Every building material comes with an environmental cost of some sort. However, some principles can help guide your choice of sustainable materials and construction systems. Careful analysis and selection of materials and the way they are combined can yield significant improvements in the comfort and cost effectiveness of your home, and greatly reduce its life cycle environmental impact.

The first step in any strategy to use sustainable materials is to reduce the demand for new materials. Rather than knocking down and rebuilding a home, it’s worth trying where possible to renovate or at least reuse materials from the existing home. Consider building smaller, well-designed houses and minimising wastage by using prefabricated or modular elements, for example, and by avoiding unnecessary linings and finishes. During design and construction, incorporate approaches that will make it easier to adapt, reuse and eventually dismantle the building. By choosing durable, low maintenance materials, you can minimise the need for new materials and finishes over the building’s lifetime.

The next step is to select materials with low environmental impact. Put simply, a ‘sustainable’ material is one that does not impact negatively on non-renewable resources, the natural environment or human health. Most products have a net-negative impact on the environment; however, it’s important to minimise the negative impacts of any materials you choose. When looking at the environmental impact of a material or product, consider all stages of the life cycle — the upstream stage (materials extraction and manufacture), the in-use or operational stage, and the downstream stage (disposal or reuse).

Life cycle assessment (LCA) is a highly detailed scientific analysis that examines all the life cycle impacts of a product in great detail. An LCA quantifies the majority of known chemical, physical, resource-based and energy impacts of a material or product. It provides us with increasingly more comprehensive and useful assessments of the sustainability credentials of products and materials, allowing better and easier comparisons between products.

Although some progressive housing companies and developers are starting to embrace LCA, a customised LCA may be beyond the scope of many home building or renovation projects. Selecting products with low life cycle impact can be complex as there are many issues to take into account. However, there is decision-making support available.

Eco-product selection databases such as Ecospecifier enable you to access information on the sustainability credentials of a broad range of materials and products. Product assessment schemes, many of them based on LCA, allow you to make even more informed comparisons. These include Ecospecifier Verified, BREEAM’s Green Guide and Global GreenTag. Linked to such assessment schemes is a range of ecolabels including Good Environmental Choice Australia (GECA), Global GreenTag® and the FSC (Forest Stewardship Council).

The articles in this section cover different types of construction systems and materials. Each reviews the benefits of the particular system or material but also lists things to watch out for, such as construction issues.

Informed decisions about materials and construction systems can significantly reduce the environmental impact of a home without adding to the cost.
Materials

Embodied energy

Embodied energy is the energy consumed by all of the processes associated with the production of a building, from the mining and processing of natural resources to manufacturing, transport and product delivery. Embodied energy does not include the operation and disposal of the building material. This would be considered in a life cycle approach. Embodied energy is the ‘upstream’ or ‘front-end’ component of the life cycle impact of a home.

Choices of materials and construction methods can significantly change the amount of energy embodied in the structure of a building, as embodied energy content varies enormously between different materials. However, assessing the embodied energy of a material, component or whole building is often a complex task. Another significant factor in reducing the impact of embodied energy is to design long life, durable and adaptable buildings.

Waste minimisation

Around 42% of the solid waste generated in Australia is building waste. A lot of energy and resources go into the manufacture and transport of materials used to construct a home, yet eventually most of these materials end up in landfill. Minimising and recycling waste can have significant social, economic and environmental benefits.

The ‘three Rs’ of waste minimisation — reduce, reuse, recycle — should be applied throughout the design and construction process: reduce (or avoid) demand for materials by renovating rather than demolishing and rebuilding, and building smaller homes that are better designed for your needs; reuse existing materials or building components; and recycle materials rather than sending them to landfill.

Construction systems

The combinations of materials used to build the main elements of our homes — roof, walls and floor — are referred to as construction systems. They are many and varied, and each has advantages and disadvantages depending on climate, distance from source of supply, budget, maintenance requirements and desired style or appearance. Important factors that may influence your choice of construction system include its durability, life cycle environmental impact, life cycle cost effectiveness, role in improving thermal performance, and reuse or recycling potential, as well as local availability of materials and skills needed to construct the system.

Lightweight framing

Lightweight framed construction is the most popular construction system in Australia. Steel and timber, the two most commonly used framing materials, can contribute to the comfort, appeal and environmental performance of a home. By assessing environmental impact, structural capability, thermal performance, sound insulation, fire resistance, vermin resistance, durability and moisture resistance, owner builders can come to a decision on what is the best option for their situation.

