Section 1:
Overview

1.1 Introduction

For many years, *Build* magazine has been providing comprehensive advice on the design and installation of flashings in buildings. The best of those articles have been compiled in this *Build* supplement to provide a valuable reference for designers, builders and building officials.

FLASHINGS PLAY a vital role in preventing external moisture from getting through the building envelope (called primary defence) and ensuring that any moisture that does get in can drain out again (called secondary defence).

Flashings are defined in New Zealand Building Code clause E2 *External moisture* as 'component[s] formed from a rigid or flexible waterproof material that drains or deflects water back outside the cladding system'.

Required in many locations

Flashings are typically required at:

- roof junctions and edges such as barges and gutters
- changes in roof pitch such as ridges and hips
- roof and wall penetrations such as windows, doors, meter boxes, skylights, flues and pipes
- roof/wall intersections such as soffits, parapets and balustrades
- vertical and horizontal junctions between cladding materials
- intersections between different building elements.

Building Code requirements

Flashings must meet the requirements of Building Code clauses:

- B2 *Durability*
- E2 *External moisture.*

Clause B2 Durability

Clause B2 *Durability* covers flashing material selection, design and installation.

Clause E2 External moisture

The clauses in E2 *External moisture* that are relevant to flashings state that:

- roofs and exterior walls must prevent the penetration of water that could cause undue dampness, damage to building elements or both – E2.3.2
- concealed spaces and cavities in buildings must be constructed in a way that prevents external moisture being accumulated or transferred and causing condensation, fungal growth or the degradation of building elements – E2.3.5.

Acceptable Solution E2/AS1 to clause E2 provides guidance on the selection and design of roof and external wall flashings. E2/AS1 is available online from the Ministry of Business, Innovation and Employment (MBIE) website www.building.govt.nz.

Alternative method

When applying for a building consent for buildings outside the scope of E2/AS1, flashing detailing must be submitted as an alternative method. Supporting information may be sourced from:

- Acceptable Solution E2/AS1
- NZ Metal Roofing Manufacturers *NZ Metal Roof and Wall Cladding Code of Practice* details
- BRANZ Details.

Selecting flashing materals

When selecting flashing materials, consider:

- the durability requirements of Building Code clause B2
- the environment and specific exposure conditions – refer to E2/AS1 Table 20
- compatibility with surrounding materials – refer to E2/AS1 Table 21 and Table 22
- thermal movement and limitations on flashing lengths for given materials and colours
- the suitability of flashings for roofs where water is collected.

Under E2/AS1, the materials that may be used for flashings are:

- uPVC – minimum 0.75 mm thick
- aluminium – minimum 0.7 mm thick
- galvanised steel – minimum 0.55 mm thick
- aluminium/zinc alloy-coated steel – minimum 0.55 mm thick
- stainless steel – minimum 0.45 mm thick
- copper – minimum 0.5 mm thick
- zinc – minimum 0.7 mm thick
- lead – minimum mass of 17 kg/m^2
- butyl rubber or EPDM flashing – minimum 1 mm thick
- bituminous flashings – used in accordance with E2/AS1 Table 20 and in concealed applications only.

1.2 Flashings keep water out

A flashing is a folded length of metal that provides a weathertight cover at junctions in and between walls and roofs. Getting flashings right is a good start towards constructing a weathertight building.

FLASHINGS ARE designed to stop water entering the building and should be designed to deflect water away. They are most commonly folded out of a coil or flat sheet of 0.55 mm base metal thickness (BMT) in the same material and paint finish as the roof. The colour can either match or contrast with the roof or wall.

On larger projects above 200 m², it is normal to order the flashing coil at the same time as the roofing coil, which ensures coatings and colours match.

The steel flashing coil has a tensile strength of 300 MPa, which allows the metal to bend without splitting, whereas the steel roofing coil has a higher tensile strength of 550 MPa.

Folding flashings

Roofing manufacturers, installers and plumbers all use folders to bend the shapes of the flashings. Flashings are folded to customer orders and requirements. They are not stocked as their shapes are difficult to store and are prone to damage. Most shapes can be folded up, provided the shape has a dimension not tighter than 10 mm. Typically, tighter folds require the shorter 2.4 m brake press folder.

Plumbers commonly make flashings from flat sheet supplied in 2.4 m long by 1.2 m wide sheets, which suit the shorter 2.4 m long folders.

Junctions where flashings are required.

Roofing manufacturers cut off a coil strip in 6 m or 8 m lengths and usually 1.2 m wide to suit the longer folders of 6 and 8 m.

Flashing use

Flashings are needed in any situation where the cladding has been cut or terminated, including:

- barges and ridges
- around roof edges
- as aprons under cladding on an upper storey that comes out over a lower roof
- to seal pipe penetration holes through a roof
- walls around door and window heads, sills and sides.

Folded ridges are used along the centre ridge of a building when rib heights of the roof profile are higher than 30 mm, typically on larger commercial roofs.

Using wide or long flashings

Longer lengths minimise end joints in flashings. Lengths need to be sealed together with a neutral-cure silicone sealant and fixed together with rivets. Under E2/AS1, allowances for thermal expansion and contraction must be made in lengths over 18 m or over 12 m long where darker colours or aluminium have been used.

Where flashings require a total girth over 1.2 m wide, the pieces must be lapped and sealed together on site. Care is needed handling these larger widths as damage increases with the wider, more complex shapes. Wider flashings installed horizontally must also be installed over a solid support to prevent the flashing deflecting and holding water.

Quality installation, quality building

Widths of flashings vary depending on their location, and the minimums are outlined in New Zealand Building Code Acceptable Solution E2/AS1 Table 7. Typically, they all cover two ribs down the roof or a minimum 130 mm along the top of the sheet in a medium wind zone.

