MULTIPLEX

CONSTRUCTION HANDBOOK – METAL ROOF

Version 01

Print Copy

Disclaimer

This is a print version whereas the structure of the construction handbook may have been adapted for ease of reference.

The handbook app should take precedence in case of any ambiguity.

Multiplex Constructions Pty Limited

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1. Metal Roof

1.1 General

Key Considerations

- Corrosion
- Penetration detailing

What is Metal Roofing?

A metal roof is a roofing system made from metal pieces or tiles characterized by its high resistance, impermeability and longevity. It is a component of the building envelope. Zinc, copper and steel alloys are commonly used.

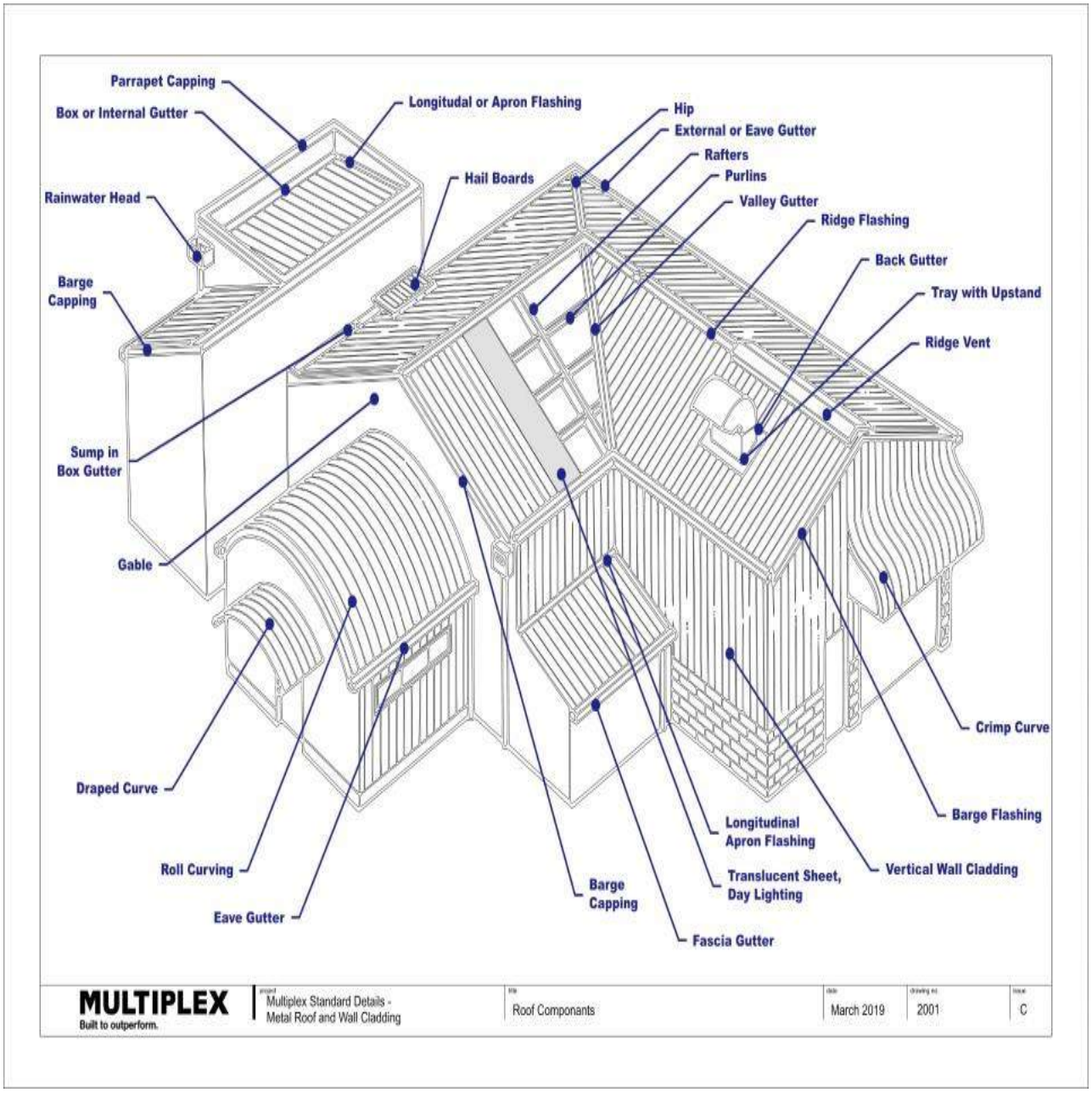


Figure 1: Roof Components

Purlins

- Prior to the installation of roofing sheeting, purlins must be orientated correctly and on the correct side of the cleats.

Safety Mesh

- Refer to the section Safety Mesh of the Health and Safety Handbook
- Sheeting must be lapped in the right direction with regard to ‘over’ versus ‘under’ i.e. the side lap is to face away from prevailing weather.

