



ENERGY-EFFICIENT HOMES



FACTS FOR DESIGNERS & BUILDERS



Bricks Are a Natural Part

“Consumers are increasingly aware of energy-efficient house design.”

Bricks have long been accepted as Australia’s preferred building material. Almost 90 percent of new houses are built in brick.

In recent years, community, industry and regulatory attention has focused on reducing energy use in all its forms. The Building Code of Australia and state regulations require new houses to achieve energy-efficiency goals.

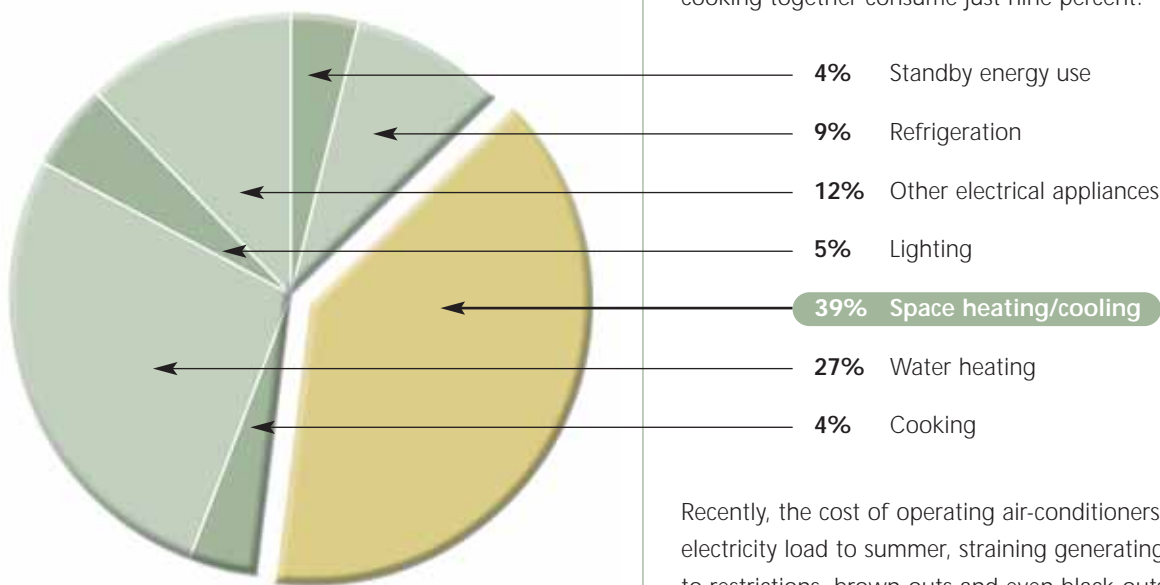
Consumers are increasingly aware of energy-efficient house design. It has emerged as a marketing issue and is used by many designers and builders to differentiate their product.

The selection and application of building materials plays a central role in the design, construction and operation of an energy-efficient house.

Where is the energy used in housing?

A study conducted by The University of Newcastle (more about this later) has established that over 90 percent of the energy consumed in the lifetime of an average house goes into its day-to-day operation.

According to the Australian Greenhouse Office, a massive 39 percent of the day-to-day energy consumed in an average Australian household goes into heating and cooling. By comparison lighting and cooking together consume just nine percent.



Energy use in the average Australian home

*(from Australian Greenhouse Office
www.greenhouse.gov.au/yourhome/technical/pdf/fs40.pdf)*

Recently, the cost of operating air-conditioners has shifted the peak electricity load to summer, straining generating resources and leading to restrictions, brown-outs and even black-outs.

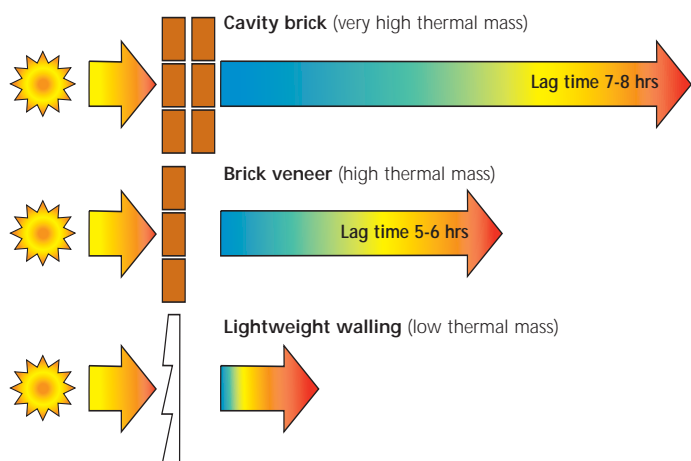
Obviously any measures that will reduce heating and cooling costs will benefit consumers and the community. Combining relatively stable internal temperatures with energy efficiency is achievable with current and well-established building technology.

of Energy-Efficient House Design

Can energy efficiency be designed into a house?

