SELECTING ROOF CLADDINGS

Given the many design and statutory requirements for roofing, and the large range of claddings available in today's market, how do we select the right roofing for a building?

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When deciding on a roof cladding, selection may be based on style, appearance, cost, durability, performance, environmental conditions or maintenance requirements. Roof cladding also needs to meet the requirements of New Zealand Building Code clauses B1 *Structure*, B2 *Durability*, C3 *Spread of fire*, E2 *External moisture* and F2 *Hazardous building materials*.

Roof pitch

One option on which to base selection is roof pitch. All roof claddings have a minimum permitted pitch – either the minimum recommended by the manufacturer, or as set out in E2/AS1 (see Table 1).

Based on minimum permitted pitch, roofs may be categorised as flat or low (which includes roof decks), medium and steep pitch (see Table 2).

Flat and low pitch roofs and decks

For low pitch roofs and decks (less than 3°), the only cladding option is a membrane roofing system.

MEMBRANE ROOFING SYSTEMS

Membrane roofing systems may consist of:

- sheet material with lapped side joints (roll-out sheets), or lapped side and end joints such as butyl rubber, polymer-modified bitumen sheets (PMBS), EPDM and PVC
- liquid-applied membranes (water- or solvent-based)
- a system built up on site such as mastic asphalt or polymer-modified mastic asphalt.

Two membrane roofing systems, butyl rubber and EPDM (see Table 1), comply with Acceptable Solution E2/AS1. They are permitted to be laid to a minimum slope of 1.5° for roofs and 1° slope for decking, but with conditions (see →

Table 1: Minimum roof pitch for roof claddings.

Roofing type	Profile/style	Minimum pitch	Conditions	E2/AS1 compliant
Membrane roofing and decking	EPDM butyl roof	1.5°	Roofs	✔
	EPDM/butyl deck	1.0°	Deck maximum area 40 m²; no steps (except into gutters), no integral roof gardens and no discharge onto deck	✔
	Polymer-modified bitumen /PVC/water- and solvent-based liquid membrane/ mastic asphalt	See manu-facturers specs.		✘
Profiled metal roofing (max. length = 18 m)	Corrugated	10°		✔
		8°	If no end laps	✔
	Trapezoidal	4°	Where crest height < 27 mm	✔
		3°	Where crest height > 27 mm	✔
	Trough	3°		✔
	Custom profiles (copper, zinc, aluminium, stainless steel)	3–10°	Dependant on profile, length of trays and local conditions	✘
Bitumen-impregnated organic fibre roofing	Corrugated	8°	12–15° min. recommended, with sheet end joints sealed	✘
Shakes and shingles (timber)		18°		✘
Shingles (asphalt)		10°	15–18° min. recommended	✘
Pressed metal tiles[1]	Standard	12°		✔
	Shake style	15°		✔
Masonry tiles[2] (to rafter length 4.5 m)	Concrete – type I	15°	With underlay	✔
		20°	Without underlay[3]	✔
	Concrete – type II	20°	With underlay	✔
	Concrete – type III	25°	With underlay	✔
	Terracota – type I	20°	With underlay	✔
		25°	Without underlay[3]	✔
	Terracota – type II	20°	With underlay	✔
	Terracota – type III	25°	With underlay	✔
Slate	Natural/man-made	25°		✘

[1] Pitch must be increased by 1° for each additional 0.5 m of rafter length over 12 m.
[2] Pitch must be increased by 1° for each additional 0.5 m of rafter length over 4.5 m.
[3] Roof underlay is required for any roof receiving discharge from a spreader.

Table 1). BRANZ recommends a minimum slope of 3° for membrane roofing.

SELECTION CONSIDERATIONS

Generally, membrane roofing systems are light-weight, provide good durability and can be readily patched if damaged. They can be used on curved roofs as well as low pitched roofs but should not be used in situations where the membrane will be permanently stretched or stressed.

They must be fully supported on construction ply or a concrete substrate and be installed by licensed applicators according to manufacturers' instructions. All roofing system components should be supplied by the same manufacturer. Some require recoating to maintain integrity and performance, the frequency of which depends on the product.

MEMBRANE THICKNESS

Sheet roofing membrane thicknesses range from 1.0–2.5 mm, except for polymer-modified bitumen, which may have a sheet thickness of up to 5.0 mm. Liquid membranes typically have a finished thickness ranging between 0.5–2.0 mm (depending on the number of coats, formulation and the reinforcing used). Mastic asphalt, applied as a hot-mix, aggregate-bound bitumen, is laid in two or three layers to give up to 40 mm total thickness.

Medium pitch roofs (3–10°)

For medium pitch roofs between 3° and 10°, the roofing options extend to include metal roofing.

METAL ROOFING

Corrugated, galvanised mild steel has a long history of use in New Zealand and has become a construction icon. However, it has largely been replaced by zinc/aluminium alloy-coated mild steel. Metal roofing materials include:

- zinc/aluminium alloy-coated mild steel (may be factory-paint finish or unpainted)
- galvanised (zinc-coated) mild steel (may be factory-paint finish or unpainted)
- aluminium
- copper
- stainless steel
- zinc
- lead.