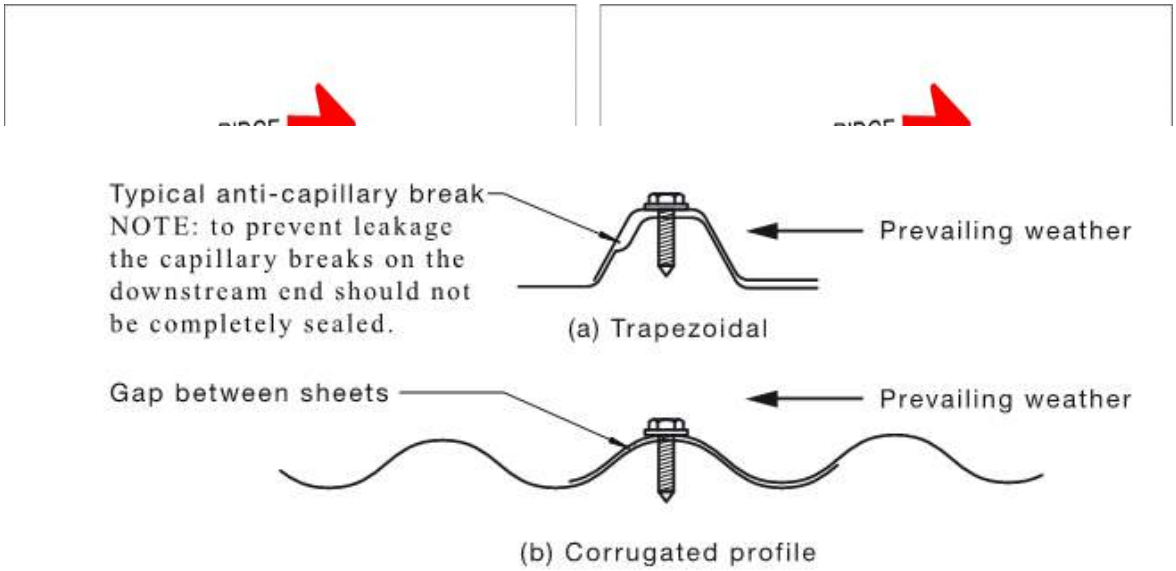


Figure 2: Purlin Orientation, M

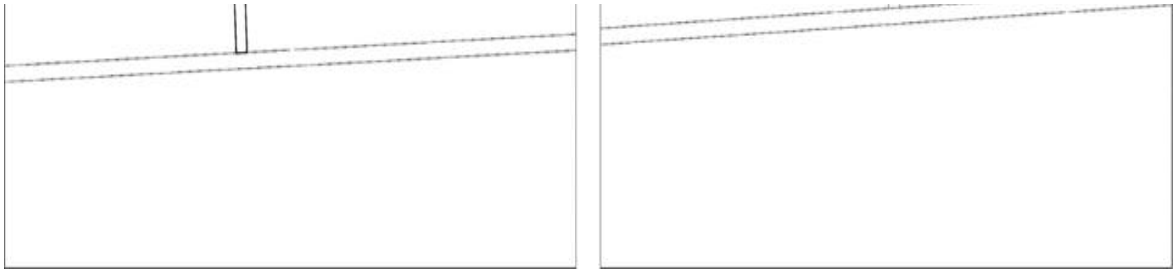


Figure 3: Installation detail from SA AS HB 39

1.2 Selection

Galvanic Series

2 different metals in contact with each other, in the presence of water will corrode. The less noble metal corrodes sacrificially to protect the more noble metal. The table is the Galvanic Series. The further the metals are apart in the series the faster and more aggressive the corrosion.

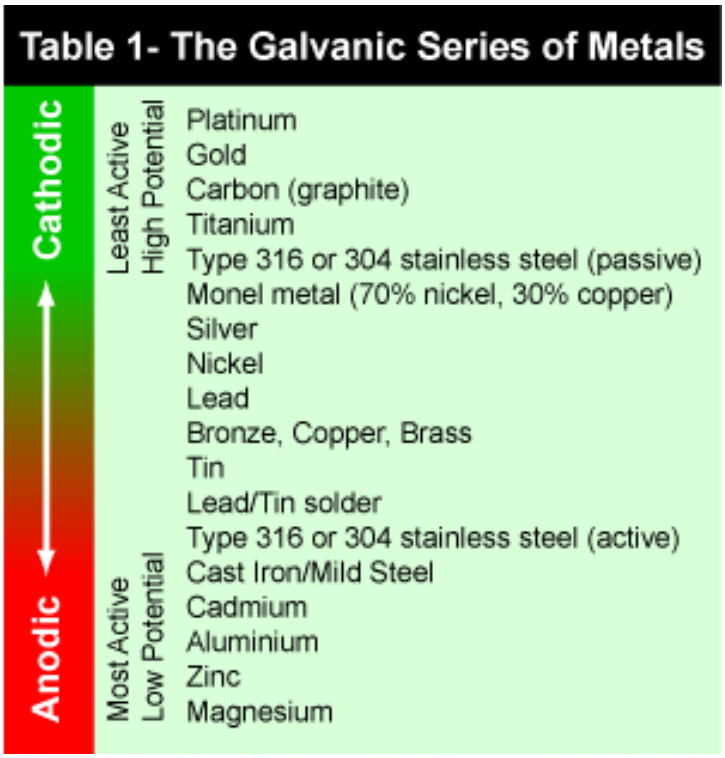


Figure 1: The Galvanic Series of Metals, AMAC Group

Comparability of Metals or Alloys

The selection of roof sheets and accessories must be in accordance with the Table.

COMPATIBILITY OF DIRECT CONTACT BETWEEN METALS OR ALLOYS

ROOF DRAINAGE SYSTEM COMPONENTS & ANY CLADDING MATERIAL	ACCESSORIES OR FASTENER OR (UPPER SURFACE)								
	ZINCALUME®	GALVANISED (ZINC COATED STEEL)	ZINC	COLORBOND®, COLORBOND® ULTRA, COLORBOND® METALLIC	COLORBOND® STAINLESS	STAINLESS STEEL	ALUMINIUM ALLOYS	COPPER & COPPER ALLOYS [1]	LEAD
ZINCALUME®	YES	YES	YES	YES	NO	NO	YES	NO	NO
GALVANISED (ZINC COATED STEEL)	YES	YES	YES	YES	NO	NO	YES	NO	NO
ZINC	YES	YES	YES	YES	NO	NO	YES	NO	NO
COLORBOND®, COLORBOND® ULTRA, COLORBOND® METALLIC	YES	YES	YES	YES	NO	NO	YES	NO	NO
COLORBOND® STAINLESS	NO	NO	NO	NO	YES	YES	NO	NO	NO
STAINLESS STEEL	NO	NO	NO	NO	YES	YES	NO	NO	NO
ALUMINIUM ALLOYS	YES	YES	YES	YES	NO [3]	NO [3]	YES	NO	NO
COPPER & COPPER ALLOYS [1]	NO	NO	NO	NO	NO	NO	NO	YES	NO
LEAD	NO	NO	NO	NO	NO	NO	NO	YES	YES

[1] Monel - copper/nickel alloy.
[2] For further guidance refer to AS/NZS 3500.3:2015.
[3] In benign environments, mixing of stainless steel and aluminium may be acceptable.

Figure 2: Source: Lysaght Roofing & Walling installation Manual, 2017

Corrosion can also be initiated by contact with any of the following and must be avoided. Where it cannot be avoided a non-galvanic coating must be considered.

- Carbon in pencils and some rubbers.
- Wet and dry concrete.

- Soils
- Vegetable matter.
- Cleaning agents e.g. brick cleaning.

-
- Any material which will inhibit normal exposure to the atmosphere.
- Green or some chemically treated timber like CCA or tanalith treatments.
- Materials subject to cycles of dryness and wetness or which have excessive moisture content such as improperly seasoned timber.
- Accumulated debris/airborne fallout due to lack of maintenance.
- Anything that will hold moisture in contact with the cladding.

