tiling these areas is not a problem.
- Make sure the windows aren't shaded while the sun is out during cooler months of the year.
- Close the curtains when the sun goes down during the cooler months of the year.
- Use ventilation to ensure your home doesn't over-heat as warm air is released from the concrete.

For more information:

- See Fact sheets on
  - Passive solar design
  - Keeping cool
  - Keeping heat in: Insulation
- The Level website has a useful section on thermal mass - www.level.org.nz/passive-design/thermal-mass/
- The Australian Government site, Your Home, has a section on thermal mass in its technical manual: www.yourhome.gov.au/technical/fs49.html