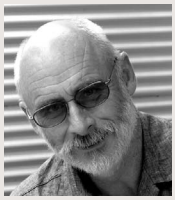

ALLOWING FOR MOVEMENT

Almost all building materials move of their own accord. This needs to be allowed for during design and construction or this movement can create problems with the durability of materials and, potentially, the building's weathertightness.

By Trevor Pringle, ANZIA, BRANZ Principal Writer

Buildings need to be designed and constructed so that movement can occur without deformation or deterioration in the materials or components. There are four types of movement that need to be accommodated:

- Moisture movement where a material absorbs and releases moisture.
- Thermal movement as a result of temperature changes in the material or component over the day, month and year.
- Permanent shrinkage as a result of curing or drying as a material releases moisture or solvent after installation or placing.
- Settlement, creep, flexing and deflection.

Moisture movement

Materials that absorb and then release moisture move in response to changes in environmental moisture levels. These include timber, concrete, cement plaster, mortars and concrete masonry.

Movement from moisture level changes and changes in temperature is reversible, that is, a material can shrink or contract and swell or expand over time. The exception is wood fibreboard, which will swell when very wet but will not return to its original dimensions on drying.

The amount of movement that occurs will depend on the material itself, how much the temperature and moisture conditions change and the way the material is finished, installed, constructed or protected.

Thermal movement

All materials expand when heated and contract when cooled – some more significantly than others (see Figure 1). This needs to be considered when designing and detailing materials that have significant thermal movement, such as (listed in decreasing severity):

- metals – lead, zinc, aluminium, brass, austenitic stainless steel, copper, mild steel, ferritic stainless steel, cast iron
- plastics – polyethylene, polypropylene, polycarbonate, acrylic, PVC, GRP.

Thermal movement is relatively small for most other materials. However, the amount of movement in any material will be influenced by:

- the daily and annual temperature ranges (from maximum to minimum) – the surface temperature of a material will typically be significantly more (or less) than the air temperature
- the location on the building – north and west-facing materials will get hotter and move more than those facing south
- the amount of shading
- the material colour
- the length of the element – as the element becomes longer the amount of movement becomes more significant.

Permanent shrinkage

Shrinkage from curing is irreversible – the material shrinks permanently. Materials that exhibit permanent shrinkage include:

- concrete
- concrete masonry
- cement plaster, such as stucco
- cement mortars
- timber as it dries down to its fibre saturation point as water is lost from cell walls
- adhesives.

Settlement, creep, flexing and deflection

Movement in building materials from settlement, creep, flexing and deflection occurs as a result of:

- applied loads, such as live load deflection or vibration that is a recurring movement – if →

Figure 1: Material that has its movement restricted and can not expand or swell freely will buckle or split, like this zinc panelling.

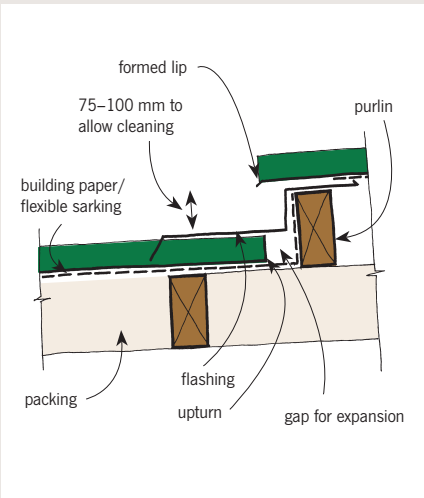

Figure 2: Roof step detail to allow for movement.

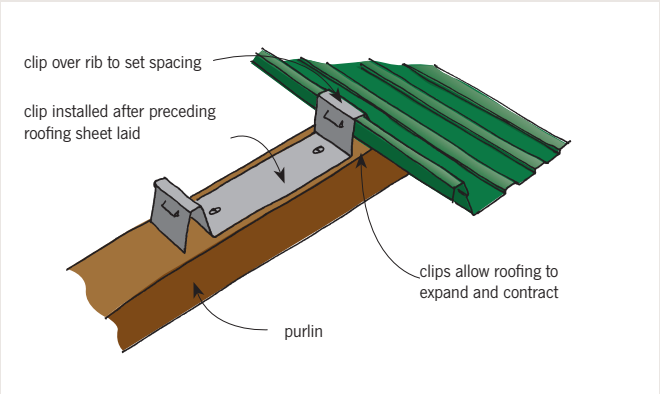

Figure 3: Sliding clip fixing for metal roofing.

