

AS/NZS 3500.3:2021



Australian/New Zealand Standard™

Plumbing and drainage

Part 3: Stormwater drainage



AS/NZS 3500.3:2021

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- Australian Stainless Steel Development Association
- Backflow Prevention Association of Australia
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Part 3: Stormwater drainage

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Preface

This document was prepared by the joint Standards Australia/Standards New Zealand Committee WS-014, Plumbing and Drainage, to supersede AS/NZS 3500.3:2018.

The objective of this document is to provide stormwater drainage solutions for compliance with —

- (a) the National Construction Code (NCC); and
- (b) the New Zealand Building Code (NZBC), Clause E1 Surface Water.

A list of all parts in the AS/NZS 3500 series for plumbing and drainage can be found in the Standards Australia and Standards New Zealand online catalogues.

The major changes in this revision are as follows:

- (i) Definitions have been relocated to AS/NZS 3500.0 for consistency across the series.
- (ii) Design rainfall intensities are now expressed in terms of the Annual Exceedance Probability (AEP) values to reflect the practice of the Australian Bureau of Meteorology (BOM) and the performance requirements of NZBC Clause E1 Surface Water. There has been no change in the requirements or the calculations, and the original ARI values are shown for comparison.
- (iii) The 5 min duration rainfall intensities for representative places in Australia given in [Table D.1](#) have been updated to show the latest values from the BOM.
- (iv) The New Zealand rainfall maps have been replaced by [Table E.1](#) showing 10 % AEP (10 years ARI) and 2 % AEP (50 years ARI) rainfall intensities for selected locations.
- (v) The range of materials that can be used for wet wells has been expanded to encompass prefabricated wells.
- (vi) Changes have been made to the requirements for the marking of pipes in commercial buildings to assist in the better identification of pipework and avoiding cross connections.
- (vii) The design rainfall intensities for balcony and terrace drainage systems in New Zealand have been included.

The terms “normative” and “informative” are used in documents to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a document, whereas an “informative” appendix is only for information and guidance.

Notes or footnotes to tables or figures that are expressed in mandatory terms are deemed to be requirements of this document.

Notes to clauses in this document are informative only and do not include requirements.

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NOTES

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Section 1 Scope and general

1.1 Scope

This document sets out the requirements for materials, design, installation and testing of roof drainage systems, surface drainage systems and subsoil drainage systems to a point of connection.

Illustrations used in this Standard are diagrammatic only and have been chosen without prejudice.

NOTE [Appendix M](#) provides general information to users of the document.

1.2 Application

1.2.1 Australia

This document shall be read in conjunction with the National Construction Code (NCC).

Where alternative Australian or New Zealand Standards are referenced (e.g. AS 1345), the Australian Standard shall be used for Australia only.

1.2.2 New Zealand

This document shall be read in conjunction with the New Zealand Building Code (NZBC). This document may be used to demonstrate compliance with the NZBC Clause E1 Surface Water.

Where alternative New Zealand Standards are referenced (e.g. NZS 5807), the New Zealand Standard shall be used for New Zealand only.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1074, *Steel tubes and tubulars for ordinary service*

AS 1273, *Unplasticized PVC (UPVC) downpipe and fittings for rainwater*

AS 1289.5.4.1, *Methods of testing soils for engineering purposes, Method 5.4.1: Soil compaction and density tests — Compaction control test — Dry density ratio, moisture variation and moisture ratio*

AS 1289.5.6.1, *Methods of testing soils for engineering purposes, Part 5.6.1: Soil compaction and density tests — Compaction control test — Density index method for a cohesionless material*

AS 1379, *Specification and supply of concrete*

AS 1432, *Copper tubes for plumbing, gasfitting and drainage applications*

AS 1478.1, *Chemical admixtures for concrete, mortar and grout, Part 1: Admixtures for concrete*

AS 1604.1, *Specification for preservative treatment, Part 1: Sawn and round timber*

AS 1628, *Water supply — Metallic gate globe and non-return valves*

AS 1631, *Cast grey and ductile iron non pressure pipes and fittings*

AS 1646, *Elastomeric seals for waterworks purposes*

AS 1657, *Fixed platforms, walkways, stairways and ladders — Design, construction and installation*

AS 1834.1, *Material for soldering, Part 1: Solder alloys*

AS 2050, *Installation of roof tiles*

AS 2200, *Design charts for water supply and sewerage*

AS 2439.1, *Perforated plastics drainage and effluent pipe and fittings, Part 1: Perforated drainage pipe and associated fittings*

AS 2865, *Confined spaces*

AS 3517, *Capillary fittings of copper and copper alloy for non-pressure sanitary plumbing applications*

AS 3571.1, *Plastics piping systems — Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin, Part 1: Pressure and non-pressure drainage and sewerage (ISO 10467:2004, MOD)*

AS 3571.2, *Plastics piping systems — Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin, Part 2: Pressure and non-pressure water supply (ISO 10639:2004, MOD)*

AS 3579, *Cast iron wedge gate valves for general purposes*

AS 3600, *Concrete structures*

AS 3648, *Specification and methods of test for packaged concrete mixes*

AS 3680, *Polyethylene sleeving for ductile iron piping*

AS 3705, *Geotextiles—Identification, marking and general data*

AS 3795, *Copper alloy tubes for plumbing and drainage applications*

AS 3996, *Access covers and grates*

AS 4060, *Loads on buried vitrified clay pipes*

AS 4139, *Fibre-reinforced concrete pipes and fittings*

AS 4198, *Precast concrete access chambers for sewerage applications*

AS/NZS 1167.1, *Welding and brazing — Filler metals, Part 1: Filler metal for brazing and braze welding*

AS/NZS 1234, *Recommendations for coordinated preferred dimensions in building*

AS/NZS 1254, *PVC-U pipes and fittings for storm and surface water applications*

AS/NZS 1260, *PVC-U pipes and fittings for drain, waste and vent applications*

AS/NZS 1477, *PVC pipes and fittings for pressure applications*

AS/NZS 1866, *Aluminium and aluminium alloys — Extruded rod, bar, solid and hollow shapes*

AS/NZS 2032, *Installation of PVC pipe systems*

AS/NZS 2033, *Installation of polyethylene pipe systems*

AS/NZS 2041.1, *Buried corrugated metal structures, Part 1: Design methods*

AS/NZS 2041.2, *Buried corrugated metal structures, Part 2: Installation*

AS/NZS 2041.4, *Buried corrugated metal structures, Part 4: Helically formed sinusoidal pipes*

AS/NZS 2179.1, *Specifications for rainwater goods, accessories and fasteners, Part 1: Metal shape or sheet rainwater goods, and metal accessories and fasteners*

AS/NZS 2280, *Ductile iron pipes and fittings*

AS/NZS 2566.2, *Buried flexible pipelines Part 2: Installation*

AS/NZS 2638.1, *Gate valves for waterworks purposes, Part 1: Metal seated*

AS/NZS 2638.2, *Gate valves for waterworks purposes, Part 2: Resilient seated*

AS/NZS 2648.1, *Underground marking tape, Part 1: Non-detectable tape*

AS/NZS 2878, *Timber — Classification into strength groups*

AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand Wiring Rules)*

AS/NZS 3500.0, *Plumbing and drainage, Part 0: Glossary*

AS/NZS 3500.1, *Plumbing and drainage, Part 1: Water services*

AS/NZS 3725, *Design for installation of buried concrete pipes*

AS/NZS 3879, *Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ABS ASA pipes and fittings*

AS/NZS 4058, *Precast concrete pipes (pressure and non-pressure)*

AS/NZS 4087, *Metallic flanges for waterworks purposes*

AS/NZS 4129, *Fittings for polyethylene (PE) pipes for pressure applications*

AS/NZS 4130, *Polyethylene (PE) pipes for pressure applications*

AS/NZS 4327, *Metal-banded flexible couplings for low-pressure applications*

AS/NZS 4401, *Plastics piping systems for soil and waste discharge (low and high temperature) inside buildings — Polyethylene (PE)*

AS/NZS 4441, *Oriented PVC (PVC-O) pipes for pressure applications (ISO 16422:2014, MOD)*

AS/NZS 4455.2, *Masonry units, pavers, flags and segmental retaining wall units, Part 2: Pavers and flags*

AS/NZS 4671, *Steel reinforcing materials*

AS/NZS 4680, *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

AS/NZS 4765, *Modified PVC (PVC-M) pipes for pressure applications*

AS/NZS 5065, *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications*

NZS 3631, *New Zealand timber grading rules*

NZS 3640, *Chemical preservation of round and sawn timber*

EN 12056-3, *Gravity drainage systems inside buildings, Part 3: Roof drainage, layout and calculation*

New Zealand Building Code (NZBC), Acceptable Solution E1/AS1

New Zealand Building Code (NZBC), Acceptable Solution E2/AS1

1.4 Terms and definitions

For the purpose of this document, the terms and definitions in AS/NZS 3500.0 apply.

1.5 Abbreviations

1.5.1 General

The following abbreviations are used in this document.

AHD	Australian Height Datum
AEP	Annual exceedance probability
ARI	Average recurrence interval
BOM	Bureau of Meteorology
FRC	Fibre-reinforced concrete
GMAW	Gas metal-arc welding
GTAW	Gas tungsten-arc welding
HASBM	Hydrometeorological Advisory Services of the Bureau of Meteorology
NIWA	National Institute of Water and Atmospheric Research
OSD	On-site stormwater detention
SW	Stormwater

1.5.2 Plastics abbreviations

The following plastics abbreviations are used in this document.

ABS	Acrylonitrile butadiene styrene
GRP	Glass filament reinforced thermosetting plastic
PB	Polybutylene
PE	Polyethylene
PE-X	Cross-linked polyethylene
PP	Polypropylene
PVC	Polyvinyl chloride
PVC-M	Modified polyvinyl chloride
PVC-O	Oriented polyvinyl chloride
PVC-U	Unplasticized polyvinyl chloride

1.6 Notation

1.6.1 Quantity symbols

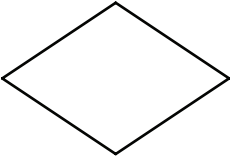
For the purposes of this document, the following symbols apply.

Symbol	Definition	Unit
A	= cross-sectional area of flow in an open channel	m ²
A_c	= catchment area of a roof and vertical surface (wall or parapet)	m ²
A_{cdp}	= for a selected eaves gutter, the maximum catchment area of roof per vertical downpipe, see Appendix G	m ²
A_{s-c}	= eaves gutter subcatchment area for a particular downpipe and high point layout	m ²
A_e	= effective cross-sectional area of a gutter	mm ²
A_h	= plan area of a roof including the gutter or parapet which is part of the catchment	m ²
A_{hs-c}	= plan area of subcatchment roof including the gutter or parapet that is part of the catchment	m ²
A_i	= total unroofed impervious (paved) catchment area	m ²
A_p	= total unroofed pervious catchment area	m ²
A_r	= total roofed catchment area	m ²
A_v	= maximum elevation area of a sloping roof, vertical surface, wall or parapet	m ²
b_f	= blockage factor for inlet-to-inlet pit	—
b_n	= nominal breadth of cross-section of a rectangular or square downpipe	mm
ΣCA	= equivalent impervious area of all upstream areas on the property	m ²
C_i	= run-off coefficient, for an unroofed impervious (paved) area	—
C_p	= run-off coefficient for an unroofed pervious area	—
C_r	= run-off coefficient for a roofed area	—
D	= diameter of the site stormwater drain	mm
D_e	= effective equivalent diameter of a rectangular downpipe $2 \times \sqrt{\frac{b_n \times w_n}{\pi}}$, or square downpipe $2 \times \sqrt{\frac{b_n^2}{\pi}}$	mm
D_i	= internal diameter of a circular downpipe	mm
d_{bg}	= minimum depth of a box gutter that discharges to a sump/high capacity overflow device (includes h_f)	mm
d_p	= depth of ponding over an inlet to an inlet pit	m
d_{oc}	= minimum depth of an overflow channel	mm
F	= multiplier for increased surface area of roof due to slope	—
h_a	= minimum depth of a box gutter that discharges to a rainhead (includes h_f)	mm
h_e	= effective depth	mm
h_f	= freeboard	mm
h_r	= total depth of a rainhead	mm
h_s	= depth of a sump	mm
h_t	= minimum height of the top of the box gutter above the crest of the overflow weir or channel	mm
$Y\%I_t$	= rainfall intensity for a duration of t and an AEP of $Y\%$	mm/h
k	= Colebrook–White roughness coefficient	mm

Symbol	Definition	Unit
l_{oc}	= for a sump/side overflow device, the minimum horizontal distance between the sides of an overflow channel and those of the sump	mm
	= for sump/high capacity overflow device, the height of the overflow weir (crest) above the sole of the gutter	mm
l_r	= length of a rainhead	mm
m	= multiplier for rainfall run-off coefficients	—
n	= Manning roughness coefficient for an open channel	—
$p\%I_t$	= rainfall intensity for an AEP of $p\%$ and a duration t	mm/h
P	= wetted perimeter of an open channel	m
	= perimeter length of the pit excluding any section against a kerb or wall (bars may be disregarded)	m
R	= hydraulic radius $R = \frac{A}{P}$	m
S	= gradient of an open channel	—
Q	= design flow of stormwater	L/s
Q_c	= discharge capacity for an open channel	L/s
Q_i	= capacity of an inlet for a sag pit	L/s
T	= time	min
v	= full-pipe velocity, in metres square	m ²
w_{bg}	= sole width of a box gutter	mm
w_e	= effective width	mm
w_{oc}	= width of an overflow channel	mm
Y	= average recurrence interval (ARI)	years

1.6.2 Flow chart symbols

Flow chart symbols and conventions used in this document are listed below.