1.3 Insulation

What is insulation?

Insulation can be made from glasswool batts or blankets, rockwool batts, natural wool, cellulose fibre, extruded polystyrene or expanded polystyrene boards, polyurethane foam, polyester fibres, and reflective foils.

Notably roof insulation is placed in direct contact with the roof sheets and usually comes with a reflective foil laminate adhered to the lower face.

Why is insulation required?

Insulation is used in order to reduce:

- Heating from the sun in summer
- Loss of interior heat in the winter
- Condensation on the inside of the roofing and walling
- Noise from rain, thermal expansion and contraction and other sources.

Note: Refer section 6.2 of the Australian Standard, SA HB 39:2015

Insulation must:

- Be as per the approved samples i.e. has correct R value, flammability, combustibility.
- Manufactured to AS/NZS 4859.1.
- Be undamaged with tears and holes through facing materials suitably sealed and repaired.
- Have no excessive sagging
- Be earthed if required
- Covered as soon as practicable after its installation, to prevent it being weather damaged.
- Have all joints sealed with a suitable tape to prevent air leakage when used as a vapour and air barrier.
- Ends appropriately trimmed and protected from weather, most notably at the ends of roof sheets terminating in a gutter.

In order to maintain the specified R value in a roofing system, the insulation may require the use of special brackets to prevent crushing at each support.

TABLE 6.4(B)

INSULATION TYPES AND APPLICABILITY

Types of insulation suitable for application	Application	
	Ceilings pitched roofs	Cathedral ceilings and metal deck roofs

Figure 1: Table 6.4(b) HB39:2015

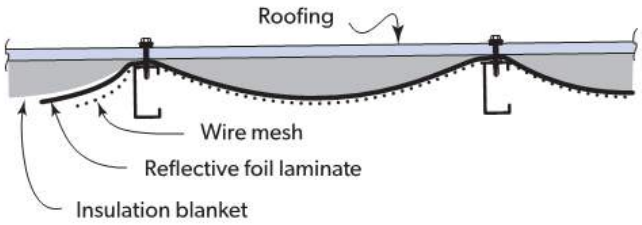
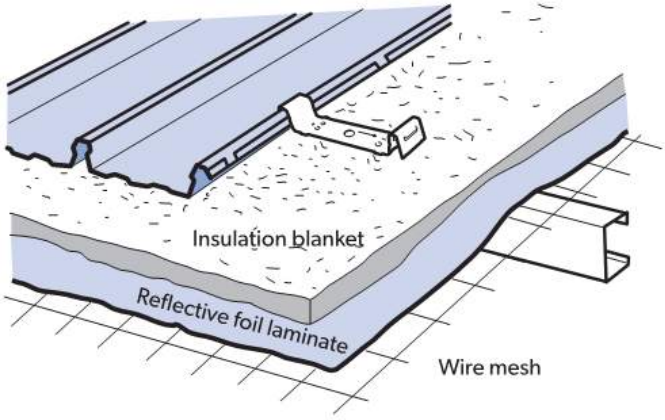


Figure 2: Typical roof insulation with foil and blanket (Lysaght)



1.4 Roof Sheets

Marking Out

- A pencil of any colour may be used except black or so-called lead pencils.
- Use a string line with chalk dust, or a fine, felt-tipped marker.

End of Sheets

Why are end of sheets treated?

Ends of sheets are treated to maximise weather resistance, environmental protection and vermin resistance.

At the high end of roofing, wind can drive water uphill, under the flashing or capping and into a building, so turn-ups are used to minimise the problem of water being driven uphill and under the flashing or capping and into a building:

The turning down process prevents water running up the underside of flat trays in low sloped roofs as a result of wind or capillary action. Valleys (or pans) must be:

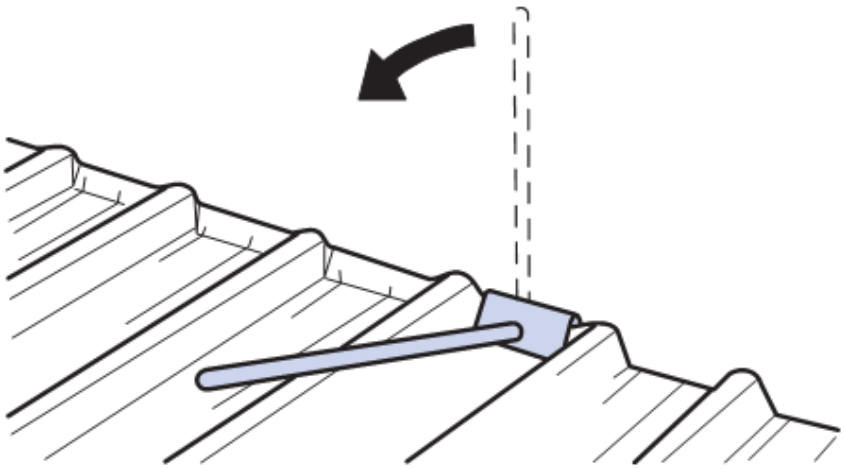
Roof Sheeting must be:

- Turned up at the high end of roofing on slopes below 1 in 2.
- Turned down on sloped below 1 in 5 (10°)

Figure 10.1.3

Turning-up (TRIMDEK® shown).

Figure 1: Turning up TRIMDEK



1.5 Expansion

Why is expansion a consideration?

All roof sheeting and accessories expand and contract with changes in temperature, significant changes in length can occur in very long runs of roofing.

On a clear hot summer day, with no wind, the temperature in roof cladding can reach up to 80°C.

As shown in the table below, the expansion and contraction of metal sheeting and flashings can as high as 27 mm in any 30 m length with an increase of 75 degrees, so the inclusion of appropriate expansion joints is a must.

