BRANZ

PLUMBING AND DRAINAGE GUIDE

THIRD EDITION

ACKNOWLEDGEMENTS

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EDITORIAL NOTE

This third edition of the BRANZ *Plumbing and Drainage Guide* has been comprehensively reviewed to bring it into line with current Acceptable Solutions, standards and practices. In keeping with previous editions, the guide makes wide use of 3D drawings and simple explanations to cover the general principles and requirements for sanitary plumbing and drainage. The guide is intended as an aid and quick reference for designers, builders, students, plumbers, drainlayers, building officials and building surveyors.

The information it contains meets the requirements of New Zealand Building Code clauses E1 *Surface water*, G12 *Water supplies* and G13 *Foul water*.

The easy-to-follow diagrams, with minimal but clear text, are an essential tool for understanding the complexity of plumbing systems and the regulatory documents surrounding them.

ABOUT THIS GUIDE AND AS/NZS 3500:2021 SERIES OF STANDARDS PARTS 0, 1, 2, 3 AND 4

AS/NZS 3500:2021 series of standards was proposed to be referenced in Acceptable Solutions for E1 *Surface water*, G12 *Water supplies* and G13 *Foul water* as part of the 2022 Building Code update plumbing and drainage consultation.

This guide references the 2021 versions of AS/NZS 3500 Parts 0, 1, 2, 3 and 4. The versions of AS/NZS 3500 standards referenced in the Acceptable Solutions and Verification Methods before November 2023 are the 2018 versions.

The 2021 versions of the AS/NZS 3500 standards were included in the Acceptable Solutions and Verification Methods published by the Ministry of Business, Innovation and Employment (MBIE) in November 2023.

The MBIE amendments published in November 2023 include:

- lead in plumbing products
- safe hot water temperatures
- protection of potable water
- updating references to AS/NZS 3500 plumbing and drainage standards
- water supply system components
- plumbing and drainage system materials standards
- resolving conflicts and editorial changes.

CONTENTS

INTRODUCTION

This guide explains, in simple terms and graphically wherever possible, the general principles of plumbing, drainage and surface water management regulated by the Building Code and supported by Verification Methods, Acceptable Solutions and standards.

The guide is intended as an aid to designers, builders, students and building owners and as a useful quick reference for registered/licensed plumbers and drainlayers, building officials and building surveyors.

The information it contains will meet the overall requirements of AS/NZS 3500 *Plumbing and drainage* set of standards and New Zealand Building Code clauses E1 *Surface water*, G12 *Water supplies* and G13 *Foul water* and their respective Verification Methods and Acceptable Solutions. Reference should be made to these documents for further information and detail, particularly when outside the scope of this guide.

In New Zealand, it is an offence for any person other than registered/licensed tradespersons to carry out plumbing and drainage work, as defined in the Plumbers, Gasfitters, and Drainlayers Act 2006.

Practically all sanitary plumbing and drainage work will require some form of prior permission, such as building consent, before it can be legally carried out.

SCOPE

This guide covers:

- sanitary plumbing systems – fully vented, single stack and single stack modified based on G13/AS1 or AS/NZS 3500.2:2021
- drainage systems based on G13/AS2 or AS/NZS 3500.2:2021

- water supply systems based on G12/AS1, G12/AS3 and AS/NZS 3500.1:2021
- hot water systems based on G12/AS1, G12/AS2, G12/AS3 and AS/NZS 3500.4:2021
- surface water (stormwater) drainage systems
- rainwater collection and use
- greywater collection and use
- multi-unit developments.

This guide does not cover specialised systems such as those used in hospitals, factories and industrial premises or cover in depth the practical hands-on aspects of installation of pipework and fixtures.

DEFINITIONS

The definitions of sanitary plumbing and some related terminology used in this guide have been simplified. The Building Act, the Building Regulations, the Plumbers, Gasfitters, and Drainlayers Act 2006 and standards incorporate definitions that should be referred to where appropriate. At the end of this guide is a glossary of terms based on and selected from (but not exclusive to) AS/NZS 3500.0:2021 *Plumbing and drainage – Glossary of terms*.

TABLES

The tables used in this guide have largely been adapted or reproduced from AS/NZS 3500 with permission. They should only be used with the text and diagrams in this guide to obtain generic advice. Reference should always be made to the appropriate Building Code clause, Acceptable Solution, Verification Method or standard.

INFORMATION USED TO PREPARE THIS GUIDE

- Building Act 2004
- Building Regulations 1992 (Building Code)
- B2 *Durability* – B2/VM1, B2/AS1
- E1 *Surface water* – E1/VM1, E1/AS1
- G12 *Water supplies* – G12/VM1, G12/AS1, G12/AS2,
- G13 *Foul water* – G13/VM1, G13/VM2, G13/VM4, G13/AS1, G13/AS2, G13/AS3
- AS/NZS 3500.0:2021 *Plumbing and drainage – Part 0: Glossary of terms*
- AS/NZS 3500.1:2021 *Plumbing and drainage – Part 1: Water services* (including Amendment 1)
- AS/NZS 3500.2:2021 *Plumbing and drainage – Part 2: Sanitary plumbing and drainage* (including Amendment 1)
- AS/NZS 3500.3:2021 *Plumbing and drainage – Part 3: Stormwater drainage*
- AS/NZS 3500.4:2021 *Plumbing and drainage – Part 4: Heated water services.*

1

GENERAL PRINCIPLES OF SANITARY PLUMBING AND DRAINAGE

This section sets out the basic principles that apply to all sanitary plumbing systems and explains the main objectives of sanitary plumbing codes.

Sanitary plumbing is an assembly of pipes, fixtures and connected fixtures that, in their operation, use water that is discharged from the above-ground fixture and conveyed through discharge pipes and stacks to a sewage system.

1.1 OBJECTIVE

The objective of sanitary plumbing is to safeguard people from:

- illness due to infection or contamination resulting from personal hygiene activities
- loss of amenity due to the presence of unpleasant odours or the accumulation of offensive matter resulting from sewage disposal.

To achieve this, a sanitary plumbing system must carry discharges away quickly, quietly and in such a way that they do not cause a nuisance or a health risk. It must be designed to:

- prevent foul air and gases that are generated in the sewer, drains and plumbing systems from entering buildings
- minimise the risk of blockage
- minimise noise generated by the flow within the system
- allow access for cleaning and maintenance
- be durable.

The provisions of plumbing and drainage codes and standards are designed to achieve these objectives as can be seen in the New Zealand Building Code, Australian Construction Code (including the Plumbing Code), Verification Methods, Acceptable Solutions, deemed-to-comply solutions and referenced standards.

1.2 PLUMBING AND DRAINAGE SYSTEMS

A plumbing and drainage system that is designed and installed to meet the objectives of this guide and the Building Code will deliver a system comprising:

- sanitary fixtures and sanitary appliances
- pipework – discharge pipes, stacks, drains and vent pipes
- water seals to prevent foul air and gases from entering buildings.

1.2.1 Sanitary fixtures and sanitary appliances

Sanitary fixtures and sanitary appliances include:

- soil fixtures that collect solid and liquid excreted wastes such as a water closet (WC) and urinals
- wastewater fixtures, which includes all fixtures other than soil fixtures and includes showers, hand basins, sinks and baths
- sanitary appliances such as clothes washing machines and dishwashers.

1.2.2 Pipework

The plumbing and drainage system comprises a range of pipes taking the discharge from sanitary fixtures and sanitary appliances to the drainage system and then to the network sewer or on-site disposal system. The range of pipes included in plumbing and drainage are:

- discharge pipes
- discharge stacks
- drains
- ventilating pipes.

1.2.3 Excluding foul air

A sanitary plumbing system (Figure 1) generally relies on water-filled traps (or water seals) to separate the interior of the piped system from the interior of the building or accessible areas and exclude foul air (Figures 2–4). Specific seal dimensions required are:

- wastewater fixture 75 mm ±10 mm
- soil fixture 50 mm ±5 mm.

In practice, experience has shown there are several circumstances under which the water seal can be broken (trap failure), which can allow foul air into buildings. These include:

- self-siphonage (Figure 5)
- induced siphonage (Figures 6–8)
- compression (positive pressure) (Figure 9)
- evaporation (Figure 10)
- oscillation (Figure 11)
- capillary attraction (Figure 12).

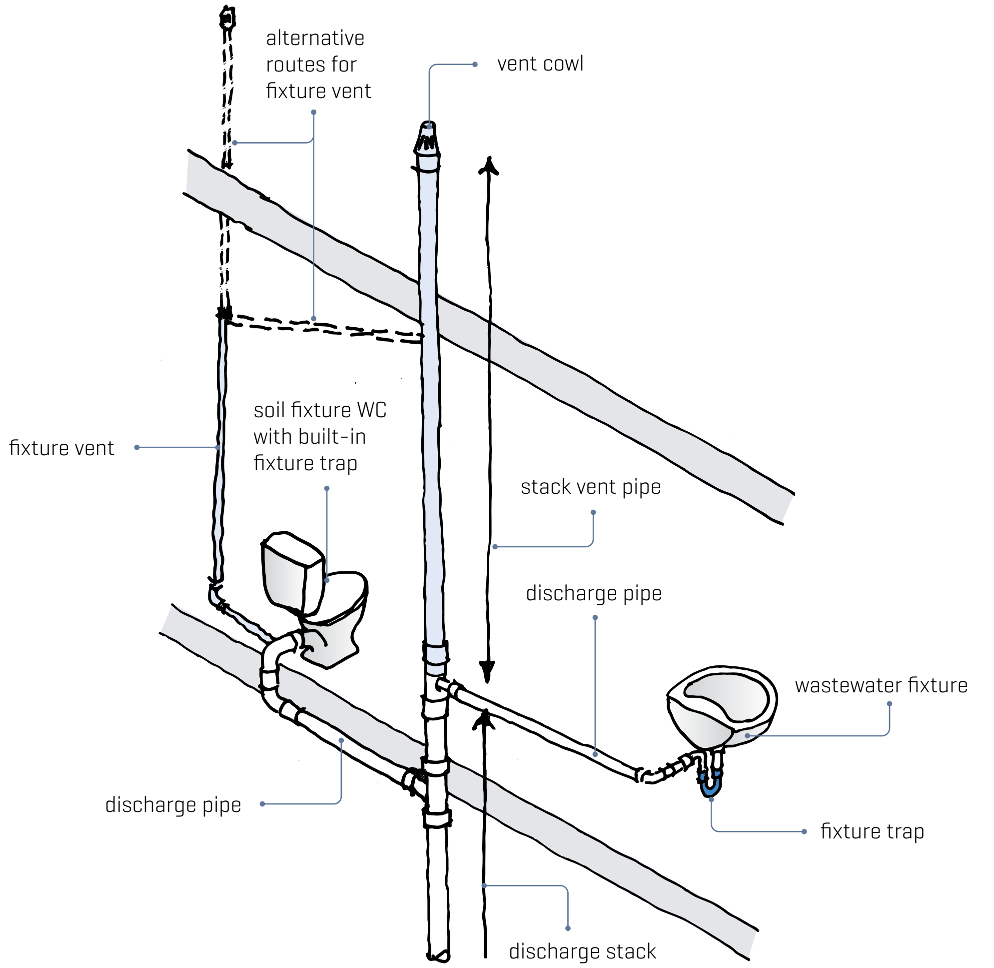


Figure 1. Parts of a sanitary plumbing system.

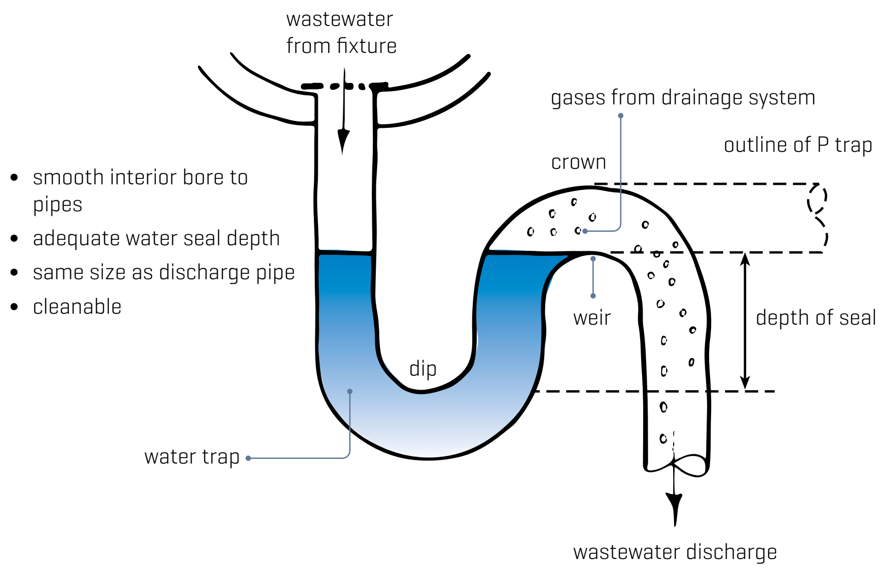


Figure 2. Principle of a water-filled S trap.

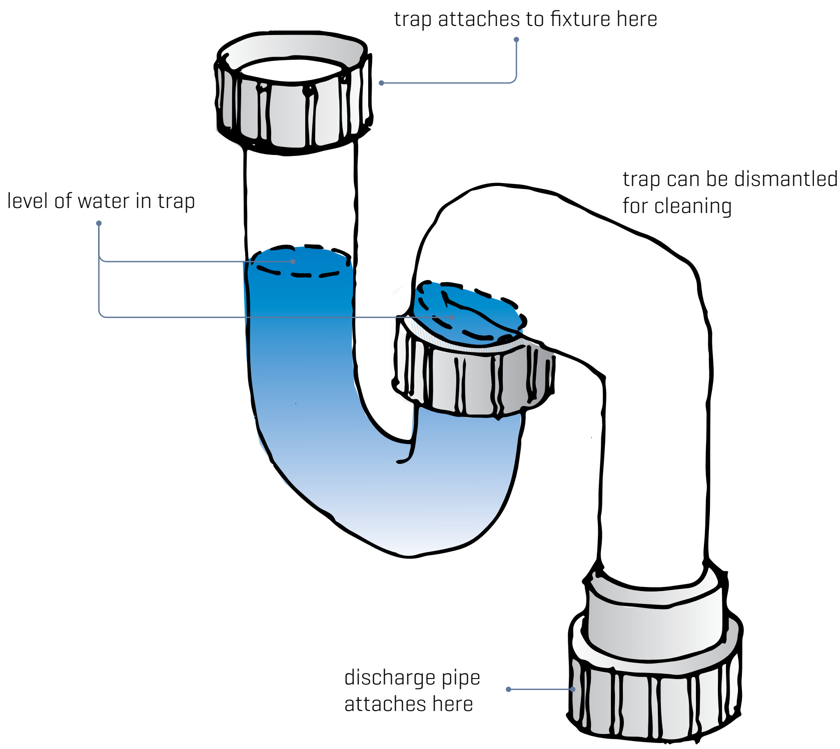


Figure 3. S trap for wastewater fixture.

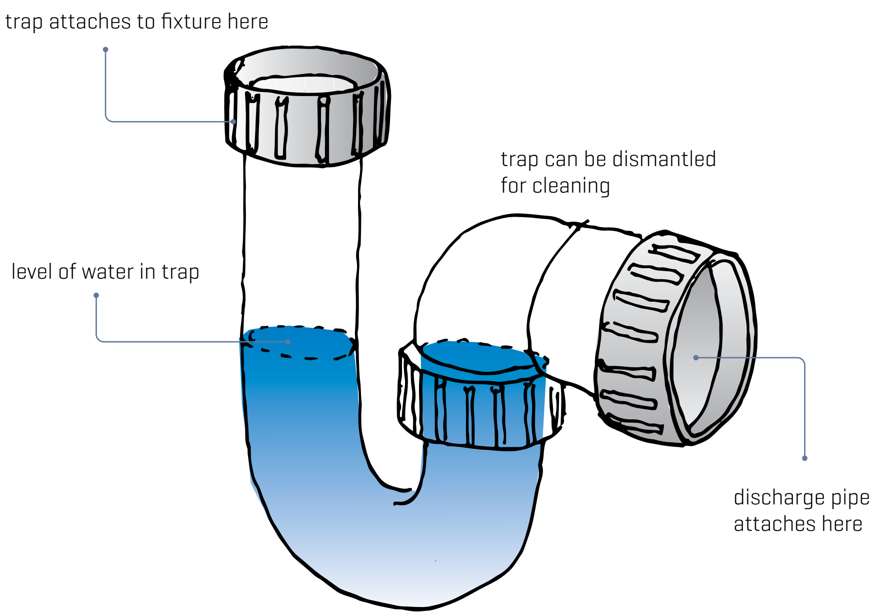
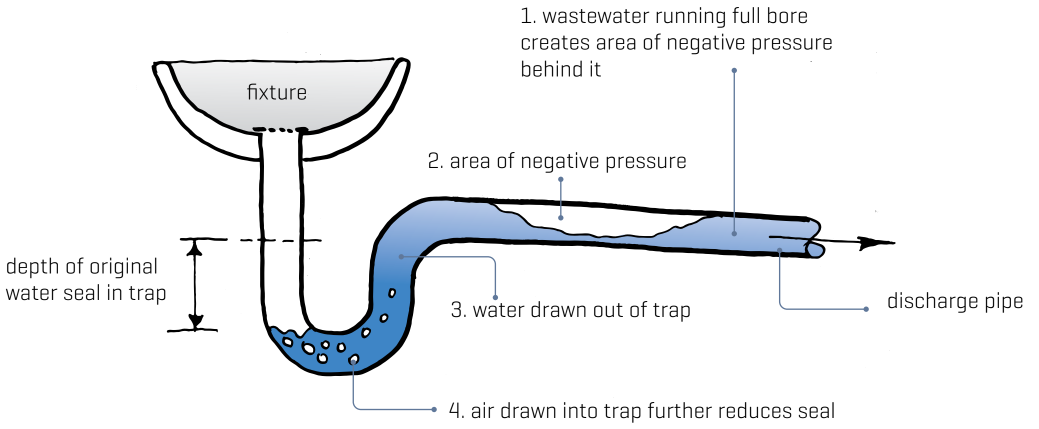


Figure 4. P trap for wastewater fixture.



factors likely to cause self-siphonage:

- small bore of discharge pipe
- long discharge pipe
- lack of pressure relief (vent)

Figure 5. Self-siphonage of trap.

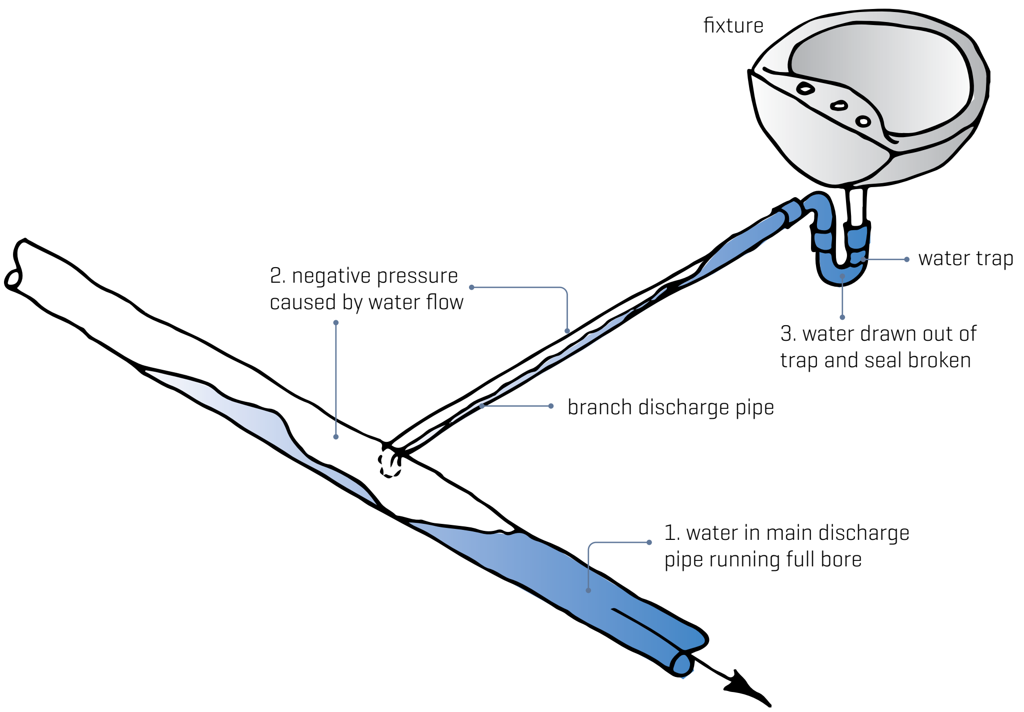


Figure 6. Induced siphonage from branch pipe.