Flow chart symbol	Use
	= terminator — represents an entry from or an exit to an outside environment (i.e. the start or the finish of a flow chart)
	= data input
	= process and execute the defined operation or group of operations, resulting in a change in value
	= decision or switching — a single entry with more than one exit, only one of which will be activated following the evaluation of the condition
	= connector — represents an exit to or an entry from either another part of the same flow chart or from another flow chart and corresponding symbols contain the same unique identification

1.6.3 Gradients

In this document, gradients are expressed in the form of a numerical ratio Y:X, where Y is the vertical dimension and X is the horizontal dimension of a right-angled triangle.

1.7 Identification of piping

Accessible pipework shall be permanently marked so as to be readily identifiable as part of the stormwater drainage system within:

- (a) In Australia, all Class 2 to Class 9 buildings (multi-unit, commercial and industrial buildings).
- (b) In New Zealand —
 - (i) Multi-unit dwellings, including apartment buildings but excluding low rise multi-unit dwellings such as an attached dwelling or flat;
 - (ii) Communal residential buildings, excluding holiday cabins and backcountry huts;
 - (iii) Communal non-residential buildings;
 - (iv) Commercial buildings; and
 - (v) Industrial buildings.

NOTE 1 Refer to the NCC or NZBC as appropriate for information on building use categories and classes.

Identification markings shall be placed —

- (i) at spacings not exceeding 6 m; and
- (ii) adjacent to branches, junctions, valves, service appliances, bulkheads, and wall and floor penetrations.
- (iii) at every floor level within vertical ducts and riser cupboards.

NOTE 2 Pipes which are marked as part of the manufacturing process are acceptable.

NOTE 3 Refer to AS 1345 for information on identification tags and labels in Australia.

NOTE 4 Refer to NZS 5807 for information on identification marking in New Zealand.

Section 2 Materials and products

2.1 Scope of section

This section specifies requirements for materials and products for use in a stormwater drainage system.

2.2 Selection and use

Materials and products used in a stormwater drainage system shall be fit for their intended purpose for the life of the installation.

NOTE 1 Factors to be taken into account in the selection include —

- (a) the nature of the intended use of the building;
- (b) the environment (refer to AS/NZS 2312, AS 4312 or the relevant product Standard);
- (c) the nature of the ground, quality of subsoil water and the possibility of chemical attack therefrom;
- (d) the physical (e.g. abrasion) and chemical (e.g. corrosion) characteristics of the materials and products; and
- (e) components of installations manufactured from more than one material, with either contact between or drainage to them, see [Clauses 4.4.1](#) or [4.4.2](#).

NOTE 2 Where materials are used for the collection of drinking water, the use of materials conforming to AS/NZS 4020 should be considered.

2.3 Roof drainage system

2.3.1 Roof drainage system components

Roof drainage system components made from aluminium alloys, aluminium/zinc and aluminium/zinc/magnesium alloy-coated steel, copper, copper alloys, zinc-coated steel, stainless steel and zinc shall conform to AS/NZS 2179.1.

2.3.2 Downpipes

Materials and products, other than those specified in [Clause 2.3.1](#), used for downpipes shall meet the following requirements:

- (a) Aluminium alloy pipes shall conform to AS/NZS 1866 and be in straight (i.e. not bent) lengths.
- (b) Cast iron pipes and fittings shall conform to AS 1631.
- (c) Copper pipes and fittings shall conform to AS 1432 and AS 3517 respectively and satisfy the following additional criteria:
 - (i) When Type B pipe is field bent, the offset angle shall be not greater than 10°.
 - (ii) Type D pipe shall be in straight (i.e. not bent) lengths.
 - (iii) Fabricated bends and junctions at the base of downpipes less than 9 m high shall be, as a minimum, fittings suitable for Type D applications.
- (d) Copper alloy pipes and fittings shall be as specified in AS 3795 and AS 3517 respectively with the following limitations on use:
 - (i) Type D shall be in straight (i.e. not bent) lengths.
 - (ii) Only junctions shall be field fabricated.

- (iii) Only cast or hot-pressed bends and junctions shall be used at the base of downpipes with heights equal to or greater than 9 m.
- (e) Ductile iron pipes and fittings shall be as specified in AS/NZS 2280.
- (f) Fibre-reinforced concrete (FRC) pipes and fittings shall be as specified in AS 4139 and be autoclaved.
- (g) Galvanized steel pipes and malleable cast iron fittings shall be as specified in AS 1074, with the following limitations on use:
 - (i) Pipes shall be in straight (i.e. not bent) lengths.
 - (ii) Pipes and fittings shall be installed in accessible locations.
- (h) Glass filament reinforced thermosetting plastic (GRP) pipes shall be as specified in AS 3571.1 and AS 3571.2. They shall be resistant to ultraviolet light when installed in direct sunlight.
- (i) Polyvinyl chloride (PVC) pipes and fittings shall be as specified in AS/NZS 1254, AS/NZS 1260, AS 1273 or AS/NZS 1477. They shall be resistant to ultraviolet light where installed in direct sunlight.
- (j) Polyethylene (PE) pipes and fittings shall conform to AS/NZS 4129, AS/NZS 4130 or AS/NZS 4401. Unless coloured black, pipes and fittings shall not be exposed to direct sunlight without protection in accordance with AS/NZS 2033.

NOTE 1 Chains should not be used as downpipes.

NOTE 2 Copper pipes manufactured in accordance with NZS 3501 are also suitable for use in New Zealand.

2.3.3 Accessories and fasteners

Accessories and fasteners manufactured from aluminium alloys, aluminium/zinc and aluminium/zinc/magnesium alloy-coated steel, copper, copper alloys, zinc-coated steel, stainless steel and zinc shall conform to AS/NZS 2179.1.

2.4 Stormwater drains (non-pressure)

Products used for non-pressure stormwater drains shall conform to the following:

- (a) Aluminized or galvanized steel shall be as specified in AS/NZS 2041.4.
- (b) Cast iron, copper, copper alloys, ductile iron pipes and fittings shall conform to [Clause 2.3.2](#) Items (b) to (e) respectively.
- (c) FRC pipes and fittings shall be as specified in AS 4139 and have the following limitations on use:
 - (i) Site fittings shall be concrete encased where the resin used to manufacture fittings has not been designed for stormwater drainage.
 - (ii) Pipes and fittings shall be autoclaved.
- (d) Galvanized steel pipes and malleable cast iron shall conform to [Clause 2.3.2\(g\)](#).
- (e) GRP pipes and fittings, minimum Class SN 2500, shall be as specified in AS 3571.1. They shall be resistant to ultraviolet light when installed in direct sunlight.
- (f) Precast concrete pipes (steel reinforced) shall be as specified in AS/NZS 4058. Where located under buildings, they shall have no lifting holes.
- (g) Circular PVC pipes and fittings shall conform to [Clause 2.3.2\(i\)](#).

- (h) Polyvinyl chloride (PVC) pipes and fittings shall be as specified in AS/NZS 1254, AS/NZS 4765, AS/NZS 4441, AS/NZS 1260, AS 1273 or AS/NZS 1477.
- (i) Polyethylene (PE) pipes and fittings shall conform to AS/NZS 4129, AS/NZS 4130, AS/NZS 4401 or AS/NZS 5065. Unless coloured black, pipes and fittings shall not be exposed to direct sunlight without protection in accordance with AS/NZS 2033.

2.5 Rising mains (pressure)

Rising mains shall be constructed from pressure pipes and fittings as specified in AS/NZS 3500.1.

2.6 Subsoil drains

Plastics pipes used in subsoil drains shall conform to AS 2439.1. Pipes of stiffness SN2 shall be limited to use in single dwellings.

2.7 Joints

2.7.1 Resin adhesives

2.7.1.1 General

Resin adhesives shall have positive adhesion to, and compatibility with, the materials being jointed.

2.7.1.2 Sealants

Sealants, including caulking compounds and tapes, shall —

- (a) be neutral cure;
- (b) be resistant to ultraviolet radiation where exposed above ground;
- (c) have the range of service temperatures for the location;
- (d) have positive adhesion to and compatibility with the materials being jointed; and
- (e) retain flexibility throughout the service life where applicable.

2.7.1.3 Silver brazing alloy

Silver brazing alloys used for jointing copper and copper alloy pipes and fittings shall conform to AS/NZS 1167.1. They shall have a silver content of not less than 1.8 %.

2.7.1.4 Soft solder

Soft solder shall conform to AS 1834.1 and —

- (a) for roof drainage system components used for the conveyance of drinking water, have a lead content not greater than 0.1 %;
- (b) for zinc-coated steel, copper, copper alloy and stainless steel, be 50/50 solder to Grade 50 Sn; and
- (c) for zinc, have an antimony content of less than 0.5 %.

2.7.1.5 Solvent cement and priming fluid

Solvent cement and priming fluid used for jointing PVC pipes and fittings shall conform to AS/NZS 3879.

2.7.2 Types

2.7.2.1 Bolted gland

Bolted gland (BG) joints shall conform to AS 1631 for cast grey and ductile iron materials with elastomeric seals compatible with the material and dimensions of the pipes or fittings being joined.

2.7.2.2 Cement mortar

Cement mortar (CM) joints shall conform to [Clause 2.9.2](#).

2.7.2.3 Elastomeric seals

Elastomeric seals (ES) shall conform to AS 1646.

2.7.2.4 Epoxy resin

Epoxy resin (ER) shall be compatible with the materials being joined.

NOTE Epoxy resin joints should only be used where the joint is designed for use with epoxy resin.

2.7.2.5 Fusion welded

Fusion welded (FW) joints shall be compatible with the materials being joined.

2.7.2.6 Mechanical coupling

Mechanical couplings (MC) shall conform to AS/NZS 2041.4.

2.7.2.7 Metal-banded flexible coupling

Metal-banded flexible couplings (FC) shall conform to AS/NZS 4327.

2.7.2.8 Silver brazed

Silver-brazed (SB) joints shall be made from silver brazing alloy conforming to [Clause 2.7.1.3](#). Joints shall be made by either —

- (a) using fittings; or
- (b) fabricating junctions from the pipes.

2.7.2.9 Soft soldered

Soft soldered (SS) joints shall be made from solder conforming to [Clause 2.7.1.4](#). They shall be used only for jointing zinc-coated steel, copper, copper alloy and stainless-steel rainwater goods.

2.7.2.10 Solvent cement

Solvent cement (SC) joints for PVC pipes and fittings shall be made in accordance with AS/NZS 2032.

2.8 Valves

2.8.1 Gate and globe

Copper alloy gate and globe valves shall conform to AS 1628.

2.8.2 Non-return

Cast iron and copper alloy non-return valves shall conform to AS 1628.

2.8.3 Sluice

Sluice valves shall conform to AS/NZS 2638.1 or AS/NZS 2638.2.

2.8.4 Wedge gate

Cast iron wedge gate valves shall conform to AS 3579.

2.9 Concrete and mortar

2.9.1 Concrete

Concrete shall conform to AS 1379. It shall have a minimum characteristic compressive strength of 15 MPa, as defined in AS 3600.

For minor works, site-mixed concrete shall consist of cement, fine aggregate and coarse aggregate, all measured by volume, and water added to make the mix workable. It shall have a minimum strength compromise of 15 MPa.