Sheet length (mm)	Expansion or contraction (mm)		
	10°C change	50°C change	75°C change
5000	0.6	3	4.5
10000	1.2	6	9
15000	1.8	9	13.5
20000	2.4	12	18
25000	3.0	15	22.5
30000	3.6	18	27

Figure 1: Examples of the thermal changes in lengths of steel cladding resulting from various temperature changes in the steel, Lysaght

Roof Expansion Joints

Flashing must have expansion joints:

- At a maximum of every 24 metres (pierce fixing).
- Minimum overlap of 250 mm
- As per Figure

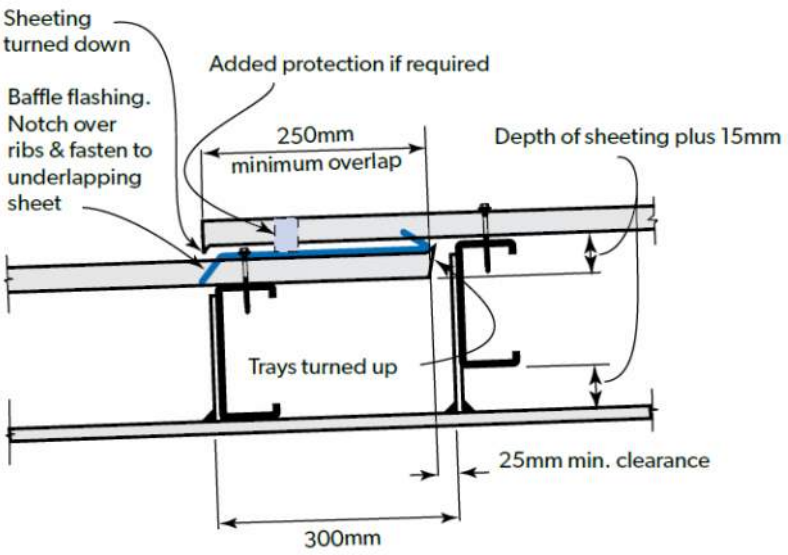


Figure 2: Source: Lysaght Roofing & Walling Installation Manual

Flashing Expansion Joints

Flashing must have expansion joints:

- At a maximum of every 12 metres,
- Within 1000 mm of a corner,
- Minimum lap of 100 mm
- As per Figure

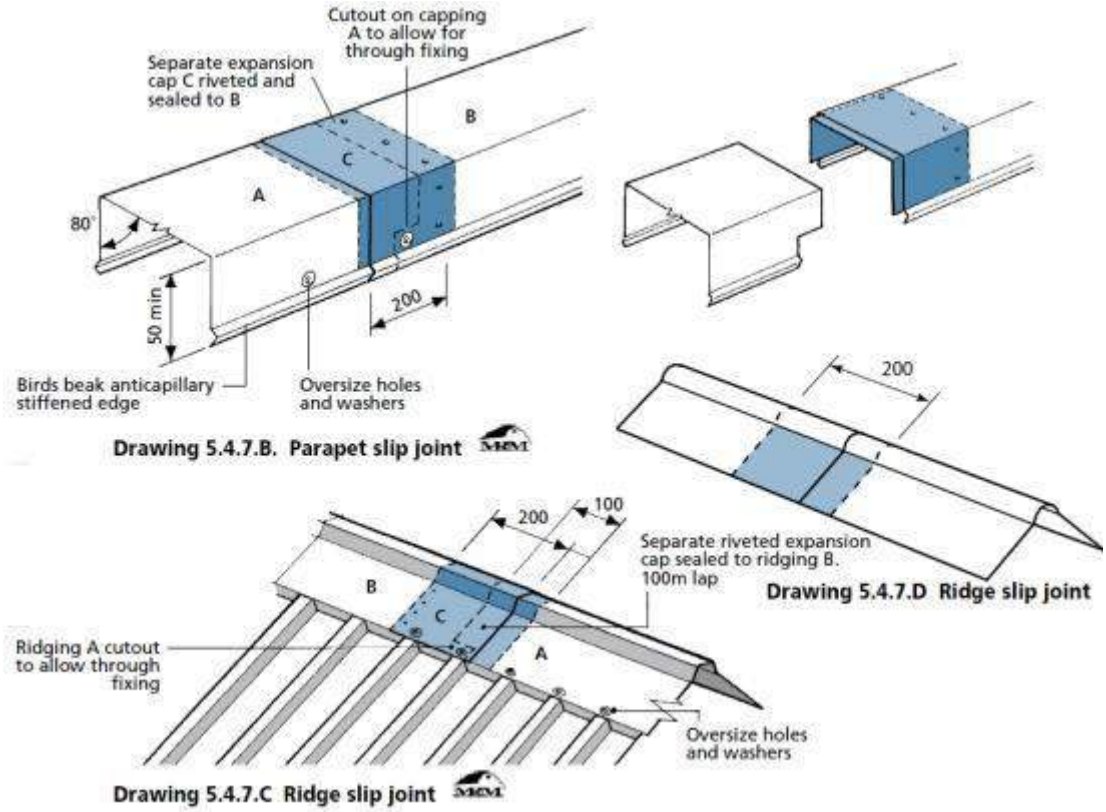


Figure 3: Drawings showing parapet slip joint and ridge slip joint (Source: NZ Metal Roofing Manufacturers Association)

1.6 Fasteners

Screws

Screws must:

- Be EPDM washers
- Be tightened so that the washer is gripped firmly but not distorted.
- Be suitable for roof type and location.

ENVIRONMENT OF INTENDED USE	AS 3566.2-2002 CORROSION RESISTANCE CLASS	BLUESCOPE STEEL ROOFING AND WALLING PRODUCTS	
External use in severe marine environments.	4 (Stainless steel screws)	COLORBOND® Stainless steel	Less than 100 metres from ocean/surf
	4 (Metallic coated steel screws)	COLORBOND® Ultra steel COLORBOND® steel COLORBOND® Coolmax® steel ZINCALUME® steel	100 to 200 metres from ocean/surf
External use in mild, moderate industrial or marine environments.	3	COLORBOND® Ultra steel COLORBOND® steel COLORBOND® Coolmax® steel ZINCALUME® steel	400 metres or more from ocean/surf
General use in other than external applications but where significant levels of condensation occur.	2	NOT TO BE USED IN EXTERNAL ROOFING AND WALLING APPLICATIONS	
General use in internal application.	1		

GENERAL GUIDE TO FASTENER SELECTION

Figure 1: Source: Lysaght Roofing and Walling Installation Manual, 2017

TYPICAL FEATURES OF SCREWS

Head		Shank	Drill Point
Hexagon head with integrated metal washer 	Hex. head with EPDM seal	Top Tread Section Extrudes sheeting towards the seal to maximise resistance to water penetration. Grips the sheeting for a secure connection. Stops sheeting from moving when walked on.	Self drilling for metal RoofZip® Point 
Hexagon head with integrated metal washer 	Hex. head with no seal	Dwell Section Prevents the sheeting from riding up during fixing and minimises distortion of the profile.	Self drilling for timber Drill Point. Type 17 
Wafer Head 	Wafer head with no seal	Shank Protection Enlarges the hole in the sheeting to minimise damage to the protective coating on the screw.	Self drilling for metal Drill Point. Standard Metal  Self drilling for metal Extended Drill Point 
Special Self-sealing Head 	RippleZips® screw head with self-sealing head		Self drilling for metal RippleZip® Point 

