

Qualities of shade materials

This information sheet details the characteristics of a range of materials commonly used for shade structures:

- metal roof sheeting
- roof tiles
- timber
- concrete
- masonry
- expanded metal mesh
- perforated metal sheet
- glass
- polycarbonate sheeting
- fibreglass sheeting
- canvas
- teflon-coated fibreglass fabric
- PVC-coated polyester fabric
- knitted polyethylene (shade cloth)
- woven PVC-coated yarn (shade cloth)
- shingles.

Further information

For more information please visit www.cancercouncil.com.au/sunsmart

The information contained in this resource has been sourced from:

- The Cancer Council Western Australia. *The Shade Handbook; A practical guide for shade development in Western Australia*. Perth; The Cancer Council WA; 2007
- The Cancer Council Victoria. *Shade for everyone; a practical guide for shade development*. Melbourne: The Cancer Council Victoria; 2004
- Greenwood JS, Soulos GP, Thomas ND. *Under cover: Guidelines for shade planning and design*. Sydney; The Cancer Council NSW and NSW Health Department 1998

Metal roof sheeting

Steel, aluminium, zinc, copper

Suitability	Roofing and walling; steep or low pitches, curved and straight forms. Typically used for permanent fixed shade structures, although may be used as adjustable louvres. Most suited to summer shading where cool shade is required.
UV radiation protection	Excellent protection, UPF 50+.
Waterproof	Yes.
Light transmission	Opaque.
Solar heat gain	Thermal resistance if insulated. Lighter colours reflect heat.
Structural implications	Adequate 'tie-down' must be designed according to the wind code. Consult professional designer.
Ease of replacement	Material readily available; easily re-fitted.
Maintenance requirements	Subject to moisture or condensation conditions. Ensure all metallic particles are swept from roof on completion of installation to prevent staining and corrosion.
Life span	Long life if well maintained. Fixings and flashing material should have a lifetime similar to that of the roof covering material.
Particular properties	Strongest of roof and wall materials available. Long lengths and range of 'profiles' available. Can be cut to length. Some profiles can be curved. Available in sandwich panels for increased insulation. Is often finished/coated to extend life span, eg. galvanised, Colourbond, stainless steel, or coated with plastics, eg. PVC.
Environmental considerations	Long life spans mean less environmental impact in terms of material replacement. However, they need considerable support structure. Made from non-renewable resources. All high embodied energy although to differing degrees, aluminium is extremely energy intensive. All produce pollutants during manufacture (including coatings) but are generally contained. All are recyclable: steel and aluminium are commonly recycled and often contain recycled content. The potential of steel, copper and aluminium to be re-used is very good, especially if designed for disassembly. Steel and aluminium are good for collecting rainwater if properly sealed. The corrosion of copper and zinc may cause contamination of nearby water and soil.
Relative cost	Economic for both small and large structures. Timber or steel frame required for support.

Roof tiles

Concrete, clay, slate, fibre cement

Suitability	Mainly roofing. Typically used for permanent fixed shade structures. Most suited to summer shading where cool shade is required.
UV radiation protection	Excellent protection, UPF 50+.
Waterproof	Yes.
Light transmission	Opaque.
Solar heat gain	Better thermal performance if lined.
Structural implications	Requires substantial support structure. Must be fixed to manufacturer's specification.
Ease of replacement	Material readily available; easily fitted.
Maintenance requirements	Hard wearing requiring minimal maintenance.
Life span	Long. Fixings and flashing materials should have a lifetime similar to that of the roof covering material.
Environmental considerations	All tiles have impacts during manufacture, are made of non-renewable resources, and require a comparatively large volume of material. Using locally reclaimed tiles lessens these impacts. Slate has the lowest manufacturing impacts, however it is usually imported, which increases its embodied energy, reclaimed slate is preferable. Clay has high embodied energy; however this may be offset by long life use, as it is more durable than concrete. Concrete tiles with slag instead of cement are preferable.
Relative cost	Low, but support structure cost may be significant.