NOTE See [Appendix A](#) for typical mixes for minor works.

Packaged concrete mixes shall conform to AS 3648.

2.9.2 Cement mortar

Cement mortar shall consist of one part cement and three parts fine aggregate, measured by volume, thoroughly mixed with the minimum amount of water necessary to render the mix workable.

Cement mortar that has been mixed and left standing for more than 1 h shall not be used.

2.9.3 Chemical admixtures

Chemical admixtures used in concrete shall conform to AS 1478.1.

2.9.4 Water for concrete and mortar

Water used for mixing concrete and cement mortar shall be free from matter that is harmful to the mixture, the reinforcement or any other items embedded within the concrete or mortar.

2.9.5 Steel reinforcement

Steel reinforcing materials used in concrete structures shall conform to AS/NZS 4671.

2.10 Embedment material

2.10.1 Site stormwater drains

Embedment material for below ground site stormwater drains shall be as specified in [Clause 6.4.2.1](#).

2.10.2 Subsoil drains

Embedment for subsoil drains shall be as specified in [Clause 6.4.2.1](#).

2.11 Trench fill

Trench fill for site stormwater drains and subsoil drains shall be as specified in [Clause 6.2.10](#).

2.12 Miscellaneous

2.12.1 Clay building bricks

Clay building bricks shall conform to AS/NZS 4455.2.

2.12.2 Concrete masonry units

Concrete masonry units (concrete bricks or concrete blocks) shall conform to AS/NZS 4455.2.

2.12.3 Cover and sump grates

Metal access cover and sump grates and frames for stormwater and inlet pits and arresters shall conform to AS 3996.

2.12.4 External protective coating

The external protective coating of metal pipes and fittings shall meet the following requirements:

- (a) They shall be impervious to the passage of moisture.
- (b) They shall be resistant to —
 - (i) the external corrosive environment; and
 - (ii) damage by the embedment material.
- (c) They shall not contain material that could cause corrosion.

2.12.5 Fibreglass-reinforced plastic tanks

Water collection tanks for re-use water shall conform to AS/NZS 3500.1.

2.12.6 Geotextiles

Geotextiles shall be marked in accordance with AS 3705 and conform to [Clause 2.2](#).

2.12.7 Polyethylene sleeving

Polyethylene sleeving for corrosion protection shall conform to AS 3680.

2.12.8 Precast or prefabricated pits and arresters

2.12.8.1 Concrete

Precast concrete units for pits shall conform to the dimensions in [Table 7.5.2.1](#) and to the following:

- (a) In New Zealand, all relevant requirements of AS/NZS 4058.
- (b) In Australia, the relevant criteria of AS 4198 to —
 - (i) support for a minimum of 30 s, without structural failure or significant cracking, the applicable pit lid design loads in accordance with AS 3996 (where a precast unit has knockout panels, this requirement shall apply with the knockout panels removed); and

- (ii) be classified and marked in accordance with the pit lid classification of AS 3996 for which they are designed.

2.12.8.2 Corrugated metal

Prefabricated corrugated metal pits and arresters shall conform to AS/NZS 2041.4. They shall support, without structural failure, the applicable pit lid design loads in accordance with AS 3996.

2.12.8.3 Other materials

Precast or prefabricated pits and arresters of materials, other than specified in [Clauses 2.12.8.1](#) and [2.12.8.2](#), shall support, without structural failure, the applicable pit lid design loads specified in AS 3996.

2.12.9 Timber

Timber exposed to the weather shall be of durability Class 2 conforming to AS/NZS 2878 or NZS 3631 or be treated in accordance with AS 1604.1 or NZS 3640.

2.13 Filters for subsoil drains

2.13.1 Filter material

Filter materials consisting of natural clean washed sands and gravels and screened crushed rock shall be —

- (a) well-graded, with a mix of different sizes of sand particles and permeability with —
 - (i) natural sand, less than 5 % passing a 75 µm sieve; and
 - (ii) screened crushed rock, sizes 3 mm to 20 mm;
- (b) sufficiently coarse not to wash into the subsoil drain, or through pores in a geotextile cover to such drain; and
- (c) chemically stable and inert to possible actions of soil and groundwater.

2.13.2 Geotextile filters

The permeability of geotextiles used in subsoil drains shall be greater than that of the native soil.

NOTE 1 A desirable permeability for geotextiles is 10 times that of the native soil.

NOTE 2 There is a tendency for geotextiles to clog at some locations, particularly where iron salts are present (e.g. scoria). Oxidization and biologically related actions can cause plate-like deposits of ferruginous particles on filter surfaces, rapidly clogging them. In such areas, carefully selected granular filters should be used instead of geotextiles. Advice from a professional engineer with geotechnical expertise should be sought in such situations.

Section 3 Roof drainage systems — Design

3.1 Scope of section

This section specifies methods for the design of roof drainage systems.

3.2 General method

The general method is applicable to —

- (a) eaves gutters and associated vertical downpipes with overflow measures, see [Clause 3.5](#);
- (b) valley gutters, see [Clause 3.6](#); and
- (c) box gutters and associated vertical downpipes with overflow devices, see [Clause 3.7](#).

NOTE 1 The general method does not include allowance for any of the following:

- (a) Localized variation in rainfall intensities due to wind or adjacent buildings.
- (b) Blockages of roof drainage systems (e.g. by snow, hail or debris).
- (c) Reduced hydraulic capacity caused by —
 - (i) reduced gutter gradient due to ground movement; or
 - (ii) turbulence due to wind.

NOTE 2 See [Appendix G](#) for an example of the application of the general method.

NOTE 3 The general method assumes regular inspection and cleaning, see [Clause M.5](#).

3.3 Meteorological criteria

3.3.1 General

The relationship between AEP and ARI is represented by the following equation:

$$AEP = \frac{\exp\left(\frac{1}{ARI}\right) - 1}{\exp\left(\frac{1}{ARI}\right)} \quad 3.3.1$$

NOTE ARI is expressed in years.

[Equation 3.3.1](#) was used to produce the conversions of AEP to ARI given in [Table 3.3.1](#).

Table 3.3.1 — AEP to ARI conversion

AEP %	ARI years
63.21	1
50	1.44
39.35	2
20	4.48
18.13	5
10	9.49
5	19.50
2	49.50
1	100
NOTE 1 These are exact conversions.	
NOTE 2 Equivalent values have been rounded to the next whole number in this document for convenience.	

Roof drainage systems shall be designed for the average exceedance probability (AEP) (see [Clause 3.3.4](#)) for the site in respect to potential loss of amenity and injury to persons due to overtopping.

NOTE 1 A frequent cause of such overtopping is inadequate inspection and cleaning (see [Clause M.5](#)) and not the intensity of rainfall.

NOTE 2 Although hail can restrict or block roof drainage systems, the present lack of performance data prevents the inclusion of requirements for hail barriers.

3.3.2 Snowfall effects

In regions subject to snowfalls, for roof drainage systems, there shall be no effect on size.

NOTE 1 Roof drainage support systems should be designed to include an allowance for snow load, refer to AS/NZS 1170.3.

NOTE 2 Sometimes eaves gutters are not used in alpine regions because the stormwater from roofs is collected at ground level, generally in site stormwater channels.

3.3.3 Wind effects

For other than flat or permanently projected sloping surfaces (see [Clause 3.4](#)), a gradient of 2:1 shall be adopted to allow for the effects of wind or rainfall.

NOTE As studies in Australia are insufficient to determine the maximum gradient of descent of wind-driven rain at design intensities, European practice has been adopted, refer to EN 12056-3.

3.3.4 Design probabilities

The average exceedance probability(AEP) shall be as given in [Table 3.3.4](#).

Table 3.3.4 — Average exceedance probability

Effect of overtopping	AEP %	
	Australia	New Zealand
(a) Eaves gutters, external	≥ 5	≥ 10
(b) Box gutters and valley gutters	≥ 1	≥ 2
NOTE 1 For Australia, this Table should be used in conjunction with the NCC, which includes requirements to prevent rain and stormwater from roof drainage from entering certain buildings.		
NOTE 2 1 % AEP is equivalent to 100 years ARI; 2 % AEP is equivalent to 50 years ARI; 5 % AEP is equivalent to 20 years ARI; and 10 % AEP is equivalent to 10 years ARI.		

3.3.5 Rainfall intensity

3.3.5.1 Australia

Five minutes duration rainfall intensity (in mm/h) for any place in Australia shall be determined for —

- (a) an AEP of 5 % (20 years ARI) and 1 % (100 years ARI), from [Appendix D](#); and
- (b) an AEP of 0.2 % (500 years ARI), assumed to be 1.5 times the 1 % AEP (100 years ARI) intensity at the same place.

NOTE 1 Guidelines for the determination of rainfall intensity are given in [Appendix C](#).

NOTE 2 Intensities for specific locations throughout Australia can be obtained using the Bureau of Meteorology rainfall intensities described in [Appendix D](#).

3.3.5.2 New Zealand

Ten minutes duration rainfall intensity (in mm/h) for any place in New Zealand shall be determined for an AEP of 10 % (10 years ARI) and 2 % (50 years ARI), from [Appendix E](#).

NOTE Guidelines for the determination of rainfall intensity are given in [Appendix C](#).

3.4 Catchment area

3.4.1 General

The catchment area for a roof, or roof and vertical wall(s), depends upon the gradient of the descent of the rain, see [Clause 3.3.3](#). It shall be the greatest value for any direction of wind-driven rain.

NOTE 1 It may be necessary to trial different directions for the wind-driven rain to determine the catchment area for a particular case.

The components of the largest catchment area for a single dwelling shall be calculated by one of the following methods:

- (a) Rational analysis.
- (b) Application of [Clauses 3.4.2](#) to [3.4.4](#), inclusive.

NOTE 2 See [Clause G.2](#) for a worked example.

3.4.2 Three-dimensional representation

A three-dimensional representation of the two components A_h and A_v of the catchment area for a sloping roof with its top edge either horizontal or not horizontal is shown in [Figure 3.4.2\(A\)](#). These components are represented in [Figures 3.4.2\(B\)](#) and [3.4.2\(C\)](#) by lines in the horizontal and vertical planes.