Top edges of flashing upstands are typically finished with a hook or hem to restrict capillary water rises. Flashing downturns are finished with a kick-out, or a bird's beak. Roof flashings can be manufactured with soft edging crimped on, or for profiles with higher rib heights, they can be scribed and cut on site around the profile ribs.

Cut edges must avoid contact with concrete or plaster work by use of a separation strip such as closed-cell foam or butynol.

Computer-driven folders

A new generation of folders, called RAS folders, are now available. The shapes and dimensions to be folded are loaded into the computer of the machine. A flat sheet cut to the required girth is loaded, and the folder automatically folds the intricate shape that has been loaded.

This new technology eliminates any human error in the measurement of the folds and is hands-free. It allows manufacturers to fold any shape accurately, removes the limits on shapes imposed by traditional folders and is all performed safely.

1.3 Cladding and flashing materials

Table 20 of Building Code Acceptable Solution E2/AS1 is often used to select building materials. Here are a few pointers to help you intrepret the table correctly.

E2/AS1 TABLE 20 is used to choose building envelope materials that are suitable for their end use, location and environment. The table covers claddings and flashings first, then fixings. Materials are listed under these headings, but you have to work through the rows and columns to find the appropriate materials for a particular situation (see Figure 1). There is a section of numbered explanatory notes at the end of Table 20. Where an item in the table has a number after it, refer to that number in the notes.

How to use Table 20

Start with some questions:

- Step 1: Where will the material be positioned in the building – hidden, exposed or sheltered?
- Step 2: What durability is required – 15 or 50 years?
- Step 3: What acceptable exposure zone applies from NZS 3604:2011 – B, C, D or E?

Materials can be used that have the acceptable exposure zone (B, C, D or E) listed in the table where the required durability (15 or 50 years) meets the correct exposure (hidden, exposed or sheltered).

Hidden, exposed or sheltered

The second column of Table 20 – exposure – refers to where the building element is located:

- 'Hidden' elements are concealed behind another element and are not visible or accessible.
- 'Exposed' elements are visible and rain washed.
- 'Sheltered' elements are visible but not rain washed.

Use the sheltered designation for:

- elements that may be either sheltered or exposed (see Note 2)
- all steel-based wall claddings (see Note 8 in the table)
- hidden steel-coated elements located in a ventilated cavity in zones D and E (exposed to salt air) (see Note 9 in the table).

15 or 50 years durability

Hidden elements require not less than 50 years durability under the Building Code. Use the far right column – 50 years – for choices.

Claddings and exposed and sheltered flashings require not less than 15-year durability, so use the 15 years column.

Acceptable exposure zones

The acceptable exposure zones column of E2/AS1 Table 20 contains letters – B, C, D and E. These are atmospheric corrosivity categories based on the corrosion rates of mild steel in NZS 3604:2011 *Timber-framed buildings*

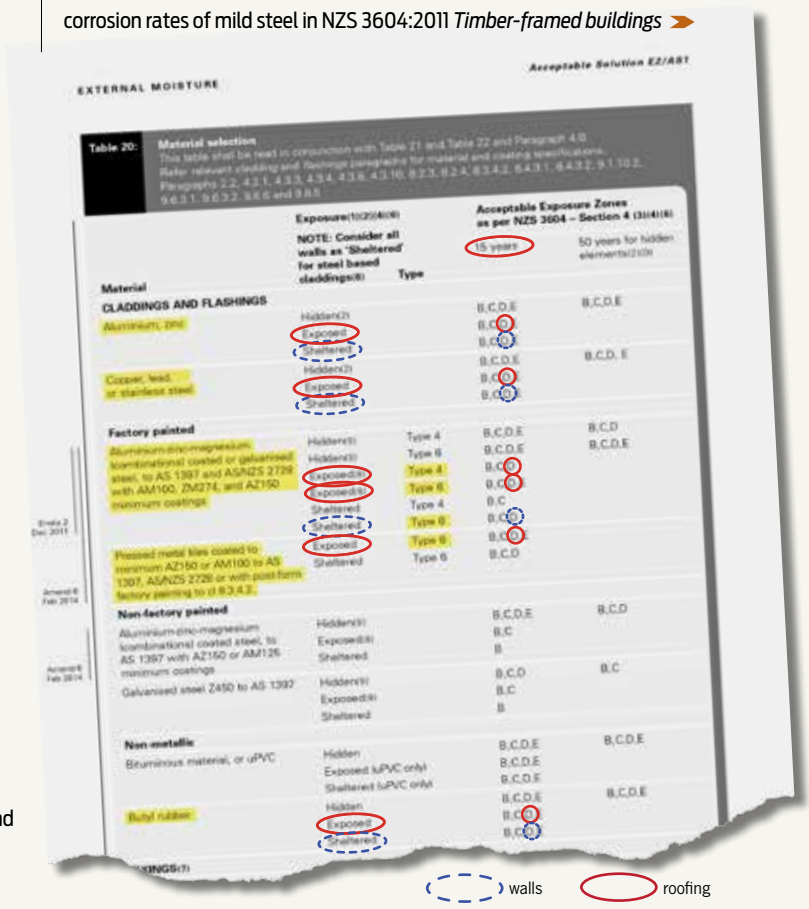


Figure 1 **Working through E2/AS1 Table 20 to find materials that can be used for roofs and walls in zone D. E2/AS1 is available from the MBIE website at www.building.govt.nz.**

and AS/NZS 2728:2013 *Prefinished/prepainted sheet metal products for interior/exterior building applications – Performance requirements*.

The zones are B (low), C (medium), D (high) and E (severe marine – breaking surf beachfronts). These use the limits outlined in NZS 3604:2011.

Before confirming material selection, designers should check with metal suppliers that the material is suitable for the environment it is to be used in so that the warranty will be valid.