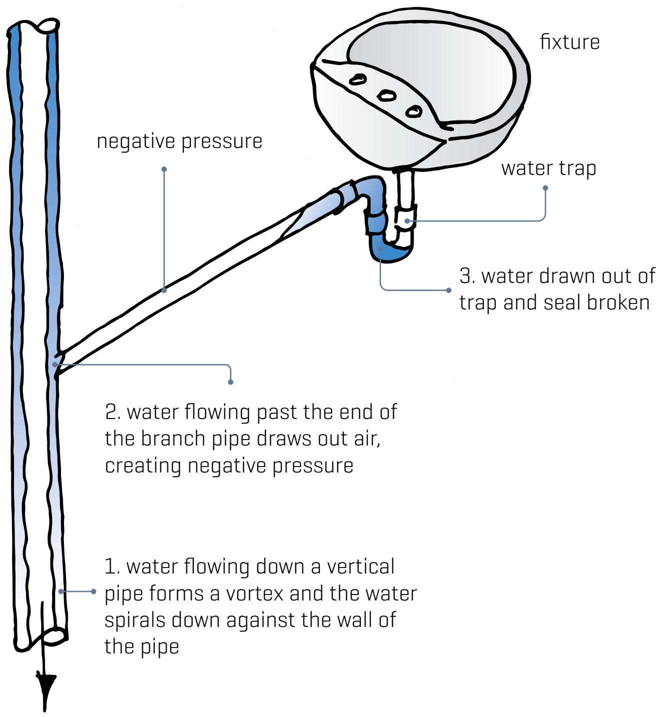


Figure 7. Induced siphonage from a discharge stack.

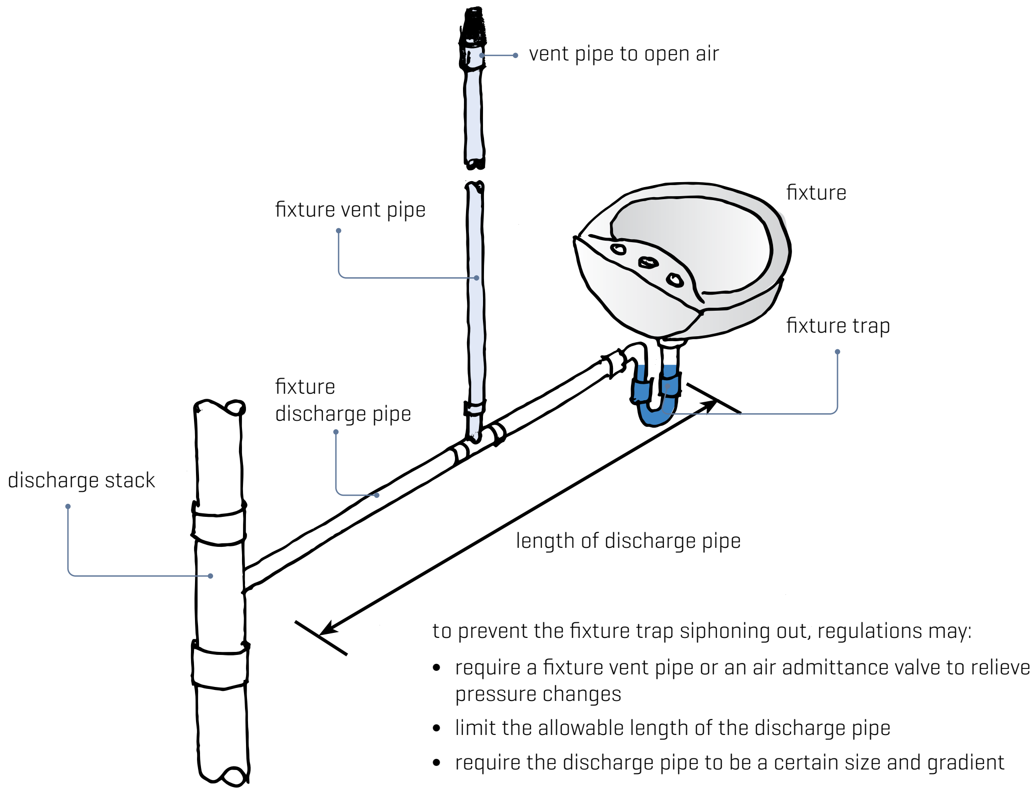


Figure 8. Controlling siphonage.

to prevent this, regulations may:

- restrict areas where connections may be made
- require pipes to be a certain size
- require a fixture vent pipe to relieve pressure changes
- prescribe minimum radiuses for bends

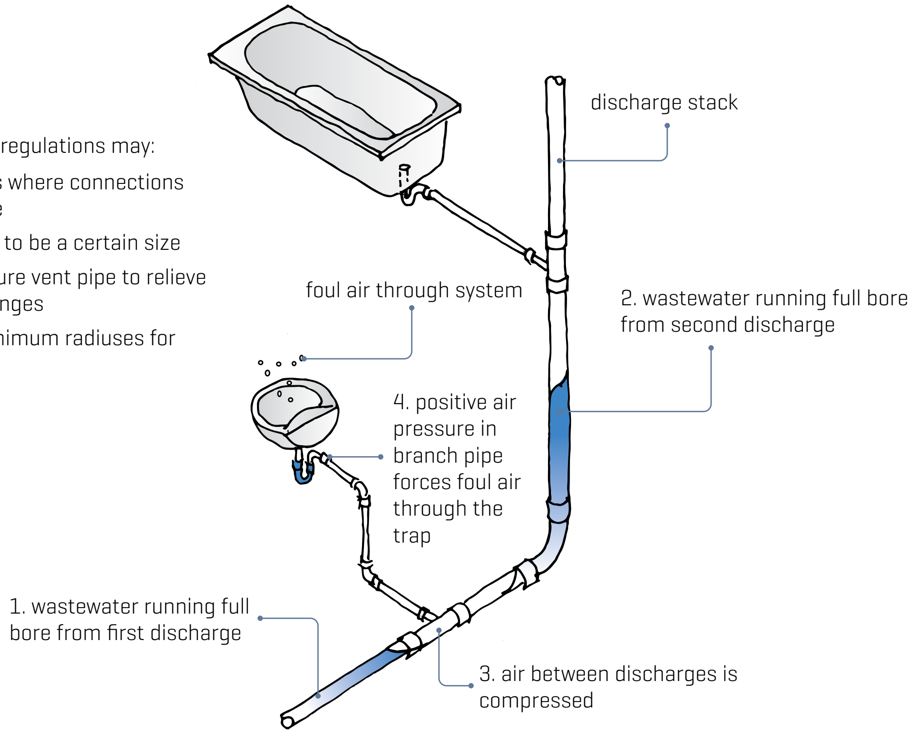


Figure 9. Failure of seal by compression.

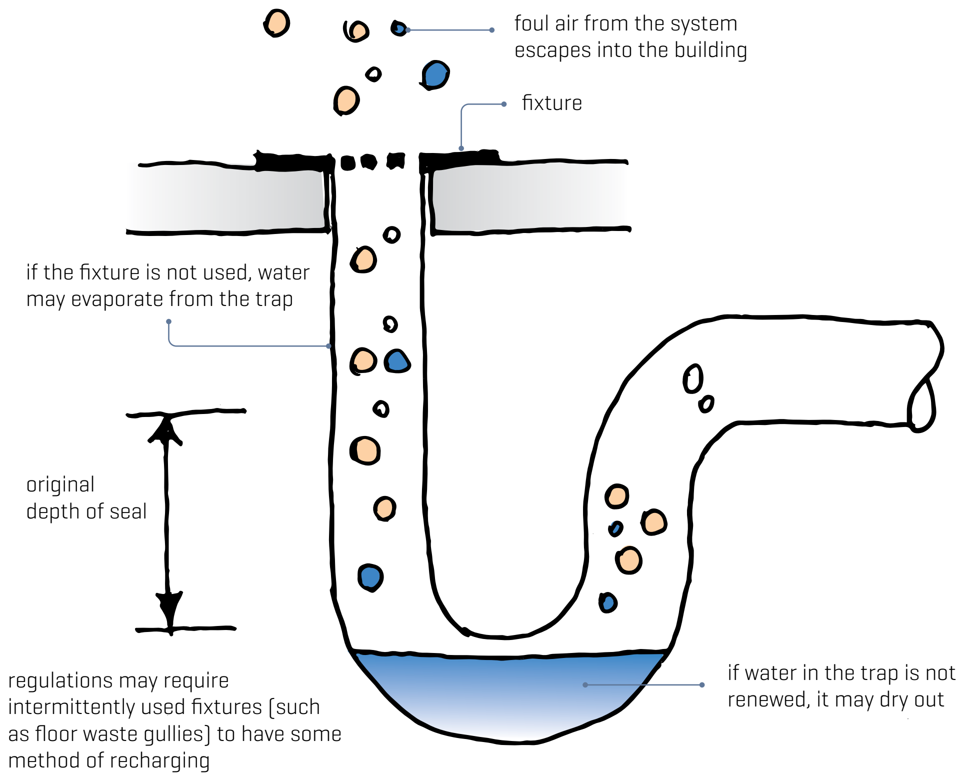


Figure 10. Failure of seal by evaporation.

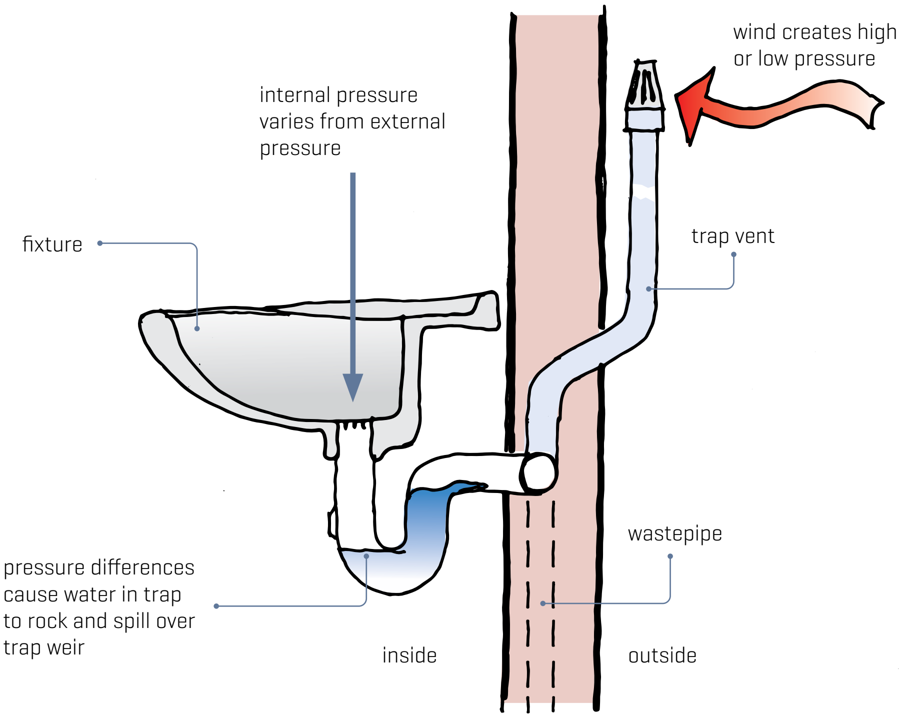


Figure 11. Trap failure due to oscillation.

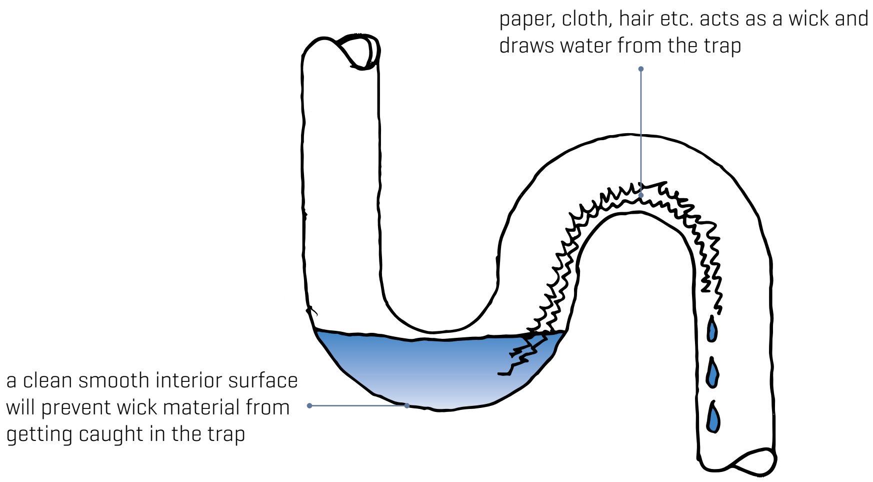


Figure 12. Capillary attraction.

1.3 COMPLYING WITH THE BUILDING CODE

The mandatory requirements for plumbing and drainage are set out in the Building Code, the first schedule of the Building Regulations 1992 and Acceptable Solutions G13/AS1 *Foul water sanitary plumbing*, G13/AS2 *Foul water drainage* and G13/AS3 *Foul water sanitary plumbing and drainage*. These Acceptable Solutions refer to requirements in AS/NZS 3500.2 *Plumbing and drainage* and can be used to establish compliance with the performance criteria in the Building Code.

Some of these requirements have been arrived at through long-accepted industry practice – others by more recent innovation. Some incorporate a large safety component – others are close to the limit of what will work in practice.

The Acceptable Solutions and standards set out to achieve their objectives by balancing:

- pipe diameter and length
- pipe gradients
- the amount of anticipated discharge from individual fixtures
- the likelihood of simultaneous discharge from other fixtures
- the need for venting
- restrictions on connection positions
- the radiuses of bends
- cost.

2

DESIGNING BUILDINGS TO ALLOW FOR PLUMBING

Problems frequently occur in the installation of plumbing in buildings because there has been insufficient consideration given at the design stage as to how to accommodate the plumbing requirements.

This lack of forethought can result in:

- compromising the structure where holes cut in plates, beams and joists are larger than permitted
- exceeding the maximum length of unvented discharge pipes
- unsightly exposed pipes (because of difficulty in concealing them)
- insufficient water pressure to operate valves and showers satisfactorily
- restricted access to tanks, valves and cylinders
- insufficient durability of pipes installed under concrete slabs
- drains with insufficient fall because of a high invert level at the outfall
- lack of space in which to fit floor waste gullies
- difficulty in achieving minimum gradients on discharge pipes within restricted spaces
- joists located directly under plumbing fixtures or discharge pipes.

2.1 DRAINS

Important drain design considerations include:

- accurately determining the invert level of the drain at the territorial authority's point of connection to ensure that sufficient fall can be incorporated in the drains within the site
- ensuring the length of unvented branch drains are within the specified limits
- accurately setting out drains under concrete floors – they are difficult to move later
- discharge pipes may have insufficient fall because gully trap invert levels are too high or the gully trap lip is too close to the finished floor level and/or finished exterior ground/paving levels.

2.2 DISCHARGE PIPES WITHIN FLOOR DEPTHS

In suspended floors, discharge should be run in the same direction as the joists (Figure 13). Large holes must not be drilled through joists unless they are specifically designed and approved or the design incorporates proprietary galvanised steel 'thru joist' plates provided they are installed in accordance with the manufacturer's specifications.

There must be sufficient depth within the floor structure to accommodate:

- the required fall
- the pipe diameter
- the number of bends
- inclined junctions in graded discharge pipes.

Figure 14 illustrates the principle of allowing for these within the floor depth, and Table 1 indicates the depth of floor required to accommodate various pipe diameters and gradients (every situation should be specifically designed). Similar consideration is required where the floor is concrete with a ceiling space below into which the pipe must be fitted.

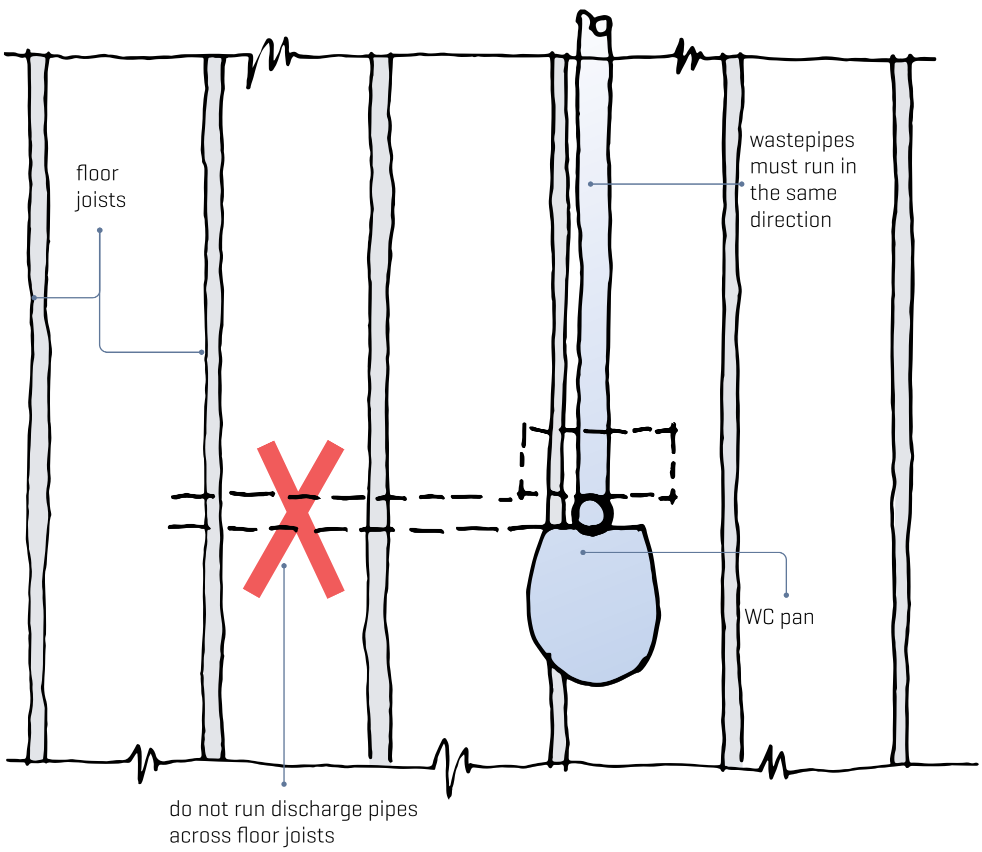


Figure 13. Discharge within floor depths.

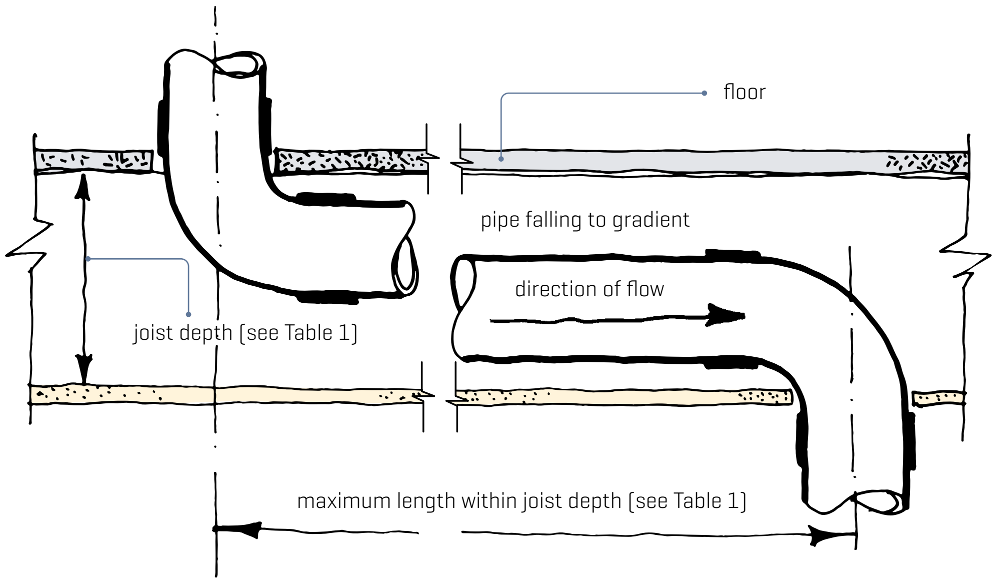


Figure 14. Allowance for fall within a floor.

2.3 FLOOR WASTE GULLIES WITHIN FLOOR DEPTHS

In a suspended timber floor, make sure there is sufficient room to fit the full depth of the trap. Approximate depths are indicated in Figure 15, but a check should be made with the manufacturer as dimensions can vary. The allowance for fall from the trap outlet can be checked using Table 1.

2.4 CHECKING OR DRILLING THROUGH TIMBER STRUCTURES

NZS 3604:2011 *Timber-framed buildings* restricts the dimensions of checking or drilling of pipes through joists, lintels, bearers and other structural members except in the case of specific design. Ensure that waste and vent pipes are run to avoid structural members and that, where other timbers such as top plates are cut, they are strengthened (Figure 16).

2.5 LABELLING PIPEWORK FOR IDENTIFICATION AND MAINTENANCE

Accessible sanitary plumbing, cold water, heated water and surface water pipes shall be permanently marked to be readily identifiable when installed in the following building types:

- Multi-unit dwellings, including apartment buildings, but excluding low-rise multi-unit dwellings such as an attached dwelling or flat.
- Communal residential buildings, excluding holiday cabins and back-country huts.
- Communal non-residential buildings, commercial buildings and industrial buildings.

Table 1. Approximate discharge pipe lengths that can be accommodated within floor joist depth.