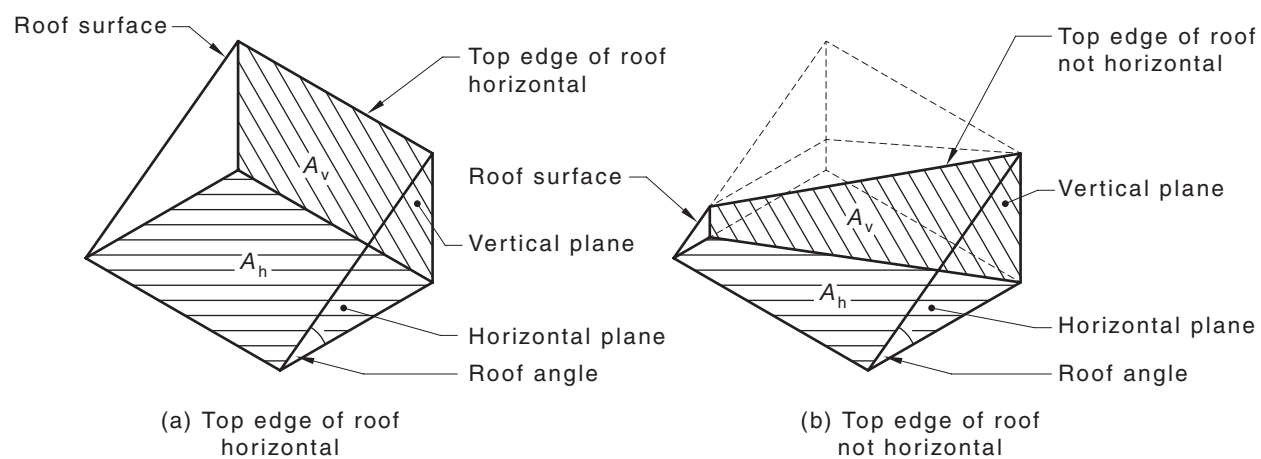
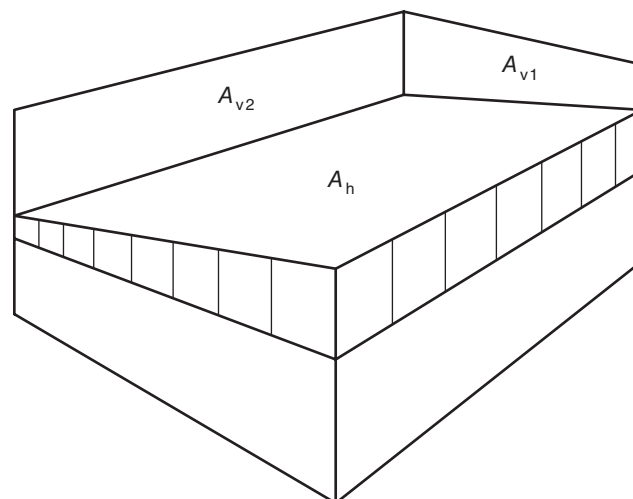
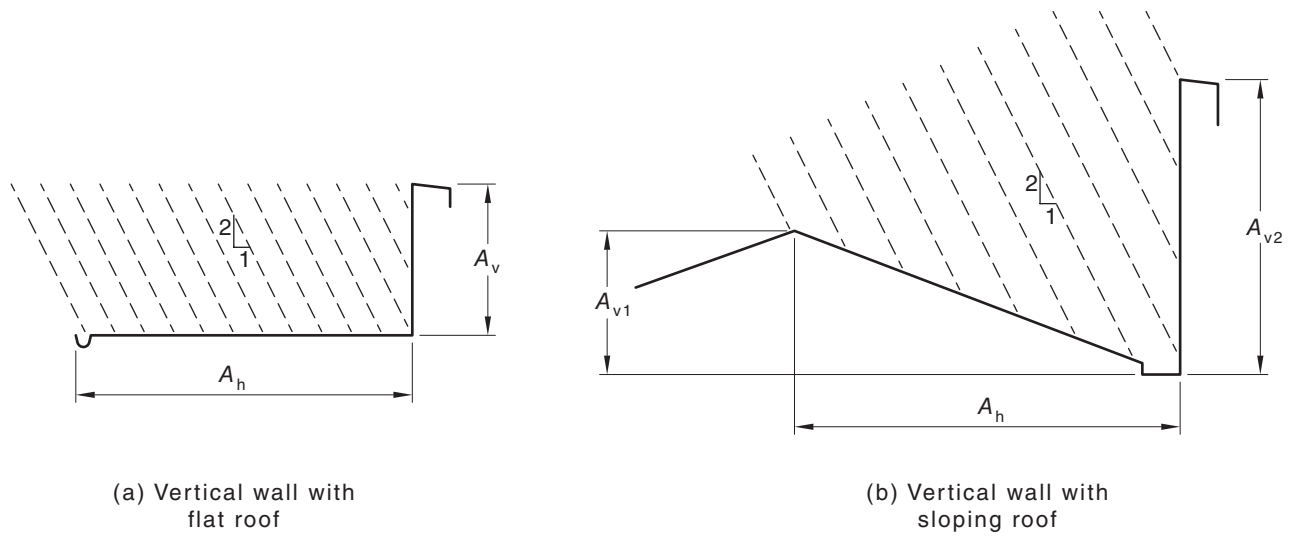


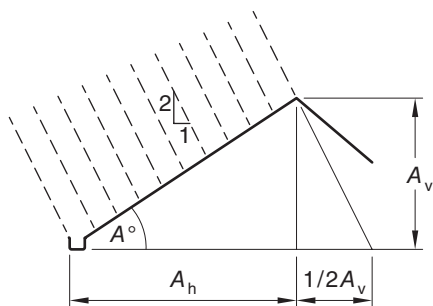
Figure 3.4.2(A) — Components of the catchment area



(c) Vertical walls at right angles to each other

$$A_c = A_h + 0.5 (A_{v1} + A_{v2})$$

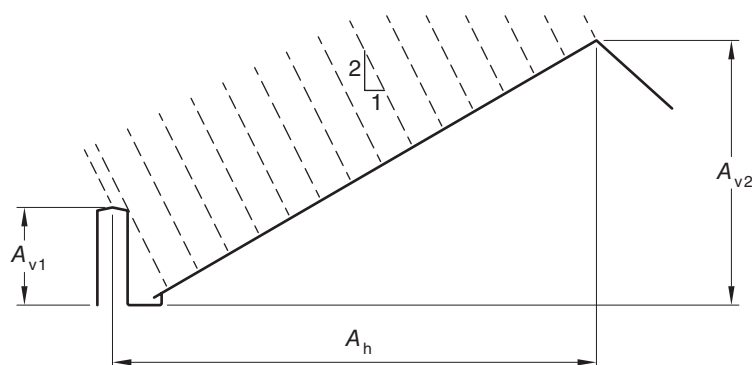
Figure 3.4.2(B) — Catchment area for vertical wall(s) and roof



(a) Single sloping roof — Freely exposed to the wind

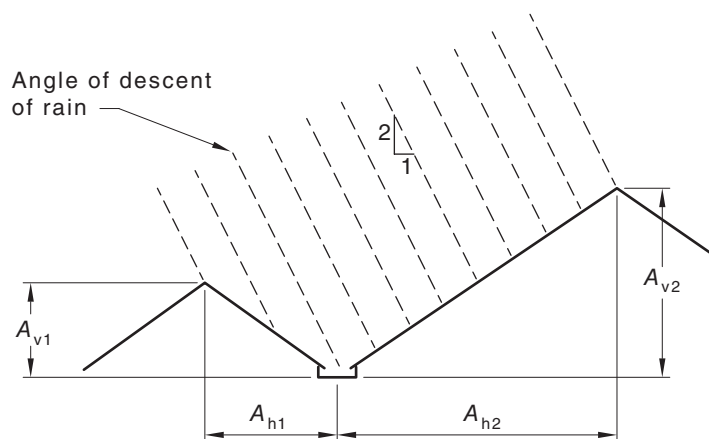
$$A_c = A_h + 0.5A_v \quad \text{Box gutters}$$

$$A_c = A_h F \quad \text{Eaves gutters}$$



(b) Single sloping roof — Partially exposed to the wind

$$A_c = A_h + 0.5 [(A_{v1} + A_{v2}) - (A_{v3} + A_{v4})]$$



(c) Two adjacent sloping roofs

$$A_c = A_{h1} + A_{h2} + 0.5 (A_{v2} - A_{v1})$$

Figure 3.4.2(C) — Catchment area for roofs

3.4.3 Roof

3.4.3.1 Flat roof

The catchment area (in m²) of a flat roof that is freely exposed to the wind shall be equal to the plan area of the roof and gutter(s).

3.4.3.2 Single sloping roof

The catchment area (in m²) of a single sloping roof that is —

- (a) freely exposed to the wind [see [Figure 3.4.2\(C\)](#) (a)] shall be calculated from —

$$A_c = A_h + 0.5A_v \quad 3.4.3.2(1)$$

or

$$A_c = A_h F \quad 3.4.3.2(2)$$

For values of F , see [Table 3.4.3.2](#).

- (b) partially exposed to the wind [see [Figure 3.4.2\(C\)](#) (b)] shall be calculated from —

$$A_c = A_h + 0.5 \left[(A_{v1} + A_{v2}) - (A_{v3} + A_{v4}) \right] \quad 3.4.3.2(3)$$

Table 3.4.3.2 — Catchment area multiplier (F) for various roof slopes (eaves gutters only)

Roof slope degrees	Multiplier (F)	Roof slope degrees	Multiplier (F)	Roof slope degrees	Multiplier (F)
0	1.00	22	1.20	44	1.48
1	1.01	23	1.21	45	1.50
2	1.02	24	1.22	46	1.52
3	1.03	25	1.23	47	1.54
4	1.03	26	1.24	48	1.56
5	1.04	27	1.25	49	1.58
6	1.05	28	1.27	50	1.60
7	1.06	29	1.28	51	1.62
8	1.07	30	1.29	52	1.64
9	1.08	31	1.30	53	1.66
10	1.09	32	1.31	54	1.69
11	1.10	33	1.32	55	1.71
12	1.11	34	1.34	56	1.74
13	1.12	35	1.35	57	1.77
14	1.12	36	1.36	58	1.80
15	1.13	37	1.38	59	1.83
16	1.14	38	1.39	60	1.87
17	1.15	39	1.40	61	1.90
18	1.16	40	1.42	62	1.94
19	1.17	41	1.43	63	1.98
20	1.18	42	1.45	64	2.03
21	1.19	43	1.47	65	2.07

3.4.3.3 Two adjacent sloping roofs

The catchment area (in m²) of two adjacent sloping roofs [see [Figure 3.4.2\(C\)](#) (c)] shall be calculated from the following equation:

$$A_c = A_{h1} + A_{h2} + 0.5(A_{v2} - A_{v1}) \quad 3.4.3.3$$

NOTE [Equation 3.4.3.2\(2\)](#) may be applied to the plan area of a roof (A_h) of a dwelling regardless of the wind direction, provided there is no vertical surface that contributes to the catchment area, see [Appendix G](#).

3.4.4 Vertical wall(s) and roof

3.4.4.1 Vertical wall with a flat roof

The catchment area (in m²) for a vertical wall with a flat roof [see [Figure 3.4.2\(B\)](#) (a)] shall be calculated from the following equation:

$$A_c = A_h + 0.5A_v \quad 3.4.4.1$$

3.4.4.2 Vertical wall with a sloping roof

The catchment area (in m²) for a sloping roof [see [Figure 3.4.2\(B\)](#) (b)] shall be calculated from the following equation:

$$A_c = A_h + 0.5(A_{v1} + A_{v2}) \quad 3.4.4.2$$

3.4.4.3 Vertical walls at right angles to each other

The catchment area (in m²) for vertical walls at right angles to each other [see [Figure 3.4.2\(B\)](#) (c)] shall be calculated from the following equation:

$$A_c = A_h + 0.5(A_{v1} + A_{v2}) \quad 3.4.4.3$$

NOTE The catchment area for high vertical walls (e.g. a multistorey building) may be considerably less than half its surface area. Therefore, for a single wall, 50 % of its total vertical surface area up to a maximum exposed height of 10 m may be used.

3.4.5 Higher catchment area

Stormwater from a higher catchment area shall be discharged directly to a rainhead, or the sump shall be sized in accordance with this document.

Alternatively, a spreader may be used subject to the following requirements:

- (a) For a tiled roof in Australia, the lower section shall be sarked a minimum width of 1 800 mm either side from the point of discharge and extended down to the eaves gutter in accordance with AS 2050.
- (b) For a corrugated metal roof in Australia, a minimum width of 1 800 mm on either side of the point of discharge shall be sealed for the full length of side laps.

NOTE 1 In New Zealand, spreaders that meet the requirements of NZBC Acceptable Solution E2/AS1 may be used.

The downpipe and gutter system of the lower catchment shall be sized in accordance with [Clause 3.4](#) to take into account the total flow from both catchments.

NOTE 2 The rainhead or sump may need to be larger than that sized in accordance with this Standard and include a device to dissipate energy. Sizing of such a rainhead or sump is beyond the scope of this document and may require hydraulic tests.

NOTE 3 Where spreaders are used, an allowance for an increased overflow provision for the gutter on the lower catchment should be considered.

NOTE 4 For a tiled roof, consideration should be given to sarking the roof below any upper eaves gutters to take into account any overflows.

3.4.6 Green, landscaped or garden roofs

The full run-off rate shall be used for the design of the system.

NOTE The run-off rates from green, landscaped or garden roofs may be lower than for an impervious roof.

