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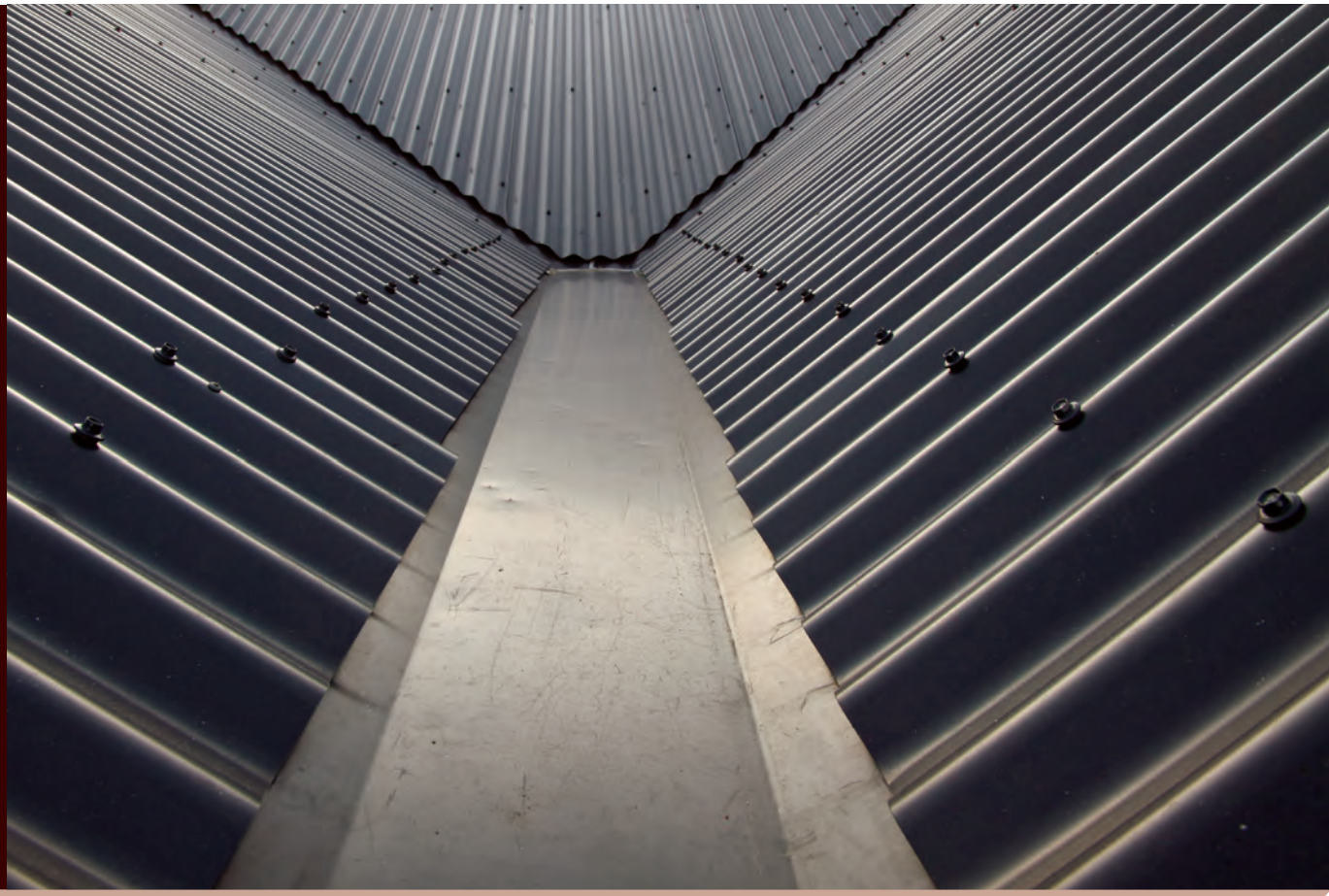


INTERNAL GUTTER DESIGN

February 2013

Internal gutters have historically caused water entry problems in buildings.

Wherever possible, design roofs to avoid internal gutters, but where unavoidable, correct design, material selection, installation and maintenance is crucial.