Standard profiles include corrugated, trapezoidal or trough sections (see Figure 1). Custom profiles include a range of sections as well as flat, pressed or folded sheet finishes.

E2/AS1 sets out minimum pitches for corrugated, trapezoidal or trough profiled metal roofing only. An alternative solution must be used to demonstrate compliance with E2 for all other metal roofing profiles.

Table 2: Categories of roof pitch.

Category	Pitch
Flat or low	< 3°
Medium	3–10°
Steep	> 10°

CORROSION RISK

Corrosion is the primary issue with metal roofing. New Zealand's very high atmospheric salt content means that corrosion occurs almost everywhere in the country. Appropriate materials and finishes must be selected for the conditions – classifications include mild, moderate, severe, severe (marine), very severe (industrial and geothermal).

Another type of corrosion risk is incompatibility of different metals, e.g. when different roofing, roof fixings or flashing materials are in contact. When two dissimilar metals are in contact in a damp environment, electro-galvanic action will result in the corrosion of the metal that is higher on the galvanic table (see Figure 2). The greater the distance apart on the table two metals are, the greater the rate of corrosion. Corrosion will even occur when two metals are not in physical contact; if water passes over a metal that is lower on the galvanic table and then flows over another metal that is higher on the table, corrosion will occur.

METAL ROOFING – GENERALLY

Mild steel roofing requires protection as it is particularly susceptible to corrosion from atmospheric salts and pollutants. A protective coating, either zinc/aluminium alloy coating or galvanising (zinc coating) acts as a 'sacrificial' metal, that is, it will oxidise (corrode) over time but provide protection to the metal underneath. Paint may be applied after installation, or as a factory-applied finish that provides a low-maintenance coating until the end of its serviceable life (typically 15 years in severe environments and up to 30 years in mild environments).

Other metals are more resistant to corrosion because they:

- are less reactive metals (copper, zinc, lead)
- form a natural protective oxide layer (aluminium).

All metal roofing should be designed with sufficient fall to receive regular rain washing and avoid ponding. Annual cleaning will also help extend the life of metal roofing.

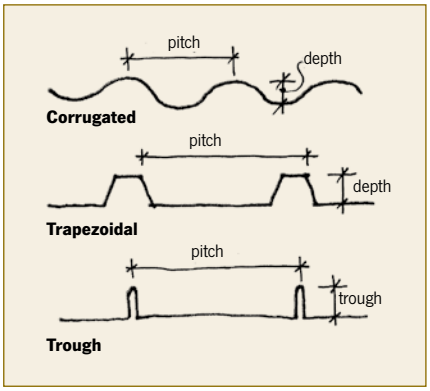

Figure 1: Metal roof profiles.

Figure 2: Galvanic series indicates the incompatibility of different metals.

Steep roofs (over 10°)

The options for roofs with pitches over 10° extend to include concrete and terracotta tiles, pressed metal tiles, shakes and shingles and bitumen-impregnated organic fibre roofing.

Table 3: Roofing selection chart.

	Suitable environments					Membrane roofing systems – application				Metal roofing profiles					BIOF[1] profile	Weight		Suitable substrates			Accessories			Colour/finish options			
Materials	Mild	Moderate	Marine	Severe marine/industrial	Geothermal	Single ply	Multi-ply	Liquid applied	Built up on site	Corrugated	Trapezoidal	Trough	Custom profiled	Pressed metal tile	Corrugated	Light	Heavy	Framing/purlins	Battens	Full support	Wide range	Limited range	None	Wide range	Unfinished/natural	Paintable	Protection from UV required
Membrane roofing																											
Butyl rubber	✔	✔	✔	✔	✔	✔										✔				✔			✔	✔		✔	
EPDM	✔	✔	✔	✔	✔	✔										✔				✔			✔		✔		
PVC	✔	✔	✔	✔	✔	✔										✔				✔			✔	✔		✔	
Modified PVC (VET)	✔	✔	✔	✔	✔	✔										✔				✔		✔		✔		✔	
Polymer-modified bitumen sheet	✔	✔	✔	✔	✔	✔	✔									✔				✔			✔			✔	
Water-based liquid membrane	✔	✔	✔	✔	✔			✔								✔				✔			✔	✔		✔	
Solvent-based liquid membrane	✔	✔	✔	✔	✔			✔	✔							✔				✔			✔			✔	
Mastic asphalt	✔	✔	✔	✔	✔				✔							✔				✔			✔				✔
Metal roofing																											
Zinc/Al alloy-coated mild steel	✔	✔								✔	✔	✔		✔		✔		✔			✔			✔	✔	✔	
Galvanised mild steel	✔	✔								✔	✔	✔		✔		✔		✔			✔			✔	✔	✔	
Aluminium	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔		✔		✔			✔	✔			✔	✔	
Copper	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔		✔		✔		✔	✔				✔		
Zinc	✔	✔	✔	✔	✔					✔	✔	✔	✔	✔		✔		✔		✔	✔				✔	✔	
Stainless steel	✔	✔	✔							✔	✔	✔	✔			✔		✔			✔				✔	✔	
Lead	✔	✔	✔	✔	✔								✔				✔			✔		✔			✔	✔	
Tiles																											
Terracotta	✔	✔	✔	✔	✔												✔		✔		✔			✔	✔		
Concrete	✔	✔	✔	✔	✔												✔		✔		✔			✔			
Slate	✔	✔	✔	✔	✔												✔		✔			✔			✔		
Pressed metal	✔	✔	✔													✔			✔		✔			✔			
Shakes and shingles																											
Timber	✔	✔	✔	✔	✔											✔				✔			✔		✔		
Asphalt	✔	✔	✔	✔	✔											✔				✔			✔		✔		
Bitumen-impregnated fibre	✔	✔	✔	✔	✔										✔	✔		✔					✔	✔		✔	