3.5 Eaves gutter systems

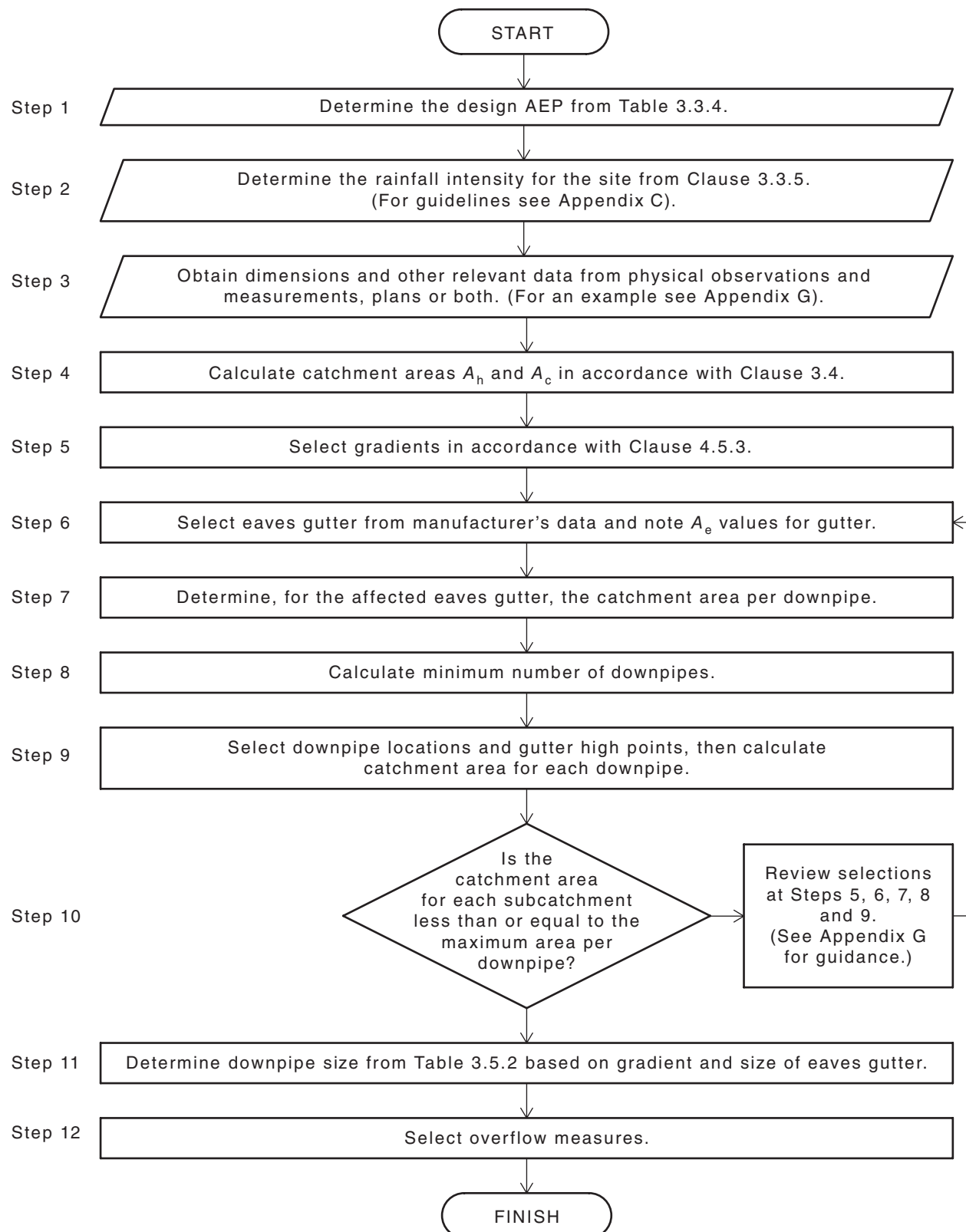
3.5.1 General

Eaves gutter systems, including downpipes, shall be designed and installed so that water will not flow back into the building.

3.5.2 Design procedure

The design procedure shall follow the general method for design of eaves gutters systems, as given in the flow chart in [Figure 3.5.2](#).

NOTE See [Appendix G](#) for an example of the application of the design procedure.



NOTE 1 Each step designation refers to the corresponding step in the example, see [Clause G.2.1](#).

NOTE 2 [Appendix C](#) provides guidelines for the determination of rainfall intensities.

NOTE 3 A_e to be in the range for gradients of — (a) 1:500 and steeper, 3 000 mm² to 18 000 mm²; or (b) flatter than 1:500, 4 000 mm² to 24 200 mm².

NOTE 4 Consideration should be given to the criteria for thermal variation, see [Clause 4.3](#).

NOTE 5 For eaves gutters of domestic buildings with hipped or gable roofs of constant slope with no flat roofs or walls contributing to the catchment area, the catchment area calculations may be based entirely on [Equation 3.4.3.2\(2\)](#) using F determined by the roof slope and A_h determined from a plan. If [Equation 3.4.3.2\(2\)](#) is used, it is not necessary to take account of wind direction. Examples of the use of this method are shown in [Appendix G](#).

NOTE 6 The vertical downpipe and any horizontal bends in an eaves gutter may be located at any point along the length of the catchment. Where this occurs, the whole catchment to that downpipe should be used with [Figure 3.5.4\(A\)](#) or [Figure 3.5.4\(B\)](#) (gutters less than 1:500) to size the eaves gutter, so as to ensure that the vertical downpipe size is sufficient.

NOTE 7 As there are no high points for flat eaves gutters to define the catchment areas for each downpipe and downpipe section, halve the total catchment area between the adjacent downpipes.

NOTE 8 For aesthetic and practical considerations, the size of eaves gutters and associated vertical downpipes for the largest catchment area of the building are usually adopted for each of the other catchments.

Figure 3.5.2 — Flow chart — General method for design of eaves gutter systems

Table 3.5.2 — Eaves gutter — Required size of vertical downpipe

Effective cross-sectional area of an eaves gutter (A_e) ^{a, b}		Internal size of vertical downpipe, mm	
Gradient		Cross-section	
1:500 and steeper	Flatter than 1:500	Circular	Rectangle or square
3 500	4 700	65	65 × 50
4 200	5 600	75	65 × 50
4 600	6 200	75	75 × 50
4 800	6 400	80	75 × 50
5 200	7 000	80	100 × 50
5 900	7 900	85	100 × 50
6 400	8 600	90	100 × 50
6 600	8 900	90	75 × 70
6 700	9 000	100	75 × 70
8 200	11 000	100	100 × 75
9 600	12 900	125	100 × 75
12 800	17 100	125	100 × 100
12 800	17 200	150	100 × 100
16 000	21 500	150	125 × 100
18 400	24 700	150	150 × 100
19 200	25 800	—	150 × 100
20 000	26 800	—	125 × 125

^a The effective cross-sectional area shall be obtained from [Figures 3.5.4\(A\)](#) and [3.5.4\(B\)](#) to the nearest 100 mm².

^b Refer to AS/NZS 2179.1.

3.5.3 Vertical downpipes

Gutter outlets shall be fitted vertically to the sole of eaves gutters.

3.5.4 Effective cross-sectional area of eaves gutters

The effective cross-sectional area of an eaves gutter (to the nearest 100 mm²) for each nominal size of eaves gutter shall be as follows:

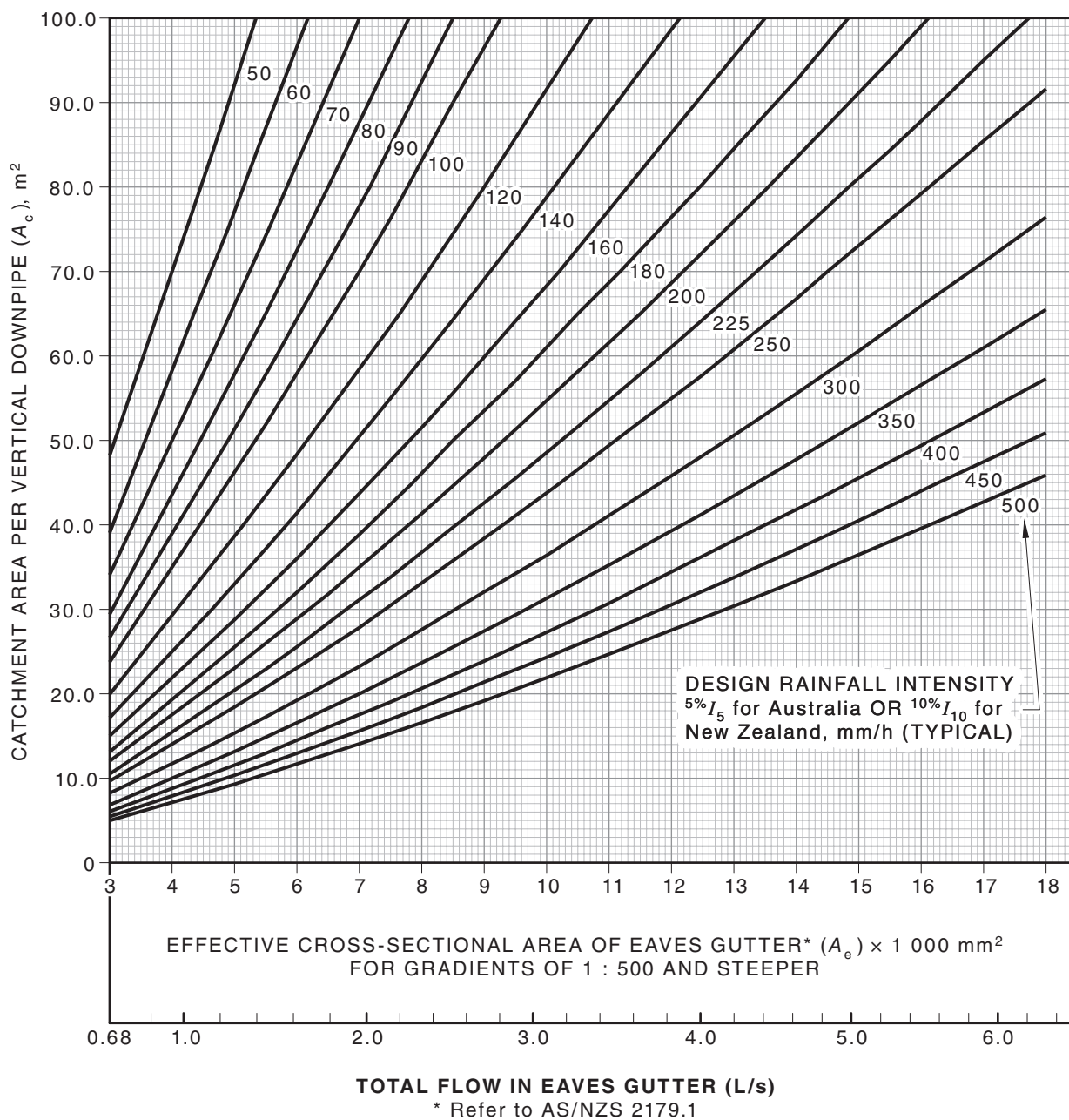
- (a) For an eaves gutter with external brackets — the cross-sectional area beneath a line not less than 10 mm below the overflow (e.g. front bead, gutter back or bottom of overflow slots).
- (b) For an eaves gutter with internal brackets — as given in [Figures 3.5.4\(A\)](#) or [3.5.4\(B\)](#), less the allowance for the effects of the brackets.

NOTE 1 For the cross-sectional area of the eaves gutter and the effect of internal brackets, the manufacturer's specifications should be consulted.

NOTE 2 The method specified in this document for the sizing of eaves gutters is based on research using eaves gutters with external brackets.

NOTE 3 Internal brackets increase the potential for debris collection.