Joist depth	Pipe diameter		Minimum gradient	Allowance for bend radius	Maximum distance
300 mm	DN 100	OD 110 mm	1:60 (1.65%)	25 + 25 = 50 mm	8.1 m
	DN 80	OD 82 mm	1:60 (1.65%)	15 + 15 = 30 mm	10.9 m
	DN 65	OD 69 mm	1:40 (2.5%)	10 + 10 = 20 mm	12.3 m
	DN 50	OD 56 mm	1:40 (2.5%)	10 + 10 = 20 mm	13 m
	DN 40	OD 43 mm	1:40 (2.5%)	10 + 10 = 20 mm	13.9 m
250 mm	DN 100	OD 110 mm	1:60 (1.65%)	25 + 25 = 50 mm	5.1 m
	DN 80	OD 82 mm	1:60 (1.65%)	15 + 15 = 30 mm	8.0 m
	DN 65	OD 69 mm	1:40 (2.5%)	10 + 10 = 20 mm	6.2 m
	DN 50	OD 56 mm	1:40 (2.5%)	10 + 10 = 20 mm	6.7 m
	DN 40	OD 43 mm	1:40 (2.5%)	10 + 10 = 20 mm	7.3 m
200 mm	DN 100	OD 110 mm	1:60 (1.65%)	25 + 25 = 50 mm	2.3 m
	DN 80	OD 82 mm	1:60 (1.65%)	15 + 15 = 30 mm	5.0 m
	DN 65	OD 69 mm	1:40 (2.5%)	10 + 10 = 20 mm	4.2 m
	DN 50	OD 56 mm	1:40 (2.5%)	10 + 10 = 20 mm	4.8 m
	DN 40	OD 43 mm	1:40 (2.5%)	10 + 10 = 20 mm	5.3 m

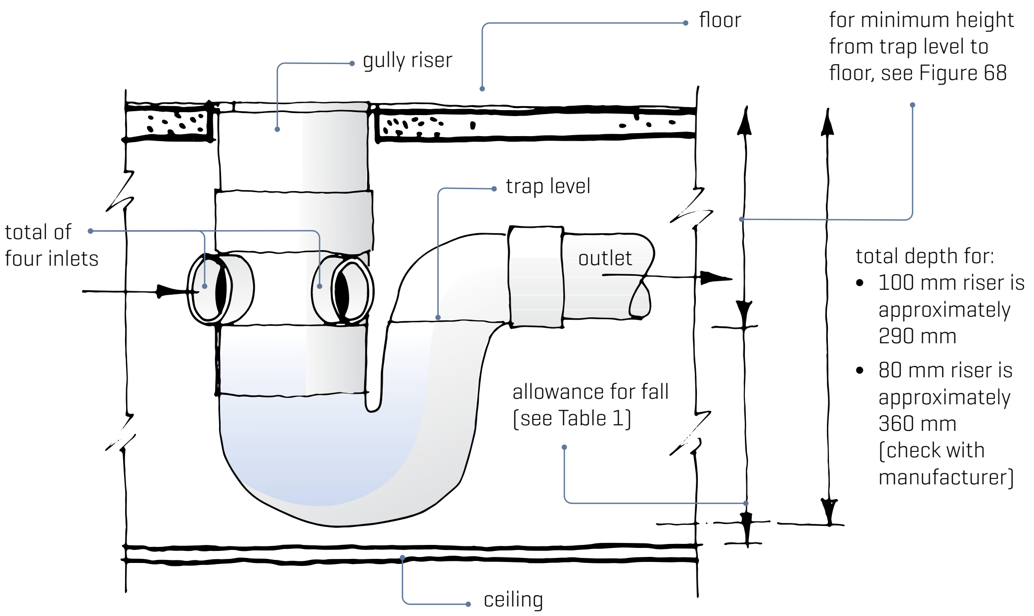


Figure 15. Space required for a floor waste gully.

Identification markings shall be:

- placed at spacings not exceeding 6 m
- adjacent to branches, junctions, valves, service appliance, bulkheads and wall and floor penetrations
- at every floor within vertical ducts and riser cupboards.

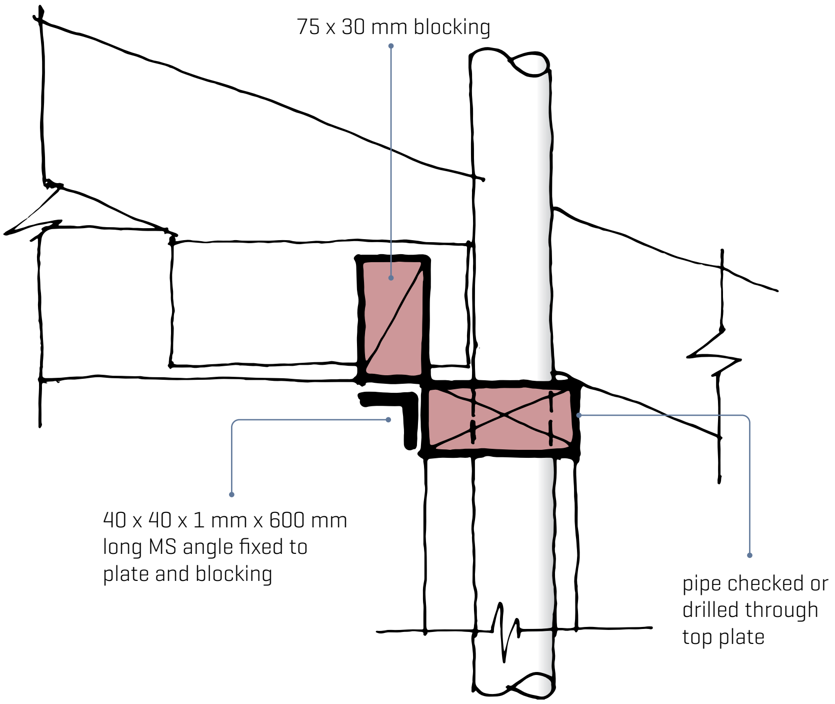


Figure 16. Strengthening the eaves where pipe is cut through top plate.

3

GUIDE TO ACCEPTABLE SOLUTION G13/AS1 SANITARY PLUMBING

Acceptable Solution G13/AS1 covers above-ground sanitary plumbing flowing under gravity (non-pressure) and includes all pipework for foulwater within or on the building, including any basements.

Scope

G13/AS1 is based on the New Zealand Drainage and Plumbing Regulations, which applied until the introduction of the Building Code in 1992. It essentially specifies a fully vented system that allows for maximum flexibility in the arrangement and length of pipework.

Note that G13/AS1 does not cover:

- buildings of more than 3 storeys
- specialised sanitary fixtures or appliances such as may be used in hospitals, laboratories and factories
- industrial, chemical or toxic wastes that cannot be discharged legally into a sewer.

3.1 PLUMBING SYSTEMS

3.1.1 Wastewater fixtures

Wastepipes from wastewater fixtures may discharge to:

- an external gully trap (Figure 17)
- a discharge stack (Figures 18–20).

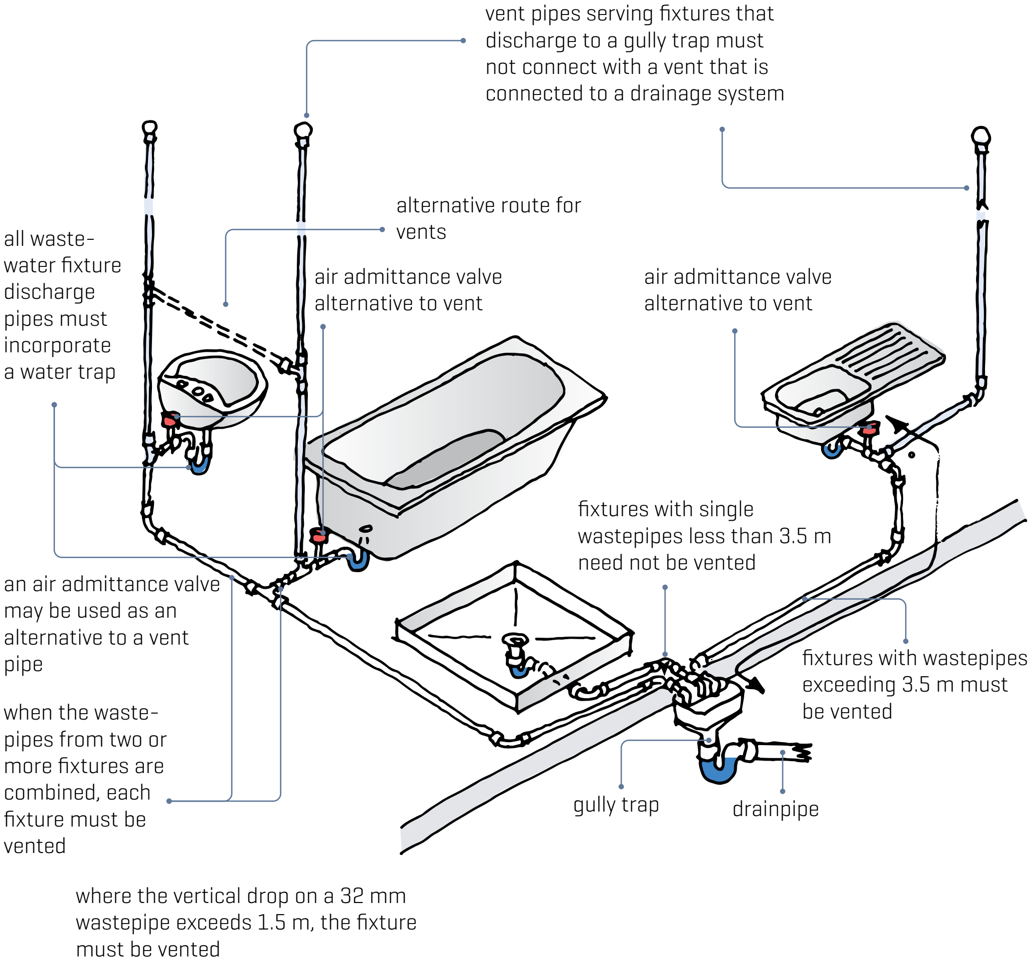


Figure 17. Basic rules for wastepipes discharging to a gully trap.

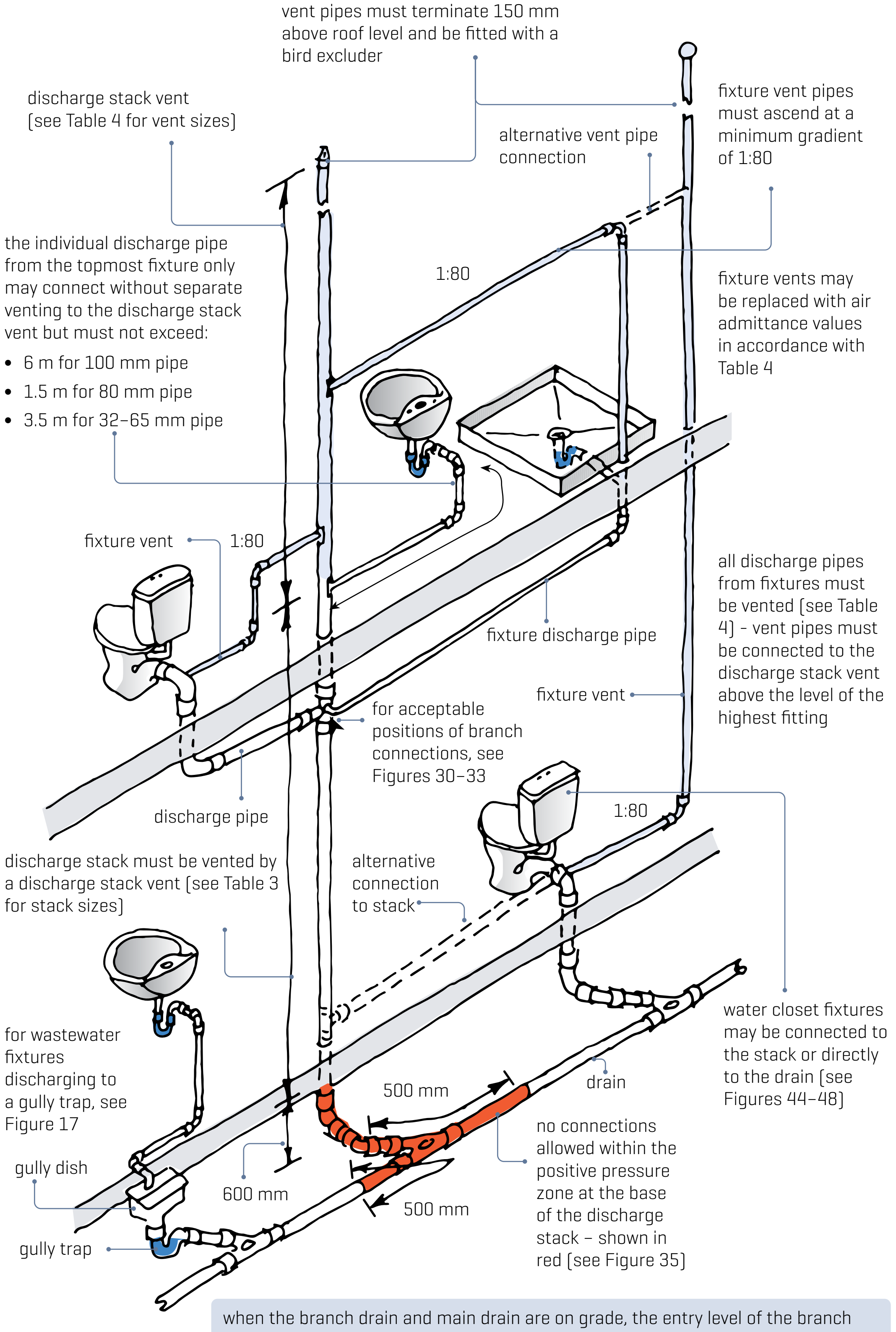
3.1.2 Soil fixtures

Soil fixtures may discharge:

- directly to a drain (Figures 18, 20 and 44–46)
- to a discharge stack (Figures 18–20).

3.1.3 Typical 2-storey system

Fixtures may discharge to a discharge stack and must be vented. The basic rules are shown in Figure 18.



when the branch drain and main drain are on grade, the entry level of the branch drain is elevated at an incline of not less than 15° to the horizontal [see Figure 160]

Figure 18. Basic rules for a system serving two floor levels.

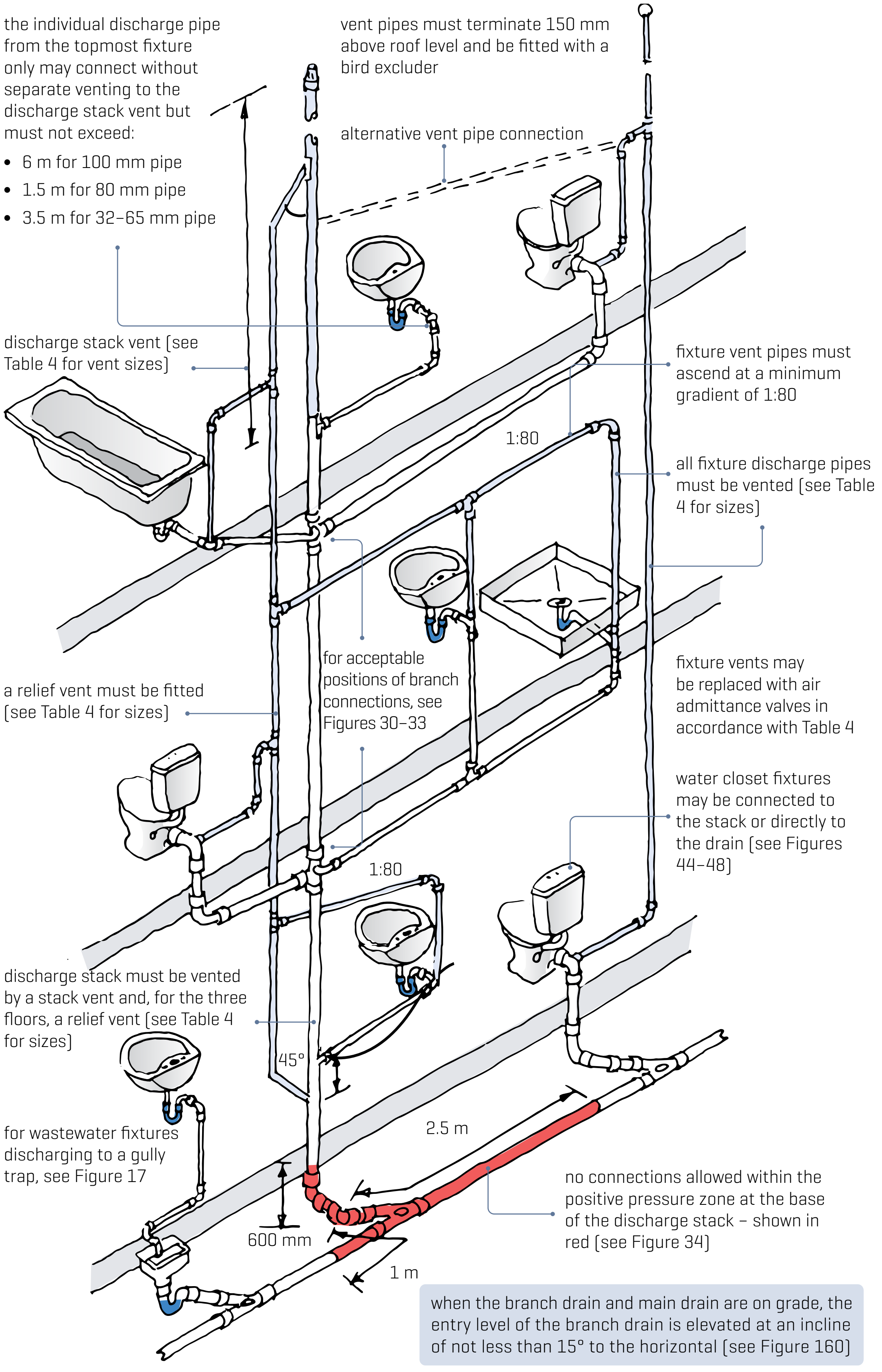


Figure 19. Basic rules for a system serving three floor levels.

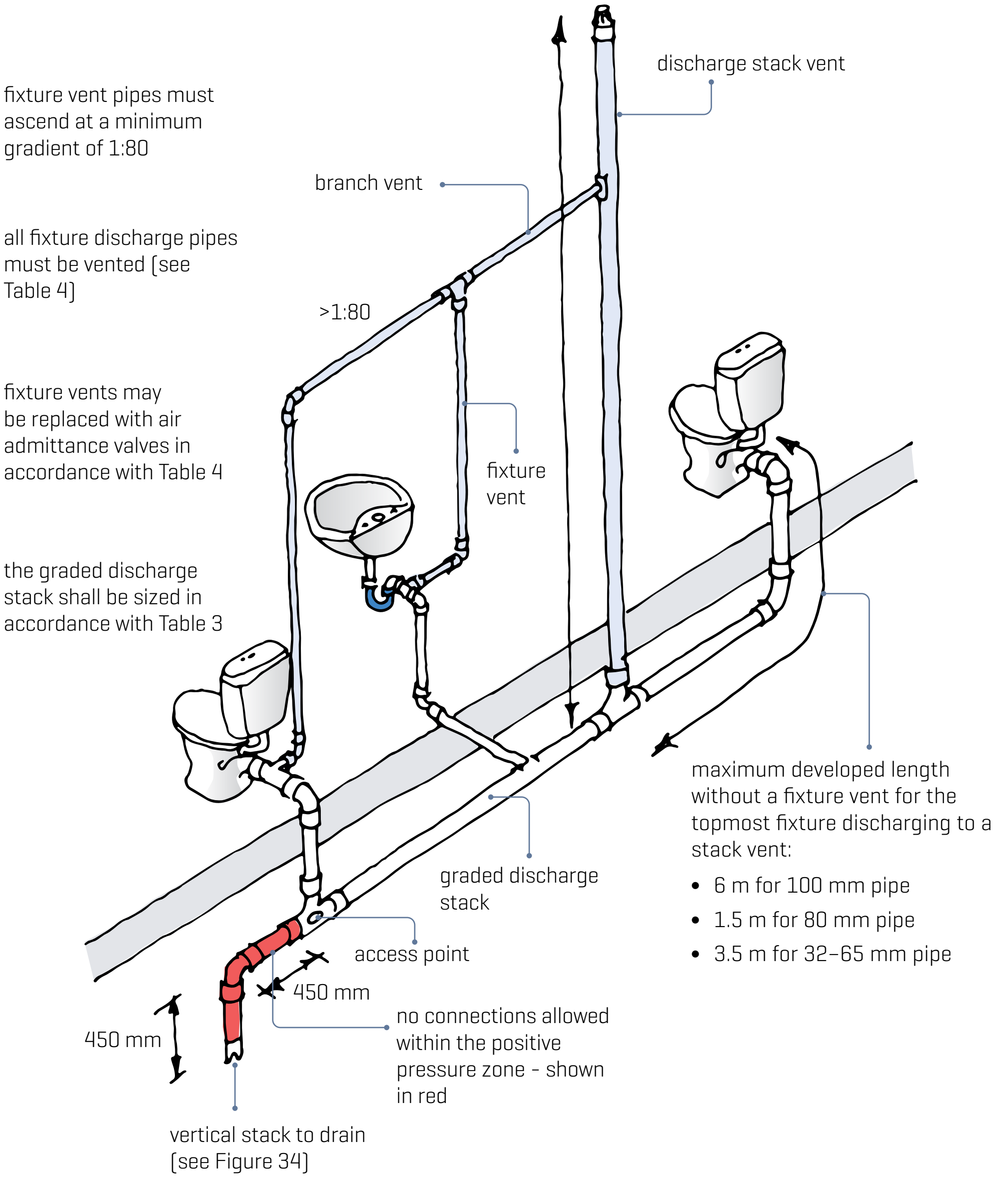


Figure 20. Basic rules for a graded discharge stack.