[1] Bitumen impregnated organic fibre cladding

MASONRY TILES

Concrete and terracotta tiles are extremely durable and provide very low maintenance roofing with warranties that may be up to 50 years depending on the manufacturer. Tiles can be used in all environments and for steeply sloping roofs. They are not suitable for curved roofs, and satisfactory installation on small roofs can be difficult to achieve. They should not be used where the roof is walked over regularly and, as a heavy roofing material, the roof framing must be designed accordingly.

Concrete tiles are available in a range of colours including two-tone effects. Terracotta tiles are also available in a range of coloured glazed finishes and natural clay colours depending on the clay used. Both concrete and terracotta tiles have a range of matching fittings and accessories.

Damaged tiles can easily be replaced. Maintenance of tile roofs involves occasional cosmetic cleaning to remove mosses or lichens, although tile performance is not affected by the growths. →

PRESSED METAL TILES

Pressed metal tile roofing is typically G300 grade zinc/aluminium alloy-coated mild steel with a natural stone chip protective coating or a prepainted finish. These roofs have properties very similar to metal roofing.

SLATE TILES

Most slate is imported, making it a relatively expensive roofing material. It is available as a natural or a man-made product, and its cost is directly related to the slate's quality.

Slate is laid progressively up the roof slope, with each row lapped over the previous one and the edge joint offset by half a slate, so there are three layers at any point on the roof. It is very low maintenance, and good quality slate will remain serviceable for many years.

TIMBER SHAKES AND SHINGLES

Timber shakes and shingles are very similar claddings. Shingles are sawn to produce a tapering thickness with relatively smooth front and back faces; shakes may be split and tend to have a more highly textured surface than shingles.

When the timber is suitably treated, or naturally durable timber is used, shingles and shakes provide a low maintenance roofing material. Their serviceable life depends on the environment – in damp conditions, they may need replacing in 7–10 years, but will last much longer in a drier climate.

Timber should be premium or No. 1 grade. Most shakes and shingles available in New Zealand are made from imported western red cedar, a timber popular in North America for its durability, low thermal and moisture movement properties, high strength to weight ratio and ability to be pressure-treated. New Zealand-produced timber is generally ACQ-treated radiata pine.

Although they can be laid to a minimum pitch of 18°, steeper pitches (25–30°) are recommended to shed water more effectively.

They require full substrate support (full sarking or close-spaced boarding) and underlay – either a:

- heavy kraft paper or impregnated roofing felt continuous underlay (for roof pitches over 30°), or
- heavy-weight building paper or wax-coated kraft paper for interleaving with shingles or shakes (for roof pitches under 30°).

ASPHALT SHINGLES

Asphalt shingles are manufactured from fibreglass-reinforced asphalt with a stone chip surface to create a very stable, durable material that gives a long serviceable life; heavier weight shingles have warranties of 25 years or longer.

They can be used in all environments as they are corrosion and rot resistant. They provide low maintenance roofing during their serviceable life, although lichen and moss removal may be required occasionally. Damaged shingles are easily replaced.

A 15–18° pitch is recommended as a minimum, although, with special installation procedures, they may be laid to pitches as low as 10°. They require full substructure support (plywood or close-butted horizontal boards). As roof valleys are easily formed by bending the shingles, they are well suited to complex roof shapes.

During installation, temperatures need to be at least 10°C or they can become brittle and crack easily.

BITUMEN-IMPREGNATED ORGANIC FIBRE ROOFING

Bitumen-impregnated organic fibre roofing is manufactured as a corrugated sheet material. It is a light-weight roofing material that is manufactured from organic fibres saturated with bitumen under intense pressure and heat. Although it can be laid on roof slopes as low as 8°, 12–15° minimum pitch is more typically recommended, and sheet end joints must be sealed.

It is corrosion and fume-resistant, economical, requires only simple tools for fixing, and its flexibility and light-weight gives planning and design freedom over many other roofing materials.

While it is available in a range of pre-pigmented colours, New Zealand's high ultraviolet levels means fading will occur over time, so painting is required to maintain the roofing colour.

There are many roof claddings on the market. Understanding their requirements is important to ensure an appropriate product is chosen for each building.