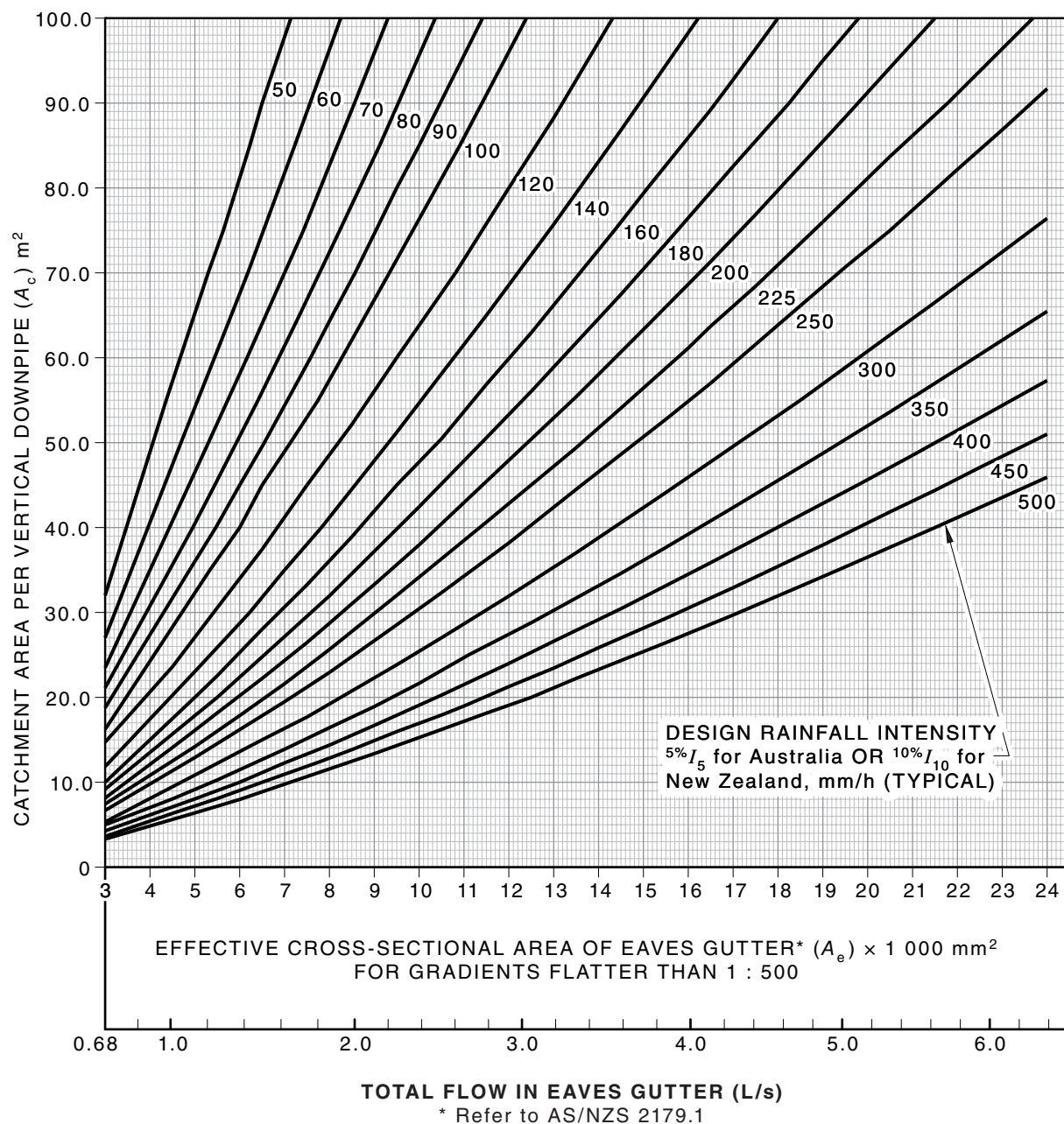
NOTE 4 Where the manufacturer does not provide data on the effect of the internal bracket, the projected gross area of the edge of the internal bracket including stiffening rib facing the direction of flow may be deducted, provided the area so deducted is not greater than 15 % of the original cross-sectional area of the gutter.



NOTE 1 This graph assumes — (a) an effective width:depth ratio of about 2:1; (b) a gradient in the direction of flow, 1:500 or steeper; (c) the least favourable positioning of the downpipe and bends within the gutter length; (d) a cross-section or half round, quad, ogee or square; and (e) the outlet to a vertical downpipe is located centrally in the sole of the eaves gutter.

NOTE 2 The eaves gutter discharge areas do not allow for loss of waterway due to internal brackets.

Figure 3.5.4(A) — Size of eaves gutters for gradients 1:500 and steeper



NOTE 1 This graph assumes — (a) an effective width:depth ratio of about 2:1; (b) a gradient in the direction of flow flatter than 1:500; (c) the least favourable positioning of the downpipe and bends within the gutter length; (d) a cross-section or half round, quad, ogee or square; and (e) the outlet to a vertical downpipe is located centrally in the sole of the eaves gutter.

NOTE 2 The eaves gutter discharge areas do not allow for loss of waterway due to internal brackets.

Figure 3.5.4(B) — Size of eaves gutters for gradients flatter than 1:500

3.6 Valley gutters

3.6.1 Limitations

The following limitations of the general method apply for valley gutters:

- (a) Roof slopes shall be not less than 1:4.5 (12.5°).

- (b) The nominal valley gutter side angle shall be 1:3.4 (16.5°).

NOTE See [Figure 3.6.1](#) for a profile of valley gutter.

- (c) The catchment area shall not exceed 20 m².

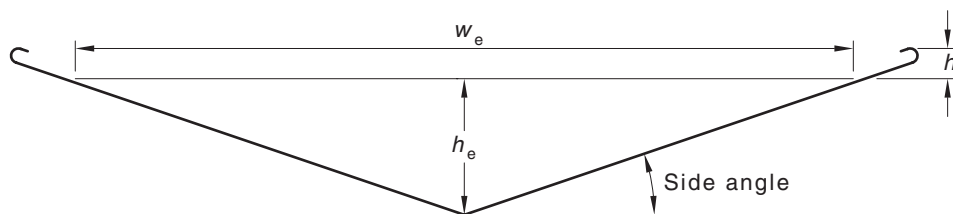


Figure 3.6.1 — Profile of a valley gutter

3.6.2 Design procedure

The design rainfall intensity for a 5 min duration in Australia and a 10 min duration in New Zealand (in mm/h) shall be determined in accordance with [Clause 3.3.5](#) and [Appendices D](#) and [E](#).

NOTE 1 See [Appendix C](#) for guidelines on determining rainfall intensities.

NOTE 2 Dimensions of valley gutters are given in [Table 3.6.2](#).

Table 3.6.2 — Valley gutters — Dimensions

Design rainfall intensity mm/h		Minimum, mm		
		Sheet width	Effective depth (h_e)	Effective width (w_e)
	≤ 200	355	32	215
> 200	≤ 250	375	35	234
> 250	≤ 300	395	38	254
> 300	≤ 350	415	40	273
> 350	≤ 400	435	43	292

NOTE 1 This Table is derived from Martin and Tilley.

NOTE 2 Freeboard (h_f), 15 mm.

NOTE 3 The sheet width from which the valley is to be formed has been calculated on the basis of $h_f = 15$ mm and an allowance for side rolls or bends of 25 mm.

3.6.3 Effective width

The effective width (w_e) of a valley gutter shall be such that the effective cross-sectional area of valley gutters, below the effective width (as shown in [Figure 3.6.1](#)), is not obstructed by bedding, anti-vermin strips or overhangs of roof cladding.

3.7 Box gutter systems

3.7.1 General

Box gutter systems shall incorporate overflow devices in accordance with [Clause 3.7.7](#).

3.7.2 Freeboard

The freeboard (h_f) for box gutters shall be 30 mm in accordance with [Figure I.5](#).

3.7.3 Limitations

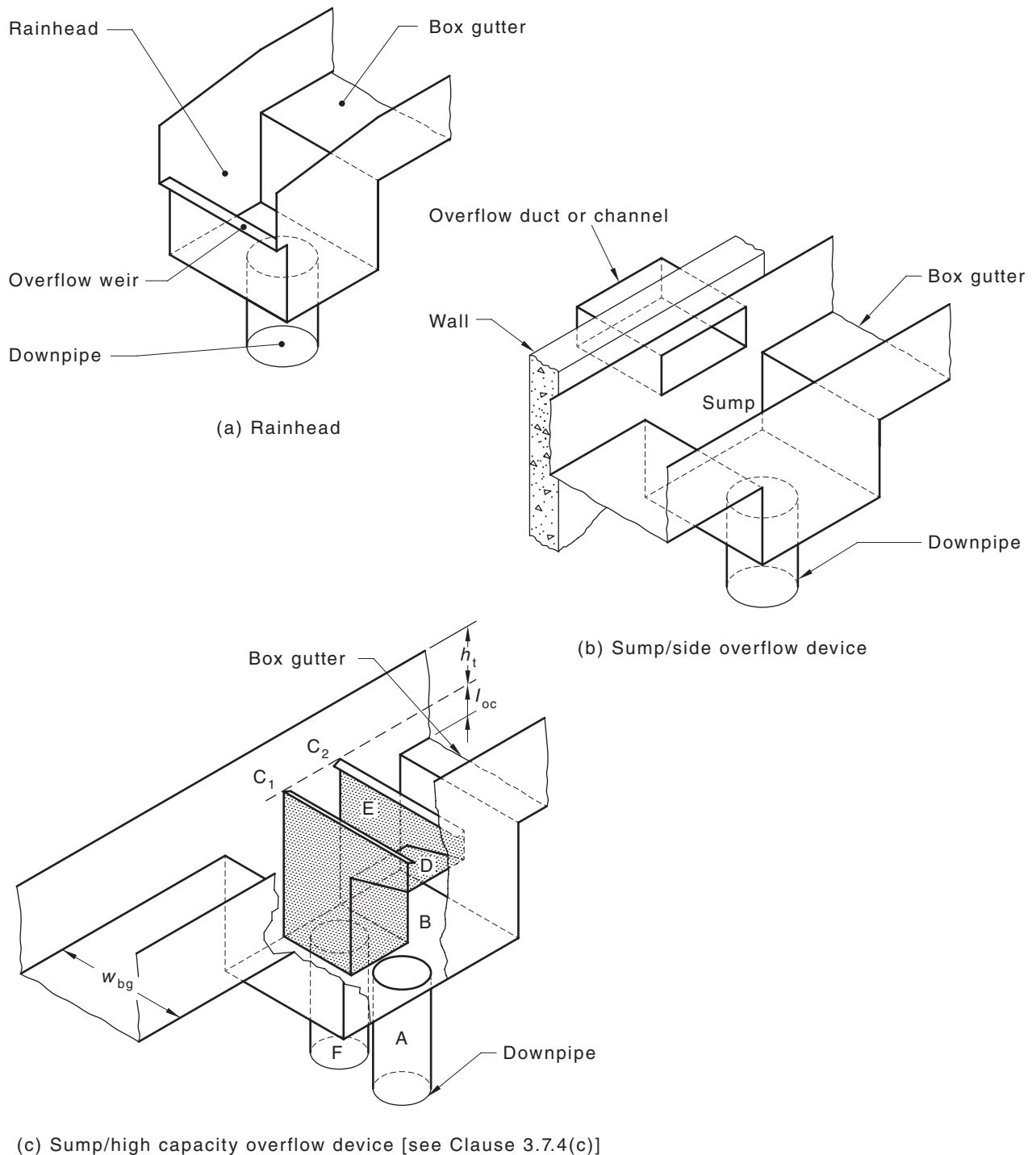
The following limitations of the general method apply to box gutter systems:

- (a) Gradients shall be in the range 1:40 to 1:200.
NOTE 1 [Figures H.6](#) and [H.8](#) assume that box gutters slope in the range 1:40 to 1:200.
- (b) Rainheads —
 - (i) design flows shall not exceed 16 L/s; and
 - (ii) size range of vertical downpipes shall be according to [Figure H.3](#).
- (c) The limitation of solution for sumps with overflow devices shall be the size range of vertical downpipes according to [Figure H.4](#).

NOTE 2 Criteria for box gutter overflow devices are given in [Clause 3.7.7](#) and illustrated in [Figure 3.7.3](#).

NOTE 3 The minimum width of box gutters used for commercial construction is 300 mm. In Australia, box gutters 200 mm wide may be used for domestic construction, but they are more prone to blockages. Additional height is recommended where possible.

NOTE 4 See [Appendix I](#) for examples of the application of the general method.



NOTE 1 Layout of sump/side overflow device may have to be varied due to constraints, see [Figure 3.7.3\(b\)](#).

NOTE 2 Where desired, the sides of the sump/high capacity overflow device may be perforated to flush the downpipe *F*, see [Figure 3.7.3\(c\)](#).

NOTE 3 The normal outlet may be moved longitudinally to enable better inspection and maintenance access, see [Figure 3.7.3\(c\)](#) and [Clause 3.7.6\(f\)](#).

NOTE 4 For criteria for overflow devices, see [Clause 3.7.7](#).

