Technical Solution Sheet 0.04
0: Roof Plumbing

Duplicate solution of 4.04 (Drainage)

Roof and Stormwater

AIM
The aim of this technical solution is to clarify requirements for the sizing of stormwater drains, external eaves gutter and downpipe design and to provide examples of overflow provision methods for eaves gutters.

PLUMBING REGULATIONS 2008
The *Plumbing Code of Australia* (PCA) is adopted by and forms part of the *Plumbing Regulations 2008*. Part D1 of the PCA specifies the objectives and performance requirements related to the installation of roof drainage systems. *AS/NZS 3500.3 Plumbing and drainage - Part 3: Stormwater drainage* & Section 2 of *AS/NZS 3500.5 Plumbing and drainage - Part 5: Housing installations* are "Deemed to Satisfy" documents listed in Part B3 of the PCA and both contain sections on "Surface and Roof Drainage Systems - design".

The *Plumbing Regulations 2008* also specify that roofing (stormwater) work must comply with *SAA/SNZ HB114 Guidelines for the design of eaves and box gutters*.

Part D2 of the PCA specifies the objectives and performance requirements related to the installation of surface and subsurface drainage systems.

AS/NZS 3500.3 is a "deemed to satisfy" document listed in Part D2 of the PCA and contains sections on "Roof drainage systems" Surface drainage systems - design", "Roof drainage systems installation", Surface drainage systems – design" and "Surface and subsoil drainage systems - installation".

SURFACE DRAINAGE SYSTEMS – DESIGN
AS/NZS 3500.3
Summary of methods to design surface drainage systems
Two methods of design are used depending on the area of the proposed allotment:

1. Nominal method for single dwellings (rural) and single dwellings (urban) where the allotment size is less than 1000m². This method does not involve any calculations and some rules are provided regarding diameter of pipes, depth of cover, gradient and layout.

2. General method for all buildings. This method involves hydraulic design calculations to determine design flows, and procedures to determine the design of channels and drains.

Nominal method - Minimum diameter of pipe
1. For single dwellings in rural areas, and single dwellings on urban allotments with areas less than 1000m², the minimum diameter of pipe shall be DN90; and

2. For other properties, downstream of a stormwater or inlet pit, shall be the greater of- the diameter of the largest pipe entering the pit, or - DN150.

Note:
An exception to this is at footpath crossings where multiple pipes of DN100 or less may be used.

External connections

The external connection can be to the street gutter, a street drainage pipe or inter-allotment drain (see Figure 1).

Layout of systems

AS/NZS 3500.3 lists a range of requirements for the layout of stormwater drains. It is important to consider:
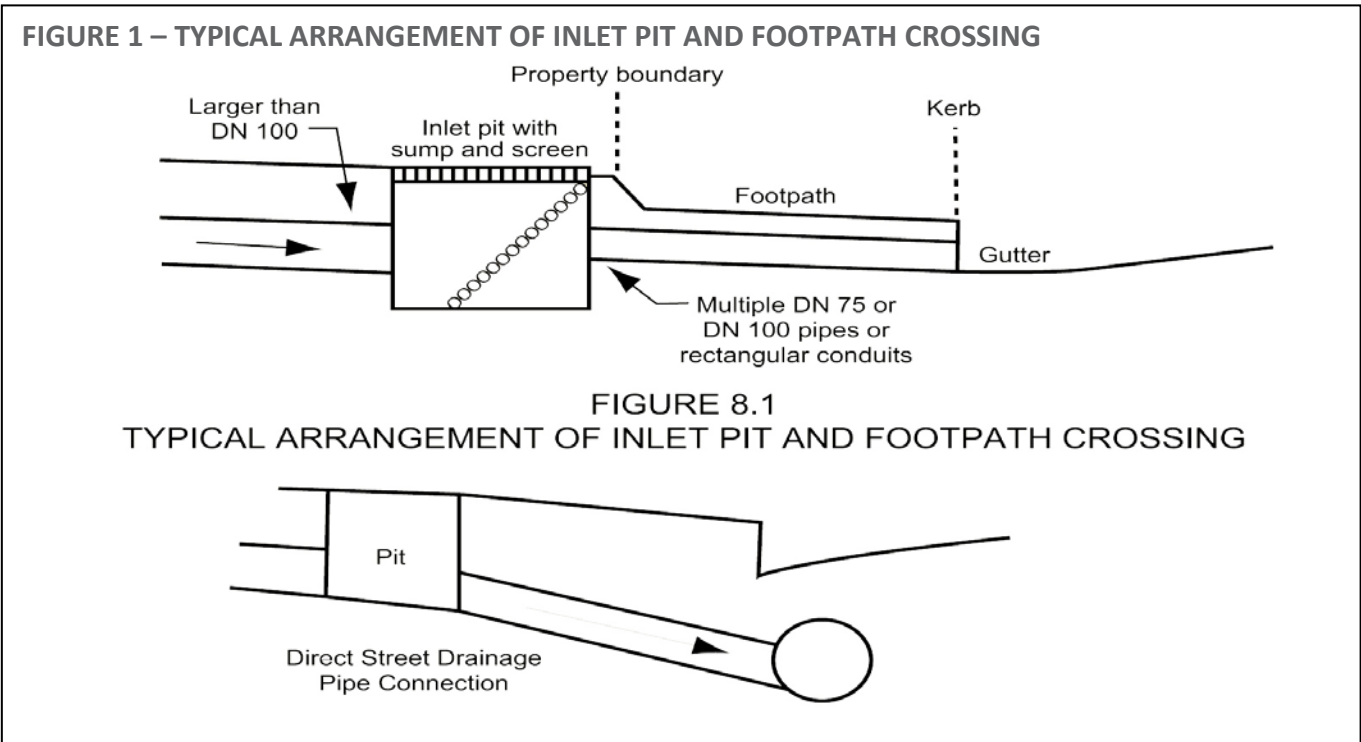
1. The allowance for possible stormwater discharges from adjacent properties,
2. Protection of buildings, and
3. The location of stormwater drains in relation to the sanitary drainage system.