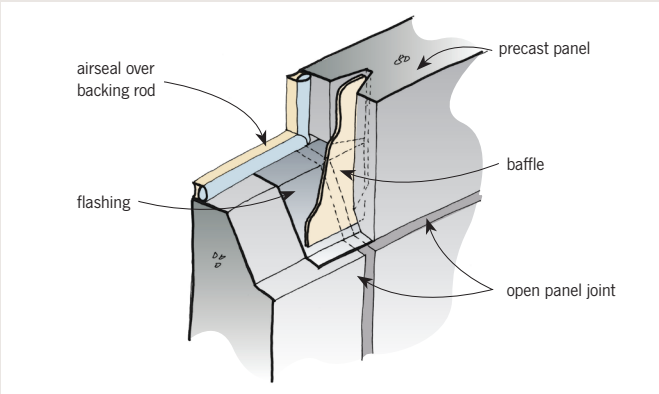

Figure 4: Schematic of an open drained joint detail that allows movement in precast panels.

the materials and systems are unable to cope with this movement, some form of failure may occur

- creep, where the material moves under applied loads but does not recover
- earthquakes or settlement, which may result in permanent damage such as cracking in rigid elements.

Movement from these causes can be minimised by ensuring:

- spans of bearers, beams, lintels, floor joists, rafters and wall studs are within the limits set for the material and its size
- the actual live and dead loads and span are within the design limits
- buildings are well founded on good ground – potential risks such as liquefaction have been identified and designed for, and where buildings are to be located on fill, that fill has been compacted to current standards
- expansive clays are identified and their presence allowed for in foundation design
- the design is appropriate for the wind and earthquake loadings.

Reducing movement

Thermal movement can be reduced by:

- providing shading to reduce the amount of sun, and therefore heating, the material is exposed to
- finishing with a light colour
- not having insulation immediately behind the materials
- limiting length.

Reducing the amount of moisture movement can be achieved by:

- coating the material and ensuring the coating remains in good condition
- protecting the material from wetting
- using a non-absorbent material.

Accommodating movement

Typical strategies used to accommodate movement:

- Providing expansion joints in the materials (see Figure 2).
- Over-drilling fixing holes.
- Using slotted fixing holes.
- Using sliding clips (see Figure 3).
- Providing clearances between elements/materials to allow the movement to occur.

See the expansion gap in Figure 2 and the open drained joint in Figure 4, which allows movement, deals with water and does not require any external sealant.

- Overlapping materials to create a sliding joint. Bevelback weatherboards and board and batten accommodate movement in the building and the board widths because of the laps. The E2/AS1 metal flashing detail (see Figure 5) allows movement at the lapped and sealed join in the flashing and with the overlap to the cladding.
- Single *not* double fixing (as with timber weatherboards). Double nailing has the opposite effect (on any timber board) and restricts the movement.
- Using sealant joints, provided the joints are correctly designed, the sealant is the correct product for the materials being sealed and the amount of movement expected to occur, and a maintenance programme is in place to ensure the sealant remains effective. Criteria for sealant joints include the correct width to depth ratio to give an hour-glass shape, adhesion to the sides of the joint only and, ideally, protection from UV rays.

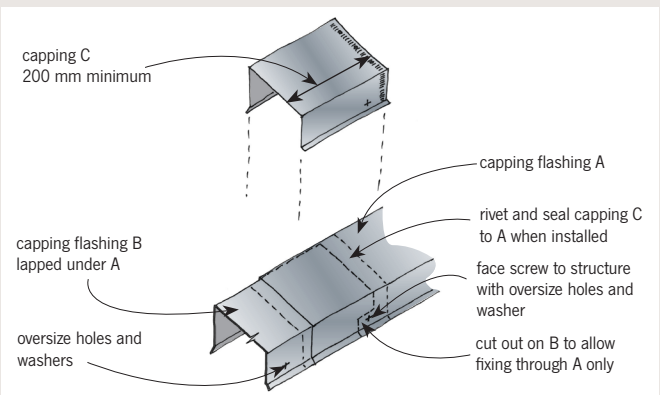

Figure 5: Flashing expansion joint adapted from E2/AS1.

Figure 6: Incorrectly sealed and lapped cap flashing joint. Water has entered through the sealant lap and riveted fixings. The flashing overlap is too small and is dished from lack of support.