Figure 3.7.3 — Overflow devices — Box gutters

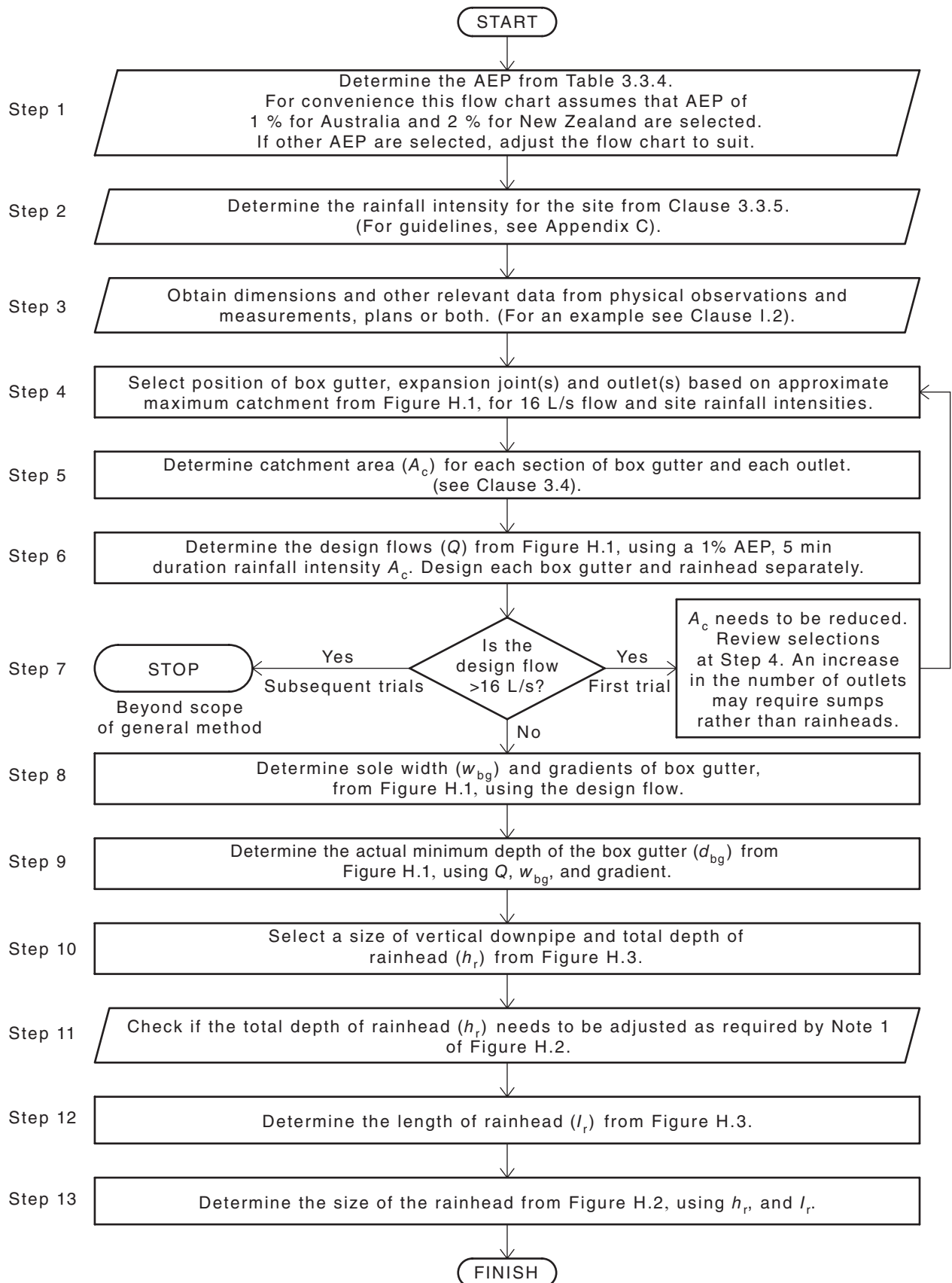
3.7.4 Design procedure

Box gutter systems shall be designed in accordance with the general method —

- (a) for box gutters, rainheads and downpipes, as given in [Figure 3.7.4\(A\)](#);
- (b) for box gutters, sump/side overflow devices and downpipes, as given in [Figure 3.7.4\(B\)](#); and
- (c) box gutters, sump/high capacity overflow devices and downpipes, as given in [Figure 3.7.4\(C\)](#).

NOTE 1 Flow chart symbols and conventions used in this document are given in [Clause 1.6.2](#).

NOTE 2 It should be ensured that the hydraulic capacities of downpipes systems or surface water drain (upstream) of a surcharge outlet as defined in [Clause 5.4.12.1](#) are sufficient to carry 1 % AEP (100 years ARI) box gutter flows.



NOTE 1 Selected positions of box gutter, expansion joint(s), rainheads, downpipes and overflow devices shall be compatible with the layout of buildings and site stormwater drains and the criteria for thermal variation, see [Clause 4.3](#).

NOTE 2 [Figure H.3](#) is for a box gutter with a gradient of 1:200. For steeper gradients, determine from [Figure H.1](#) for the design flow, the equivalent total depth of box gutter with a gradient of 1:200. Determine from [Figure H.3](#) for the equivalent total depth, the increased I_r .

Figure 3.7.4(A) — Flow chart — General method for design of box gutters, rainheads and downpipes

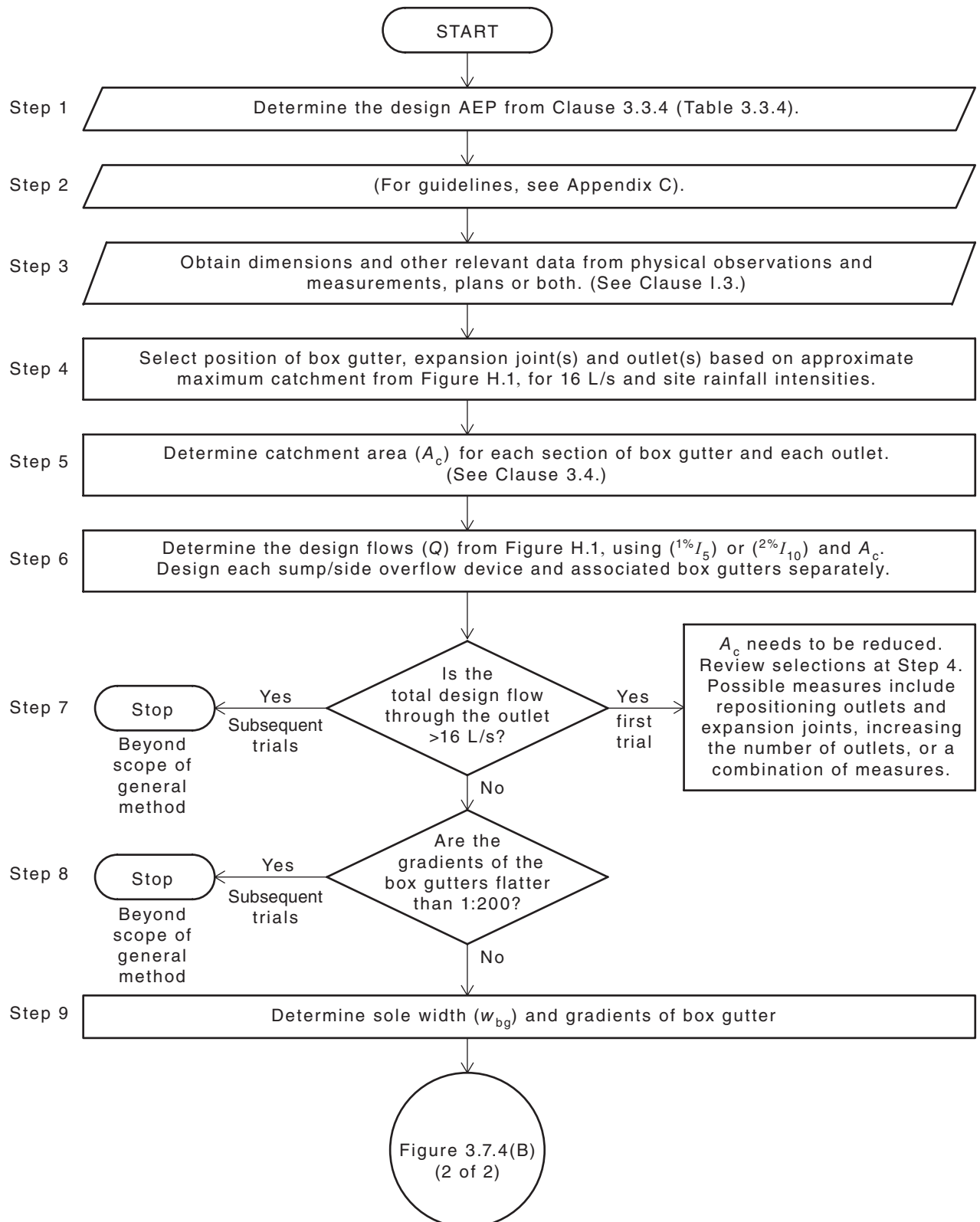
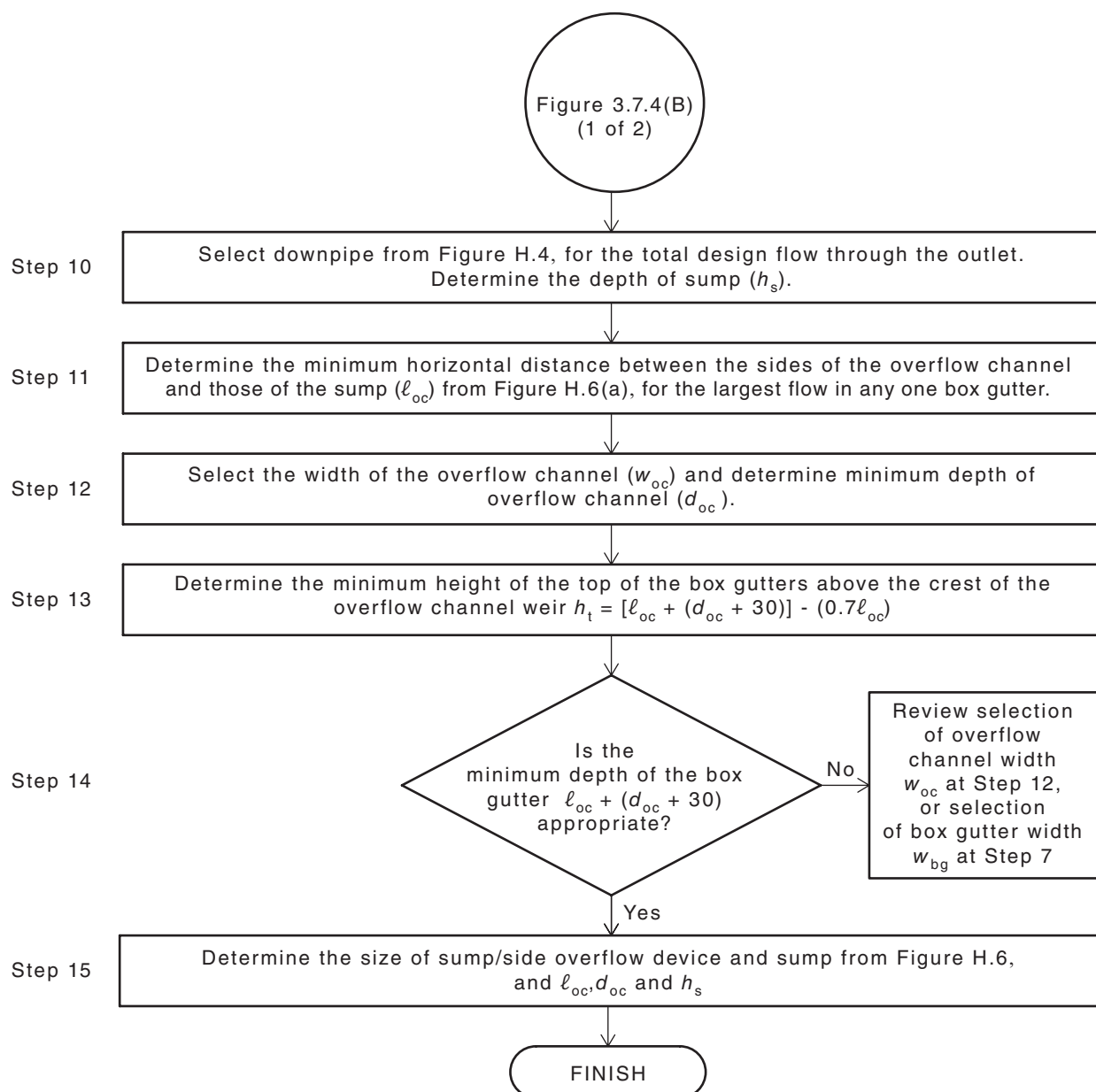


Figure 3.7.4(B) — (1 of 2) — Flow chart — General method for design of box gutters, sump/side overflow devices and downpipes



NOTE 1 Selected positions of box gutter, expansion joint(s), sumps, downpipes and overflow devices shall be compatible with the layout of buildings and site stormwater drains and the criteria for thermal variation, see [Clause 4.3](#).

NOTE 2 The total design flow is the summation of the design flow for each box gutter and the section of roofing discharged directly into the sump.