Timber

Suitability	Pergolas, trellis, lattice, screens, vertical or horizontal louvres. Suitable for use in combination with natural shade elements. Generally used in fixed permanent structures.
UV radiation protection	Solid sections provide excellent protection, UPF 50+. Other situations depend on density of construction, eg. lattice or covering vegetation.
Waterproof	Depends on detailing and use.
Light transmission	Depends on detailing.
Solar heat gain	Does conduct heat, but this is lessened in open air situations.
Structural implications	Design for appropriate wind code.
Ease of replacement	Usually readily available; ease of re-fitting depends on type of construction.
Maintenance requirements	Guard against termites. If using preserved or treated timber, care must be taken in handling. Painting or other protective treatment will extend life span.
Life span	Longevity will depend on: ongoing maintenance and servicing; types of treatments; grade of timber used; type of timber, eg. hardwoods/treated softwoods, as well as its detailing (how it is fixed).
Particular properties	Available in a wide range of sizes and strengths. Can also be in sheet form, eg. plywood.
Environmental considerations	<p>Timber is a renewable resource but only if forests are managed correctly. It generally has low embodied energy (depending on transport energy) but some wastage to produce building materials. The main issue with timber and environmental impact is its sourcing – preference should be given to sustainably managed forests or plantation resources. Timbers with the longest life span are hardwoods that are often unsustainably harvested.</p> <p>Look to use recycled/reclaimed timbers. Treatments which extend life span for timber are often highly toxic, especially copper chrome arsenic (CCA). As ammoniacal copper quaternary (ACQ) has less heavy metals than CCA, it is preferable; both treatments mean that timber cannot be burnt. Use of hardwoods can avoid this environmental problem, however they are often from old growth forests. Life span can be extended beyond its initial use by keeping pieces in long lengths and designing for disassembly. For plywood sheeting, ensure facing is a sustainably grown local product and specify marine grade; other grades have higher volatile organic compounds in glues.</p>
Relative cost	Depends on design lengths, proposed usage, etc. Readily available, economical material.

Concrete

Precast or in situ, concrete blocks, autoclaved aerated concrete, fibre cement sheet

Suitability	Walls, roofs, louvres, sunhoods. Suitable for permanent fixed structures.
UV radiation protection	Excellent protection, UPF 50+.
Waterproof	Yes.
Light transmission	Opaque.
Solar heat gain	Absorbs heat slowly and re-transmits as air temperature falls.
Structural implications	Requires substantial support and footings.
Ease of replacement	Materials readily available; re-fitting depends on form of material – large precast units and cast in situ forms, eg. suspended reinforced concrete slabs, are very difficult to replace; smaller pre-manufactured units, eg. fibre cement sunhoods or block walls, easily replaced.
Maintenance requirements	Low
Life span	Long
Particular properties	Flexible material in many forms. Slow heat absorption.
Environmental considerations	Uses a high volume of material with high embodied energy. Concrete (precast, in situ or blocks) can be used as a thermal mass. All finite resources – scarcity is becoming an issue in some localities. Production of the critical ingredient (cement) is major contributor to CO ₂ emissions (also nitrous oxides and sulphurous oxides emissions). Concrete aggregates may be supplemented with slag to reduce overall impact. Large volumes of water required in manufacturing/construction. Possibility for down-cycling (the recycling of material into a material of lesser quality).
Relative cost	Low, but cost of support structures may be significant required for support.