This bulletin outlines the requirements of E1/AS1 and E2/AS1 and gives design parameters to minimise the risk of problems. It replaces and updates Bulletin 537 of the same name.

1.0 INTRODUCTION

1.0.1 Internal or 'within roof area' gutters, also known as box gutters, are seen as an easy solution to the collection and disposal of roof water. However, significant inconvenience, damage, repair cost and health issues may occur if water from the gutter gets into the building structure and/or the space below.

1.0.2 Failure of internal gutters is commonly the result of:

- poor design – lack of fall, insufficient outlets, no overflows, insufficient capacity, insufficient allowance for movement
- incorrect material selection leading to a lack of durability
- poor quality of installation
- blockages from hail, snow or leaves
- lack of maintenance (or difficulty in accessing for maintenance).

1.0.3 Wherever possible, design roofs to avoid internal gutters. Where unavoidable, internal gutters must be carefully designed and constructed as well as being regularly checked and maintained to minimise the risk of water entering the building from leaks or overflow.

1.0.4 This bulletin outlines the design parameters to minimise the risk of problems. It supersedes the information on internal gutters given in section 3.5 of Bulletin 509 *Sizing gutters and downpipes* and replaces Bulletin 537 of the same name.

2.0 BUILDING CODE REQUIREMENTS

2.0.1 New Zealand Building Code clauses that apply to the design and installation of internal gutters are:

- B2 *Durability*
- E1 *Surface water*
- E2 *External moisture.*

2.1 B2 *DURABILITY*

2.1.1 To meet the performance requirements of clause B2, a gutter must remain durable with normal maintenance for not less than 15 years. However, the gutter will need to continue to perform for the serviceable life of the roof cladding system, and this is likely to be much more than 15 years. Replacing the gutter without replacing the roofing is considered difficult.

2.2 E1 *SURFACE WATER*

2.2.1 Clause E1 states buildings should be constructed in a way that protects people and other property from the adverse affects of surface water. E1/AS1 sets the design rainfall intensities in Appendix A and also requires the following:

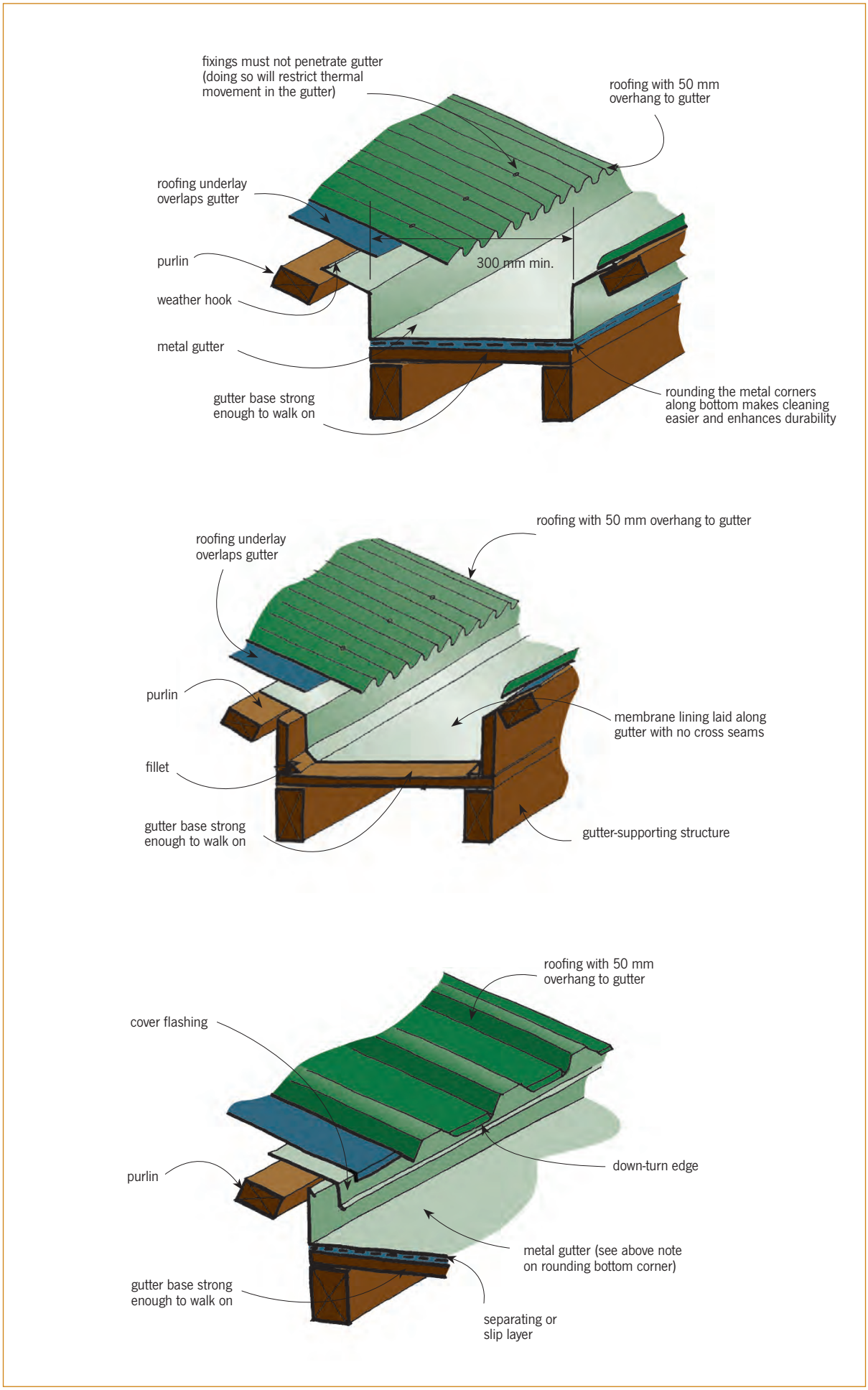
- All internal downpipes shall withstand, without leakage, a water test with an applied head of 1.5 m of water or a high pressure air test as described in E1/VM1 paragraph 8.3.
- Gutter sizes are given in Figure 16 of E1/AS1 and are based on a rainfall intensity of not less than 100 mm/hour. Appendix A of E1/AS1 gives gutter size modifications for areas where the rainfall intensity is higher. BRANZ recommends using not less than 200 mm/hour to give an additional safety margin when sizing internal gutters.
- Any gutter under consideration shall be divided into sections and each section shall be sized for the specific roof catchment it serves. A section shall comprise the length of gutter between a downpipe and the adjacent high point on one side only of that downpipe. Each section of gutter shall have a cross-sectional area of no less than that determined in Figure 16 of E1/AS1.
- Allowance shall be made for the thermal expansion and contraction of gutters. Table 7 of E1/AS1 shows for different materials the change in length of 5.0 m of guttering when subjected to a 50°C change in temperature.
- All internal gutters shall be fitted with overflow outlets that drain to the exterior of the building. The top of the outlet shall be set at least 50 mm below the top of the gutter. The cross-sectional area of the outlet shall be no less than the cross-sectional area of the downpipes serving the gutter.

2.3 E2 *EXTERNAL MOISTURE*

2.3.1 Clause E2 performance requirement E2.3.1 states that roofs (and associated features such as gutters) must shed precipitated moisture. In locations subject to snowfall, roofs must also shed melted snow. E2.3.2 also requires that water does not penetrate into the building and cause undue dampness or damage (or both) to building elements.

2.3.2 General design parameters given in E2/AS1 are that internal gutters (Figures 1 to 3) shall:

- be continuously supported with gutter boards, treated in accordance with NZS 3602:2003 *Timber and wood-based products for use in building* (as modified by Amendment 7 of B2/AS1)
- receive no direct discharge from downpipes or spreaders
- be formed from the same material as or be compatible with the roofing. For gutters with a minimum slope of 1:100, E2/AS1 permits:
  - 5000 series aluminium to AS/NZS 1734, temper O, with a minimum thickness of 0.9 mm, or
  - 316 stainless steel in accordance with Table 1 of ISO/TS 15510 with a minimum thickness of 0.45 mm, or
  - C1100 or C1220 copper to AS 1566 with a minimum thickness of 0.5 mm, or
  - zinc with a minimum thickness of 0.7 mm in accordance with BS EN 988
  - butyl rubber or EPDM – 1 mm minimum thickness for gutters up to 1.0 m wide and 1.5 mm minimum thickness for wider than 1.0 m.
- if made of metal, be separated from any timber treated with a copper-based treatment by roof underlay or other compatible separating layer
- have no fixings in gutter bottom or sides
- for metal gutters, have all joints welded