3.1.4 Typical 3-storey system

Fixtures may discharge to a discharge stack as for a 2-storey system but the discharge stack must have a relief vent. The basic rules are shown in Figure 19.

3.1.5 Graded discharge stack

Fixtures may discharge to a graded discharge stack. The basic rules are shown in Figure 20.

3.2 WATER TRAPS AND SINGLE DISCHARGE PIPES

All points at which foulwater is discharged into a plumbing system must incorporate a water trap to prevent foul air from entering the building. The fixture outlet diameter dictates the diameter of the fixture trap and the discharge pipe. Water traps must:

- be located as close as possible to the sanitary fixture that they serve
- be removable or be fitted with a cleaning eye
- have a waterseal depth of not less than 75 mm ±10 mm for a wastewater fixture and 50 mm ±5 mm for a soil fixture
- under normal operating conditions, retain a depth of water seal of 25 mm (Figures 21-22).

Easy-clean traps are acceptable and are used mainly in showers, urinals and trapped floor wastes (Figure 23).

The developed length of a fixture discharge pipe between the water seal and the sanitary fixture outlet or a sanitary appliance (such as a washing machine) discharge point must not exceed 1.2 m.

Wastewater discharge pipes must comply with Figures 21-22. The minimum gradient of discharge pipes is:

- 1:20 for 32 mm pipe
- 1:40 for 33-65 mm pipe
- 1:60 for 66-100 mm pipe.

Discharge units and discharge pipe sizes must comply with Table 2.

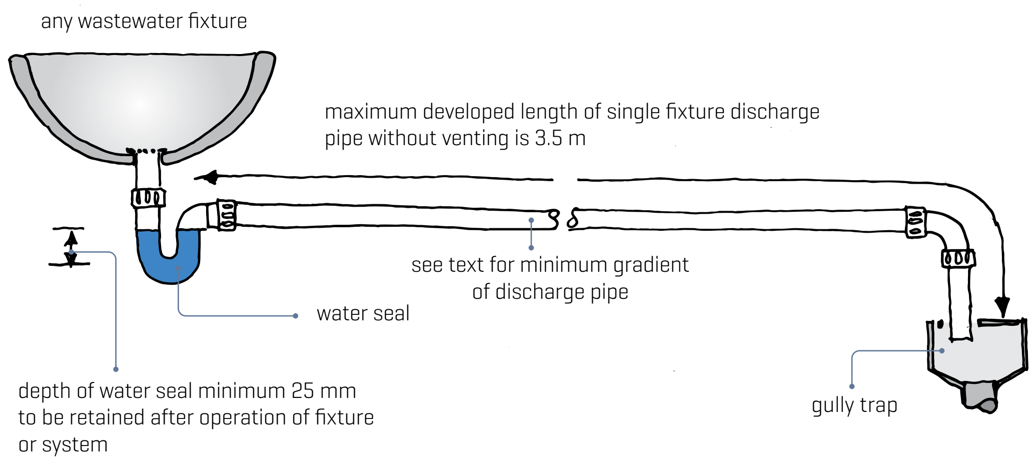


Figure 21. Discharge pipe from wastewater fixtures to gully trap.

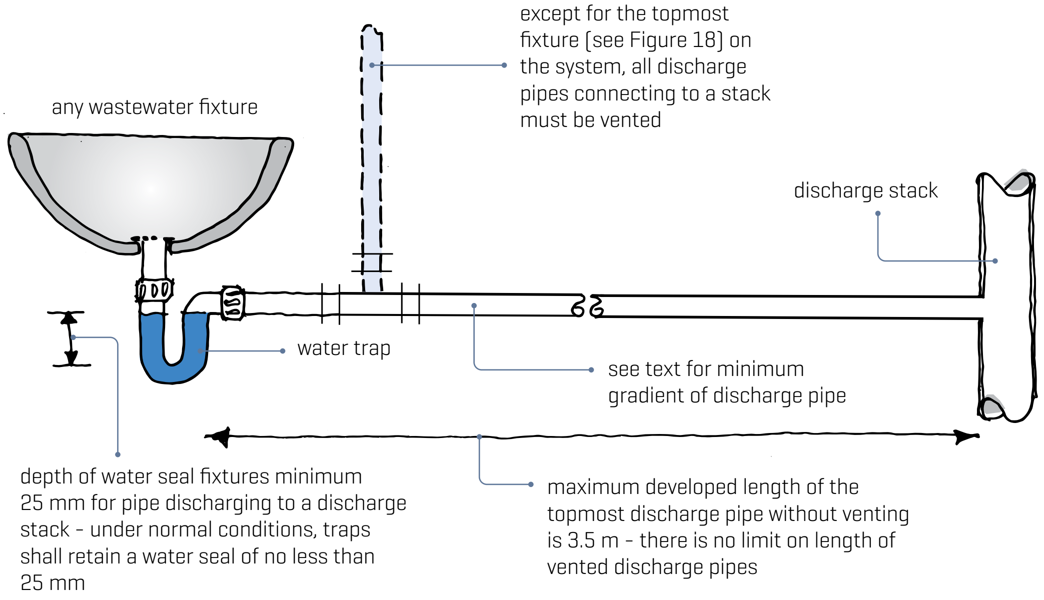


Figure 22. Discharge pipe from wastewater fixture to discharge stack.

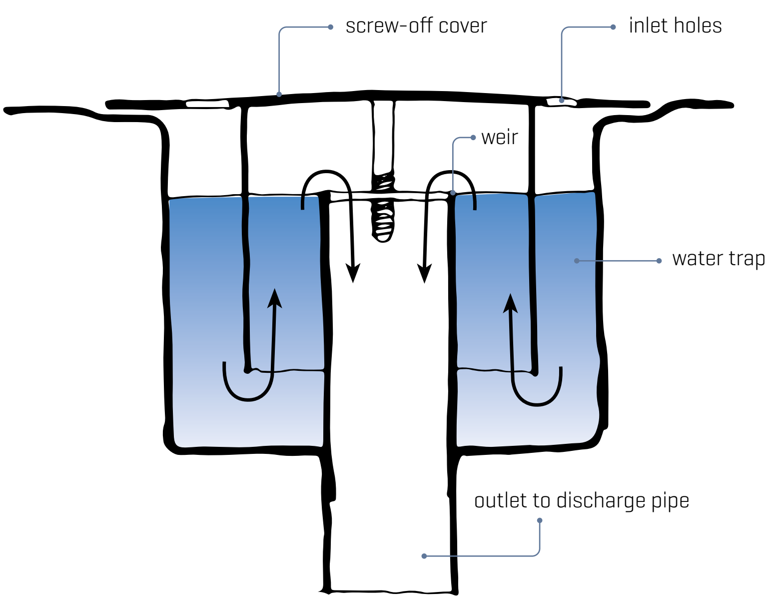


Figure 23. Easy-clean type trap.

3.3 WATER TRAPS SERVING MORE THAN ONE OUTLET

In addition to trapping a single fixture, a water trap may serve the following combination of fixtures:

- Two domestic kitchen sinks and one dishwasher (Figure 24). Where the second sink has a waste disposal unit installed, these may be trapped separately or served by a single 50 mm water trap and discharge pipe (Figure 25).
- Two laundry tubs or a laundry tub and clothes washing machine discharge (Figures 26–27).
- Two hand basins (Figure 28).

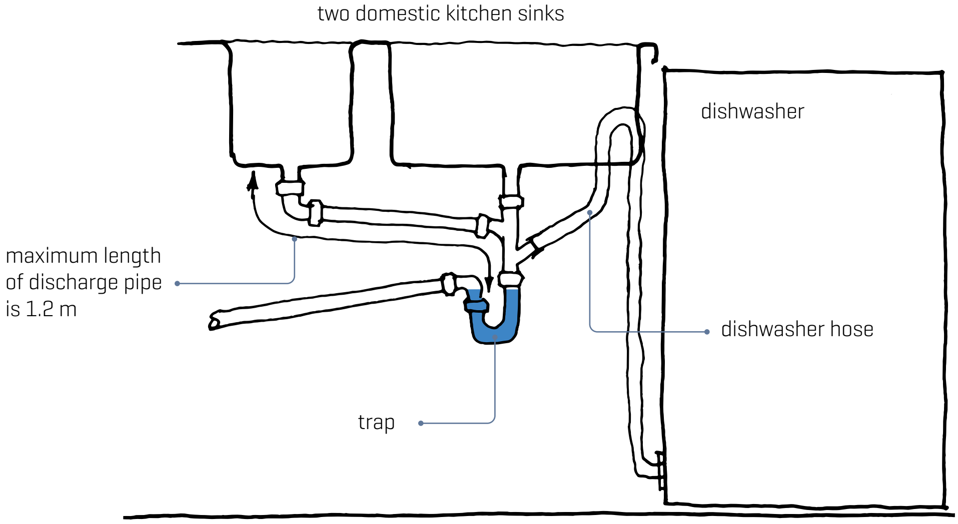
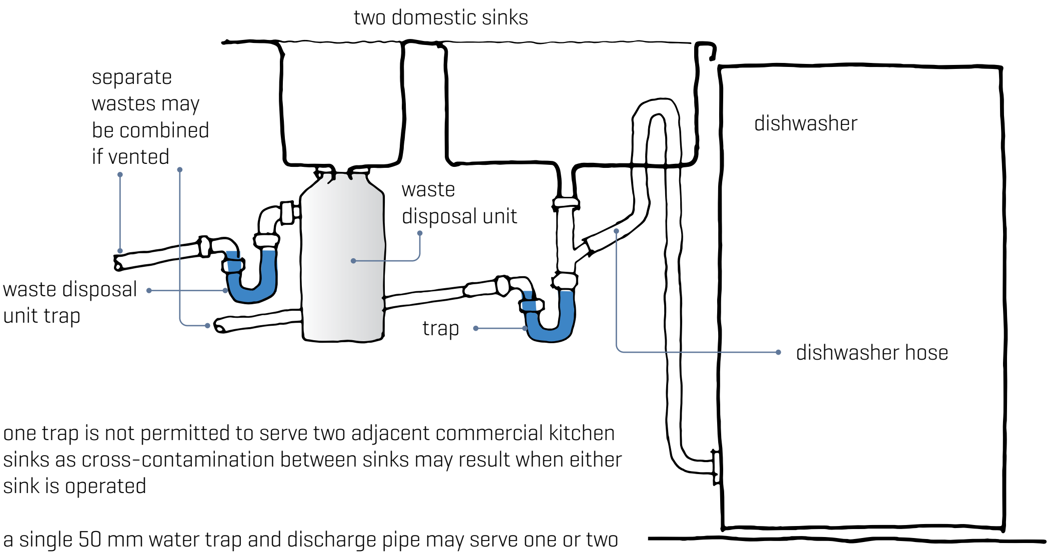


Figure 24. A water trap may serve two domestic kitchen sinks and one dishwasher.



one trap is not permitted to serve two adjacent commercial kitchen sinks as cross-contamination between sinks may result when either sink is operated

a single 50 mm water trap and discharge pipe may serve one or two adjacent domestic sinks together with a waste disposal unit and a dishwashing machine

Figure 25. A waste disposal unit in the second sink must be trapped separately – for commercial sinks, each fixture must have its own trap.

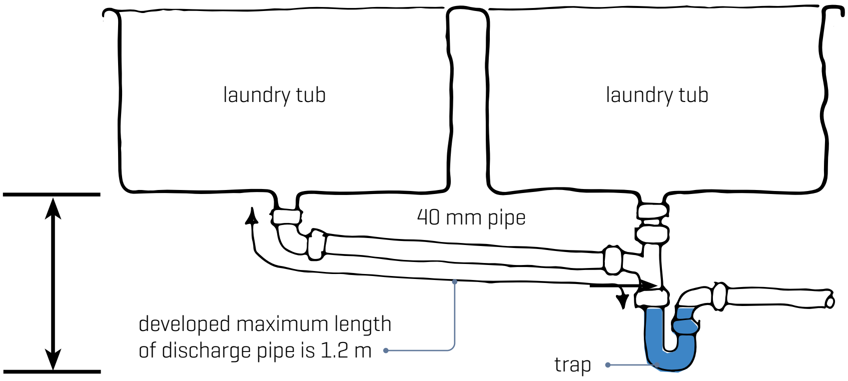


Figure 26. A water trap may serve two laundry tubs.

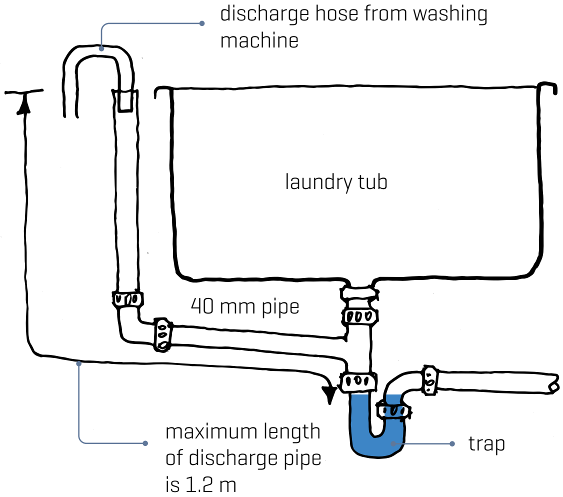


Figure 27. A water trap may serve one laundry tub and one washing machine.

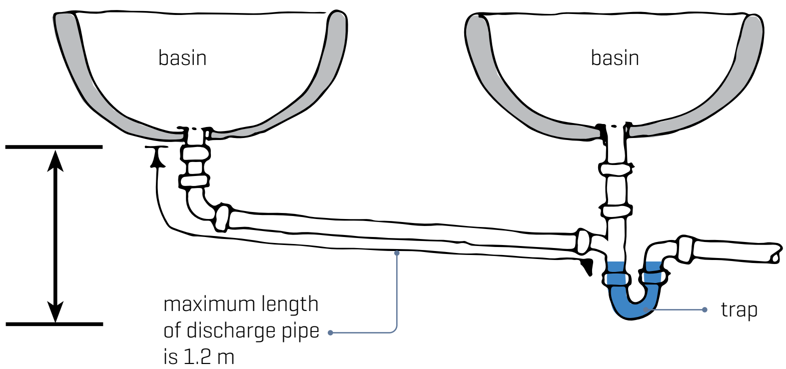


Figure 28. A water trap may serve two hand basins.

3.4 COMBINED DISCHARGE PIPES

A discharge pipe that receives the discharge from two or more fixtures must have a minimum diameter calculated as follows:

- From Table 2, add the total number of discharge units that the pipe will carry.
- From Table 3, select the pipe size and gradient.

Discharge pipes must not decrease in size in the direction of flow.

Access must be provided to allow for clearance of blockages.

For examples of discharge pipe sizing, see Figure 29.

Table 2. Discharge units and fixture discharge pipe sizes.

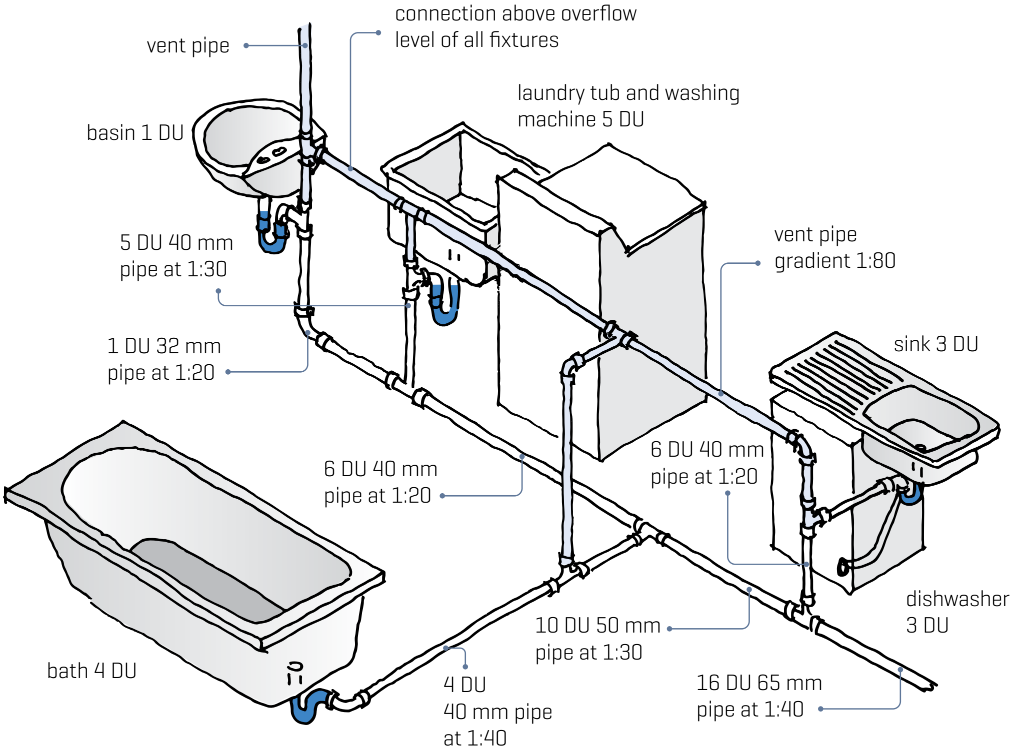
Fixture type	Discharge units	Minimum discharge pipe size (mm)
Basin	1	32
Bath (with or without overhead shower)	4	40
Bathroom group (WC pan, bath and shower, bidet, and basin all in one room)	6	For combined discharge pipe sizes for groups of fixtures, see Table 3
Bidet	1	32
Cleaner's sink	1	40
Clothes washing machine (domestic)	5	40
Dishwasher (domestic)	3	40
Drinking fountain	1	25
Kitchen sink (commercial)	3	50
Kitchen sink (domestic, single or double with waste disposal unit)	3	40
Laundry (single or double tub with washing machine)	5	40
Shower	2	40
Urinal (1 or 2 stall type)	1 per 600 mm	50
Urinal (3 or more stalls)	1 per 600 mm	80
Urinal (bowl type)	1	32
WC pan	4	80

Adapted from G13/AS1 Table 2.

Table 3. Discharge unit (DU) loading for stacks and graded discharge pipes.

Diameter (mm)	Maximum discharge from any one floor	Maximum loading at base of vertical stack	Maximum DUs for a gradient of:				
			1:20	1:30	1:40	1:50	1:60
32	1	1	1				
40	2	6	6	5	4	not permitted	
50	5	15	15	10	8		
65	6	18	51	29	21		
80	13	40	65	39	27	20	16
100	65	195	376	248	182	142	115

Adapted from G13/AS1 Table 4.



DU = discharge unit

Figure 29. Example of discharge pipe sizing.

3.5 ACCESS POINTS

Access must be provided so that blockages can be cleared where:

- a soil discharge pipe connects to a stack
- a soil stack connects with a drain
- there are a number of bends and/or junctions likely to cause a blockage
- access to a pipe is otherwise restricted.

Access panels to access points should be provided.

3.6 LIMITATIONS ON CONNECTION TO A DISCHARGE STACK

Some limitations are placed on the positions at which connections may be made to a discharge stack. To prevent the flow from one pipe entering another connection directly opposite it across the stack, two connections entering at the same level must be formed with swept junctions or with an included angle of 90° between them (Figures 30–31).

Branch connections opposite and below another connection must be made either:

- below the 200 mm restricted zone or
- at 90° to the other connection on the centreline of the discharge pipe (Figures 32–33).

To avoid connections within positive pressure zones and to reduce the pressure at the foot of a discharge stack:

- the bend to horizontal at the foot of the discharge stack must be made with two 45° bends
- connections must not be made within the area shown in green in Figures 34-35.

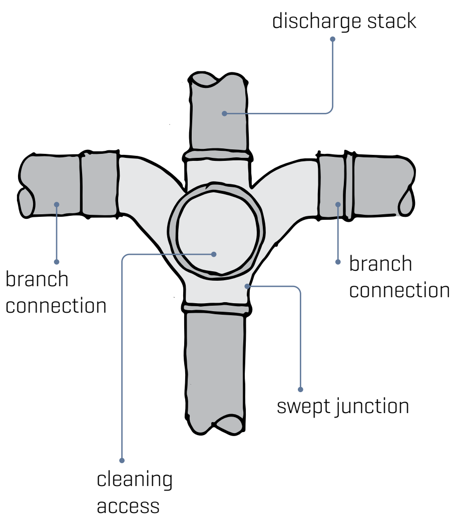


Figure 30. Acceptable opposite connections at the same level – swept junctions.