Type 4 and type 6

Prepainted and prefinished metal products are divided into types defined in AS/NZS 2728:2013 Table 1.1 related to corrosion rates and the severity of application. Table 20 includes two of these types:

- Type 4 for high corrosive or tropical environments.
- Type 6 for very high geothermal and marine environments.

The types may also have different scratch resistance and blistering requirements.

Example in zone D

Follow these examples to find suitable materials for a structure in zone D.

Roof

Roofing materials are considered exposed (see Note 8) and require a durability of not less than 15 years.

Suitable materials in Table 20 for the roof in zone D (see Figure 1) include:

- aluminium, zinc, copper, lead, stainless steel
- factory-painted aluminium-zinc-magnesium (combinations) coated or galvanised steel to AS 1397 and AS/NZS 2728 with AM100, ZM274 and AZ150 minimum coatings (type 4 or 6)
- pressed metal tiles, coated to minimum AZ 150 or AM100 to AS 1397, AS/NZS 2728 or with post-form factory painting to clause 8.3.4.2 (type 6 only)
- non-factory coated option – not permitted
- non-metallic option – butyl rubber.

The base metal thickness (BMT), profiles and roof pitches for metal roofing and other permitted roofing materials are found in E2/AS1 Section 8.

Walls

Table 20 considers all walls as sheltered for steel-based claddings (see Note 8) and requires a durability of not less than 15 years.

Suitable materials in Table 20 for walls in zone D (see Figure 1) include:

- aluminium, zinc, copper, stainless steel
- factory-painted aluminium-zinc-magnesium (combinations) coated or galvanised steel to AS 1397 and AS/NZS 2728 with AM100, ZM274 and AZ150 minimum coatings (type 6 only)
- non-factory coated option – not permitted.

The BMT, profiles and application requirements (direct-fixed or on a cavity) for profiled metal wall claddings are covered in E2/AS1 section 9.6.

Where roofs and walls are different materials, check E2/AS1 Tables 21 and 22 for compatibility in contact and run-off.

Flashings

In zone D, the materials for flashings that are not hidden must have a durability of not less than 15 years and are considered sheltered. Options include:

- aluminium, zinc, copper, lead, stainless steel
- factory-painted aluminium-zinc-magnesium (combinations) coated or galvanised steel to AS 1397 and AS/NZS 2728 with AM100, ZM274 and AZ150 minimum coatings (type 6 only)
- non-metallic flashings – uPVC, bituminous material and butyl rubber.

Hidden flashings require a durability of not less than 50 years (see Note 2).

See E2/AS1 section 4 for flashing material types and minimum thicknesses, and always check compatibility of flashing materials with materials in contact and run-off (see E2/AS1 Tables 21 and 22).

Note E2/AS1 can be downloaded for free from the MBIE website at www.building.govt.nz.

Flashing cross-falls

E2/AS1 specifies a minimum cross-fall for some flashings. Do you know which ones and how much?

FOR SOME FLASHINGS, E2/AS1 specifies a minimum cross-fall to ensure water drains from the surface. Typically these are a minimum of:

- 15º for a head flashing to a window
- 5º for a balustrade or parapet cap flashing
- 15º for inter-storey flashings
- 10º for sill flashings to stucco and horizontal profiled metal.

Sill flashing on profiled metal

For the sill flashing to the top of direct-fixed vertical profiled metal terminating below a window, E2/AS1 shows a slope to the part of the flashing capping the cladding. However, no angle is given. A minimum cross-fall of 5º is suggested to ensure water drainage.

Raking apron flashings

It is the same for raking apron flashings. E2/AS1 shows a slope, but the amount of slope is not stated.

While a cross-fall may appear unnecessary because of the roof slope, without it, water draining down the surface of the flashing can be trapped and held by the metal stop-end. When water is trapped with dirt and dust, the potential for corrosion is created.

BRANZ recommends a 5º minimum cross-fall for raking apron flashings.

1.4 Sizing E2 roof flashings

It can be difficult to determine the critical dimensions for roof flashings in E2/AS1. We step through Table 7 to help clarify confusion when working out the minimum sizes of flashings.

THE REQUIRED DIMENSIONS of a roof flashing are determined by three factors – wind zone, roof pitch and roofing material. Wind zone has the most significant influence on flashing dimensions, especially for sites in extra high wind zones.

Look to E2/AS1

New Zealand Building Code Acceptable Solution E2/AS1 Table 7 prescribes the critical dimensions for flashings. These are in terms of the:

- cover – 'X' for transverse apron flashings (see Figure 2) and 'Y' for barge flashings parallel to the roof (see Figure 3)
- downstand – 'Z' for verge flashings and cappings (see Figure 3).

The dimensions given exclude any soft edge, turn-down or drip edge.

What are the situations in Table 7?

In Table 7, Notes 2–3a define Situations 1–3 which are in columns 4–6 of the Table (see Figure 4):

- For low, medium or high wind zones where the roof pitch is 10° or more, use the minimum dimensions given for Situation 1 (column 4).
- For any roof in a very high wind zone and for roofs with a pitch of less than 10° in low, medium or high wind zones, use the minimum dimensions given in Situation 2 (column 5).
- For all roofs in extra high wind zones, use the minimum dimensions given in Situation 3 (column 6). Note that a change of roof pitch in a roof plane is not permitted in an extra high wind zone.