Passive design is the most practical method of designing a house to reduce our dependency on artificial heating and cooling. It has four principles that work together to manage the sun's energy, summer and winter.

- **Orientation** Large glass areas on the northern elevation allow the low winter sun to penetrate and warm the interior. Shading, such as broad eaves, blocks the higher summer sun.
- **Ventilation** Once the peak of the summer's day has passed, ventilation allows air to enter and leave the building (cross-ventilation), cooling it – and its occupants – naturally.
- **Insulation** Wall and ceiling insulation creates a barrier to the movement of heat. Insulation's effectiveness is measured by its R-value (the 'R' stands for resistance). The higher the number, the greater the insulation factor. Most common insulated wall types have similar R-values.
- **Thermal mass** This factor is frequently overlooked, even though it is regarded as an essential component of passive design by authorities such as the Australian Greenhouse Office and the US Department of Energy (see over). Dense wall materials such as bricks, absorb and store heat, slowing its passage through a wall. The time taken for heat to pass through a wall is called its 'lag time'. Lightweight walls such as fibro, weatherboards and corrugated iron have little or no thermal mass, and consequently very short lag times. Brick walls have much longer lag times.



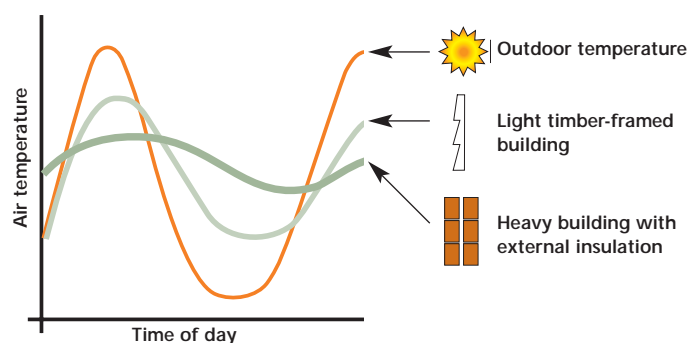
Brick walls are more able to moderate temperatures than lightweight walls.

How does thermal mass work?

Thermal mass is the capacity of a material to retain heat energy when it experiences a temperature differential. Brickwork's unique combination of thermal capacitance and moderate heat conduction makes it an extremely effective 'thermal battery'.

Heat is not a static property. It flows between hot and cold surfaces and through conducting materials. Brickwork is an efficient heat conductor that transfers heat at a moderate rate. In contrast, glass for example, conducts heat very rapidly.

On a hot day, brickwork can slow the passage of heat from the outside for up to eight hours by storing it in its mass. Before the heat reaches the interior, the peak of the day has passed, the outside cooled and the stored heat starts to flow back out (heat flows from hot to cold). In winter, internal mass absorbs, stores and slowly releases any heat generated internally or gained through the day.



Source: *Your Home, Technical Manual, sec 1.7, Australian Greenhouse Office*

What about R-values?

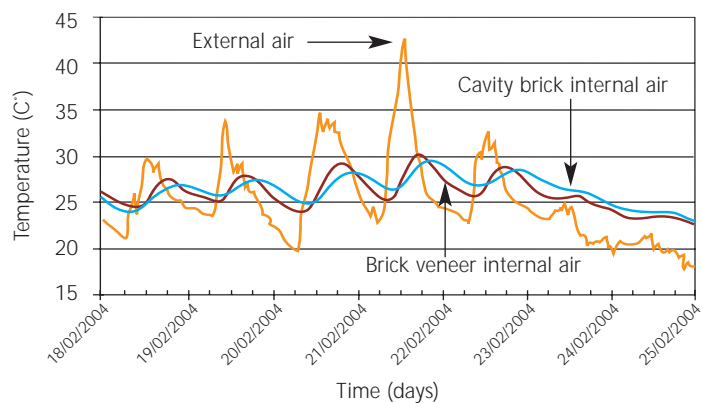
Thermal mass is a very different quality to the insulation value. R-values tell only part of the story. The R-value is a laboratory measurement and does not effectively measure the beneficial effects of thermal mass as it only measures one thermal property.

Focusing on the R-value to the exclusion (or minimisation) of other thermal factors such as air leakages, thermal bridging, conductivity and thermal mass, will reduce energy efficiency.

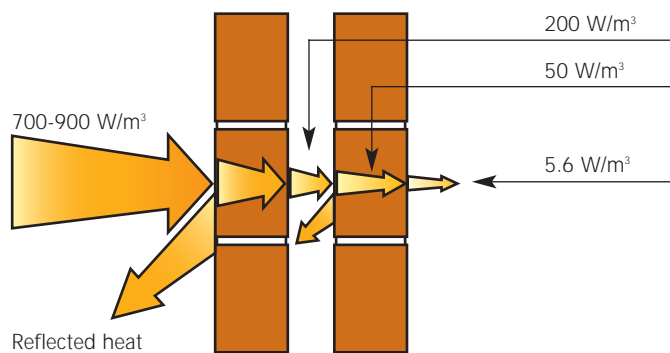


How effective is thermal mass?