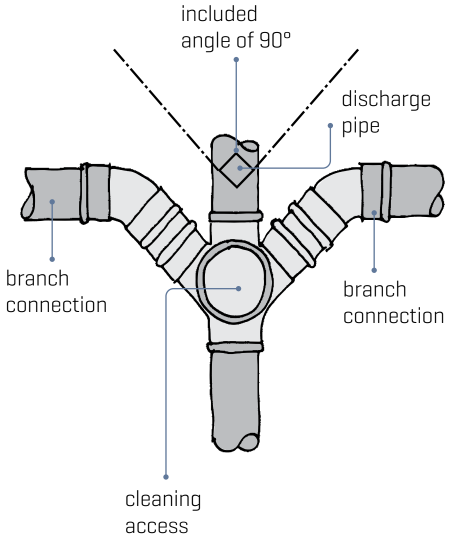


Figure 31. Acceptable opposite connections at the same level – included angle of 90°.

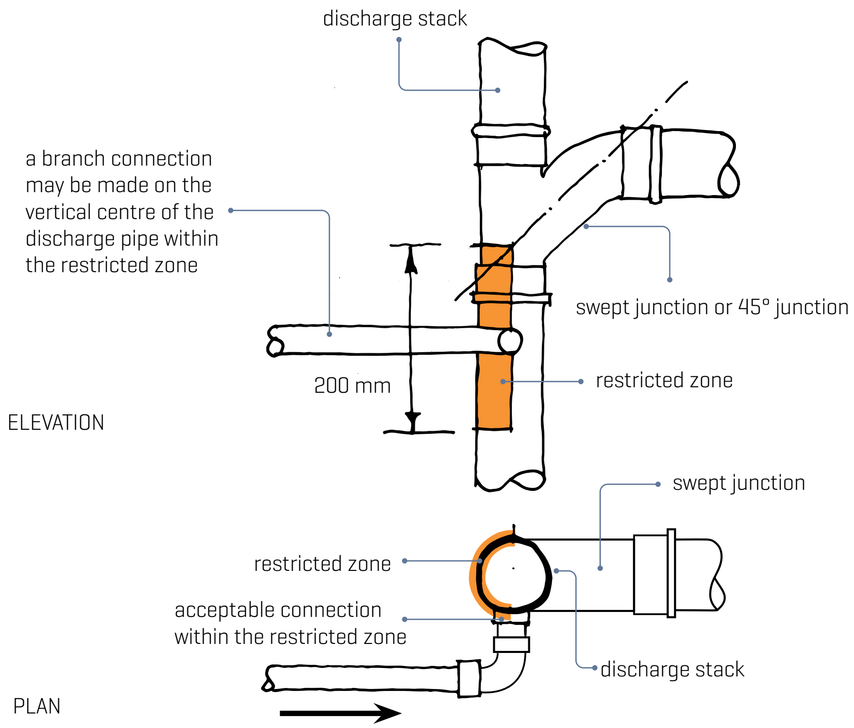


Figure 32. Restricted zone for connections and acceptable branch connections.

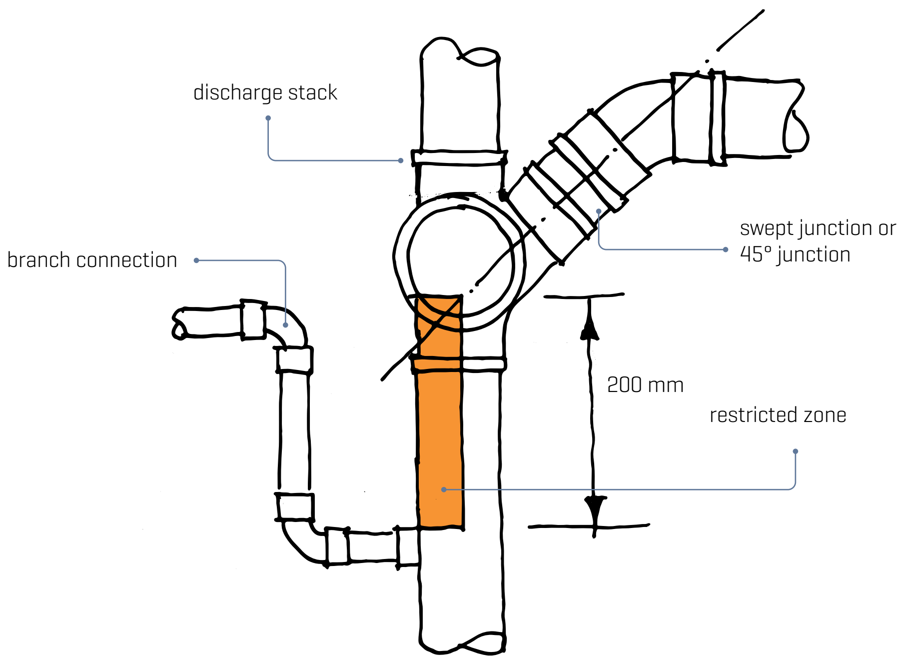


Figure 33. Dropped entry connection.

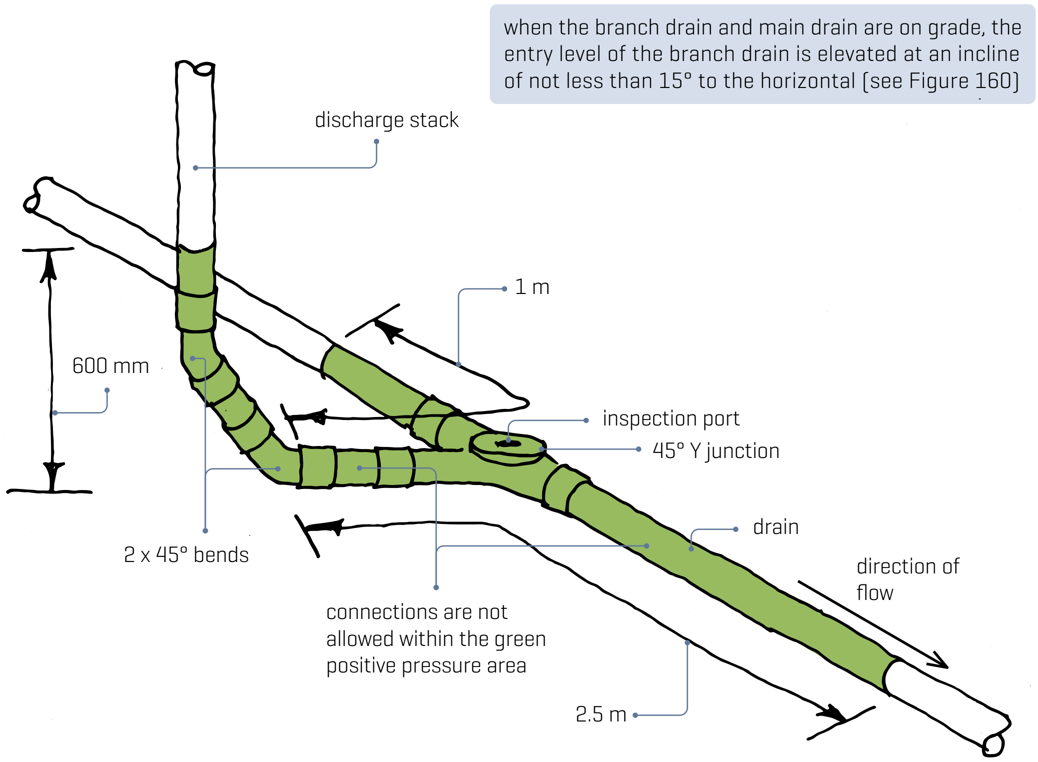


Figure 34. Restrictions on connections at base of discharge stack serving three floors.

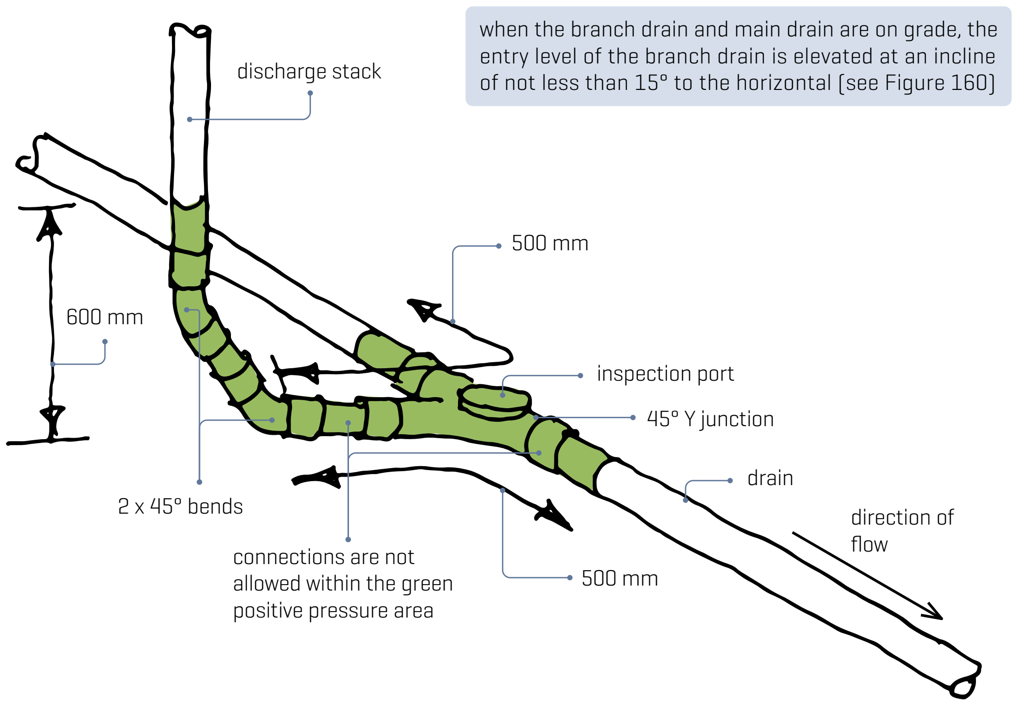


Figure 35. Restrictions on connections at base of discharge stack serving two floors.

3.7 SIZING OF VENTS

Discharge stack vents must not be smaller than:

- given in Table 4
- the discharge stack they serve.

3.8 VENT PIPES

Vent pipes must:

- have a continual rise with a minimum gradient of 1:80 from the point of connection to the discharge pipe to the open air – this allows condensation and other liquids to drain back into the discharge pipe and reduces the chance of water restricting venting
- terminate in the open air (directly or via another vent pipe) and be fitted with a device to exclude birds
- terminate a minimum of 50 mm above the overflow level of the highest fixture they serve.

Vent pipes may be connected to a relief vent, a discharge stack vent or a branch vent at a minimum height of 50 mm above the overflow level of the fixture they serve (Figures 36–39).

Vent pipes must not be smaller than given in Table 5.

Table 4. Vent pipe sizes.

Fixture vent pipes	Diameter of fixture discharge pipe (mm)	Minimum diameter of fixture vent size (mm)
	32	32
	40	32
	50	40
	65	40
	80	40
	100	40
Branch vents, branch drain vents, relief vents and discharge stack vents	Maximum discharge units carried by pipe	Minimum diameter of vent (mm)
	up to 15	40
	16–65	50
	66–376	65
	more than 376	80
Main drain vents	Minimum diameter of open vent pipe is 80 mm	

Adapted from G13/AS1 Table 6.

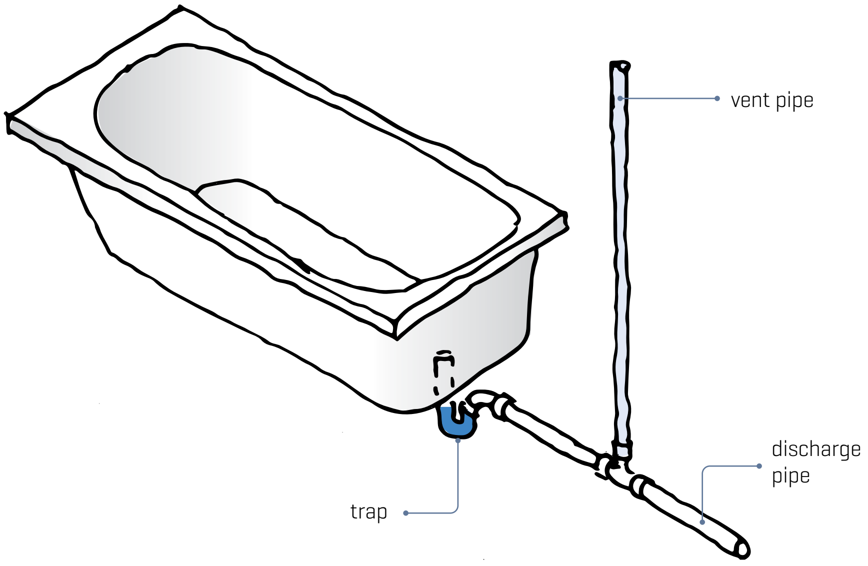


Figure 36. A vent pipe may rise vertically.

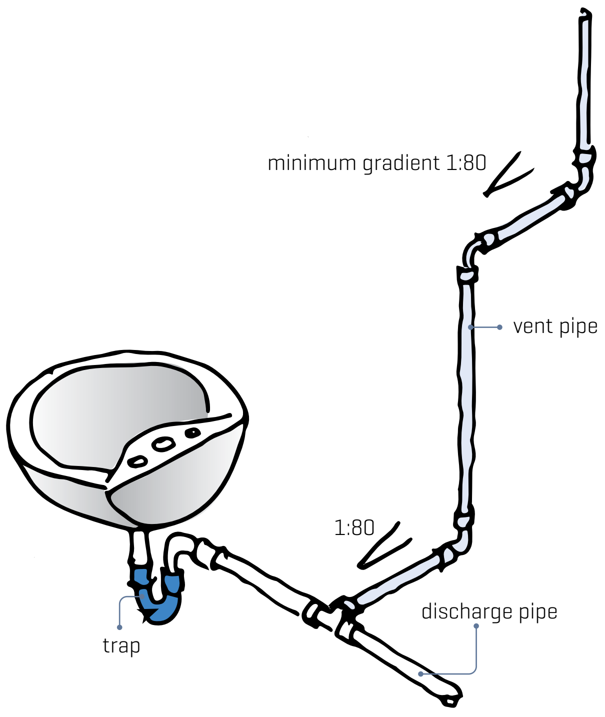


Figure 37. A vent pipe may incorporate vertical and graded sections.

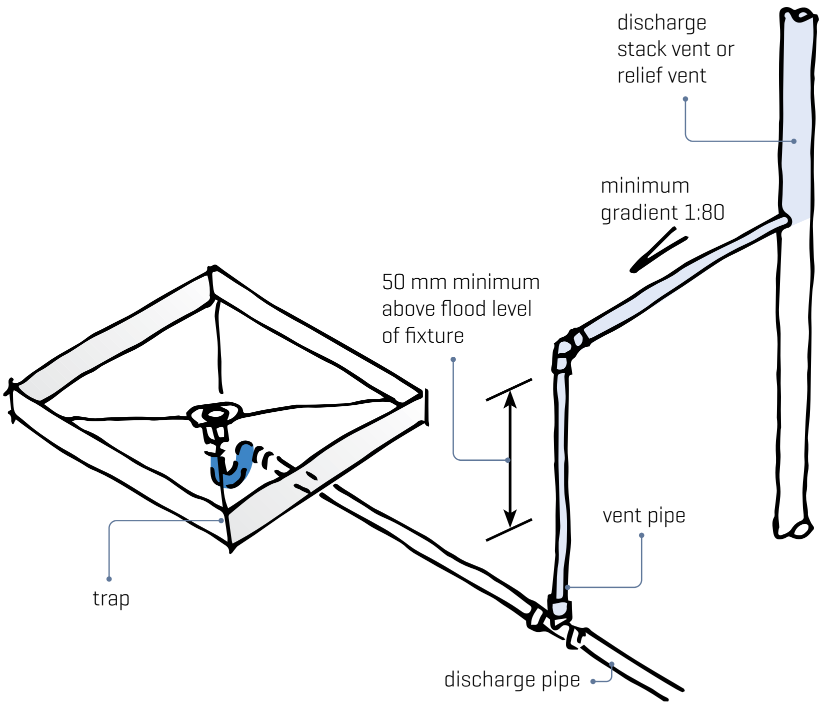


Figure 38. A vent pipe may connect to a branch vent pipe, a discharge stack vent or a relief vent.

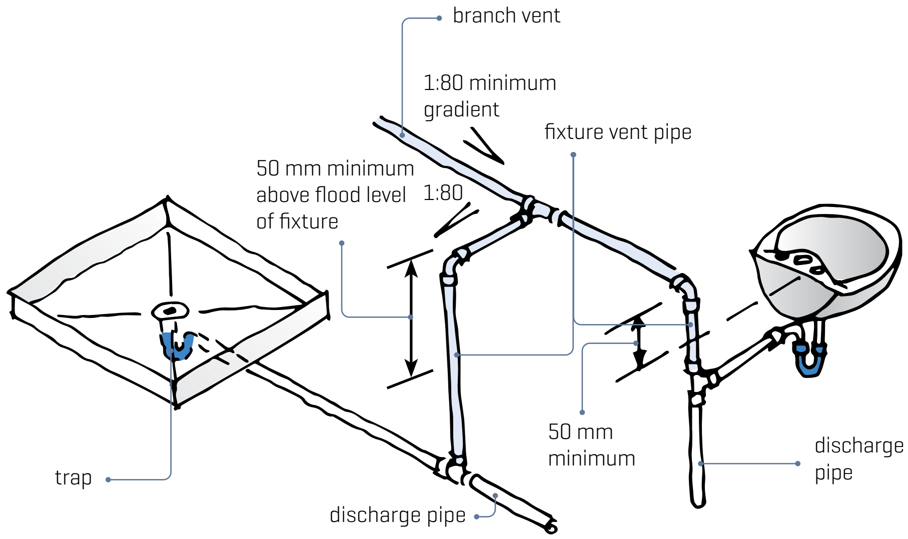


Figure 39. A vent pipe may connect to the vent from another fixture to form a branch vent.

Table 5. Venting requirements.

Stack vent	All stacks must be vented in accordance with Table 4. At least one stack in a system (that is acting as a main drain vent) must be vented to the open air. Other stacks may be vented with air admittance valves.
Relief vent	All stacks serving more than three floor levels must have a relief vent in accordance with Table 4. Relief vents must be vented to the open air.
Fixtures connected to a stack	All fixtures connected to a stack must be vented by a vent to the open air or an air admittance valve in accordance with Table 4.
Highest fixture connected to a stack	Must be vented by a vent to the open air or an air admittance valve in accordance with Table 4 if the discharge pipe exceeds: • 6 m for 100 mm pipe • 1.5 m for 80 mm pipe • 3.5 m for 32–65 mm pipe.
Soil fixtures connected to an unvented branch drain	Must be vented by a vent to the open air or an air admittance valve in accordance with Table 4.
Soil fixtures connected to a vented drain with a gradient less than 1:60	Must be vented by a vent to the open air or an air admittance valve in accordance with Table 4.
Individual soil fixtures connected to a vented drain with a gradient of 1:60 or steeper	Must be vented by a vent to the open air or an air admittance valve in accordance with Table 4 if the discharge pipe: • has a gradient of less than 1:60 • exceeds 6 m for 100 mm pipe or has a vertical drop greater than 2 m • exceeds 1.5 m for 80 mm pipe.
Fixtures discharging to a gully trap	• Fixtures discharging to a combined wastepipe must be vented by a vent to the open air or an air admittance valve in accordance with Table 4. • Individual fixtures must be vented by a vent to the open air or an air admittance valve in accordance with Table 4 if the discharge pipe exceeds 3.5 m. • Vent pipes serving fixtures that discharge to a gully trap must not be connected to a vent pipe connected to a drainage system. • 32 mm discharge pipes with a vertical drop greater than 2 m must be vented by a 32 mm vent to the open air or an air admittance valve. • Vent pipes shall terminate outside the building no less than 900 mm from any opening – see section 3.12.
Main drains discharging to a sewer or on-site disposal system	Must be vented by a minimum 80 mm open vent.
Branch drains connected to a vented drain	Must be vented by a vent to the open air in accordance with Table 4 if the branch exceeds 10 m in length.

Adapted from G13/AS1 Table 5.

3.9 AIR ADMITTANCE VALVES

An alternative to running vent pipes to the outside of the building is to use air admittance valves (AAV) (Figures 40–43). These valves are designed to open automatically to admit air into the wastewater system if flowing water causes a reduction in air pressure within the system. The valve automatically closes to prevent the discharge of foul air whenever the pressure in the system is equal to or greater than the external pressure.

Air admittance valves must:

- be used strictly in accordance with the manufacturer's instructions
- not be used as main or branch drain vents – these must be vented to the open air
- only be used on a stack vent that is not acting as a drain vent
- be a minimum of 100 mm above the weir of any trap they serve (or as recommended by the manufacturer) – the position must be as for wastewater fixture vent pipe connections (see section 3.8) and venting of WC pans (see section 3.10)
- be installed in an accessible ventilated space protected from vandalism, the sun and freezing
- be fitted in an upright position – they may fail if they are not vertical.