Brickwork and blockwork

Bricks and blocks are components of durable masonry construction. They consist of high mass materials with good compressive strength formed into units that can be lifted and handled by a single worker. Materials used can include brick, stone (e.g. marble, granite, travertine, limestone), manufactured stone, concrete, glass, stucco and tile. They vary in environmental impact, structural capability, thermal performance, sound insulation, fire resistance, vermin resistance, durability and moisture resistance. Of the many kinds of bricks and blocks used in modern Australian house construction the most common are made from concrete or clay.
Cladding

Cladding is a non-loadbearing skin or layer attached to the outside of a home to shed water and protect the building from the effects of weather. Your choice of cladding has significant implications for the environmental performance of your home. Initial environmental impacts such as embodied energy, resource depletion and recyclability must be balanced against maintenance and durability appropriate to life span. Many different cladding options are available, some best suited to specific applications.

Concrete slab floors

Concrete slab floors come in many forms and can play a significant role in thermal comfort due to their high thermal mass. Slabs can be on-ground, suspended, or a mix of both. Often a slab will need insulation in order to perform satisfactorily. Polishing or tiling a slab allows for better utilisation of its ‘thermal mass’. Conventional concrete is responsible for high greenhouse gas emissions, mostly from the production of Portland cement and the mining of raw materials. However, this impact can be significantly reduced through the use of cement ‘extenders’ (e.g. fly ash, ground blast furnace slag and silica fume), new cements (e.g. geopolymers, magnesium cements), and alternative forms of concrete (e.g. hempcrete).

Insulating concrete forms

Insulating concrete forms (ICFs) are proprietary modular units in the form of interlocking blocks or panels, made from polystyrene or polyurethane foam and filled with concrete. Substantial thermal mass and structural support is contained within easily stacked and joined insulation. The sealed nature of the construction and the high levels of insulation make these units particularly suited to projects seeking to achieve very high levels of thermal performance, and they have been used extensively in Europe for homes that meet the ‘passive house’ standard.

Autoclaved aerated concrete

Autoclaved aerated concrete (AAC) is concrete that has been manufactured to contain many closed air pockets. It is lightweight with a moderate embodied energy content and performs well as thermal and sound insulation, due to the aerated structure of the material and its unique combination of thermal insulation and thermal mass. AAC is light, does not burn, is an excellent fire barrier, and is able to support quite large loads. It is relatively easy to work with and can be cut and shaped with hand tools. AAC comes in the form of blocks, storey-height wall panels, and floor or roof panels.

Precast concrete

Precast concrete offers durable, flexible solutions to floor, wall and even roof construction in every type of housing from individual cottages to multi-storey apartments. High initial embodied energy can be offset by its extended life cycle (up to 100 years) and high potential for reuse and relocation. Common production methods include tilt-up (poured on site) and precast (poured off site and transported to site). Each method has advantages and disadvantages, and choice is determined by site access, availability of local precasting facilities, required finishes and design requirements.

Mud brick

The ideal building material would be ‘borrowed’ from the environment and replaced after use. There would be little or no processing of the raw material and all the energy inputs would be directly, or indirectly, from the sun. This ideal material would also be cheap and would perform well thermally and acoustically. If used carefully mud bricks come close to this ideal. Basic mud bricks are made by mixing earth with water, placing the mixture into moulds and drying the bricks in the open air. Straw or other fibres that are strong in tension are often added to the bricks to help reduce cracking. Mud bricks are joined with a mud mortar and can be used to build walls, vaults and domes. With its low embodied energy, this ancient construction method has much to commend it.
Materials

Rammed earth
Rammed earth walls are constructed by ramming a mixture of selected aggregates, including gravel, sand, silt and a small amount of clay, into place between flat panels called formwork. Stabilised rammed earth is a variant of traditional rammed earth that adds a small amount of cement to increase strength and durability. Most of the energy used in the construction of rammed earth is in quarrying the raw material and transporting it to the site. Use of on-site materials can lessen energy consumed in construction. Rammed earth provides limited insulation but excellent thermal mass.

Straw bale
Straw has been used as a building material for centuries for thatch roofing and also mixed with earth in cob and wattle and daub walls. Straw is derived from grasses and is regarded as a renewable building material. Strawbale walls are surprisingly resistant to fire, vermin and decay. Finished straw bale walls are invariably rendered with cement or earth so that the straw is not visible. The final appearance of rendered straw bale can be very smooth and almost indistinguishable from rendered masonry, or it can be more expressive and textural.

Green roofs and walls
Green roofs and walls are building elements designed to support living vegetation in order to improve a building’s performance. Also known as ‘living’ roofs and walls, they are emerging as important additions to the palette of construction techniques for creating healthy, ecologically responsible buildings. They can contribute to thermal performance, stormwater management, biodiversity conservation and local food production. A green roof is a roof surface, flat or pitched, that is planted partially or completely with vegetation and a growing medium over a waterproof membrane. They may be ‘extensive’ and have a thin growing medium with groundcover vegetation, or ‘intensive’ and have soil 200mm deep or more supporting vegetation up to the size of trees. Green walls are external or internal vertical building elements that support a cover of vegetation that is rooted either in stacked pots or growing mats.

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