An ongoing long-term study* at The University of Newcastle has shown that high thermal mass is very effective in moderating internal temperatures all year round. This chart shows results from this study taken during a summer heatwave, graphically demonstrating that external temperature fluctuations are moderated by brickwork to a range more consistent with human comfort.



The study also shows that only a small proportion of heat striking a typical west-facing wall enters the building directly through the wall. Most is reflected and some is absorbed into the brickwork, leaving less than one percent with the potential to penetrate the wall.



How do you build-in thermal mass?

Thermal mass requires just that: heavy-weight materials. By definition, lightweight walls don't have the necessary mass. A simple and economical means of building mass in a wall is with brick. Clay bricks have a very high thermal mass potential and can be used to build an energy efficient house, cooled naturally by smart design.

What effect does colour have?

Wall colour affects the material's ability to absorb solar energy. This is a function of the material colour. This property of 'solar absorptance' is recognised in the Building Code of Australia and New South Wales' BASIX energy rating system.

The lighter the colour, the lower the solar absorptance. Therefore in hot climates light colours will assist in reducing absorptance, whereas darker colours may be beneficial in cooler climates. Austral Bricks is progressively publishing solar absorptance indices for all products on its website (www.australbricks.com.au).

What about embodied energy?

Embodied energy refers to the energy required to manufacture a house, from the acquisition of raw materials through to construction. All materials use energy in their manufacture, and brick is no exception.

But that's where the story ends, at least for bricks. Unlike most building materials, brick does not require finishes such as paint or galvanising, to maintain its finish. (Paint manufacture is very high in energy consumption.) Bricks can also give you a lifetime of benefits.

Bricks have the potential to last virtually forever. They are one of the few materials that when reused, retain their original qualities.

Life-cycle studies[†] at the Centre for Sustainable Technology at The University of Newcastle, have shown that over the lifecycle of a typical house "utilisation energy had the greatest environmental impact over the life of the house, accounting for more than 90% of energy consumption and greenhouse emissions." The researchers went on to say "the materials of construction have only a very small impact on the overall resource energy and greenhouse emissions."

Therefore, it is important to use materials that will help a building use less energy over its lifetime. This factor is possibly becoming even more pronounced, particularly as our dependence on artificial cooling grows.

Downloads

* www.cbpi.com.au/resources/research/research-paper-18.pdf

† www.cbpi.com.au/resources/general/lca-fact-sheet.pdf



Building in brick – it's only natural

1. Over 90 percent of a household whole-of-life energy is consumed in day-to-day living (utilisation).
2. Heating and cooling is the largest energy component of household utilisation.
3. Passive design helps manage natural forces to reduce our dependency on artificial heating and cooling.
4. Insulation's R-value tells only a small part of the energy-efficiency story of a wall.
5. Thermal mass has an important role in all good passive design.
6. Brick walls have a high thermal mass. Lightweight walls, whatever their R-value, cannot provide this benefit.
7. Clay bricks are an effective and economical way to build thermal mass into a wall.

Bricks have long been renowned for their blend of good looks, strength, economy and durability. Adding energy efficiency to this equation ensures that 'bricks and mortar' will remain Australia's favourite investment.





^{your}Home

What Do the Authorities Say?

Thermal mass acts as a 'thermal battery'. During summer it absorbs heat, keeping the house comfortable. In winter the same thermal mass can store the heat from the sun or heaters to release it at night, helping the home stay warm.

(www.greenhouse.gov.au/yourhome/technical/fs17.htm)

Clay brickwork has high thermal mass. If a building with internal clay brickwork walls and concrete floors is subjected to a heating and cooling cycle that crosses the comfort zone, the brickwork and concrete will maintain a stable level of heat energy for an extended period. In summer, they will remain relatively cool and in winter, the same building will remain relatively warm.

(www.greenhouse.gov.au/yourhome/technical/fs34g.htm)



California Energy Commission "What truly sets a passive design home apart from a standard tract home is thermal mass. If solar heat is to be used when the sun is not shining, excess heat must be stored. Everyone has leaned against a sun-warmed brick or stone. It's warm and comfortable and takes a while to cool off. That's thermal mass."

(www.consumerenergycenter.org/homeandwork/homes/construction/solardesign/thermal.html)



US Department of Energy "Thermal mass stores heat by changing its temperature, which can be done by storing heat from a warm room or by converting direct solar radiation into heat. The more thermal mass, the more heat can be stored for each degree rise in temperature."

(www.eere.energy.gov/consumer/your_home/designing_remodeling/index.cfm/mytopic=10260)

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