Figure 3.7.4(B) — (2 of 2) — Flow chart — General method for design of box gutters, sump/side overflow devices and downpipes

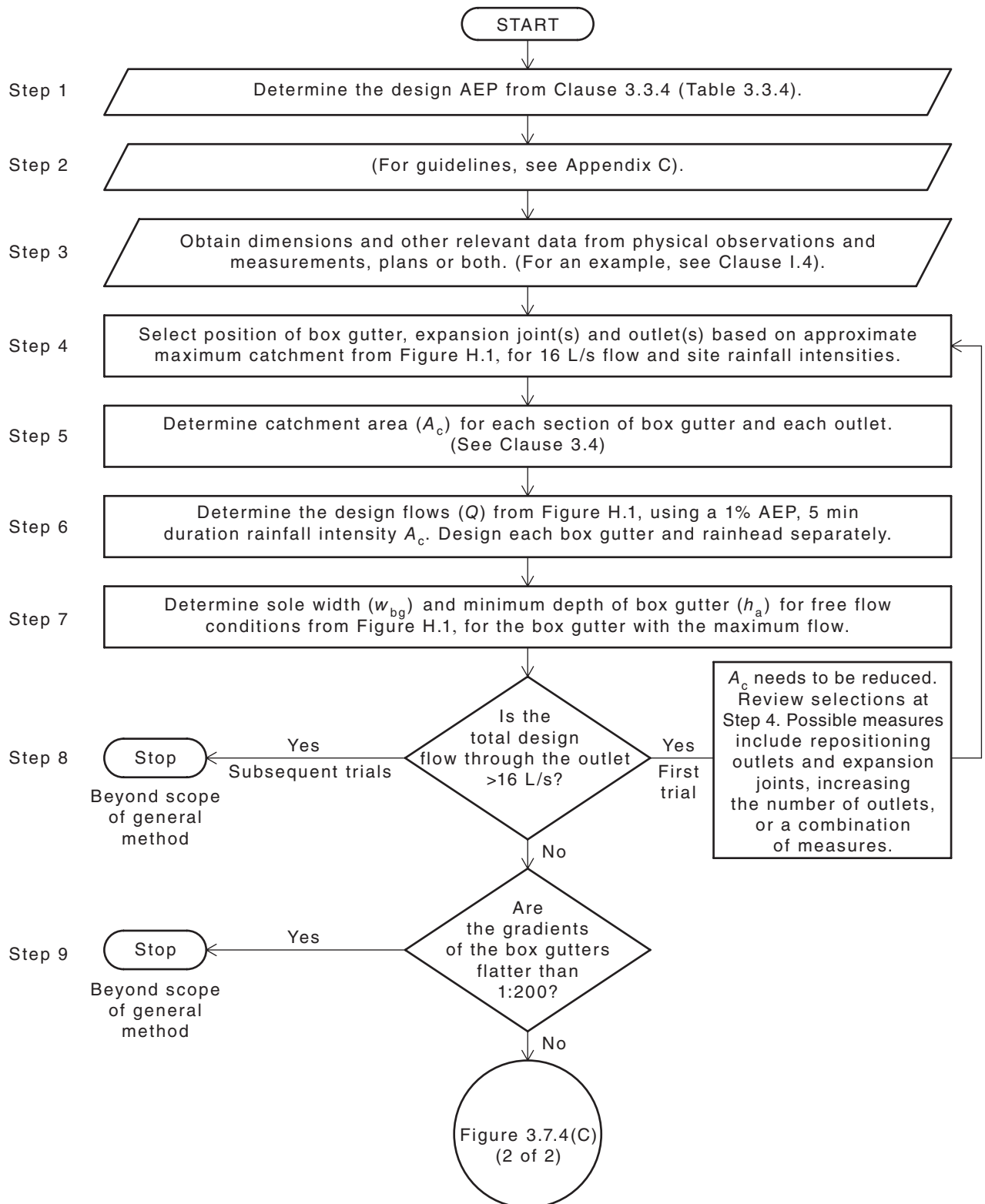
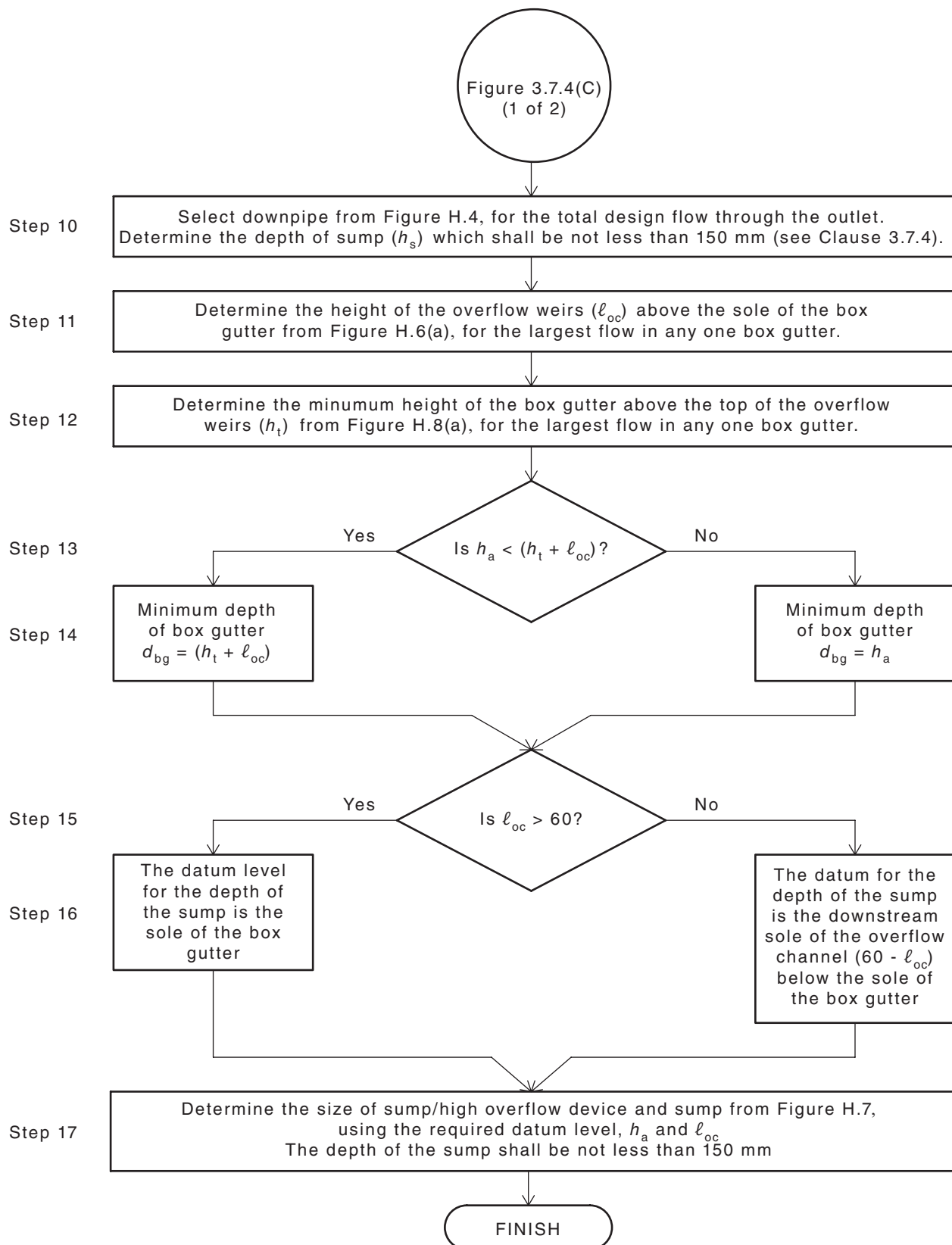


Figure 3.7.4(C) — (1 of 2) — Flow chart — General method for design of box gutters, sump/high capacity overflow devices and downpipes



NOTE 1 Selected positions of box gutter, expansion joint(s), sumps, downpipes and overflow devices shall be compatible with the layout of buildings and site stormwater drains and the criteria for thermal variation, see [Clause 4.3](#).

NOTE 2 The total design flow is the summation of the design flow for each box gutter and the section of roofing discharged directly into the sump.

Figure 3.7.4(C) — (2 of 2) — Flow chart—General method for design of box gutters, sump/high capacity overflow devices and downpipes

3.7.5 Hydraulic capacity

The hydraulic capacity (e.g. maximum design flow) of a box gutter is based on the sole width and gutter depth, the gradient [see [Clause 4.5.4\(a\)](#)], and whether the discharge is to a rainhead, a sump/side overflow device or a sump/high capacity overflow device.

The hydraulic capacity of an associated rainhead or sump is dependent on the selected size of the vertical downpipe and the depth of the rainhead or sump, see [Figures 3.7.4\(A\), 3.7.4\(B\) and 3.7.4\(C\)](#).

NOTE For the same design flow, the required depth of a rainhead or sump increases if the cross-sectional area of the vertical downpipe decreases.

3.7.6 Layout

The following apply to the layout of box gutter systems:

- (a) The location and size of the box gutter shall be taken into consideration.
- (b) The size of the support system (see [Clause 4.9](#)) shall be taken into consideration.
- (c) Provision for the effects of thermal variation (see [Clause 4.3](#)) on the box gutter and support system shall be taken into consideration.
- (d) Consideration shall be given to the location of associated vertical downpipes with rainheads or sumps in relation to —
 - (i) features within the building and usage;
 - (ii) surface water drainage system external to the building;
 - (iii) the space within or external to the building; and
 - (iv) provision for flow from each overflow device (see [Clause 3.7.5](#)) to be discharged, without danger, indirectly to the surface water drainage system.
- (e) For the sump/high capacity overflow device, the depth of the sump (h_s) shall be not less than 150 mm regardless of the position of the normal outlet. Changes to the depth of the sump are not required, provided the sump/side overflow device is used.
- (f) The normal outlet may be moved longitudinally to clear the overflow channel to enable better inspection and maintenance access. The outlet shall not be moved laterally to cross the longitudinal centre-line of the overflow device.

NOTE If the normal outlet is moved, it should preferably be moved towards the box gutter with the greater flow.
- (g) Box gutters shall —
 - (i) be straight (without change in direction);
 - (ii) have a horizontal constant width base (sole) with vertical sides in a cross-section;
 - (iii) have a constant longitudinal slope between 1:200 and 1:40;

- (iv) discharge at the downstream end without change of direction (i.e. not to the side); and
- (v) be sealed to the rainheads and sumps.

3.7.7 Overflow devices

3.7.7.1 Hydraulic capacity

The hydraulic capacity of an overflow device shall be not less than the design flow for the associated gutter outlet. Overflow devices shall discharge to the atmosphere.

NOTE In New Zealand, overflow outlets should be located to give an early, conspicuous warning to the building occupier that maintenance is required. Overflow outlets should discharge outside the building, clear of doors, windows or other opening, and within the property boundary.

3.7.7.2 Operation

There shall be an increase in the depth of flow in the box gutter for overflow devices that discharge from sumps. The overflow devices shall be either —

- (a) side overflow, see [Figure 3.7.3](#) (b); or
- (b) high capacity overflow [see [Figure 3.7.3](#) (c)], where in the event of a blockage in the normal vertical downpipe A, the water level in the primary sump B will rise to and overtop the overflow weirs C_1 and C_2 (each weir length equal to the width of the adjacent box gutter) to flow either directly or indirectly by the overflow channel D, to the secondary sump E and then to the overflow vertical downpipe F.

NOTE 1 Overflow devices that discharge from rainheads do not require an increase in the depth of flow in the box gutter, see [Figure 3.7.3](#) (a).

NOTE 2 Vertical piped overflow outlets, covered overflow devices and other type overflow provisions not specifically presented in [Figure 3.7.3](#) are not covered by this document.

NOTE 3 Where water flowing directly into the overflow is a problem, a deflector or cap may be installed to divert the water.

3.7.8 Downpipes

Downpipes shall be at least 90 mm in diameter or 100 mm × 50 mm rectangular downpipe, be fitted vertically to the base of a rainhead or sump, and discharge to —

- (a) a rainhead or sump of a lower gutter; or

NOTE See [Clause 3.4.5](#) for higher catchment area.

- (b) a surface water drainage system with the capacity to convey run-off from a storm event in accordance with [Table 3.3.4](#).

3.8 Balcony and terrace areas

Systems for draining balconies and terraces shall be designed for —

- (a) In Australia —
 - (i) 5 % AEP (20 years ARI) rainfall intensity; and