



# ROOF DRAINAGE DESIGN

The roof on a new building needs to be more than just aesthetically appealing and able to keep the building weathertight – it must also effectively collect and dispose of rainwater.

By Greg Burn, Structure Limited, Auckland

**O**ften, the floor plan of a building is designed, then a roof is fitted over the plan. The result can be an overly complex roof that is difficult to both construct and drain.

The roof shape and style is an important consideration at all design stages. Designing the roof as an integral component of the overall building design will ensure roof drainage is not compromised. This is particularly important with 2-storey designs where upper floor walls intersect lower storey roofs and drain water onto the roof, increasing the total roof catchment area. These intersections can also create complex junctions that hinder drainage.

When designing a roof, consider how rainwater will impact both roof and upper floor walls, and how this water will be drained, collected and disposed of. Walls that drain onto a lower storey roof can increase the effective roof area by around 50%.

## Drainage design specific to location

Rainfall intensities vary throughout New Zealand and are often very high. Roof drainage systems need to be designed to cope with the rainfall intensities for the specific building location. It is prudent to design systems with extra capacity to deal with a possible increase in rainfall and more regular extreme weather events due to climate change.

The shape, style and pitch of a roof all impact on the drainage capabilities of the actual roof itself. Roofs that are simple in design and fall from a ridge to the eaves generally have the most effective drainage. Roof drainage can be compromised by complex roofs that require water to be diverted, or collected and drained within the roof plane. This can cause problems elsewhere



A complex series of roofs and junctions makes roof drainage design more difficult.

on the roof, overloading drainage systems with the amount of water diverted into them.

## Roof pitch

The pitch of the roof is also an important design consideration, as the roof slope affects the velocity of water that drains off it. Pitch also affects how the wind acts upon the water being drained – wind may slow the descent of water on low pitched roofs and alter its path. Therefore, consider wind speeds specific to the building location.

An increase in roof pitch also increases the roof catchment area and the volume and flow rate of water being drained.

Different roofing materials require different minimum pitches. They may also require an increase in pitch relative to the length of the run of the roof. This will increase the run-off velocity

to cope with the increased amount of water.

## Gutters and flashings

Water falling on a roof drains over the roof surface and into internal or external gutters, where it is collected and drained to downpipes connected to a stormwater disposal system or drained via a spreader onto a lower roof area.

### FLASHINGS

It is important to incorporate suitable flashings that protect critical junctions in the roof surface and allow water to drain freely over them. Material for flashings must be fit for purpose and sized and installed in accordance with the roof manufacturer's installation requirements. Where possible, flashings should be lapped away from the prevailing wind.

### VALLEY GUTTERS

Valley gutters are a common form of internal →

gutter. These are formed beneath the surface of the roof and need to be correctly designed and built – any failure can result in water entering the building.

Valley gutters must be wide and deep enough to provide the capacity needed for the specific rainfall intensity of the building location. A minimum width of 250 mm is recommended in E2/AS1 and BRANZ roofing details to allow maintenance, with side upstands to stop water flowing over the sides.

Water needs to drain from a valley gutter over an adjacent roof surface or directly into an external gutter with the capacity to manage this concentrated water discharge.

Terminating a valley gutter at an internal corner of an external gutter is common. Size the gutter to accommodate the extra water and locate a downpipe near the corner to dispose of the water.

#### INTERNAL GUTTERS

Internal gutters, such as box gutters, that are generally low pitch and constructed from a roofing membrane, need to be specifically designed and should have a:

- minimum width of 300 mm
- minimum depth of 50 mm (plus a minimum of 20 mm freeboard)
- BRANZ-recommended minimum fall of 1:100 (E2/AS1 only specifies a fall for butyl rubber-lined gutters)
- design able to cope with double the location's 10-minute rainfall intensity given in E1/AS1, with the proviso that the figure used is not less than 200 mm/hour.

BRANZ Bulletin 509 *Sizing gutters and downpipes* covers the design of these types of gutters.

Internal gutters often drain, either directly or through scuppers, into rainwater heads. The rainwater heads need to be of a suitable capacity for the design discharge of the gutter and have an adequate size downpipe and an overflow below the level of the gutter sole.

#### EXTERNAL GUTTERS

External gutters must be adequately sized and installed with a fall towards downpipes that are connected to a stormwater disposal system. They need to be designed to a 10-minute rainfall intensity of not less than 100 mm/hour – a higher intensity may need to be used depending on the actual rainfall intensity for the location of the building.



The poor roof design means there will be a major concentration of water flow from a valley gutter in a constricted area.

#### Downpipes

Downpipes need sufficient capacity to manage the design discharge for the roof area they are servicing. A general guideline is that a 75 mm diameter round downpipe will manage a roof area of 85 m<sup>2</sup> at a rainfall intensity of 100 mm/hour, and a 100 mm diameter round downpipe will manage 210 m<sup>2</sup> of roof.

A 75 × 50 mm rectangular downpipe offers less discharge capacity than a 75 mm diameter round pipe. A 75 × 75 mm square downpipe will manage 110 m<sup>2</sup> of roof at a rainfall intensity of 100 mm/hour as it has a larger cross-sectional area than a 75 mm diameter downpipe.

The location of downpipes is also important. They should be:

- at the corners of the gutter
- in any other location where the water flow within the gutter is restricted
- where the water catchment is concentrated into the gutter.

A maximum spacing of 12 m is recommended.

The outlet from the gutter to the downpipe also needs to be protected to prevent blockage.

#### Discharge

Where downpipes discharge onto a lower roof, under E2/AS1 8.1.6:

- a spreader is required – both ends of the spreader should be capped to prevent water flowing into end laps
- the maximum catchment area that can be discharged through a spreader is 25 m<sup>2</sup>
- for concrete and clay tile roofs, the roofing must be installed over roof underlay, otherwise discharging onto the roof is not permitted.

#### Maintenance

Regular maintenance of the roof drainage systems and the roof itself is fundamental to the on-going performance of the entire system. The roof surface and associated flashings need to be kept in good repair and the gutters and downpipes regularly cleaned and kept free of debris.

#### Building Code compliance

The compliance documents E1/AS1 for Building Code Clause E1 *Surface water* and E2/AS1 for Clause E2 *External moisture*, offer some guidance for the design of residential roof drainage systems.

BRANZ Bulletin 509 can also be used as an Alternative Solution for the sizing of gutters and downpipes. ◀