Example of layout and sizing

Figure 2 is from Appendix K of *AS/NZS 3500.3* which details a solution to stormwater drainage on an urban allotment not exceeding 1000m². The drainage system is constructed of approved non-metal materials.

Solution

1. The layout should comply with *AS/NZS 3500.3* so that the overland flow path is directed away from the building.

FIGURE 1 – TYPICAL ARRANGEMENT OF INLET PIT AND FOOTPATH CROSSING

FIGURE 8.1
TYPICAL ARRANGEMENT OF INLET PIT AND FOOTPATH CROSSING

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2. The stormwater drains are sized in accordance with *AS/NZS 3500.3* as follows:
- between a downpipe outlet and a stormwater or inlet pit, DN90
- between the stormwater pits A & B, DN150; and
- between pit B and the street kerb, two drains DN100 or less

3. Minimum cover for PVC-U from *AS/NZS 3500.3*
- under the paved driveway within the property, 75mm below the underside of brick or unreinforced concrete for light vehicle loadings. Elsewhere for single dwelling properties 100mm.
- under the paved footpath outside the property, 75mm below the underside of the paving.

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4. The minimum gradient for stormwater drains (from AS/NZS 3500.3) for DN90, DN100 and DN150 is 1:100.

5. Stormwater pits, A & B are sized based on *AS/NZS 3500.3* Each pit would be 450mm x 450mm with a minimum fall of 20mm between the invert of the inlet and outlet.

ROOF DRAINAGE SYSTEMS – DESIGN
AS/NZS 3500.3 & SAA/SNZ HB114

Elements of Roof Drainage Design
1. Catchment areas
- Vertical walls abutting a roof must be included in the catchment area. For hipped roofs with eaves gutters a simplified formula can be used to calculate catchment area, but the slope of the roof must be known. Refer to *AS/NZS 3500.3* and *SAA/SNZ HB114* which simplify the roof catchment calculations. (see Appendix A) *SAA/SNZ HB114* for example calculations for typical roof styles. (see page 14 step 2) for the method using the slope factor for a pitched roof to an eaves gutter (hip & valley with no abutting vertical walls or flat roofs).
- The catchment area of a roof and any vertical walls is greatly influenced by the direction of wind driven rain, therefore the combined catchment area must be used for sizing purposes.

2. Rainfall intensity
- Rainfall intensities are given in Appendix E *AS/NZS 3500.3* The appendix gives five minute duration rainfall intensities. There is also reference to an Average Recurrence Interval (ARI) of 20 and 100 years.