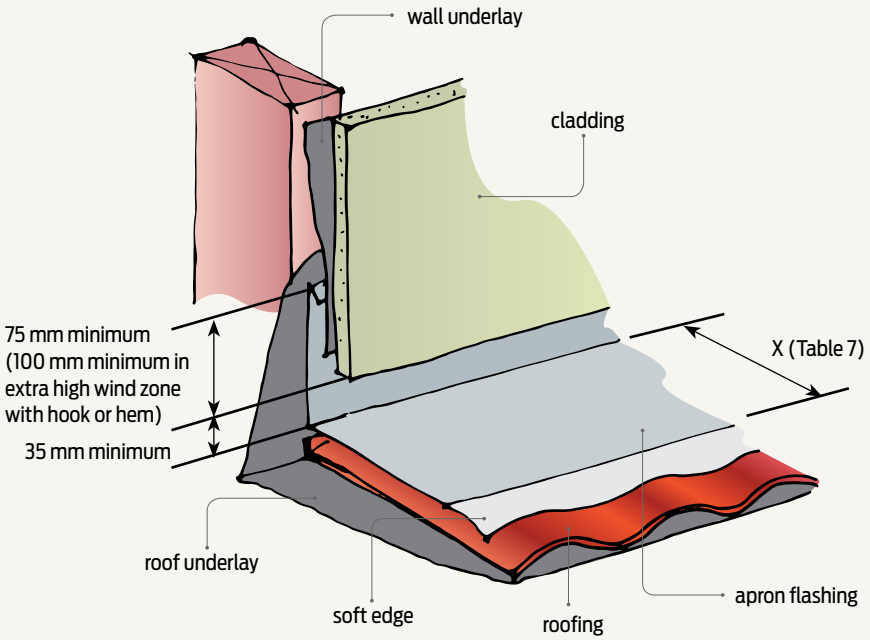


Figure 2 **Transverse apron flashing.**

Working out X, Y and Z dimensions

Work through these steps to determine X and Z dimensions for a corrugated profile roof with a pitch of 8° in a medium wind zone:

1. Check Notes 2–3a on the second page of Table 7 to select the correct situation (see Figure 4). Note 3 defines this roof as Situation 2.
2. Read down Situation 2 (column 5) on the first page of Table 7 (see Figure 5) and across the relevant rows to find the minimum dimensions:
   - For X, read across the row 'Aprons:general: Transverse flashing over roofing that gives 200 mm minimum, excluding the soft edge (Note 4)
   - For Z, read across the row 'Barges: Overlap to barge board'. This gives 70 mm minimum, excluding drip edge (Note 8).

Y is governed by the geometry of the roofing material. For this corrugated profile roof, the flashing must cover two crests and finish in the next trough (see Figure 3).