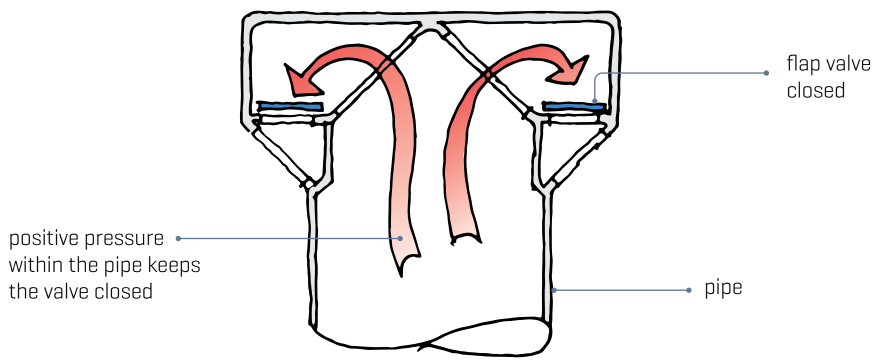


Figure 40. Air admittance valve – closed.

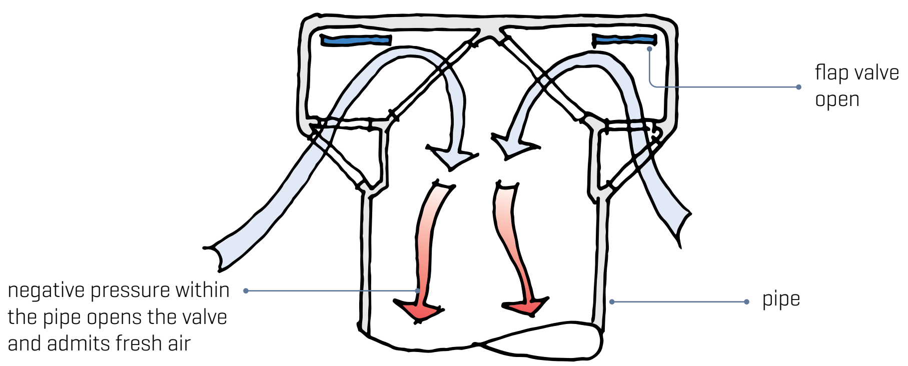


Figure 41. Air admittance valve – open.

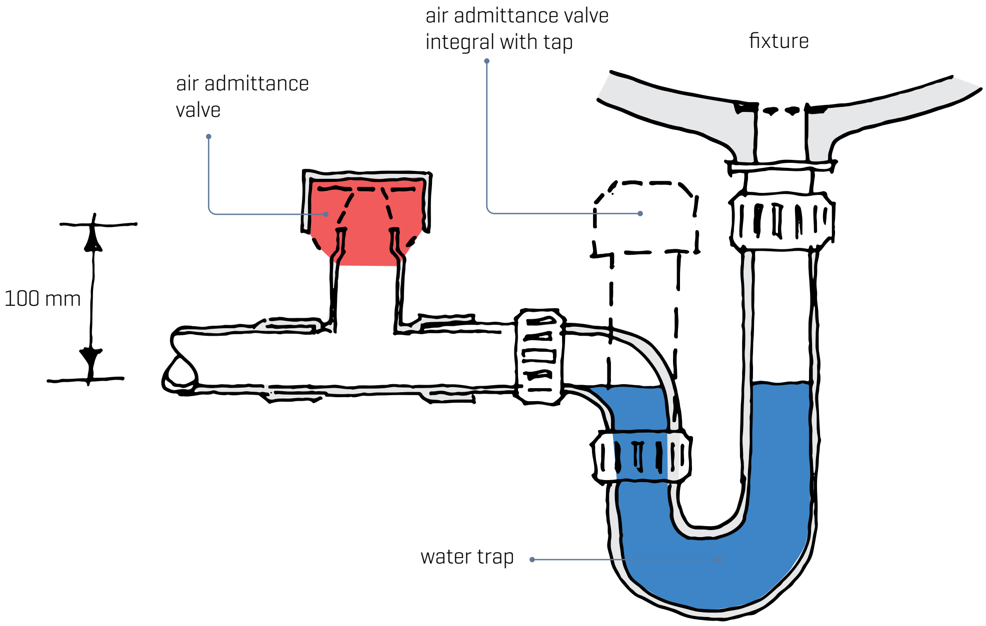


Figure 42. Air admittance valve to discharge pipe.

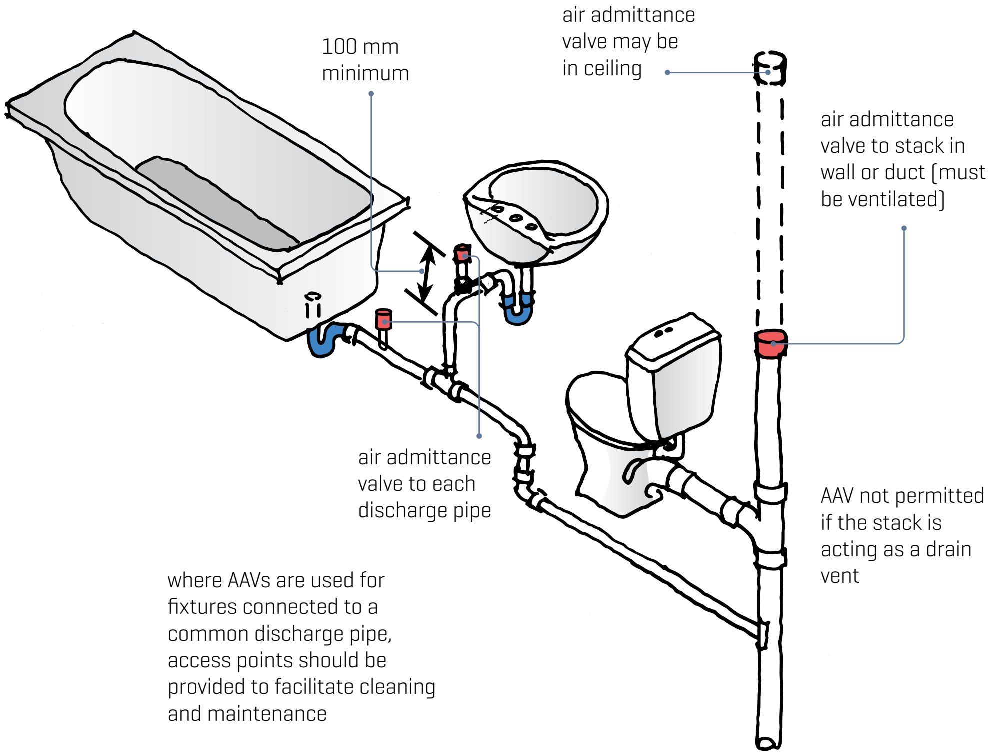


Figure 43. Typical air admittance valve installation.

3.10 VENTING OF WC PANS

Water closet pans require venting as follows:

- May connect directly to a drain or a discharge stack.
- Must be vented if discharging to a stack.
- May be discharged and vented by connection to a drain vent (Figures 44–45) provided the crown of the trap is no further from the drain vent than:
  - 6 m for 100 mm pipe
  - 1.5 m for 80 mm pipe.
- May be connected directly to a drain without venting provided:
  - the discharge pipe gradient is 1:60 or more
  - the main drain gradient is 1:60 or more
  - the length of the discharge pipe from trap to drain (Figure 46) does not exceed:
    - 6 m for 100 mm pipe
    - 1.5 m for 80 mm pipe.
- Must be vented where discharging to a stack (Figures 47–48).

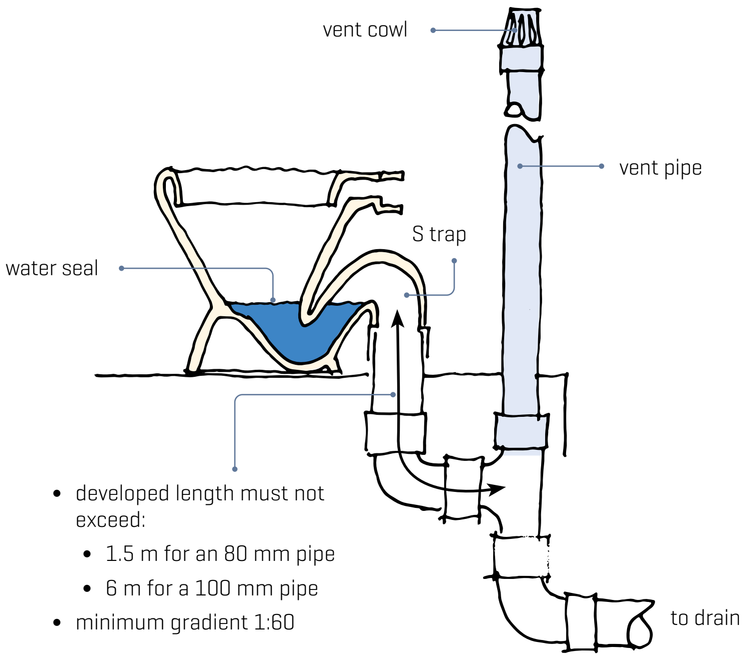


Figure 44. S trap soil fixture connected to drain and using the drain vent as a fixture vent.

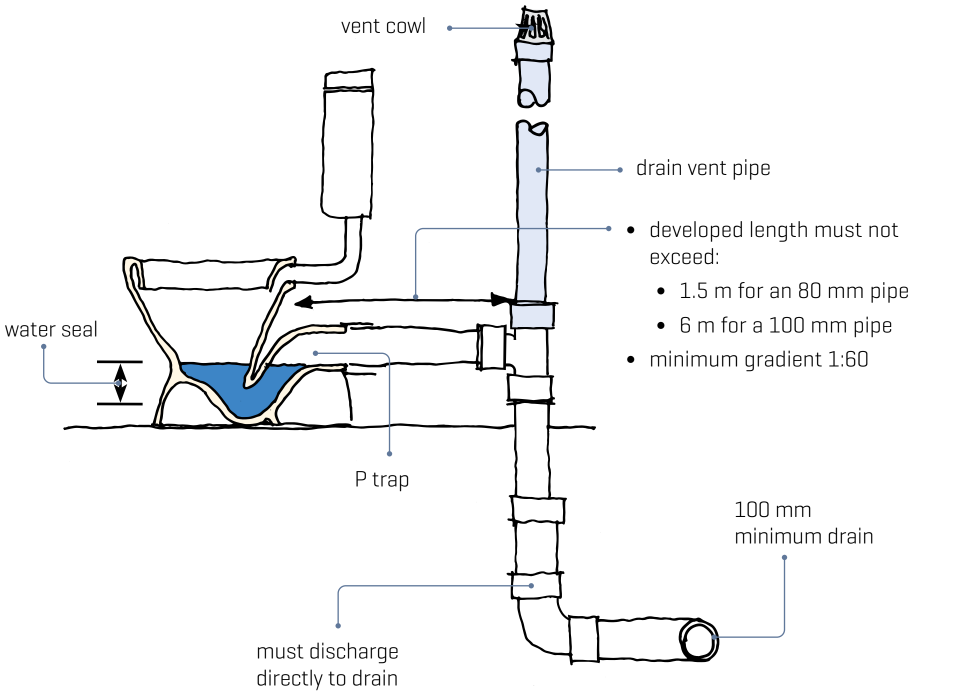


Figure 45. P trap soil fixture connected to a drain and using the drain vent as a fixture vent.

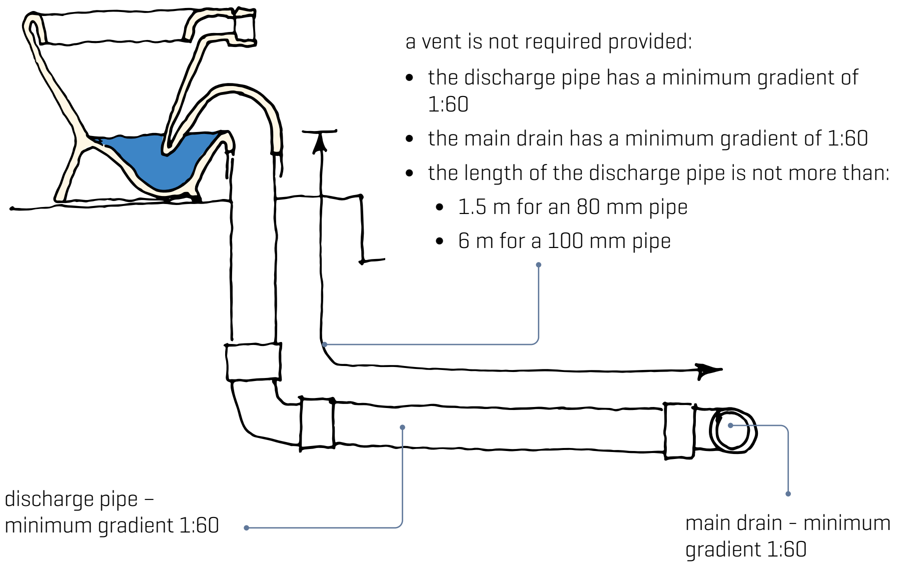


Figure 46. Water closet connected directly to a drain not requiring venting.

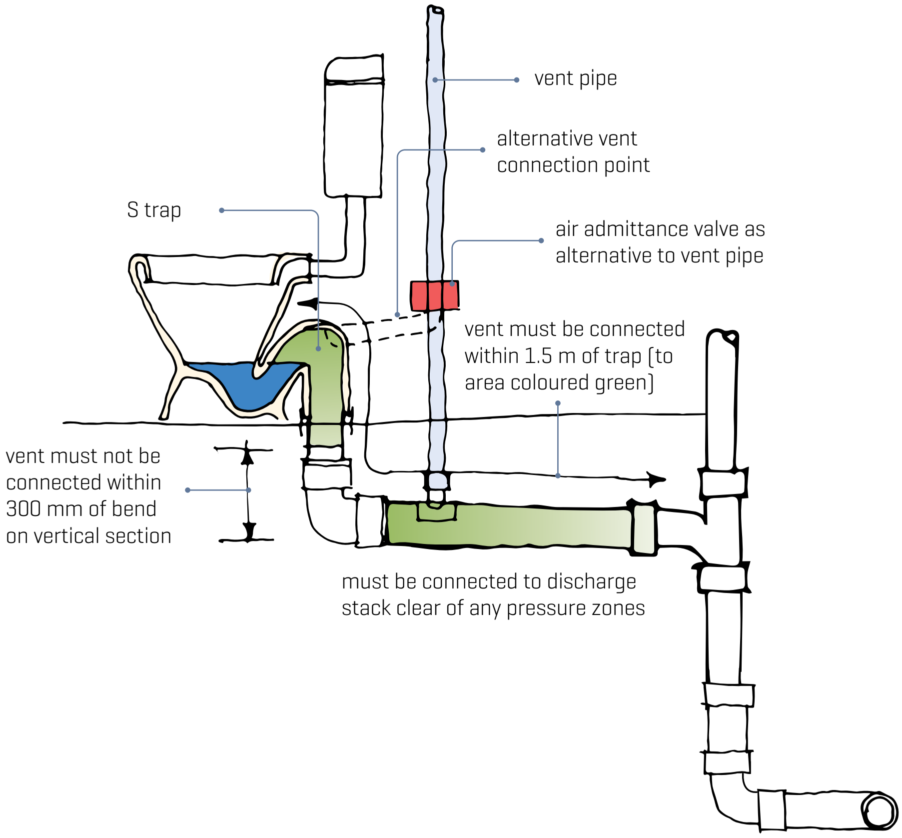


Figure 47. Venting an S trap water closet pan.

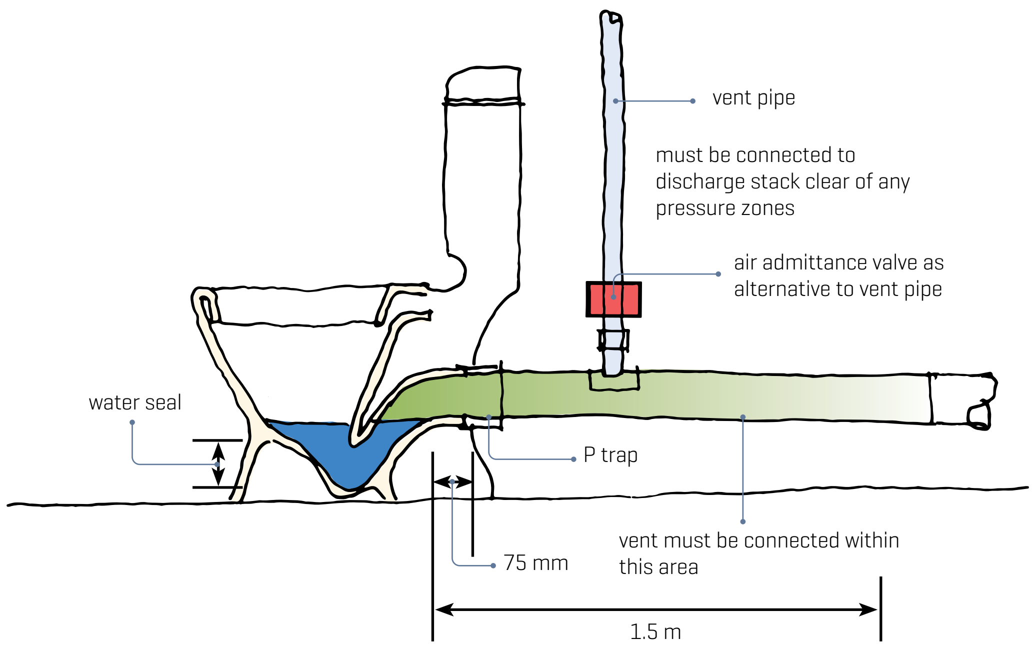


Figure 48. Venting a P trap water closet pan.

3.11 WASTEWATER FIXTURE VENT PIPE CONNECTIONS

Fixture vent pipe connections to a wastepipe discharging to a gully trap must be connected at a point between 75 mm and 3.5 m from the crown of the trap (Figure 49).

A fixture vent pipe connection to a wastepipe serving a hand basin or a bidet and discharging into a discharge stack must be connected:

- at a point between 75 mm and 600 mm from the crown of the trap
- before the first bend in the fixture (Figures 50–51).

A fixture vent pipe connection to a wastepipe serving wastewater fixtures other than a bidet or a hand basin and discharging into a discharge stack must be connected at a point:

- between 75 mm and 1.5 m from the crown of the trap
- not less than 300 mm above bends at the foot of a vertical drop (Figures 52–53).

For vents to WC pans, see section 3.10.

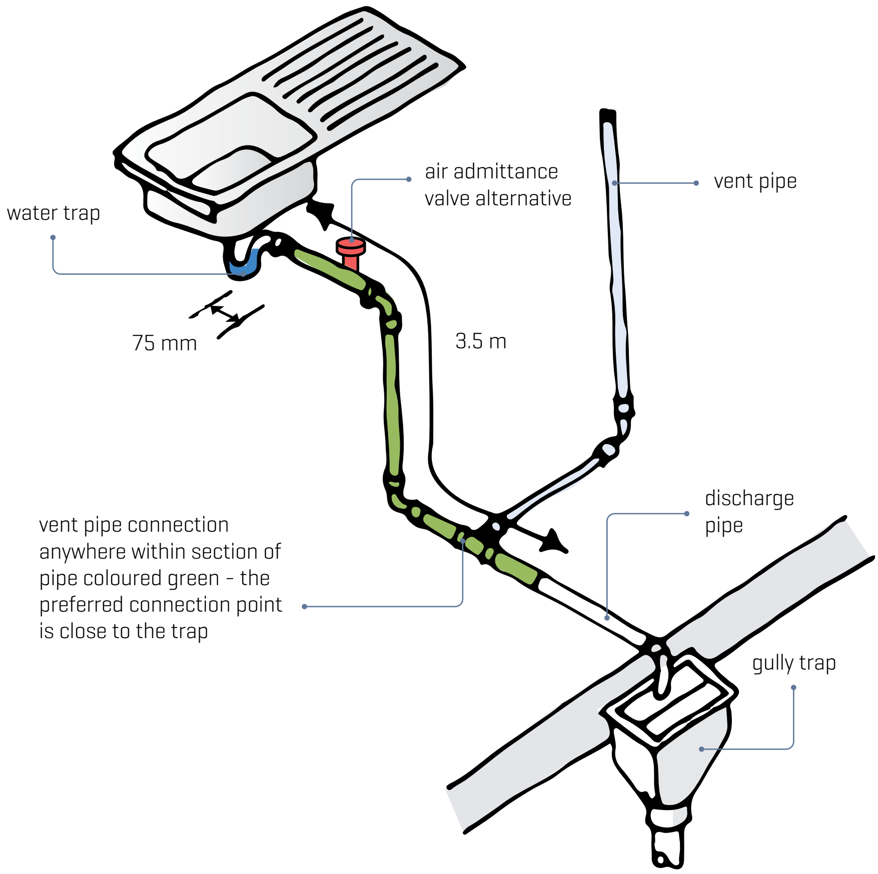


Figure 49. Connection position of vent pipe to wastewater fixture discharge pipe discharging to a gully trap.