  The ARI is used in accordance with Table 3.1, *AS/NZS 3500.3* where the risk of property damage, inconvenience or injury to people is taken into account

FIGURE 2 – SOLUTION TO STORMWATER DRANAGE ON URBAN ALLOTMENT
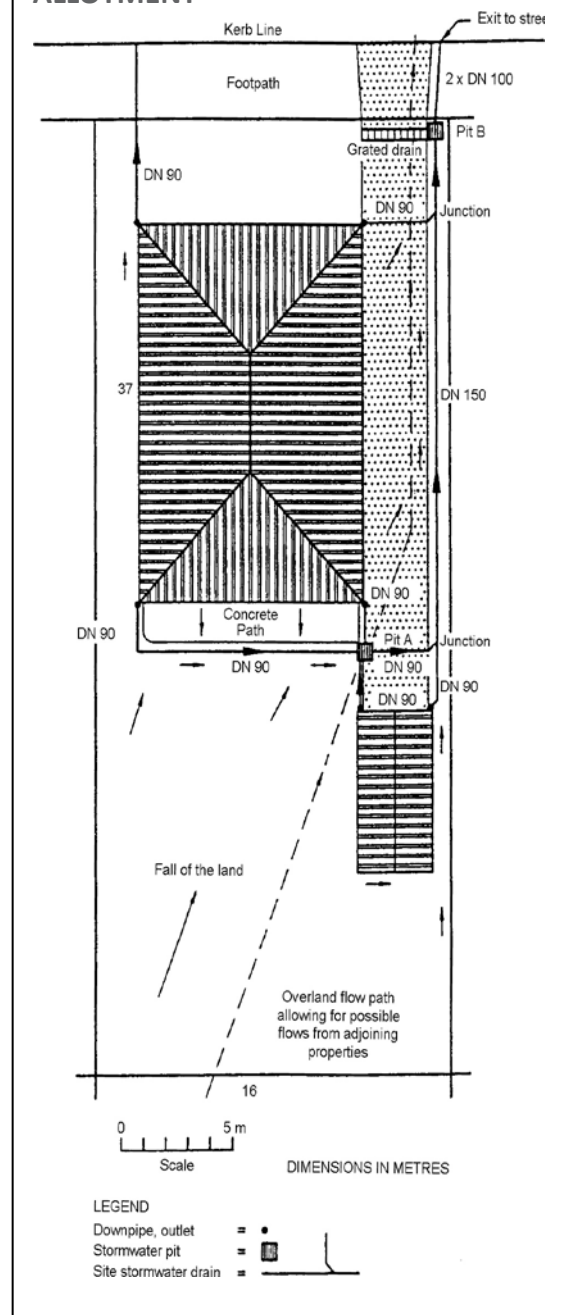
For example:
- external gutters eaves gutters 20 years ARI Internal gutters, box gutters 100 years ARI

Note:
For a 500 year ARI, multiply 100 year ARI x 1.5

- Table E1 lists latitude and longitude of selected places, some of which are marked on the maps. If there is any doubt regarding

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the rainfall intensity for a particular area, refer to the relevant council / shire for accurate rainfall intensity figures.

3. Overflow measures for eaves gutters

- Always consider what will happen if the gutter overflows. If water cannot flow back into the building, e.g. gutter fixed to rafters without eaves linings, no overflow measures are required. If water can flow back into the building; e.g. through eaves linings, then overflow methods must be provided.
- Blockages can occur in eaves gutters anywhere along the gutter; therefore an overflow device at the outlet may not prevent such overflows.
- Examples of acceptable overflow measures for eaves gutters can be found in Appendix G of *AS/NZS 3500.3*.
- Simplified ways of providing for overflow of external eaves gutters can be found in *SAA/SNZ HB114*.

Design Example

The following example is shown to illustrate the procedure adopted by *SAA/SNZ HB114* to design eaves gutters and downpipes.

A house is to be constructed in Melbourne. The plan is shown in Figure 4. There roof pitch is 23°. Gutter overflow could cause significant damage, therefore overflow measures are required.

Step 1:   Determine the 5min/20 year ARI for the locality

From *AS/NZS 3500.3* Figure E6, the ARI for Melbourne is 130mm/hour.

Step 2:   Select eaves gutter and gutter slope

The eaves gutter selected is quad spouting with an effective cross sectional area of 6125mm² installed with a slope of 1:500.