Figure 2: Features of Screws (Source: Lysaght Roofing and Walling Installation Manual, 2017)

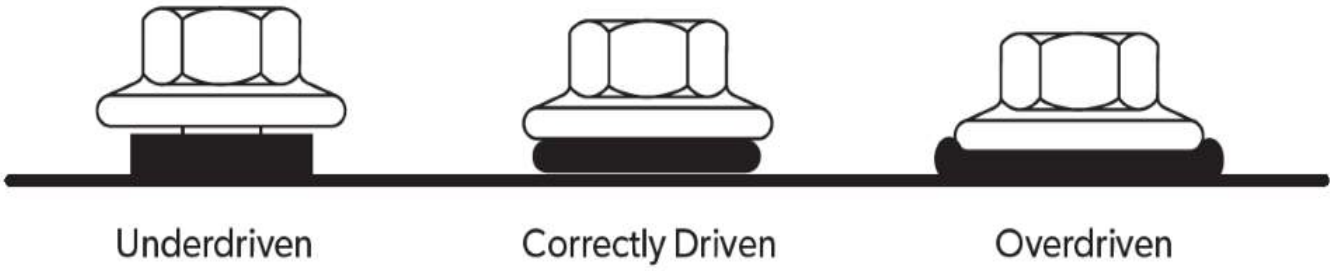


Figure 3: Screw installation (Source: Lysaght Roofing and Walling Installation Manual, 2017)

Rivets

Rivets must be:

- Sealed blind rivets only
- Suitable metal for the roof sheet and location.
- Should also be sealed over with neutral cure silicone sealant.

Figure 4: Sealed blind rivets

What is pierce fastened roofing?

Generally corrugated or trapezoidal in profile, pierce fixed roofing is metal or plastic sheet that is attached to the building with fasteners. Screws, for timber and steel frames, nails for timber alone. The fasteners penetrate the sheets the crests of each sheet generally at every 2rd or every 3rd crest. However, some profiles require fixing through every crest.

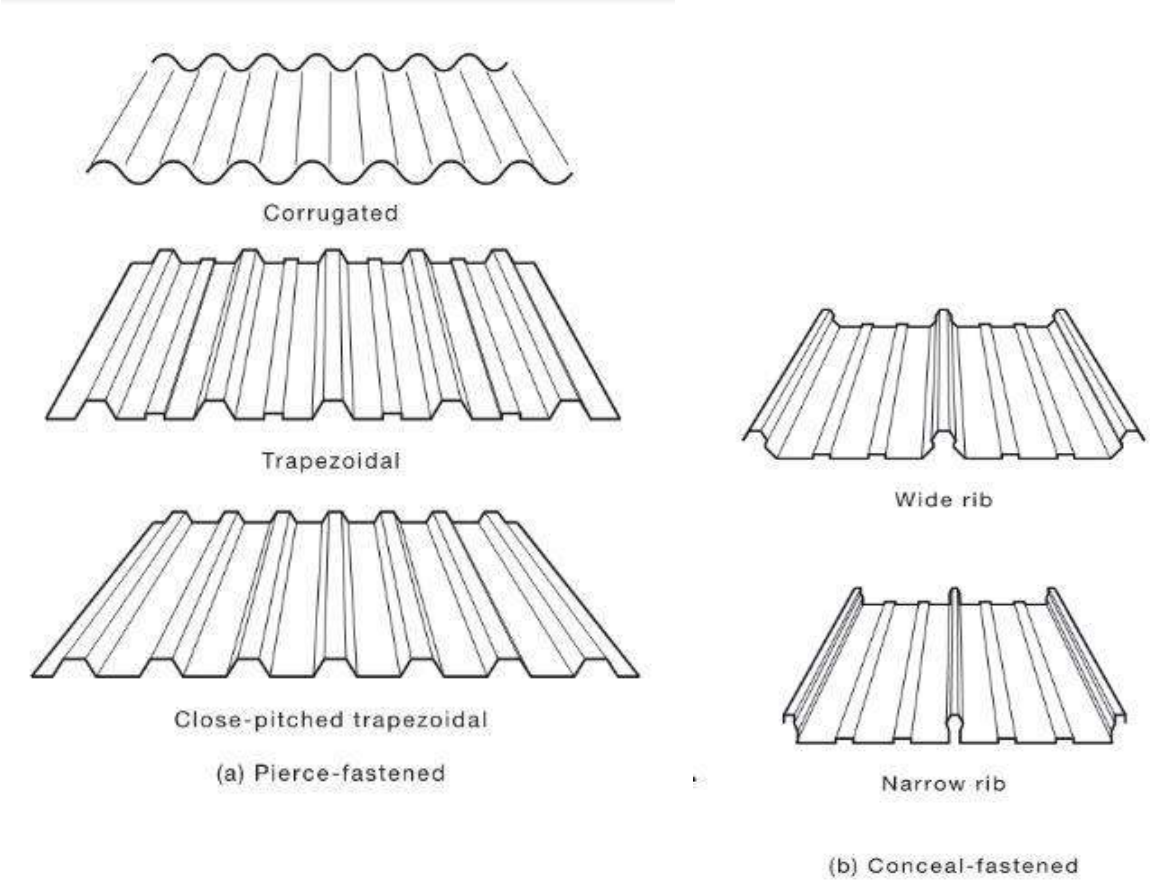


Figure 5 Pierce Fastened Roofing

What is concealed fastened roofing?

Concealed-fixing is the method of fixing sheets using fasteners which do not pass through the sheet, instead, the sheeting is held in place with clips fixed to the roof framing.

Figure 6 Concealed Fastened Roofing

1.7 Roof Penetrations

Large Penetrations

- When a penetration is 15 m or less from the highest point of the roof, a soaker tray is the preferred option to be installed to the termination.
- Large penetrations that exceed the pan width must be provided with additional structural framing to all four sides.
- Wherever one or more of the sheet ribs are cut, framing must be provided to support the cut ends of the roof cladding each side of the penetration.

