Thermal movement in claddings

After a great summer with lots of sun, now is a good time to consider the impact the sun and higher temperatures have on a building's cladding.

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ALL MATERIALS move in response to temperature changes - some significantly more than others. The hotter or colder a material gets, the more movement there will be. Other factors that influence the amount of movement are:

- daily temperature range
- material - for example, steel expands and contracts more than timber but less than aluminium
- the amount of insulation behind the cladding - material surface temperatures will be higher where insulation is fitted tightly to the back of the cladding
- colour - darker-coloured materials get hotter so will expand more when heated
- orientation - north and west-facing materials get hotter and move more than those facing south
- potential shading
- cladding (panel) length - the longer the element, the greater the expansion and contraction that must be accommodated.

Common wall cladding materials in decreasing order of thermal movement can be seen in Table 1.

To give an example of how to use Table 1, take a steel cladding panel that is 10 m long and subject to a 35° temperature change on a sunny day. The thermal movement is 0.012 mm per m length, so the panel expansion would be 35 × 10 × 0.012 = 4.2 mm.

Signs of restricted movement

Where insufficient allowance has been made for thermal movement, you may see:

- buckling or distortion of metal or plastic
- oil canning of metals
- tearing of the material at fixing points
- loss of edge adhesion, tearing or over-compression of sealant
- cracking in grout, tiles, stone (tiles, benchtops), mortar, plastered finishes, fibre-cement or plasterboard sheet or glass
- fracturing of uPVC and metal guttering
- loss of seal at joints in uPVC and metal gutters
- exposed lines of primer or other colour or uncoated material along the lap edges on timber and other weatherboards, particularly for dark colours
- loss of adhesion of brick slips, tiles and the like.

Darker-coloured materials will expand more.

Light reflectance

Dark colours generally have lower reflectance (matt black has a reflectance of 0%), with reflectance increasing as the colour lightens (white has a reflectance of 100%). All coatings fade and chalk, but this is usually less noticeable on lighter colours with higher reflectance.

Lighter colours tend to last longer than darker colours on less stable substrates, such as timber, because movement in the substrate is reduced.

Dealing with thermal movement

Typical strategies used to accommodate movement in wall claddings:

- Specifying light colours.
- Limiting panel or material lengths, particularly of those that have higher rates of thermal movement such as zinc and aluminium.
- Providing defined expansion joints as part of the detailing.
- Allowing sufficient gap at each end of materials or components to accommodate the expected movement.
- Providing clearances between elements/materials to allow the movement to occur.
- Overdrilling or using slotted fixing holes.
- Using sliding clips or interlocking panels.
- Having overlapping joints. Bevel-back weatherboards and board and batten accommodate movement in the building and the board widths because of the laps. The E2/AS1 Figure 6 metal flashing detail (see Figure 1) allows movement at the lapped and sealed join in the flashing and with the overlap to the cladding.
- Single not double fixing of timber weatherboards - double nailing restricts the movement.
- Using open drained or sealant joints, provided the joints are correctly designed and, for sealant, the sealant is the correct product for the materials being sealed and the amount of movement expected to occur. There must also be a maintenance programme in place to ensure the sealant remains effective. Criteria for sealant joints include the correct width-to-depth ratio to give an hourglass shape, adhesion to the sides of the joint only and, ideally, protection from UV rays.

Table 1

Thermal movement of claddings

MATERIAL	THERMAL MOVEMENT (MM/M/ºC)
Zinc across rolling	0.7
Zinc with rolling	0.3
Aluminium	0.024
Radiata pine across grain	0.03–0.07
Western red cedar across grain	0.03–0.07
Plywood	0.02
Austenitic stainless steel	0.018
Copper	0.017
Mild steel	0.012
Ferritic stainless steel	0.010
Concrete	0.010–0.014
Granite	0.008–0.010
Fibre-cement	0.008–0.012
Concrete masonry	0.006–0.012
Porcelain tile	0.005–0.007
Ceramic tile	0.005–0.008
Radiata pine with grain	0.004–0.006
Western red cedar with grain	0.004–0.006
Marble	0.004–0.006

Figure 6: **Joints in metal flashings**
Paragraphs 4.5.2, 8.4.11.1, 9.6.7

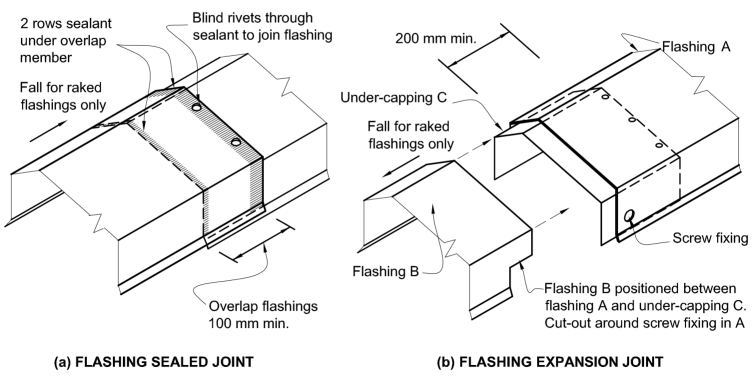

Figure 1: Building Code E2/AS1 Figure 6 metal flashing detail.