Step 3:   Determine downpipe size

From Table 3.3 in *AS/NZS 3500.3*, or Table 3.2 in *SAA/SNZ HB114*, the minimum size downpipes compatible with spouting of 6125mm² cross sectional area (installed at a 1:500 gradient) are 90mm diameter round or 100mm x 50mm rectangular.

Note:

A minimum gradient of 1:500 is preferred.

Step 4:   Select 100 x 50 rectangular downpipe.

From Figure 3.5 (A) in *AS/NZS 3500.3* or Figure 4 in *SAA/SNZ HB114* the maximum catchment per downpipe is 47m².

Step 5:   Determine minimum number of downpipes

To calculate the minimum number of downpipes, divide the roof catchment area by the allowable maximum catchment per downpipe.

Min number of downpipes =

$$= \frac{\text{roof catchment area}}{\text{allowable maximum catchment per downpipe}}$$

$$= \frac{223.8}{47}$$

$$= 4.76\text{m}^2$$

= Five downpipes are required (round up to the next whole number)

Step 6:   Determine the average catchment area per downpipe

To calculate the average catchment per downpipe, divide the roof catchment area by the number of downpipes. Average catchment per downpipe =

$$\frac{\text{Roof catchment area}}{\text{No. of downpipes}}$$

$$= \frac{223.8}{5}$$

$$= 44.76\text{m}^2$$

Step 7: Divide the roof into approximately equal catchment areas and determine downpipe positions

Divide the roof into five catchments and nominate the high points between downpipes (see Figure 5).

Step 8: Select an overflow method if required
The example building requires overflow measures.

SSA/SNZ HB114 and *AS/NZS 3500.3* both provide various methods depending on the type of gutter used. For this job select Example 1 from Figure 1 in *SSA/SNZ HB114* where the gutter is installed with a minimum h_f mm value between the top of the front bead of the gutter and the top of the fascia (see Figure 6). *SSA/SNZ HB114* also provides information to size box-gutters, rain-heads, sumps and overflow devices — plumbers must be aware of design requirements, and apply them on the job.

Note:
- The minimum h_f value is based on $^{100}l_5$ for Australia (see Table G1 minimum h_f values) in *AS/NZS 3500.3*
- There are many possibilities for downpipe positions. In some cases depending on roof shape or building layout extra downpipes may be needed as it is not always possible to achieve approximately equal catchment areas.
- Valley gutters should be at high points to allow drainage away from internal angles.
- The sub catchment areas may not add up exactly due to rounding off during calculations.
- In this particular example, as per step 5, no catchment area should exceed the allowable 47m².

FIGURE 3 – PROVIDING FOR OVERFLOW OF EXTERNAL EAVES GUTTERS (h_f)