Masonry

Clay bricks, rammed earth, mud bricks, straw bale

Suitability	Walls. Suitable for permanent, fixed structures.
UV radiation protection	Excellent protection, UPF 50+.
Waterproof	Yes.
Light transmission	Opaque.
Solar heat gain	Absorbs heat slowly and re-transmits as air temperature falls.
Structural implications	Requires substantial support and footings.
Ease of replacement	Materials readily available; re-fitting usually straightforward.
Maintenance requirements	Low
Life span	Generally long; rammed earth and straw bales durable if protected by eaves.
Particular properties	Slow heat absorption. Straw bales have a far less thermal mass than others.
Environmental considerations	Made from finite resources (although not scarce), these materials can also be used as an energy store. As walling, these materials use a high volume of material. Locally sourced natural stone, mudbricks, straw bale and rammed earth have extremely low environmental impact. More traditional clay bricks have impacts in manufacturing of high embodied energy, contribution to acid rain and the possible release of toxic gases. Re-used bricks or natural stone are therefore preferable and often available. Use soft mortar with clay bricks so that bricks can be re-used later.
Relative cost	Low, though substantial footings required.

Expanded metal mesh

Suitability	Adjustable or fixed screens and wind deflectors. Openable roofs and walls.
UV radiation protection	Forms an effective shield depending on the positions of the slit opening. depend on density of construction.
Waterproof	No.
Light transmission	Moderate transmission of light.
Solar heat gain	Barrier to direct solar radiation while allowing ventilation.
Structural implications	Can span quite large openings. Must withstand lateral forces. No uplift forces.
Ease of replacement	Readily available.
Maintenance requirements	Should be galvanised to ensure low maintenance.
Life span	Very durable. Affected by such things as coatings and hole size, eg. rust.
Particular properties	Depending on angle of mesh, will let air through.
Environmental considerations	Non-renewable, however it could contain a percentage of recycled content. No waste material in production as it is made from one continuous piece of metal. Requires less structural support than solid sheet metal and uses a low volume of material. Usually made from steel, also can be made from aluminium (which requires more energy to produce) and copper (which has some problems with nearby soil and water contamination). Different finishes usually applied pre-purchase; often galvanised, plastic coated, eg. PVC, or painted. Can be recycled and re-used, especially if designed for disassembly.
Relative cost	Low.

Perforated metal sheet

Suitability	Screens, awnings and sunhoods. Used for both permanent and adjustable systems.
UV radiation protection	Varies as only solid sections provide barrier to UV radiation.
Waterproof	No.
Light transmission	Modulates light.
Solar heat gain	Cuts direct solar radiation and allows ventilation.
Structural implications	Must be strong enough to span required opening.
Ease of replacement	Readily available; easily replaced.
Maintenance requirements	Should be galvanised. Pre-painted sheets require low maintenance unless in a highly corrosive environment.
Life span	Very durable. Specify for appropriate life span, ie. coatings and hole size to minimise rust.
Particular properties	Holes will allow air through.
Environmental considerations	Non-renewable, however it could contain a percentage of recycled content. Small amount of waste material in production. Requires less structural support than solid sheet metal and uses a low volume of material. Usually made from steel, also can be made from aluminium (which requires more energy to produce) and copper (which has some problems with nearby soil and water contamination). Different finishes usually applied pre-purchase; often galvanised, plastic coated, eg. PVC or painted. Can be recycled and re-used, especially if designed for disassembly.
Relative cost	Low.

Glass

Suitability	Roofs or walls. Use where light and/ or visibility is required. Generally permanent fixed structures.
UV radiation protection	Depends on thickness and type. Ordinary window glass offers little protection from UV radiation. Laminated glass can absorb almost all UVB; by contrast, toughened glass transmits some UVB. Additives during manufacture and reflective surface laminates can affect UV radiation penetration.
Waterproof	Yes
Light transmission	High depending on tint.
Solar heat gain	Less heat gain if tinted.
Structural implications	Talk to manufacturer to select glass appropriate to the job.
Ease of replacement	Usually readily available and easily re-fitted.
Maintenance requirements	Needs regular cleaning. Breakage and safety issues if not toughened or laminated.
Life span	Long life if it doesn't sustain impact or over-pressurisation.
Particular properties	Transparency allow wide range of uses, eg. Wind breaks.
Environmental considerations	High embodied energy although small volume of material required. Additives and coatings required to provide UV radiation protection made of Oxides of metals: iron, nickel, cobalt, silver halide which complicate the recycling of glass and may have disposal complications. Glass used in buildings is not currently recycled and has very little recycled component.
Relative cost	Reasonably high compared to other translucent materials. May require more sophisticated support structure.