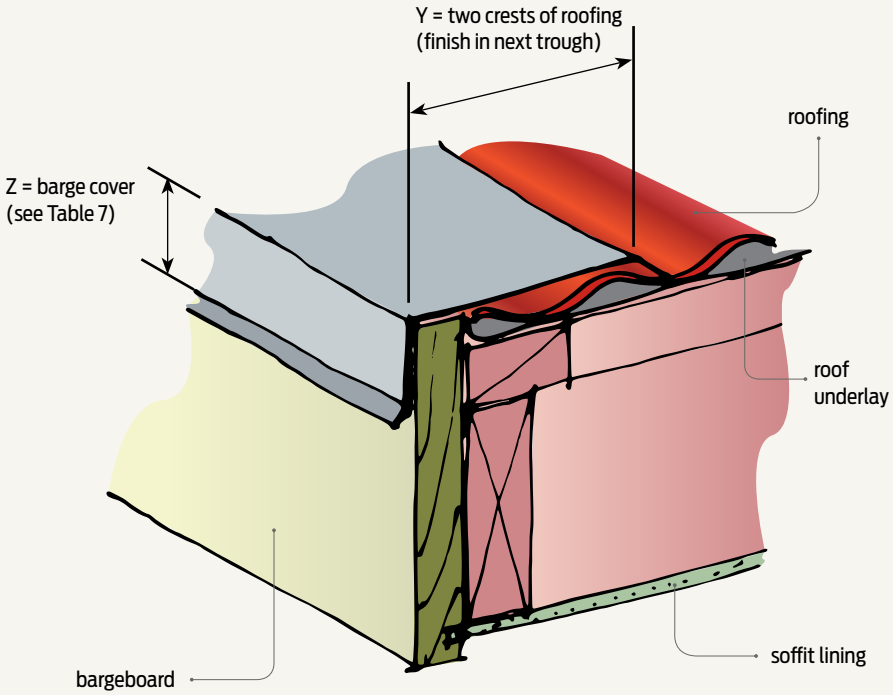


Figure 3 **Barge flashing.**

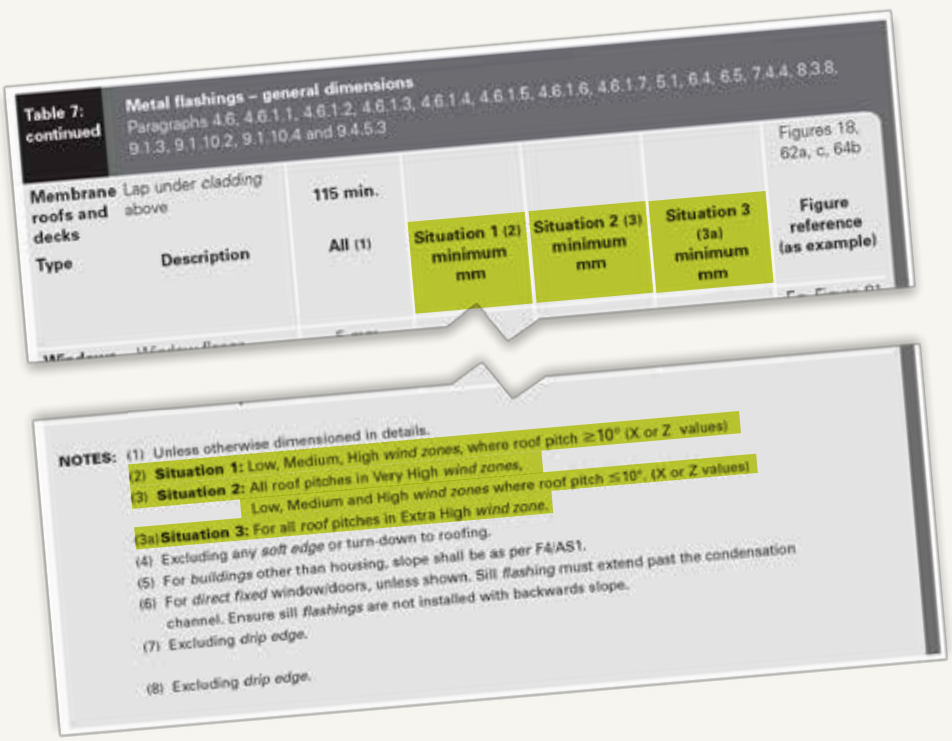


Table 7: continued — Metal flashings – general dimensions
Paragraphs 4.6, 4.6.1.1, 4.6.1.2, 4.6.1.3, 4.6.1.4, 4.6.1.5, 4.6.1.6, 4.6.1.7, 5.1, 6.4, 6.5, 7.4.4, 8.3.8, 9.1.3, 9.1.10.2, 9.1.10.4 and 9.4.5.3

Membrane roofs and decks	Lap under cladding above	115 min.				Figures 18, 62a, c, 64b
Type	Description	All (1)	Situation 1 (2) minimum mm	Situation 2 (3) minimum mm	Situation 3 (3a) minimum mm	Figure reference (as example)

NOTES:
(1) Unless otherwise dimensioned in details.
(2) **Situation 1:** Low, Medium, High *wind zones*, where roof pitch ≥10° (X or Z values)
(3) **Situation 2:** All roof pitches in Very High *wind zones*, Low, Medium and High *wind zones* where roof pitch ≤10°. (X or Z values)
(3a) **Situation 3:** For all roof pitches in Extra High *wind zone*.
(4) Excluding any *soft edge* or turn-down to roofing.
(5) For *buildings* other than housing, slope shall be as per F4/AS1.
(6) For *direct fixed* window/doors, unless shown. Sill *flashing* must extend past the condensation channel. Ensure sill *flashings* are not installed with backwards slope.
(7) Excluding *drip edge*.
(8) Excluding *drip edge*.

Figure 4 **New Zealand Building Code clause E2/AS1 Table 7 — selecting the situation.**

Edge treatment of flashings

The exposed bottom edge of a flashing must have an edge treatment to stiffen the flashing and form a drip edge, allowing positive drainage. Acceptable edge treatments are:

- kick-out
- bird's beak (see Figure 6).

In an extra high wind zone, flashing upstands must:

- have hems or hooks
- be 25 mm higher than given by Table 7 or the relevant figures.

In other wind zones, the top edge of the flashing may have:

- a hem or hook with upstand dimensions as shown in the relevant figures
- no hem or hook but upstand dimensions 25 mm higher than shown in the relevant figures.

Range of roofing materials covered

E2/AS1 includes typical details for a selection of roofing materials, which are referred to in ection 8.

Profiled metal

This is corrugated, trapezoidal or trough section:

- transverse apron flashing (X) – see E2/AS1 Figure 44b
- parallel apron flashing (Y) – see Figure 48a–c
- barge flashing (Y and Z) – see Figure 47a–c
- change in pitch (X) – see Figure 44a (not permitted in extra high wind zone)
- roof/wall ridge (verge) flashing (X and Z) – see Figure 45b.

For corrugate profiled roofing, Y must be large enough to cover two crests of the roofing, finishing in the next trough. Some combinations of roof ➤

dimension and roofing profile can result in large flashings, which may be a consideration when choosing the roofing profile.

Pressed metal tiles

Refer to E2/AS1 Figures 35a, 35b and 36b. Flashings are generally supplied by the tile manufacturer and must meet the minimum dimensions of the figures.

Where an overflashing is used, ensure:

- the minimum cover to the tile upstand is 35 mm
- the minimum cover behind the cladding is 75 mm
- a 5 mm minimum clearance is required between the bottom of the cladding and the overflashing.

For a barge flashing, dimension Z relates to cover to the bargeboard only. The total depth of the flashing will need to be larger to allow a minimum cover of 25 mm to the 40 mm tile edge upstand.

Masonry tiles

Refer to E2/AS1 Figure 26. X and Y are not specifically shown.

Minimum cover is given as:

- 150 mm for the transverse flashing
- 150 mm for the parallel flashing, and it must cover at least one crest, finishing in a trough.

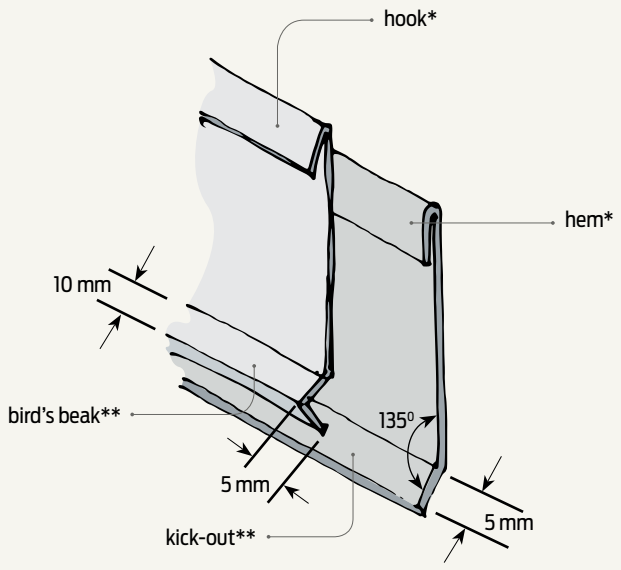
There must be 35 mm minimum clearance between flashing and cladding and 75 mm minimum upstand behind the cladding (total upstand of 110 mm).

For more All Building Code clauses are freely available at www.building.govt.nz/building-code-compliance/.