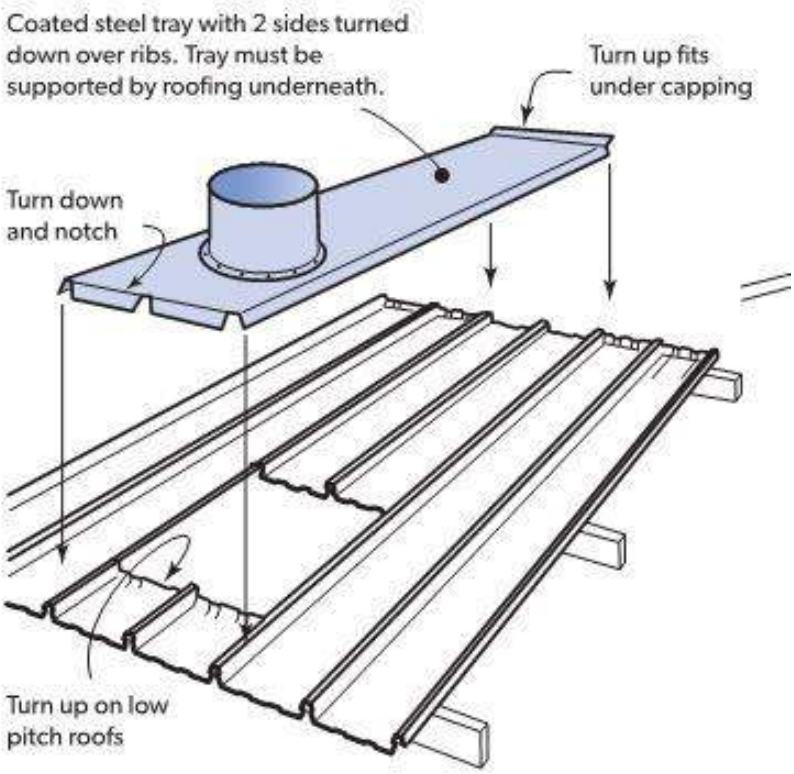


Figure 1 Example of a tray utilised for a large penetration

Small Penetrations

Penetrations through metal roofs must:

- Be positioned at or near the high point whenever practicable
- Have “Dektites” fitted on a tray
- Incorporate a shepherd’s crooks where suitable (refer figure below).
- Only have smooth-walled conduit (flexible conduit is not permitted under any circumstances).
- Incorporate EPDM rubber grommets for copper pipe penetrations
- If a copper pipe, it must be painted over the entire exposed length
- Incorporate a shepherd’s crooks where suitable (refer figure below).
- Incorporate Red Dektites flues where heat resistant is required.

Figure 2: Training mock-up MPX Centre for Excellence

Figure 3: Red Dektites are used on flues and are heat resistant

1.8 Flashings

What are flashings?

Flashings are a barrier of impervious material, built-in to prevent moisture movement to any part of a building requiring protection (usually the part below it). It includes a waterproof strip barrier around an opening in a wall or, at a roof junction, or at a roof penetration to prevent the ingress of water to the inner parts of a building.

Flashings for metal roofs must be the same metal as the roof sheets, fixed or built into an abutment to form a weathertight joint. There are many different types and geometries.

The terms flashing and capping are often used interchangeably.

What are longitudinal flashings?

Longitudinal flashings run parallel to the pans or valleys and are made to suit the cladding profile. They must have an edge turned-down that dips into the pan or valley.

What are transverse flashings?

Transverse flashings run across the pans or valleys. They usually have a stiffening lip along the lower edge, which is turned down to dip into the pan or valley.

To maximise weatherproofing, the bent lip is commonly fashioned (such as notching or scribing) to fit the profile.

Typical transverse flashings include ridge capping, fascia capping and parapet flashing.

Why is flashing important?

Flashings provides continuity of the cladding and makes a building watertight. Wind can drive rain hard against wall flashings, so it is important that attention is paid to the detailing of flashings around windows, doors, re-entrant and external corners (particularly near the edge of a building where wind pressure can be greater than elsewhere), to ensure a watertight and aesthetically appealing building.

Typical transverse flashings.

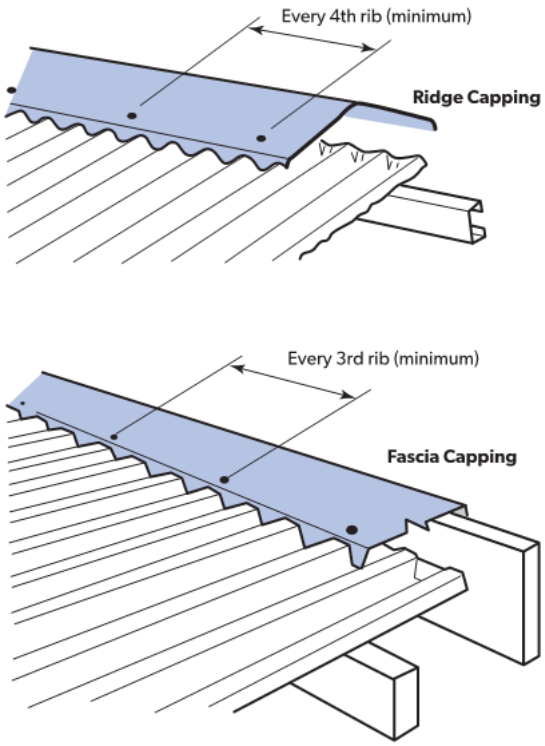


Figure 1: Fascia Capping (Source: Lysaght Roofing and Walling Installation Manual, 2017)

Typical longitudinal flashings.