Polycarbonate sheeting

Suitability	Roofing, walling, louvre systems, awnings, skylights and canopies. Typically used for permanent fixed shade structures, although could be used as adjustable louvres. Most suited to winter shading where warm shade is required.
UV radiation protection	Very high protection.
Waterproof	Yes.
Light transmission	High. Differs according to thickness, profile and colour. Clear or opal transmits more light and heat than darker tints.
Solar heat gain	High. Becomes warm and produces a heating effect.
Structural implications	Design structure for wind uplift.
Ease of replacement	Readily available; easily re-fitted.
Maintenance requirements	Low maintenance. Impact resistant.
Life span	About 10 years. Material may become brittle and discolouration may occur sooner than 10 years.
Particular properties	Long lengths; range of profiles and colours available.
Environmental considerations	The environmental problems associated with plastics such as polycarbonate sheeting occur in their manufacture and disposal – they cause fewer problems during construction and use. Toxicity during manufacture depends on the stabilisers used (which is what protects polymer from solar degradation so is necessary for shade provision). These are often environmentally dangerous (especially phosgene). Made from non-renewable resources, high embodied energy offset by low amount of material needed. Can be recycled, but generally down-cycled. Because of long life span and durability, potential for re-use is high; specify shapes/mouldings and support structures with this in mind. Will not decompose. Disposal is to landfill. Good for water collection. Requires less structural support materials.
Relative cost	Low.

Fibreglass sheeting

Teflon coated, silicone coated

Suitability	Roofing, walling, louvre systems, awnings, skylights and canopies. Typically used for permanent fixed shade structures, although could be used as adjustable louvres. Most suited to winter shading where warm shade is required.
UV radiation protection	Very high protection. Differing UV stabilisers and coatings will change level of UPF.
Waterproof	Yes.
Light transmission	High. Various tints, UV stabilisers and coatings will change level of light transmission. Clear or opal transmits more light and heat than darker tints.
Solar heat gain	High. Becomes warm and produces a heating effect.
Structural implications	Design structure for wind uplift.
Ease of replacement	Readily available.
Maintenance requirements	Low maintenance. Impact resistant.
Life span	Coatings (such as teflon/silica) protect the resin/glass fibres from weathering and will extend the life span, as will detailing. Weathering will gradually make material more opaque.
Particular properties	Fibreglass sheeting consists of glass fibres mixed with polymer resins. Can be bought in sheets or moulded for specific applications.
Environmental considerations	Material uses non-renewable resources. High embodied energy as well as problems with toxicity and volatile organic compounds in manufacture, although manufacturers are increasingly following best practice initiatives. Pollution and waste during manufacture depends on type of plastic resin and stabilisers used. Currently not recycled in Australia; re-use depends on design specifications, ie. whether bought in sheeting or hand-moulded.
Relative cost	Low.

Canvas

Or similar tightly woven cloths

Suitability	Good for adjustable, short-term fixed and demountable structures. Not suitable for large projects.
UV radiation protection	Good protection when new. Prolonged or severe weathering may reduce UPF.
Waterproof	Watertight up to saturation point. Greater protection can be achieved using coatings.
Light transmission	Lighter colours transmit greater light.
Solar heat gain	Darker colours gain more heat.
Structural implications	Guy ropes cause obstruction.
Ease of replacement	Readily available. Ease of replacement of individual panels usually means that the whole structure would need to be dismantled.
Maintenance requirements	Lacks self cleaning properties. Is not mould resistant. Life span can be extended by regular maintenance and proper drying to inhibit rotting. Will still retain strength even if partially affected by rot.
Life span	Limited. Susceptible to break down due to UV radiation exposure.
Particular properties	Wide range of colours and fabric designs; also wide range of proprietary products available using canvas.
Environmental considerations	Usually made from low grade (otherwise waste material) canvas, although can be made from hemp and flax. Renewable resource although high use of water, fertilisers and pesticides in production. Canvas (especially for outdoor application) usually finished with a waterproofing agent such as aluminium or plastic sprays such as polyurethane (which have high toxic volatile organic compound emissions) to extend life. Low volume of material in relation to area covered and low volume of structural support material needed. At end of life will degrade but aterproof coatings may cause leaching problems in landfills.
Relative cost	Material cost low, though some proprietary products may be relatively expensive on a square metre basis.