Table 7: Metal flashings – general dimensions
Paragraphs 4.6, 4.6.1.1, 4.6.1.2, 4.6.1.3, 4.6.1.4, 4.6.1.5, 4.6.1.6, 4.6.1.7, 5.1, 6.4, 6.5, 7.4.4, 8.3.8, 9.1.3, 9.1.10.2, 9.1.10.4 and 9.4.5.3

Type	Description	All (1)	Situation 1 (2) minimum mm	Situation 2 (3) minimum mm	Situation 3 (3a) minimum mm	Figure reference (as example)
Aprons: general	*Transverse flashing* over roofing		130 (4)	200 (4)	200 mm	Figure 7 and Figure 44 (X values)
	Parallel flashing over roofing		Two crests, finish in next trough – refer 4.6.1.1b)			Figures 47, 48 (Y values)
Ridges/ hips	*Transverse flashing* over roofing		Refer **Aprons: general**			Figures 43, 45b, 46
Changes in roof pitches	Upper lap under roofing	250 mm min.			Not permitted under E2/AS1	Figure 44
	Transverse flashing over roofing		Refer **Aprons: general**			
Barges	Overlap to barge board		50 (8)	70 (8)	90 mm	Figure 47 (Z values)
Cappings	Overlaps to *cladding*		50 (8)	70 (8)	90 mm	Figure 10 (Z values)
	Slope to top: *parapet* and balustrade – metal capping	5° min.				Figures 10, 11, 12, 130
	Slope to balustrade – *flush-finished EIFS* and fibre cement(5)	10° min.				Figures 117, 129, 130
Roof or Deck to Wall – See membranes below	Overlaps to roofing		Refer **Aprons: general**			
	Lap under *cladding* above	75 mm min.			90 mm	Figures 7, 26, 30, 35, 37, 44, 48, 50
	Clearance below *cladding*	35 mm min.				
	Total upstand	**110** mm min.				

Figure 5 **New Zealand Building Code clause E2/AS1 Table 7 finding minimum dimensions.**



*stiffen top edge and prevent moisture tracking behind the flashing

**stiffen bottom edge and provide a positive drip edge

Figure 6 **Flashing edge treatments.**

1.5 Folded and ironed

Flashing junctions can be tricky but it's important to get them right. Here we review the steps for barge and ridge flashing intersections and termination of a raked apron flashing.

FLASHINGS ARE A CRITICAL component of the weathertightness of a building, whether protecting the head of a window or a roof cladding junction.

Flashing basics

While metal flashings need to be aesthetically pleasing, to ensure they will be durable and keep out water when installed, you must:

- allow for thermal movement
- prevent damage to factory-applied coatings during installation
- correctly lap the flashing elements so that water cannot get into and/or be trapped within the joint
- avoid total reliance on sealants to weatherproof the junction
- ensure the finished joint is neat and precise with straight folds where required
- install the fixings through the flashing and into underlying framing
- meet cladding and bargeboard cover requirements – for buildings within the scope of E2/AS1, Table 7 gives the required flashing covers for the wind zone the building is erected in.

Assembling in the right order

Two flashings junctions that need to be accurately folded and assembled in the right order are:

- the intersections of the barge flashing and the ridge flashing to the gable end of a roof (see Figures 7a–d)
- the termination of a raked apron flashing that requires the forming of a stop-end by folding the flashing (see Figures 8–9) or by inserting a proprietary fabricated stop-end at the termination of the flashing.

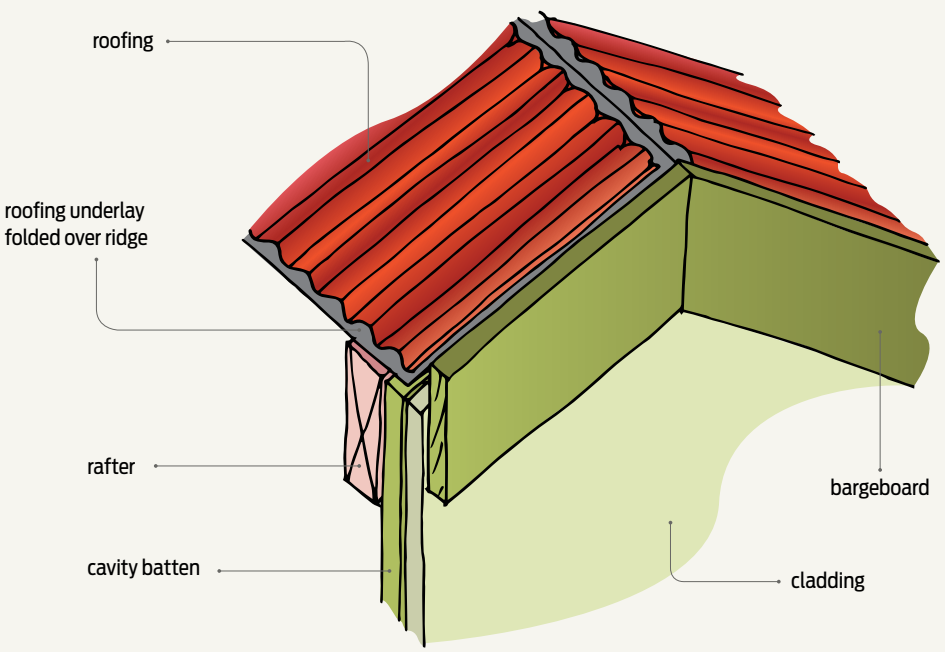


Figure 7a **Intersection of the barge flashing and the ridge flashing to the gable end of a roof – Step 1.**