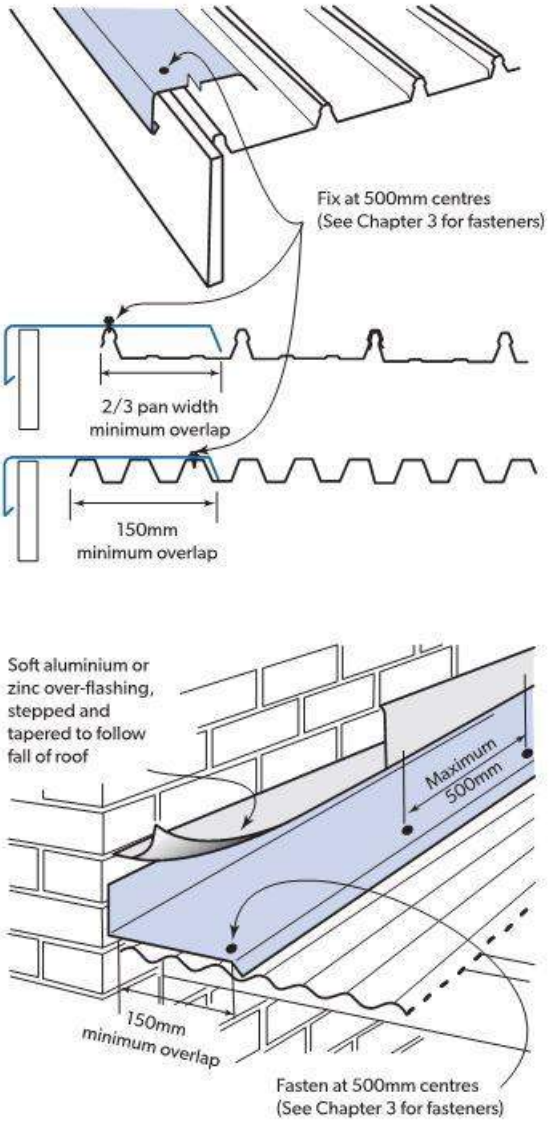


Figure 2: (Source: Lysaght Roofing and Walling Installation Manual, 2017)

General

Flashings must:

- Overlap between under & over flashings by 50 to 75 mm
- 75 mm minimum overlap to cladding
- Have laps with a minimum of 25 mm wide with:
    - Sealant between the sheets
    - Sealed rivets or screws at max. 40 mm centres
    - Always lapped in the direction of flow
- Cover the roof sheeting by not less than two ribs
- Be installed at wall abutments
- Be folded to shed water - 10º minimum fall
- Have additional continuous support framing at max. 200mm centres if capping and flashing have a width over 150 mm
- Have an air gap to the roof sheets
- Be sealed with an appropriate sealant.
- Consider additional fixing in situations of higher exposure to wind
- Have fasteners which are:
    - Located to minimise the length of unsecured overhangs
    - Located along both long edges of the flashings
    - Fastened by some other method (e.g. clips, overlapping stiffening strips, other suitable restraint) where an edge cannot be secured by fasteners.

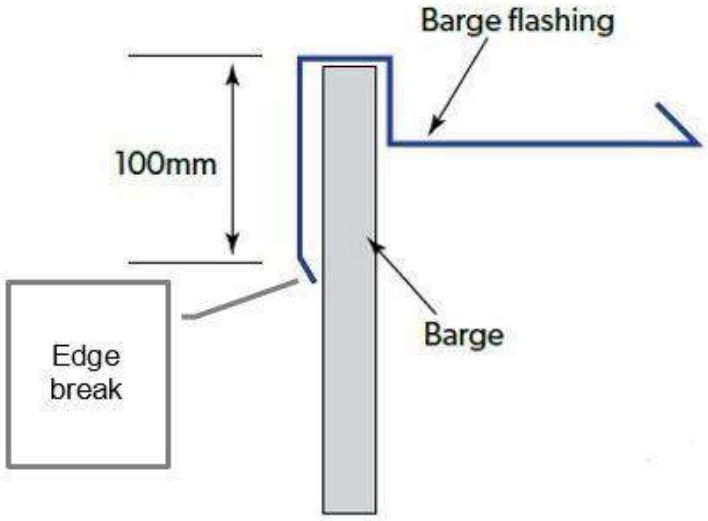
Lap Joints

Overlaps of transverse flashings must be sealed with a recommended sealant and fastened.
Note: QLD Only

- Single lap joint not to be used for box gutters where made of more than one length of sheet.
- Double lap joint to be used for box gutters where made of more than one length of sheet

Edge Break – Used in over flashings to provide an edge that pushes the face of the flashing away from an adjacent flat surface. This may be a barge board, flat cladding or the under flashing when applied to an over flashing.

Figure 3: Edge Beak



Drip Edge – Used in over flashings to provide an edge that pushes the lower edge of the flashing away from an adjacent flat surface. This may be a barge board or flat cladding.

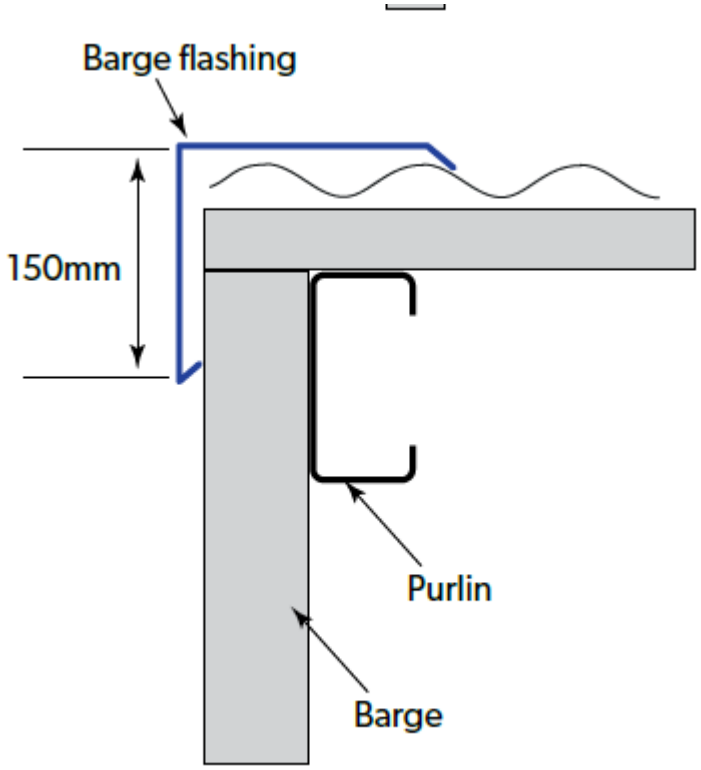


Figure 4: Drip Edge

Flattened – a.k.a. Fold and Crush, usually used as the edge detail for the termination of a cut edge to stiffen and protect the cut from water. It also provides a smaller capillary break than other folds and when used on an under flashing can assist in preventing wind driven rain from bypassing the flashing.