Teflon coated fibreglass fabric

(PTFE)

Suitability	Large span canopies – able to achieve lower curvatures than PVC coated polyester. Fixed permanent structures – not recommended for retractable systems or flat surfaces
UV radiation protection	Very high.
Waterproof	Yes.
Light transmission	Translucent.
Solar heat gain	Less heat gain if tinted.
Structural implications	Structures must resist wind loads, especially uplift.
Ease of replacement	Fully imported. Consider using smaller panels for ease of replacement in the case of damage and to ensure continuous use of the covered space.
Maintenance requirements	Beware of potential for water ponding in sudden downpours.
Life span	Very durable. Design life of 20 to 30 years.
Particular properties	More difficult to fabricate and erect than PVC polyester. Non-combustible - satisfies Building Code requirements for fire protection in enclosed spaces, eg. shopping malls. Resistant to UV radiation exposure and airborne pollution.
Environmental considerations	Non-renewable resource. High embodied energy in production. Low volume of material needed in relation to area, and minimal support structures. Toxicity in production, though is generally contained. Cannot be incinerated or recycled, usually goes to landfill where there may be some problems with leaching.
Relative cost	About two to three times the cost of PVC coated polyester fabric structures.

PVC coated polyester fabric

Suitability	Canopies and side panels. Highly curved structures - not suitable for flat surfaces. Typically used for fixed permanent structures though can be retractable or demountable. Most popular material in use for construction of fabric structures.
UV radiation protection	Very good.
Waterproof	Yes.
Light transmission	High.
Solar heat gain	Heat transmission is similar to glass.
Structural implications	Structures must resist wind load, especially uplift.
Ease of replacement	Fully imported material, though readily available. Ease of re-fitting depends on use; 'structural' fabrics may require dismantling of structure for full replacement. Can be readily patched.
Maintenance requirements	High gloss self-cleaning surfaces.
Life span	Minimum 7-8 years in zones experiencing intense UV radiation. Effective life is very dependent on location and environment; in excess of 20 years likely in areas of low pollution. Pollution acts as a corrosive agent on PVC surface causing erosion. Vehicle emissions are among the worst polluting agents. Manufacturers usually provide 5 year guarantee.
Particular properties	Usually white or light cream in colour. Usually coated with clear Tedlar film which assists cleanability and prolongs the life of the PVC medium. Easy to work with. Fire resistant - fabric will char or holes will be formed if placed over a flame source but is not likely to ignite.
Environmental considerations	PVC and polyester are from non-renewable resources. Problems in production due to stabilisers/additives such as fire retardants, which may also leach in landfills. High pollution and toxicity during manufacture of PVC (though closed systems can minimise escape of dioxins). Support structure needed is minimal and volume of material is small in relation to the area covered. After use, product can be re-used unless is too degraded. PVC can theoretically be downcycled and polyester recycled, but combination of the two cannot be recycled. Both are thought to release dioxins in landfill.
Relative cost	Relatively expensive.