Figures 1 to 3 Internal gutter detail options

- for butyl or EPDM strip-lined gutters, have the membrane laid parallel to the gutter so that there are no cross joints in the gutter – that is, to lay the membrane in one continuous length.

2.3.3 E2/AS1 paragraph 8.1.6.3 also requires that internal gutters shall be constructed as shown in the Acceptable Solution for the applicable roof cladding, and shall:

- be sized in accordance with E1/AS1 provided that the gutter has a minimum depth of 70 mm and a minimum width of 300 mm
- be sized to provide an additional freeboard allowance of 20 mm minimum
- be provided with a weir outlet and discharge into a rainhead that has an overflow with the bottom below the sole of the gutter
- allow for an expansion joint at the upper end (or termination of each gutter section) (Figures 4 and 5).

2.3.4 The Acceptable Solution does not allow the use of AZ150 or Z275 coated steel with a factory finish or unfinished AZ150 or Z275 steel.

3.0 DESIGN RECOMMENDATIONS

3.1 GENERAL DESIGN

3.1.1 To make the design of internal gutters as safe and as durable as possible, be conservative:

- Design for a 10-minute rainfall intensity for the location with a recommended minimum design intensity of 200 mm/hour (rainfall intensity is for a storm with a 10% probability of occurring annually).
- Ensure there is sufficient freeboard to prevent overflowing due to wave action in windy conditions. Overflowing can occur in windy conditions when the water level in the gutter reaches a point 50 mm below the top of the gutter.
- Ensure that the sides of the gutter extend well above the outlet. A severe hailstorm could block the outlet, and if this is followed by heavy rain, water could run over the gutter sides into the roof space.
- Make the gutter wider rather than narrower (over the 300 mm minimum required) to allow for foot traffic during maintenance. Wider gutters are easier to keep clean or repair than narrower ones.
- Allow for any discharge flow from the testing of any fire-fighting hydrant extending above the roof level.
- Detail a base that is strong enough for the gutter to be safely used as a foot traffic route, particularly if there are steeply pitched roofs draining into it.
- Detail snow guards or snow boards in snow-prone areas so that the gutter will remain free to drain the melted water.
- Do not discharge downpipes and/or spreaders directly into the gutter.
- Locate downpipes at not more than 12 m intervals (provided catchment areas are not exceeded). This gives a maximum gutter run of 6 m if regularly spaced.
- Provide a weir outlet and discharge into a rainhead (preferably external) that has an overflow with the bottom below the sole of the gutter.
- Specify dome-type leaf guards to reduce the risk of downpipe blockage.
- For membrane gutters, fillet or chamfer all transitions.
- For metal gutters:
  - galvanised steel or aluminium/zinc alloy-coated steel are not acceptable materials for internal gutters in E2/AS1
  - allow for expansion at the ends of the gutter where it abuts an adjacent structure (Figure 5)
  - form gutters with curved or chamfered horizontal to vertical transitions to make cleaning easier and assist long-term durability.

3.2 GUTTER SLOPES

3.2.1 A minimum fall of 1:100 to the outlets is required in E2/AS1. A fall of 1:60 provides even better drainage. The requirement for minimum gutter slopes is so that:

- a fall to the outlet is always maintained and all water is removed
- some inaccuracy in construction will not negate the fall
- some sagging in the gutter over time can be accommodated without compromising the drainage.

3.2.2 If a metal gutter does not have a fall of 1.5° or more, it is unlikely to meet the manufacturer's warranty requirements.