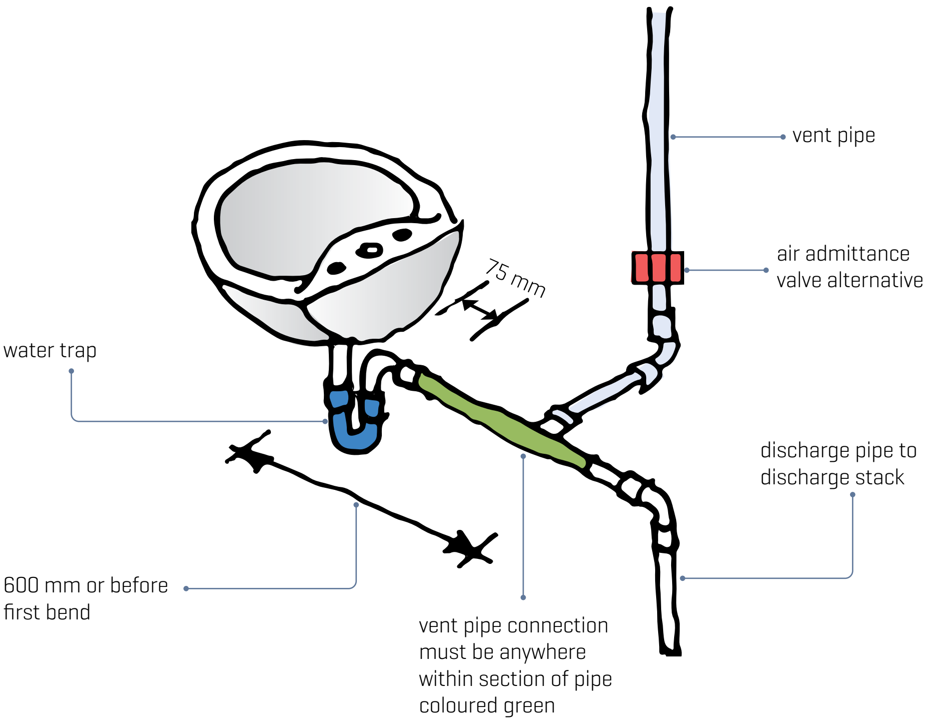


Figure 50. Connection position of vent to basin or bidet discharge pipe discharging into a discharge stack.

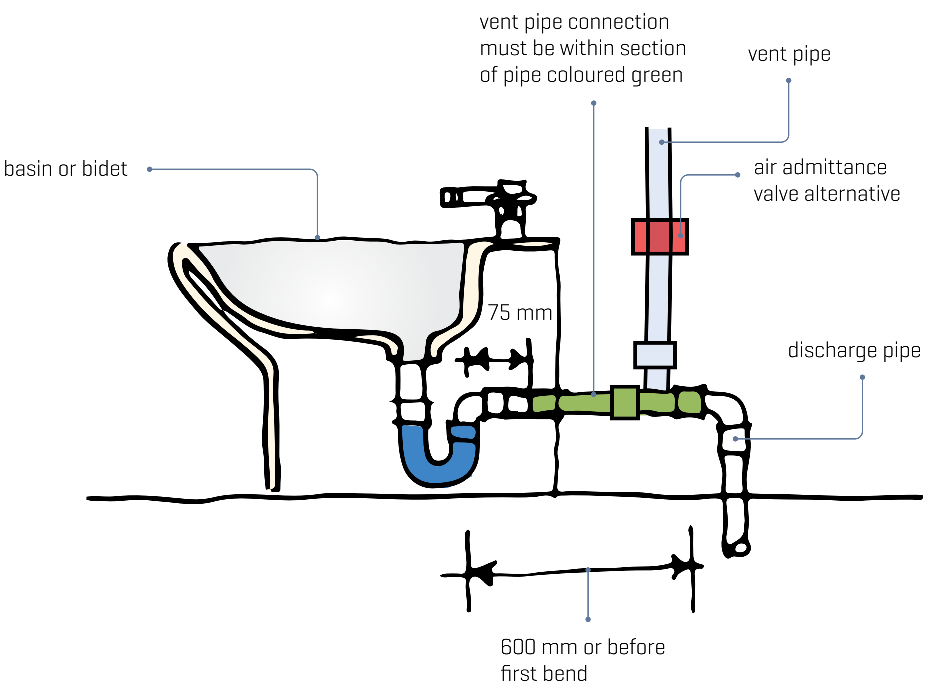


Figure 51. Connection position of vent to basin or bidet discharge pipe discharging into a discharge stack – cross-section.

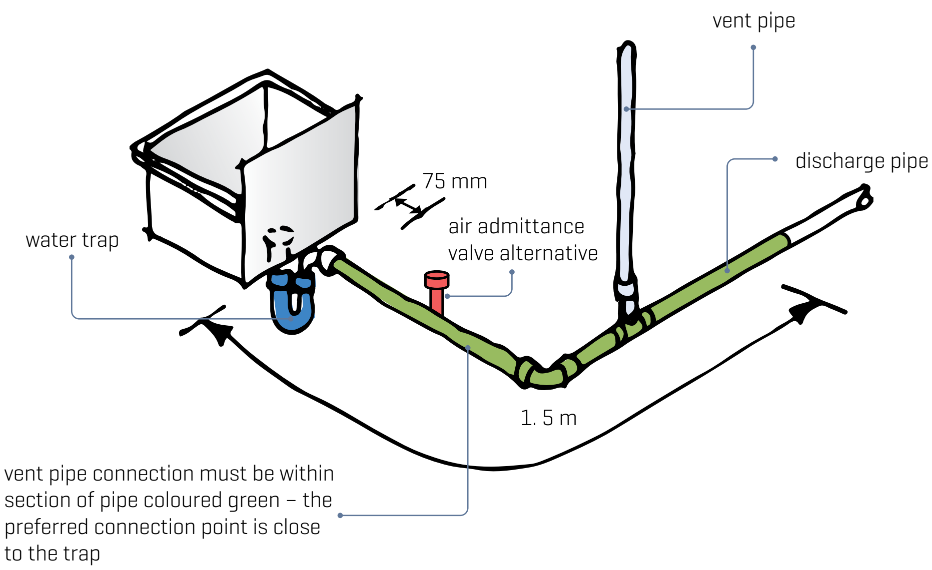


Figure 52. Connection of vent to wastewater fixture discharge pipe, other than from basins or bidets and discharging into a discharge stack.

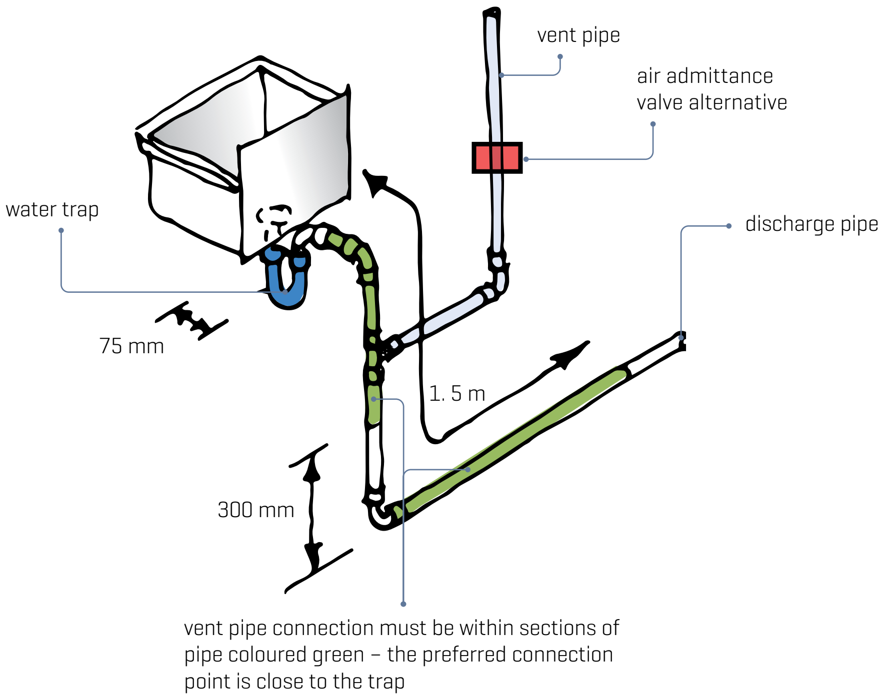


Figure 53. Connection of vent to wastewater fixture discharge pipe, other than from basins or bidets and discharging into a discharge stack.

3.12 TERMINATION OF VENT PIPES

Vent pipes serving discharge pipes that are directly connected to a foulwater drainage system should terminate in a position such that foul air does not enter buildings or cause a nuisance or a health hazard.

This will be achieved if the termination point is more than:

- 3 m above ground level
- 600 mm above eaves or parapet level and 150 mm above a roof (Figure 54)
- 600 mm above the head of an opening including windows, roof lights or doors and 3 m away horizontally (Figure 55)
- 3 m above a deck and 3 m away horizontally (Figure 56)
- 5 m from any air intake (Figure 57)
- 2 m above, 600 mm below and 3 m away horizontally from a flue (Figure 58).

Vent pipes serving discharge pipes from wastewater fixtures that discharge to a gully trap must not:

- terminate within 900 mm of any opening into a building – the risk of foul air building up in these pipes is low
- be connected to any vent pipe that is directly connected to the foulwater drainage system to prevent sewer gases escaping at a gully trap or entering the building.

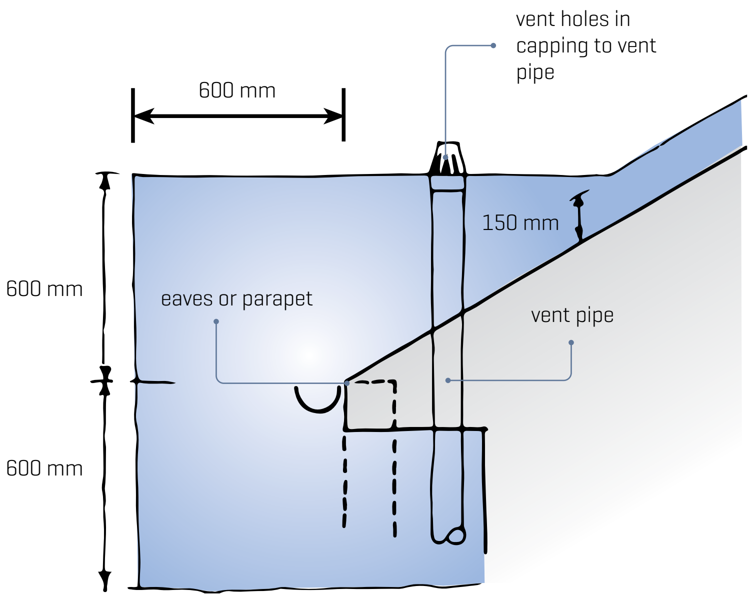


Figure 54. Termination point of vent 600 mm above an eave or parapet and 150 mm above a roof.

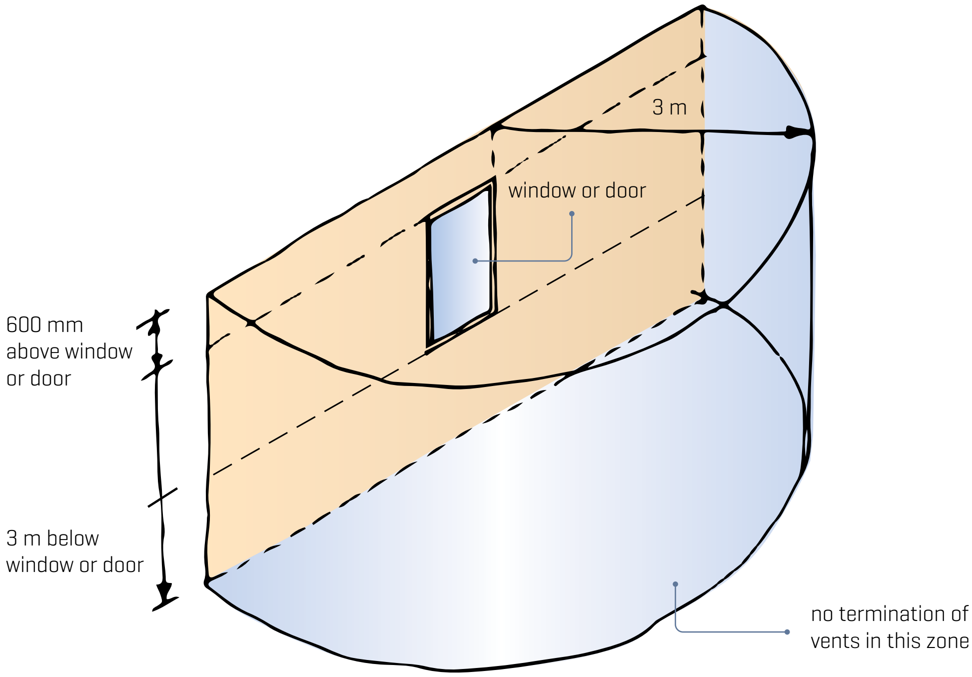


Figure 55. Termination point of vent 600 mm above and 3 m horizontally from a window, door or roof light.

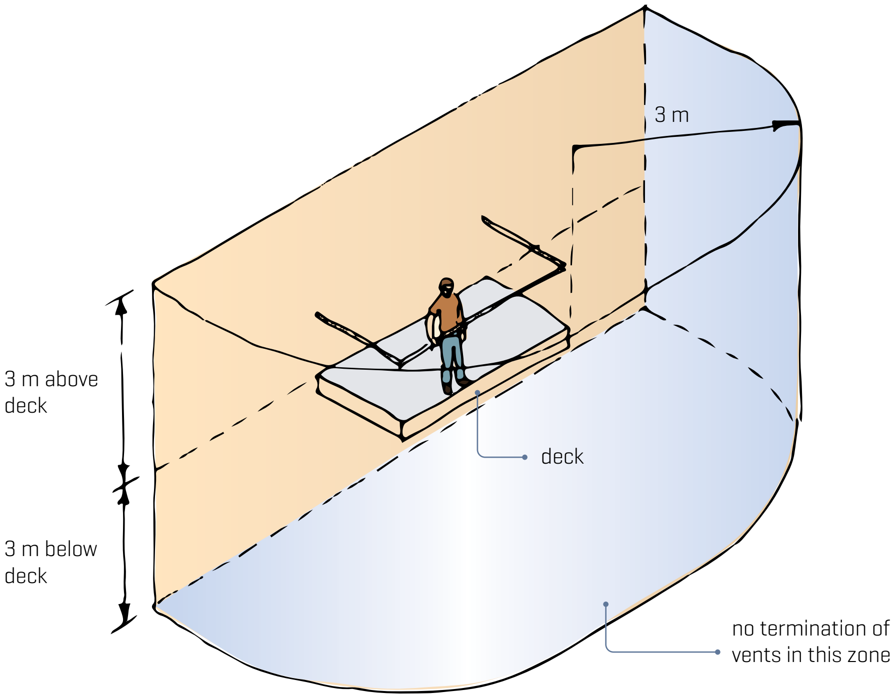


Figure 56. Termination point of vent 3 m above and 3 m horizontally from a deck.

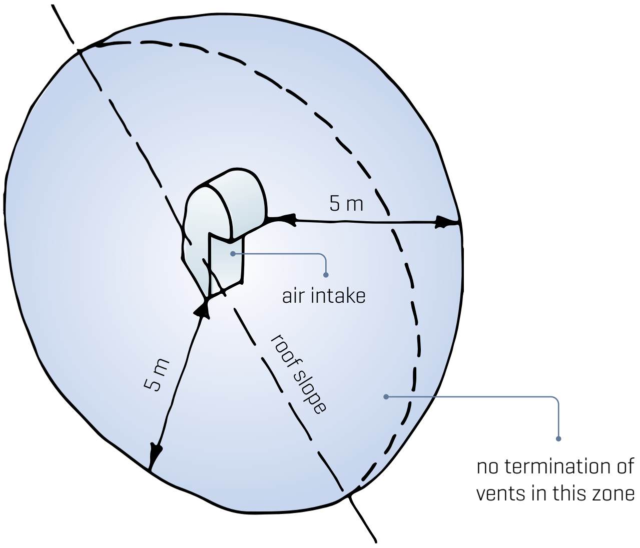


Figure 57. Termination point of vent 5 m from an air intake in any direction.

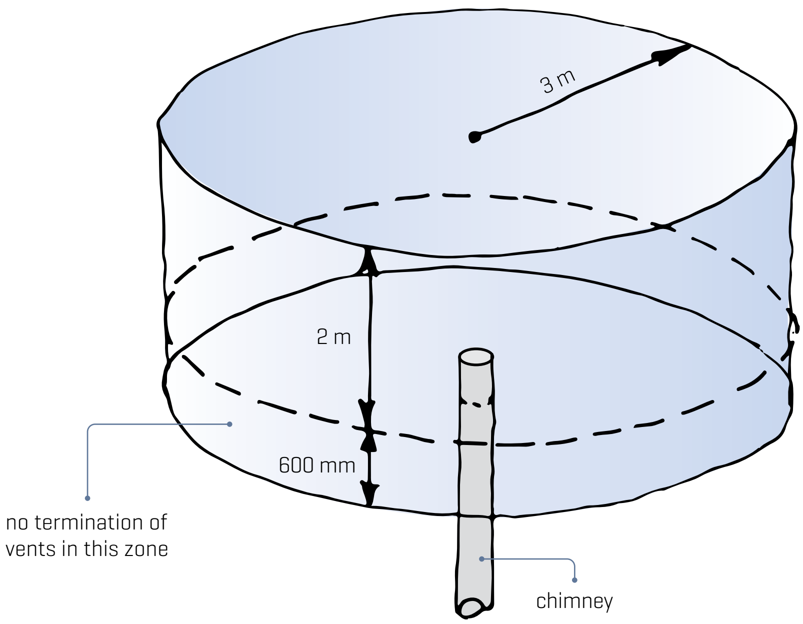


Figure 58. Termination point of vent 2 m above, 600 mm below and 3 m horizontally from a chimney.

3.13 PIPE MATERIALS AND SUPPORT

Acceptable materials for sanitary plumbing and the applicable standards include:

- pipes and fittings
  - copper – NZS 3501:1976 *Specification for copper tubes for water and sanitation*
  - PVC – AS/NZS 1260:2017 *PVC-U pipes and fittings for drain, waste and vent applications*
- traps
  - copper – AS 1589-2001 *Copper and copper alloy waste fittings*
  - plastic – AS 2887-1993 (R2017) *Plastic waste fittings.*

Sanitary plumbing pipework must allow for thermal expansion to prevent damage to pipes and fixtures.

Pipe supports must not exceed the spacing shown in Figures 59–63.

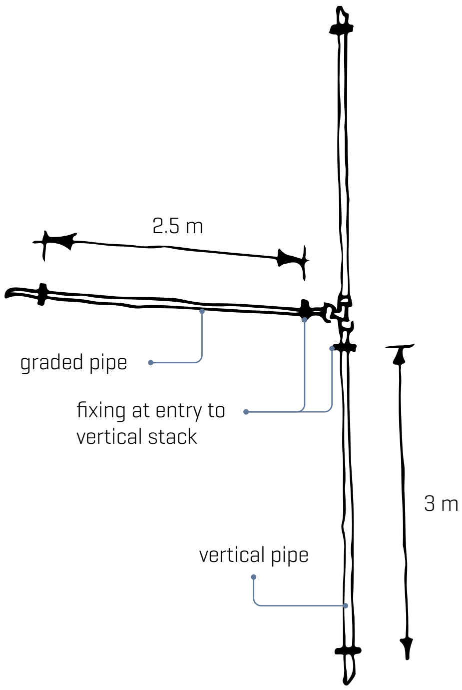


Figure 59. Supports for copper pipe 32–50 mm diameter.

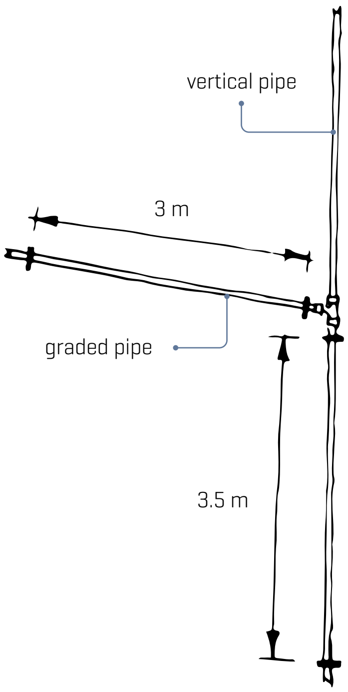


Figure 60. Supports for copper pipe greater than 50 mm diameter.