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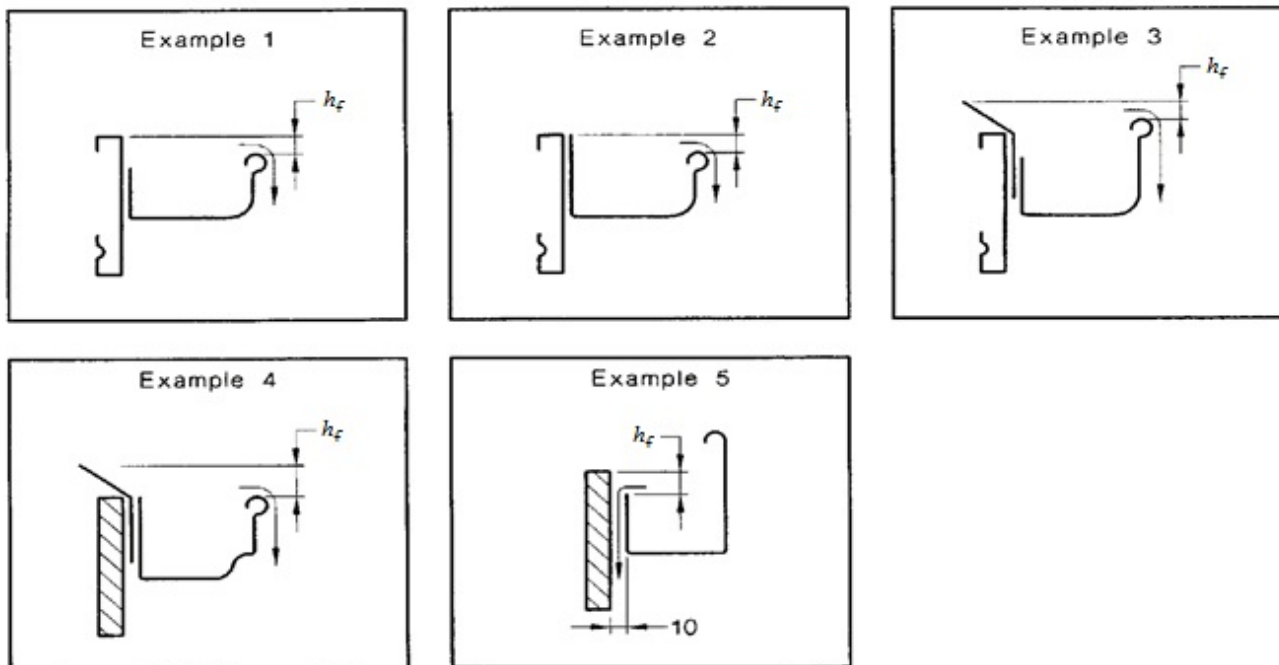
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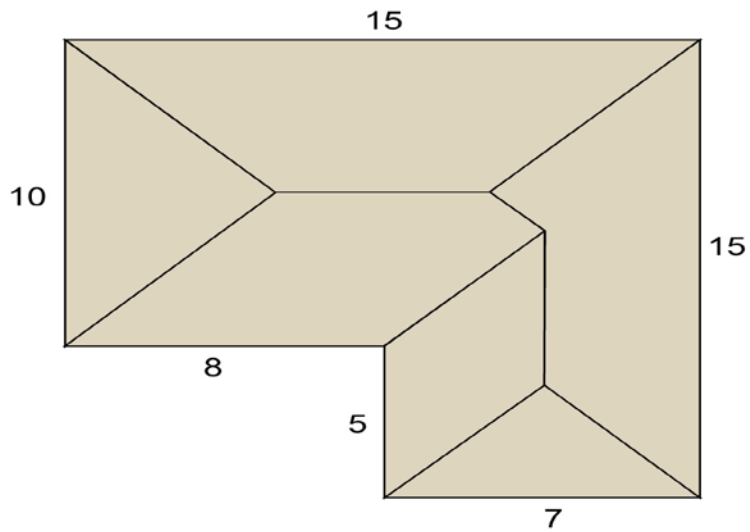

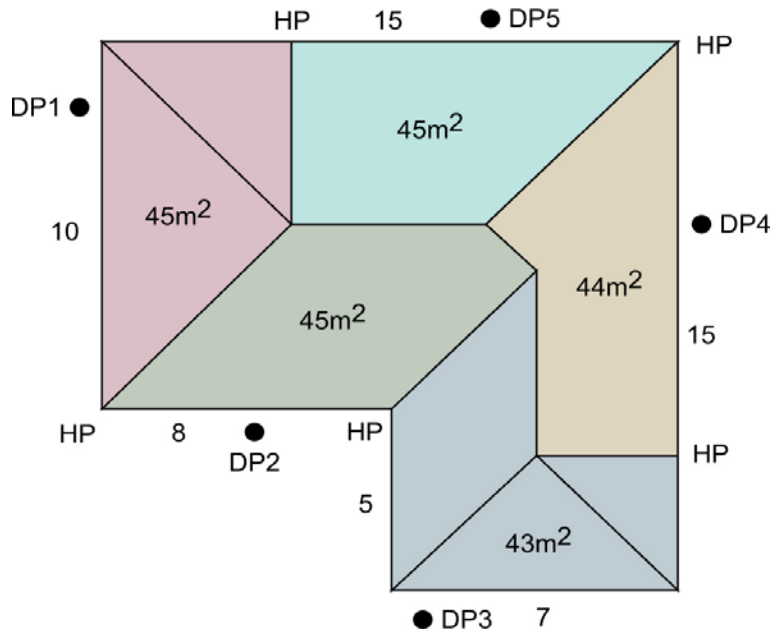**FIGURE 4 – DESIGN EXAMPLE HOUSE PLAN**

FIGURE 5 – ROOF DIVIDED INTO FIVE CATCHMENTS

FIGURE 6 – EXAMPLE OF OVERFLOW METHOD

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