Knitted Polyethylene

(shade cloth)

Suitability	Proprietary products such as canopies and freestanding pavillions. Commonly used for shade in car yards or pergola covering.
UV radiation protection	UPF varies according to colour, fabric density and degree of stretch. Only the solid sections form a barrier to UV radiation. Typically, cover factors vary from less than 50% UV radiation protection to more than 90%. Shade cloths with a rating of 90% give only medium UV radiation protection or UPF 10. Double knits or double layers may give higher UPF. Use only fabric that provides 94% or greater protection from direct UV radiation.
Waterproof	Porous, lacks rain protection.
Light transmission	Lighter colours allow more light but reflect and scatter more UV radiation.
Solar heat gain	Darker colours are hotter but reflect less UV radiation.
Structural implications	Minimal down or uplift force due to porous nature of the material.
Ease of replacement	Readily available - many different sources and countries of origin. Re-fitting generally easy.
Maintenance requirements	Keep clear of tree debris to avoid sagging problems. Susceptible to mould growth and dirt pick-up.
Life span	About 5 years depending on location. It should be noted that shade cloth may be characterised by poor durability if used in a location that is subject to windy conditions. Prone to vandalism.
Particular properties	Easier to fabricate than solid fabrics. High strength fabric. Curved surfaces can be formed easily.
Environmental considerations	Non-renewable resource, made in Australia and imported. Contains no chlorides, however additives to ensure low flammability are often highly toxic and can emit volatile organic compounds. Short life span means regular replacement. Less structural material needed due to small weight. After use it is too degraded to be recycled and usually goes to landfill; it can be incinerated depending on additives. Easily transported. Not suitable for water collection/other uses.
Relative cost	Inexpensive. Cost of different cloths is directly proportional to quality.

Woven PVC coated yarn

(shade cloth)

Suitability	Adjustable and fixed systems, outdoor furniture and other proprietary products.
UV radiation protection	UPF varies according to colour, fabric density and degree of stretch. Only the solid sections form a barrier to UV radiation. Typically, cover factors vary from less than 50% UV radiation protection to more than 90%. Shade cloths with a rating of 90% give only medium UV radiation protection or UPF 10. Double knits or double layers may give higher UPF. Use only fabric that provides 94% or greater protection from direct UV radiation.
Waterproof	Porous, lacks rain protection.
Light transmission	Lighter colours allow more light but reflect and scatter more UV radiation.
Solar heat gain	Darker colours are hotter but reflect less UV radiation.
Structural implications	Minimal down or uplift force due to porous nature of the material.
Ease of replacement	Readily available, many different sources and countries of origin. Re-fitting generally easy.
Maintenance requirements	Keep clear of tree debris to avoid sagging problems. Susceptible to mould growth and dirt pick up.
Life span	About 5 years depending on location. It should be noted that shade cloth may be characterised by poor durability if used in a location that is subject to windy conditions. Prone to vandalism.
Particular properties	Easier to fabricate than solid fabrics. High strength fabric. Curved surfaces can be formed easily.
Environmental considerations	PVC is made from non-renewable resources. The type of yarn used may either be renewable or non-renewable. High toxicity during manufacture of PVC (though closed systems can minimise escape of dioxins). Its short life span means regular replacement and thus more material. Volume of materials is small in relation to the area covered. After use, this product is usually too degraded to be recycled. Not suitable for water collection/other uses.
Relative cost	Inexpensive. Cost is directly proportional to quality.

Shingles

Timber, fibre-cement

Suitability	Roofing and walling. Aesthetic suitability in some contexts. Fixed permanent structures.
UV radiation protection	Excellent protection, UPF 50+.
Waterproof	Yes.
Light transmission	Opaque.
Solar heat gain	Better thermal performance if lined.
Structural implications	Structural framework required.
Ease of replacement	Material may not be readily available; high degree of skill required.
Maintenance requirements	High. Shingles may require fireproofing treatments.
Life span	Long.
Particular properties	Available in timber, usually Western Red Cedar, or fibre-cement.
Environmental considerations	Timber shingles may be derived from a renewable resource (which depends upon timber source). They require little energy in manufacture, are biodegradable and able to be re-used. Fibre-cement products (both shingles and sheets) have relatively minimal environmental impact and are otherwise resource efficient. As fibre-cement products are durable they should be used in long life applications as their potential for re-use and recycling is poor.
Relative cost	Expensive, labour intensive to install.