



GETTING THE SUBSTRATE RIGHT

For membrane roofing systems, the installation and quality of the substrate is critical to the performance of the membrane.

By Trevor Pringle, ANZIA, BRANZ Principal Writer

There is a long held belief in the building industry that, if you get the foundations right, the prognosis for the rest of the project is good. This saying also applies to some specific tasks carried out during construction, one being membrane roofing systems where the installation and quality of the substrate is critical to the performance of the membrane.

Typically, membranes are installed over plywood or concrete substrates. While there are subtle differences in substrate requirements between membrane types, the basic principles of the substrate design and construction are similar.

Design for minimum fall

The aim with a membrane roofing system is to ensure water is effectively drained from the roof and the roof remains durable.

Roof slopes are usually low, so installing the substrate accurately is critical to achieving the design fall. E2/AS1 considers that the minimum slope for a flat roof when completed should be 1.5° (1:40), but BRANZ recommends using a minimum slope of 3° to ensure efficient water drainage from the roof, particularly when:

- construction accuracy to achieve the minimum permitted falls may be difficult
- the roof area or supporting structure is large
- creep or settlement of the supporting structure may occur
- snow loads are likely
- the area is known for high rainfall intensities
- lapped joints create a damming effect.

To maintain this minimum fall, a prudent designer will:

- make allowance for deflection, sagging or settlement – maximising spans increases the risk of deflection under gravity loads, which can be sufficient to negate the fall provided
- allow a safety margin – achieving a 1.5° fall on site is difficult, so specifying an increase in slope will give the installer a safety margin
- identify the location of and detail the outlets and water drainage systems
- design falls into the framing – falls cannot readily be added later
- specify kiln dried framing (H3.1 treatment is required where the slope is 10° or less) and that it must be protected to keep it dry during construction
- specify the spacing of the framing – typically, most membrane suppliers require the plywood to be supported at 400 mm centres in each direction (framing that deflects when walked over is not rigid enough).



Figure 1: Getting falls correct before the membrane is laid is critical.

Plywood substrate installation

There are specific construction requirements for framing supporting plywood. Install any bowed timber framing with the bow facing up and reject any dodgy framing member. After framing installation, check that the upper surfaces are level or even across the joists, that all necessary blocking has been installed and that, when installed, the completed substrate will be at the specified slope. Finally, make sure the framing is protected from rain wetting.

PLYWOOD CHOICE

The specified minimum thickness for plywood is 17 mm – anything thinner is too flexible for the membrane. Plywood should be sanded and plugged, to a minimum standard of C-D.

CCA-treated (or other waterborne treatment types) plywood is typically recommended where H3 preservative-treated material is required with an adhesive-fixed membrane. Plywood substrates that have been treated with a light organic solvent preservative (LOSP) or oil-based preservatives are not suitable for use with most membranes. Check the membrane manufacturer's recommendations.

INSTALLATION

When installing the plywood:

- lay sheets in a running bond (brick pattern) with the face grain at right angles to the main supporting framing →



Figure 2: Install 20 × 20 mm angle fillets where a membrane is turned up a vertical surface.

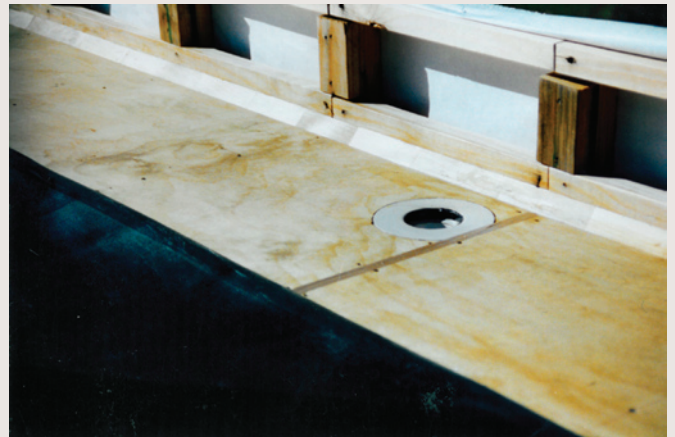


Figure 3: PVC tape to allow the membrane to accommodate plywood movement at the joint for butyl and EPDM membranes.