3.3 OUTLETS

3.3.1 Good practice for outlets:

- Provide multiple outlets (two minimum) to each gutter run.
- Locate gutter outlets to maintain drainage. As an example, in one project, gutter outlets were located above the downpipes (which were encased within columns to protect them). As a result of building deflection in the gutter between the columns, the outlets ended up at the highest point in the gutter, resulting in ineffective drainage.
- Locate overflow outlets in an obvious position (such as beside a doorway) to give the earliest possible warning of a problem. Overflows must discharge clear of the building and have a cross-sectional area equal to that of the downpipes serving the gutter.
- Do not make sharp changes in downpipe direction.
- Downpipes with sharp bends inhibit drainage. Downpipe sizing needs to be increased to the cross-sectional area of the gutter.
- Avoid internal downpipes where possible.

3.4 TESTING

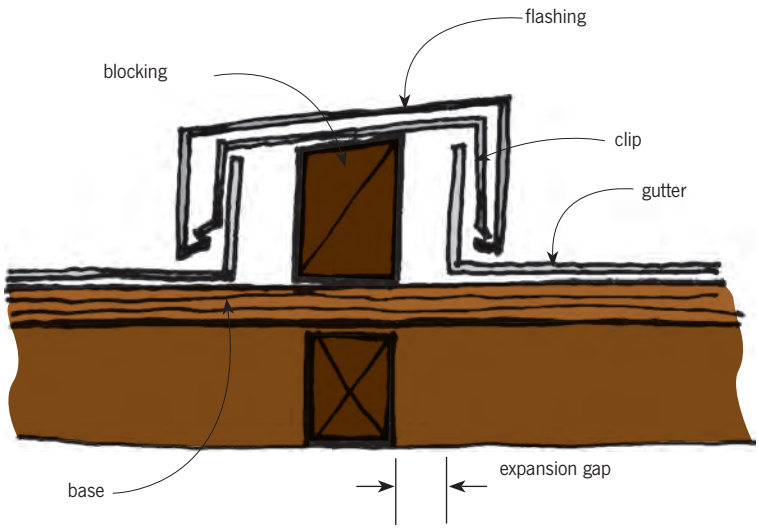
3.4.1 Once the gutter is installed, it should be flood tested (before internal finishing is done) to ensure there are no leaks. It is also a requirement that all concealed internal downpipes are pressure tested to ensure joints are adequately sealed before they are built in.

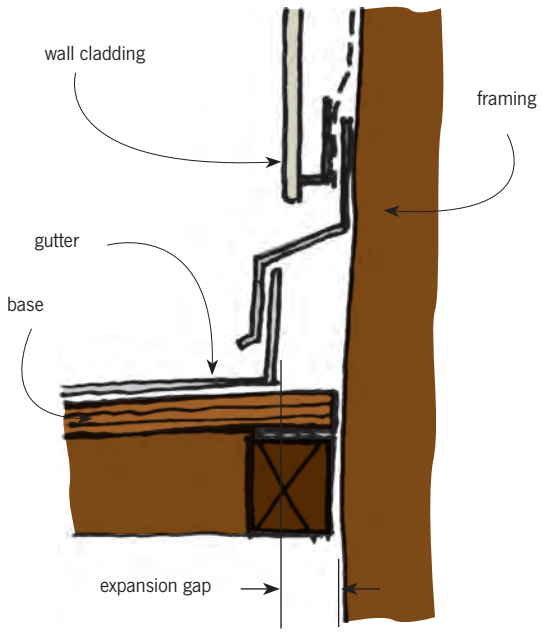
3.5 MAINTENANCE

3.5.1 E2/AS1 clause 2.5 requires that "Maintenance shall be carried out as necessary to achieve the required durability of materials, components and junctions."

3.5.2 Regular maintenance includes:
- inspecting surfaces and junctions
- repairing or replacing items when necessary to preserve weathertightness
- maintaining proper clearances.

3.5.3 With internal gutters in particular, homeowners need to be made aware of the need for regular checks of gutters and downpipes for any build-up of debris.





Figures 4 (top) and 5 (bottom) Expansion joint details

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