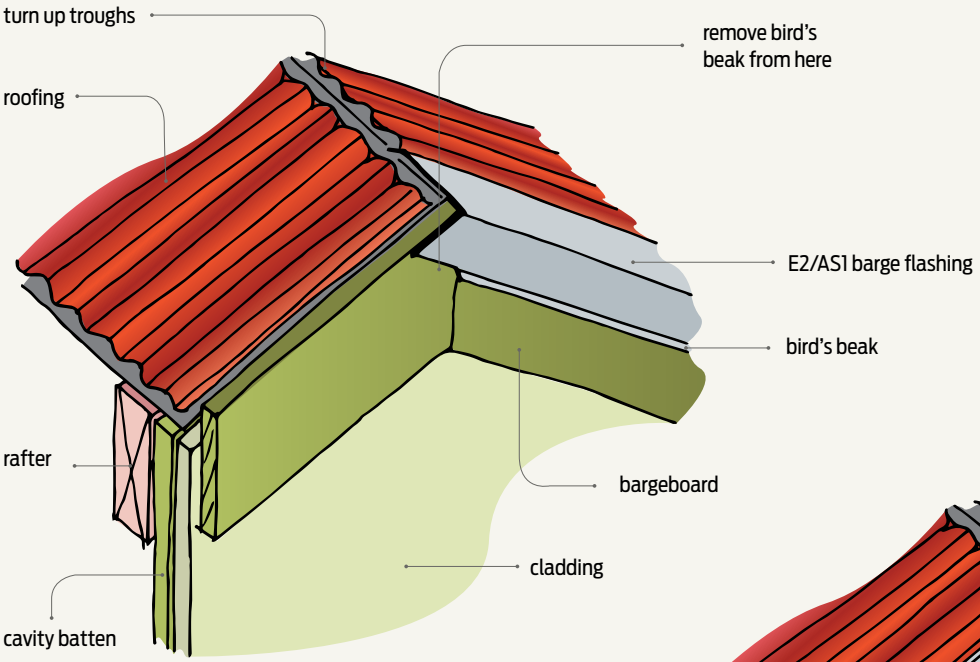


Figure 7b **Step 2.**

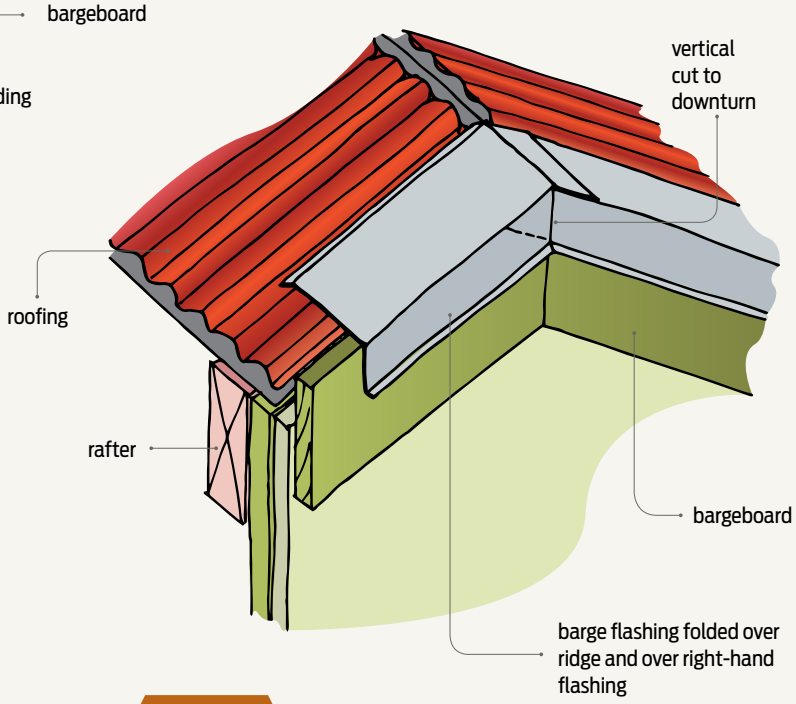


Figure 7c **Step 3.**

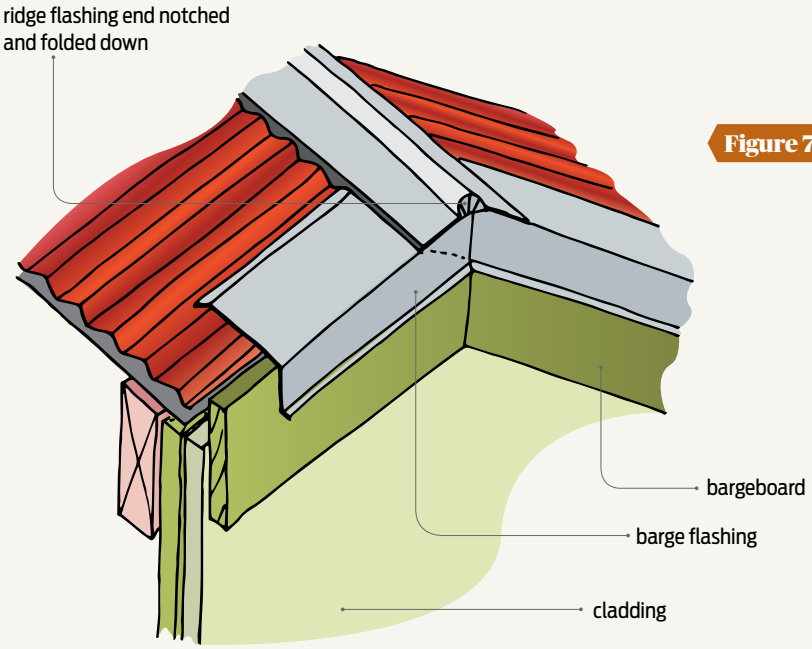


Figure 7d **Step 4.**

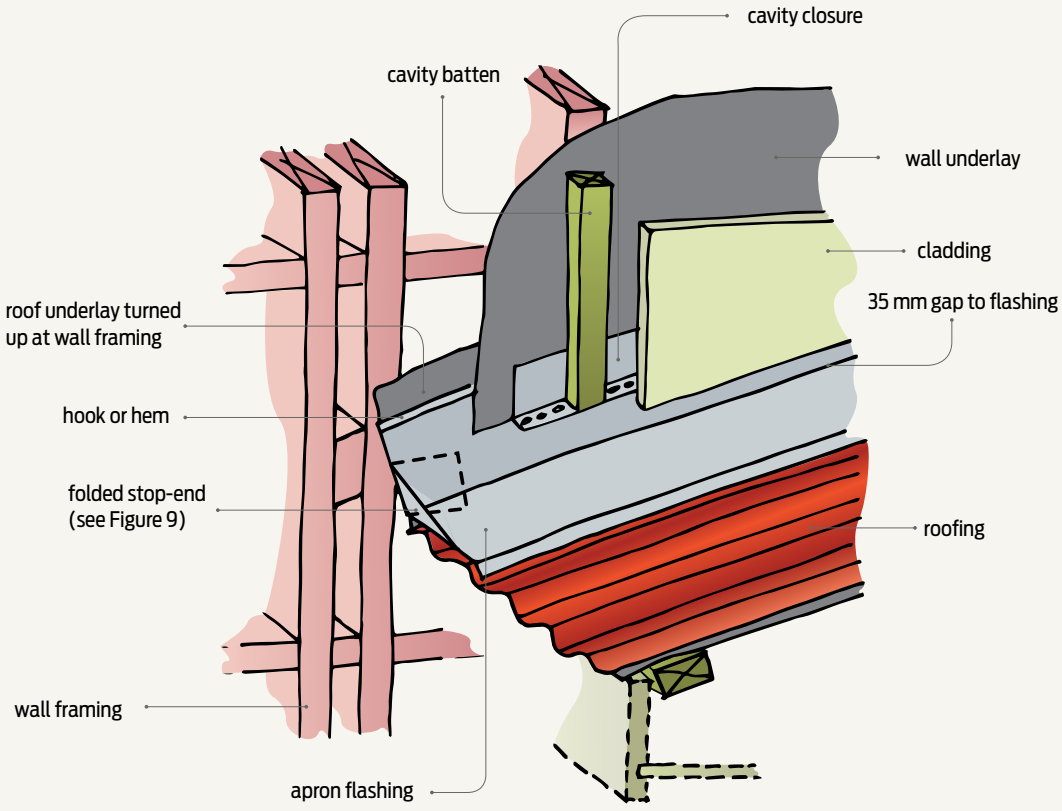