1.9 Box Gutters

Box gutters must:

- Be designed by a hydraulic engineer and verified by the MPX hydraulic engineer.
- Filled and tested for 24 hours.
- Be supported at:
    - Each stop-end
    - Either side of sumps
    - Either side of expansion joints
    - At rain heads
    - At generally not greater than 750 mm centres elsewhere
- Be straight with no reduction in width or changes in direction.
- Have a constant slope between 1:40 & 1:200 with no ponding except for water retained due to surface tension. Ponding result from any one of or a combination of the following, is a defect.
- Have lapped joints made against the direction of flow.
- Have expansion joints to be a proprietary EPDM rubber expansion joint.
- Have expansion joints at the high point of the gutter.
- Overhang of the roof sheeting must extend a minimum of 50 mm into the box gutter but never more than 200 mm.
- Maintain a minimum of 300 mm between sheet ends to permit cleaning of the gutter.
- Box gutter sumps must be fitted with overflow ducts, overflow channels or high capacity overflow devices
- Box Gutter Sumps
- Ensure that adequate overflow provisions are made, and any surcharge is accommodated
- Have an overflow weir not less than 25 mm below the sole of the gutter discharging to the rain head.
- Box gutters must be installed with sumps or rainheads
- Overflows must discharge outside of the building in a visible location. This provides a visual warning that when running, indicates the stack our sump is choked.

TABLE 4.3.2

BOX GUTTERS AND SUPPORT SYSTEMS—MAXIMUM LENGTH BETWEEN EXPANSION JOINTS AND MINIMUM EXPANSION SPACE

Material	Coefficient of thermal expansion per °C	Base metal thickness mm	Maximum length between expansion joints m		Minimum expansion space mm
			One end fixed and one end free to move	Both ends free to move	
Aluminium	24×10^{-6}	0.90 1.00	12 12	24 24	50
Copper	17×10^{-6}	0.60 0.80 1.00	9 15 26	18 30 52	50
Steel	12×10^{-6}	0.55 0.75	20 25	40 50	50
Stainless steel	17×10^{-6}	0.55	20	40	50
PVC	70×10^{-6}	—	10	20	30
Zinc	26×10^{-6}	0.80	10	20	50

Figure 1: Table 4.3.2, AS3500.3:2018

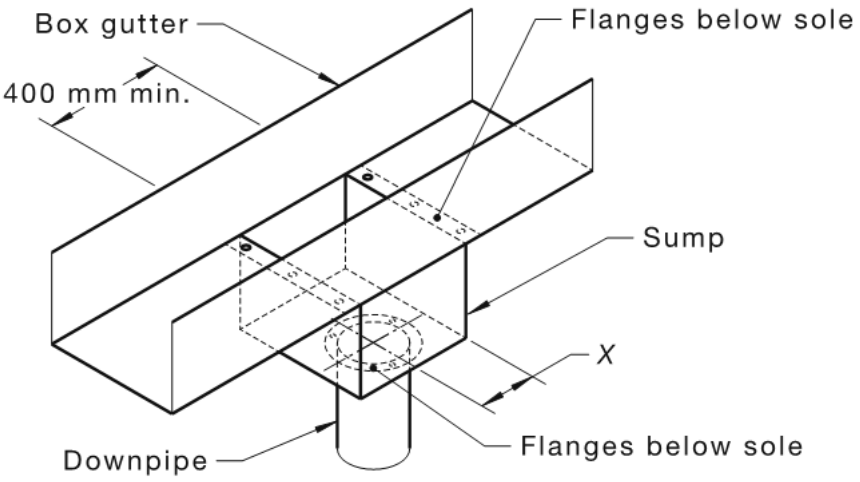


Figure 2: HB 39

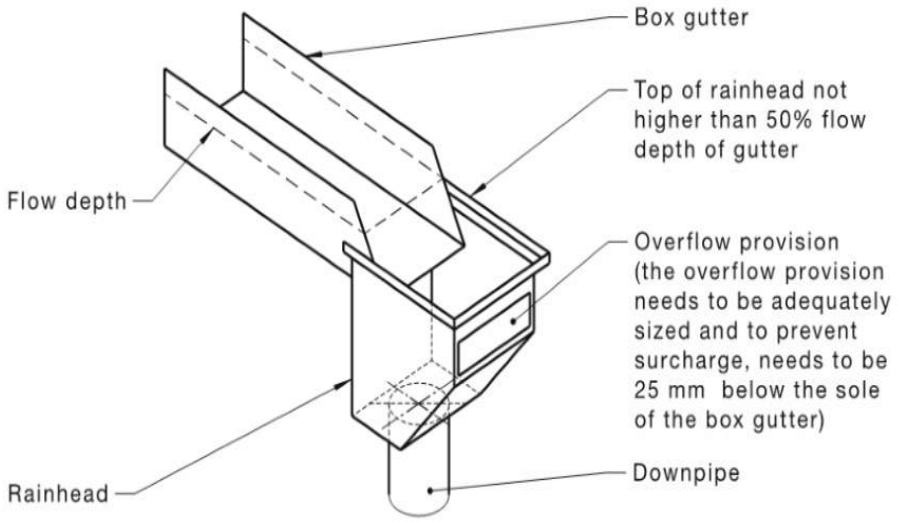


Figure 3: HB39

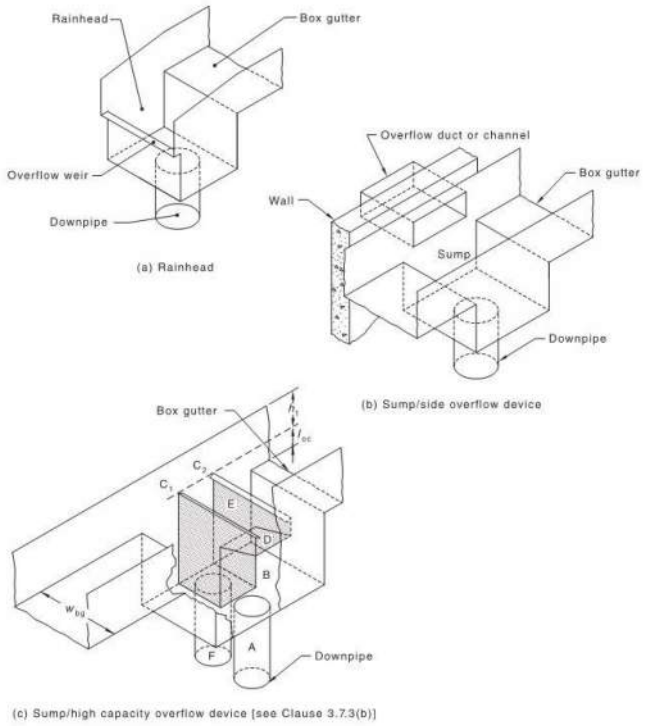


Figure 4: From AS3500.3:2018