- provide support to all sheet edges, or use 21 mm minimum thick or structurally tested sheets with a T&G edge profile
- with sandpaper, lightly abrade sheet edges of the exposed face before installation
- allow a perimeter expansion or movement gap of 5 mm where sheets are fitted within a confined area such as a roof surrounded by parapets
- use appropriate adhesive for bonding plywood to timber or metal
- rebate sheets for metal edge trims where detailed
- install 20 × 20 mm angle fillets where a membrane is turned up a vertical surface, except for some PVC membranes where an angle fillet is not usually required (see Figure 2)
- chamfer (10 mm) or radius corners where the membrane is turned around an external corner (for example, into a gutter) – E2/AS1 allows a 5 mm chamfer but 10 mm is better to reduce potential for membrane stress
- fill or level all holes, cracks and imperfections to stop them being visible through the membrane
- sand sheet joints to remove any differences in level, treat joints as recommended by the membrane supplier – Figure 3 shows PVC tape to allow the membrane to accommodate plywood movement at the joint for butyl and EPDM membranes.

FIXINGS

Fix with countersunk stainless steel screws (10 × 50 mm for 17 mm plywood fixed to timber). New Zealand Building Code Clause B2 *Durability* requires a fixing durability of not less than 15 years, but a durability not less than 50 years is required where the plywood is a structural element such as a diaphragm.

Plywood manufacturers typically recommend screwing at 150 mm centres for wind speeds up to 44 m/sec (see Table 1). Fixings for roofs with a wind speed over 44 m/sec must be specifically designed. Some membrane manufacturers may require closer centres or screw and glue fixing of all sheets.

Staple or nail fixing is not recommended because of the risk of fastener back-out due to timber movement.

WHEN TO LAY THE MEMBRANE

Ensure the substrates are clean and smooth before applying the membrane. Surface imperfections or contaminants such as concrete splashes will show through the finished membrane.

The maximum moisture content when the membrane is applied needs to be not more than 18% for timber and plywood. E2/AS1 allows membrane to be laid at 20% moisture content, but BRANZ believes the drier the substrate is at time of laying the better, hence the 18% recommended maximum moisture content.

Once the plywood is dry enough, begin laying membrane as soon as possible to minimise the risk of wetting. Where rain is likely before the membrane can be laid, cover the plywood with tarpaulins (see Figure 4). Plywood that has dew on it can be dried with a hot air gun or a gas blow drier. Forced drying is *not* recommended for wet sheets.

Concrete substrates

For concrete slabs, designers should specify how falls are to be achieved. Options are for falls to be formed in the structural slab, or in a bonded topping slab (20–40 mm thick) or a lightweight concrete slab laid over the structural slab.

During concrete placing, regularly check levels and alignment.

Specify the curing method, curing period and the required surface finish, for example, a steel trowel finish for butyl rubber and EPDM, and a lightly broomed or wood float finish for torch-on modified bitumen membranes.

Screed rails should be used during placement to ensure there are no hollows or dips in the surface that could restrict drainage.

Table 1: Fixing spacing (from Carter Holt Harvey plywood roofing and decking manual).

Design wind speed	Maximum fixing spacing		
	Fixings within 1,500 mm of a gable end	Fixings within 1,200 mm of eaves, ridge or hip	Fixings in body of the roof
up to 37 m/sec	100 mm	150 mm	150 mm
up to 44 m/sec	100 mm	100 mm	150 mm
over 44 m/sec	Specific design to NZS 3603 and NZS 4203, or AS 1720.1, or AS 4055 and AS 1170.2		



Figure 4: Tarpaulins cover the plywood to keep it dry until the membrane can be laid.

PREPARATION FOR MEMBRANE

Allow sufficient drying time so that the concrete has a maximum relative humidity of 75%, measured with a hygrometer (Edney gauge), at the time of membrane application. Many membrane manufacturers also require a minimum curing period of 28 days before the membrane is applied.

Protect the slab before the membrane is applied to prevent it being contaminated by dirt, rust stains, form oils and so on. This surface contamination can affect the bond of the membrane.

Before the membrane is applied:

- grind off any projections in the concrete and even out variations in level at construction joints or junctions between slabs poured at different times
- check slab for level and fill holes and depressions with a filler suitable for use with concrete and the membrane system
- install 20 × 20 mm mortar or timber angle fillets at junctions with vertical surfaces
- where curing compounds are proposed, contact the manufacturer to check if the membrane can be successfully laid over the compound remnants
- repair any cracks wider than 1.5–2 mm by saw cutting the crack to form a 6 mm wide × 8–10 mm deep defined joint, then fill with a sealant (over a backer rod) compatible with the membrane system
- immediately before membrane application, cover repaired cracks and construction joints with a polyethylene tape or similar slip layer at least 25 mm but preferably 50 mm wide (if required by the membrane manufacturer). ❖