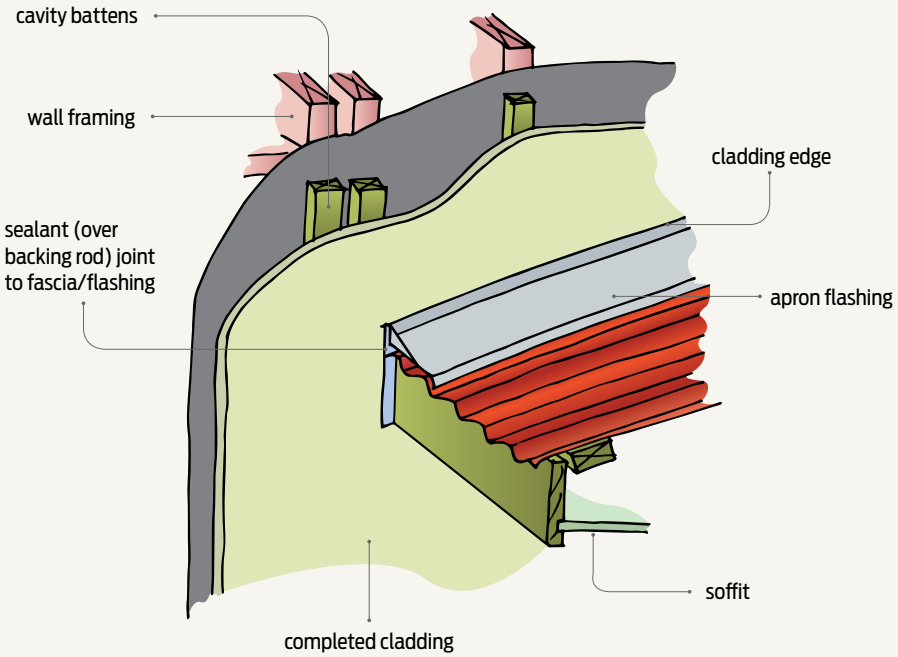


Figure 8a **Termination of a raked apron flashing – Step 1.**



Note: Gutter not shown.

Figure 8b **Step 2.**

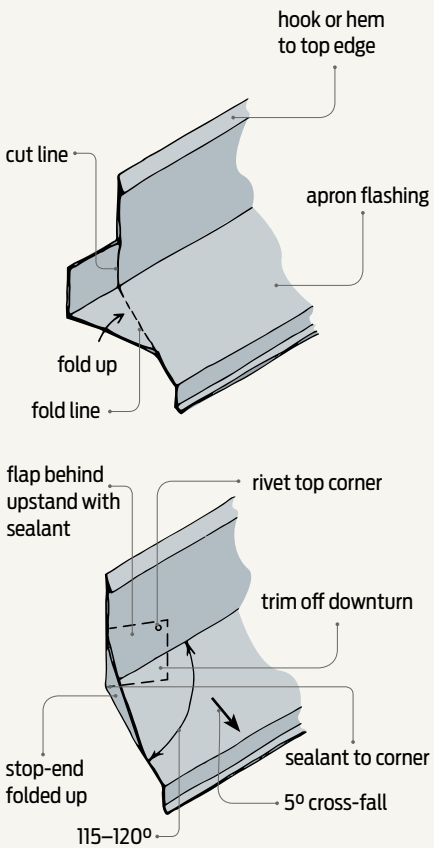


Figure 9 **Stop-end folds in Figure 8a.**