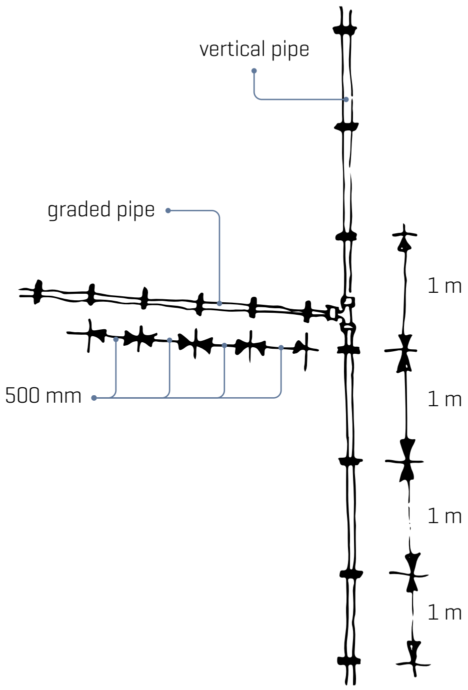


Figure 61. Supports for PVC pipe 32–50 mm diameter.

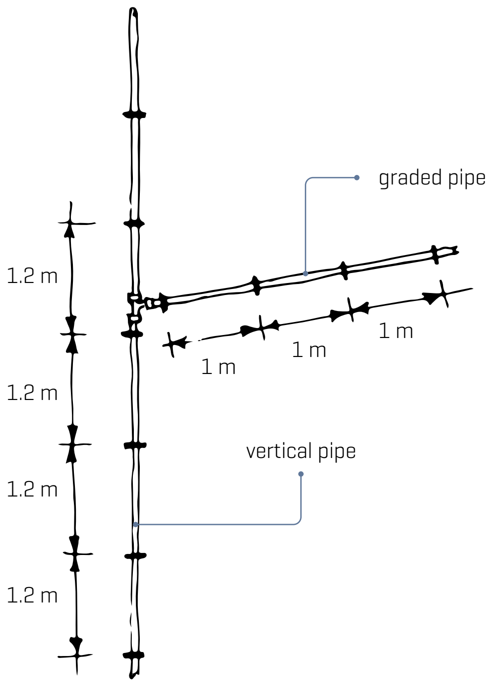


Figure 62. Supports for PVC pipe 65–100 mm diameter.

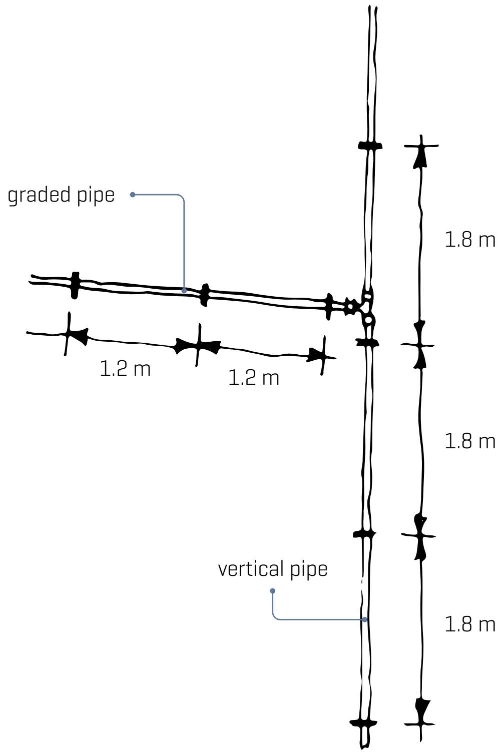


Figure 63. Supports for PVC pipe greater than 100 mm diameter.

3.14 FLOOR WASTES

Floor waste outlets complying with G13/AS1 can be specified to drain away accidental water spillage. A trapped floor waste outlet connected to the drainage system:

- must have a minimum diameter of 40 mm, including trap
- must be trapped and charged (G13/AS1 3.4.6) to maintain the water seal and discharge to the foulwater plumbing system – floor wastes may discharge to a gully trap
- must not be connected directly to the foulwater drainage system – the water trap may be lost through evaporation
- may be connected into an open-vented floor waste stack
- must have a grating flush with the floor so it will not be a hazard (Figure 64).

Untrapped floors wastes installed to discharge an accidental water spillage must:

- discharge to open air or within the property boundary
- discharge to a safe location
- be fitted with a means to prevent the entry of birds and vermin
- when discharging over a gully trap, terminate 50 mm above the gully trap.

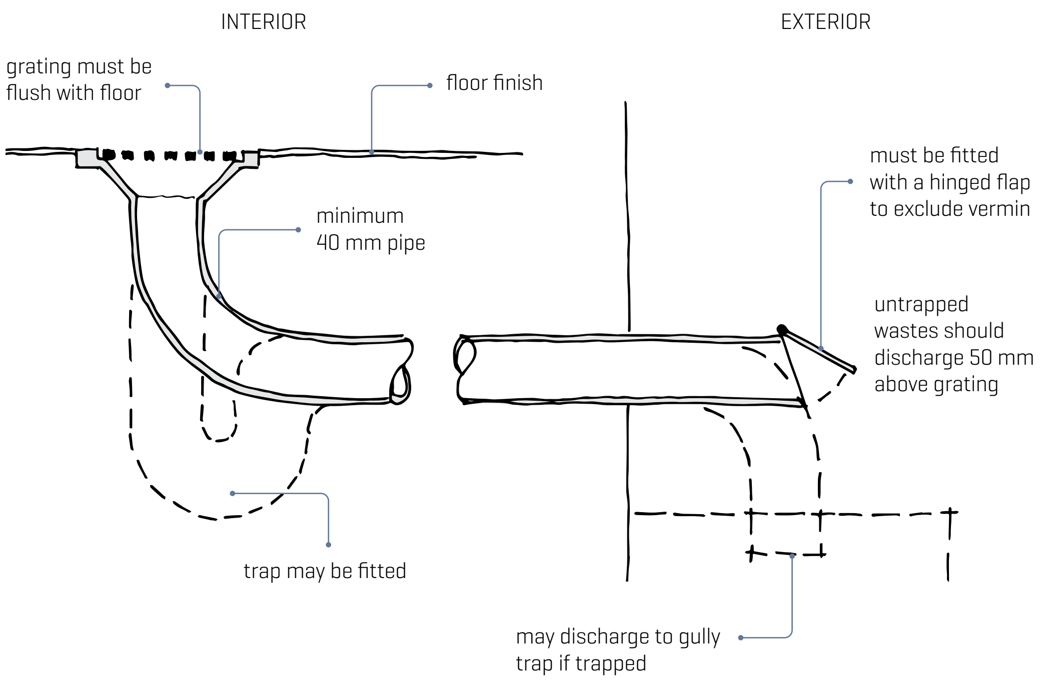


Figure 64. Untrapped floor waste.

4

GUIDE TO AS/NZS 3500.2 SANITARY PLUMBING AND DRAINAGE

Interpreting the standard

The interpretations set out in this guide are not intended as a substitute for the original document, to which reference should always be made. The purpose of this guide is to illustrate graphically wherever possible the general principles of AS/NZS 3500.2 *Plumbing and drainage – Part 2: Sanitary plumbing and drainage* with some common examples.

AS/NZS 3500.2 sets out the minimum practical requirements for a wide variety of design situations, and for this reason, it covers several plumbing systems available, options and variations to those options.

In order to simplify the explanations of the systems in AS/NZS 3500.2, this guide covers the most common situations and:

- does not include specialised equipment such as that used in hospitals
- limits pipe sizes in most cases to 100 mm diameter
- does not cover detailed pipework installation.

Readers who require information on these can follow the general principles set out in this guide and then refer to the standard for further details.

4.1 GENERAL REQUIREMENTS

Some general requirements are common to all sanitary plumbing systems.

4.1.1 Fixture discharge units

The diameter and gradient of a drain, a discharge pipe or a stack is based on the total fixture unit rating that each carries. Fixtures are given a rating derived from their expected discharge (Table 6).

Table 6. Fixture unit ratings.

Sanitary fixture or appliance	Minimum size of trap outlet and discharge pipe (DN)	Fixture unit rating
Basin	32	1
Bidet	32	1
Drinking fountain	25	1
Cleaning sink	40	1
Urinal (wall-hung)	32	1
Urinal (stall type or each 600 mm length)	80–100	1 (per 600 mm section)
Shower (single)	40	2
Shower (multiple per head)	40	2 (per head)
Sinks (single or double + disposal unit)	40	3
Dishwasher (domestic)	40	3
Bath (with or without overhead shower)	40	4
Shub (combined shower and bath tub)	40	4
WC pan (cistern flush)	80–100	4
Clothes washing machine (domestic)	40	5
Laundry tub/trough (single or double)	40–50	5
WC pan (flushing valve)	80–100	6
Bathroom fixtures in one compartment including hand basin, bath, shower, WC	80–100	6
Floor waste gully (without fixture connections)	50–80	0
Floor waste gully (with fixture connections)	See Figure 69	Sum of all fixture units connected

Notes:

- For any fixture with a discharge in excess of 500 litres, refer to AS/NZS 3500.2:2021 Table 6.3B.
- For specialist and healthcare fixture unit ratings, refer to AS/NZS 3500.2:2021 Table 6.3A.

Adapted from AS/NZS 3500.2:2021 Table 6.3A.

4.1.2 Discharge pipe sizes and gradients

A single discharge pipe is sized from Table 6.

A combined discharge pipe that receives the discharge from two or more fixtures must have a minimum diameter calculated as follows:

- From Table 6, add the total number of fixture units that the pipe will carry.
- From Table 7, select the pipe size and gradient.

Table 7. Maximum allowable discharge units related to pipe size and gradient in graded discharge pipes.

Minimum gradient of pipe		Discharge pipe diameter (DN)				
%	Ratio	40	50	65	80	100
5.0	1:20	6	15	51	65	376
3.35	1:30	5	10	29	39	248
2.5	1:40	4	8	21	27	182
2.0	1:50	Combinations of gradients and pipe sizes not permitted			20	142
1.65	1:60				16	115

Notes:

- For larger pipe sizes and lower gradients, refer to AS/NZS 3500.2:2021 Table 8.2.2(A).
- It is recommended that a discharge pipe from a WC with a 4.5 litre flushing cistern has a minimum gradient of 2.5% not 1.65%.

4.1.3 Water traps

All points at which discharge from sanitary fixtures passes into a plumbing system must incorporate a water trap with a water seal depth of not less than 75 mm ±10 mm for a wastewater fixture and 50 mm ±5 mm for a soil fixture to prevent foul air from entering the building.

Water traps must be located as close as possible to the sanitary fixture that they serve (refer to AS/NZS 3500.2:2021 clause 6.5.3.)

Easy-clean type traps are acceptable and are used mainly in showers, urinals and trapped floor wastes (Figure 65).

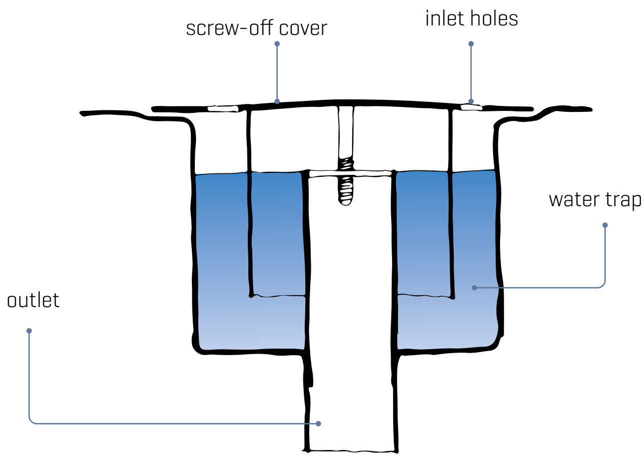


Figure 65. Easy-clean type trap.

4.1.4 Water traps serving more than one outlet

In addition to trapping a single fixture, provided they have similar spill levels and the distance between outlets is not more than 1.2 m, fixtures that may be connected to a single fixture trap are:

- two basins (Figure 66)
- two sinks
- two showers
- two laundry tubs (Figure 67)
- two ablution troughs.

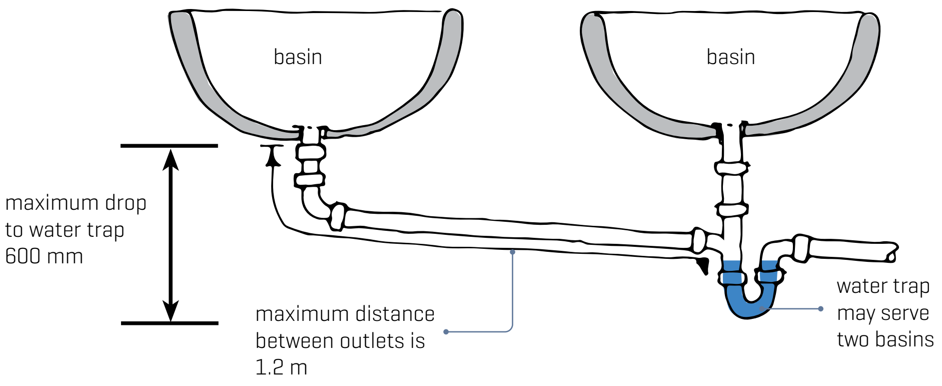


Figure 66. Water trap serving two basins.

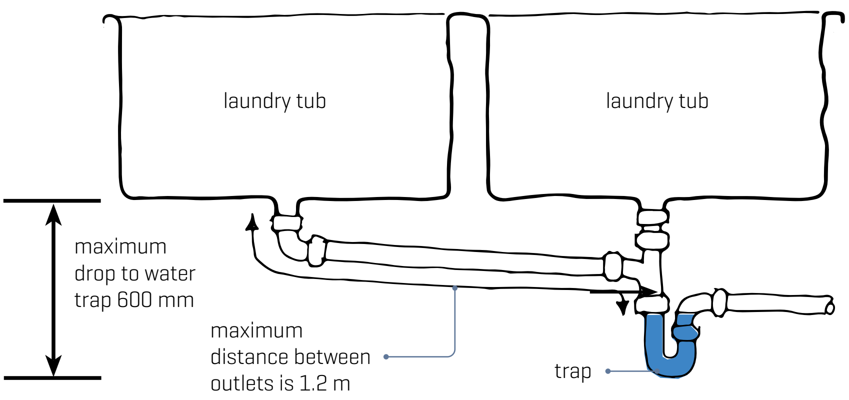


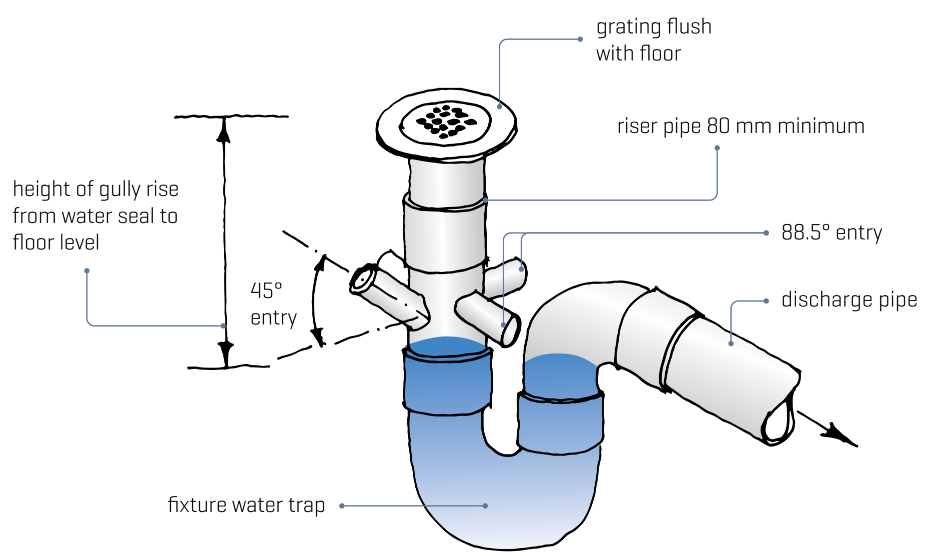
Figure 67. Water trap serving two water tubs.

4.1.5 Floor waste gully traps

Floor waste gullies are used to drain wet areas such as bathrooms but may also receive the discharge from basins, showers, baths, laundry tubs, washing machines and bar sinks (Figure 68). See AS/NZS 3500.2:2021 Table 4.6.7.2 for all permitted discharges to floor waste gullies.

A floor waste gully trap:

- must only receive discharge from fixtures, except for minor discharges such as a tundish waste in the same room
- must not receive the discharge from a vented fixture
- may be used as a shower outlet
- must not receive discharges that are likely to foam – the foam may bubble up through the trap
- must not receive discharge from soil fixtures or kitchen sinks (Figure 69).



Height of floor waste gully riser		
Riser size	Minimum height	
	88.5° entry	45° entry
DN 80	200 mm	150 mm
DN 100	150 mm	100 mm

Adapted from Table 4.6.7.7 of AS/NZS 3500.2:2021

Floor waste gully outlet size	
Maximum fixture units	Size of outlet
3	DN 50
10 (1 bath maximum)	DN 65
More than 10	DN 80

Adapted from Table 4.6.7.9 of AS/NZS 3500.2:2021

Figure 68. Floor waste gully.

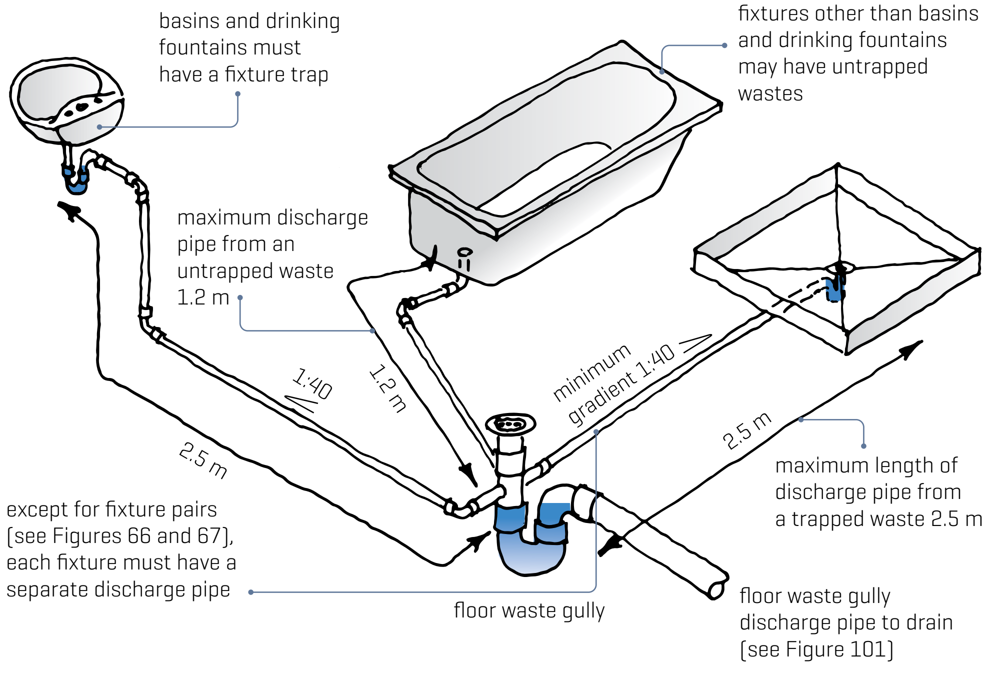


Figure 69. Connections to a floor waste gully.

4.1.6 Junctions in discharge pipes

Junctions in discharge pipes must conform to the following:

- Junctions between discharge pipes must be at 45° (Figure 70).
- The soffits of different sized pipes must be level at the junction (Figure 71).
- Where a pipe changes in size along its length, the soffits of the different sections must be level (Figure 72).
- The level of the trap weir must be 10 mm higher than the soffit of the pipe to which it connects (Figure 73).
- Junctions in a 100 mm pipe connecting to another 100 mm pipe on grade must be at an angle of 45° and inclined 15° above the horizontal (Figure 74).
- Junctions opposite one another on a branch must not overlap (Figure 75).

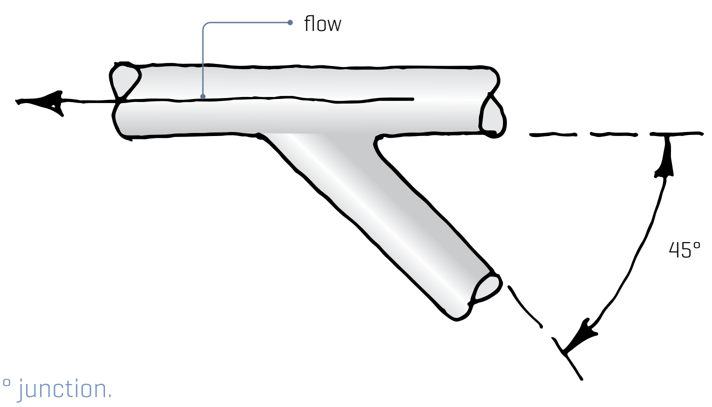


Figure 70. 45° junction.

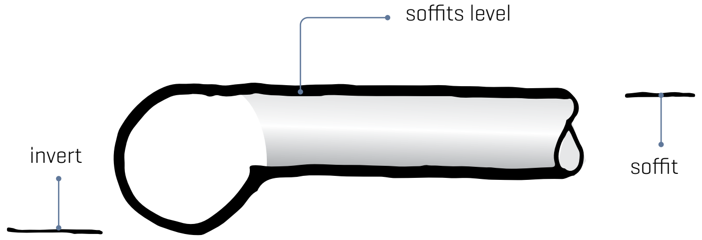


Figure 71. Junction must have level soffits.

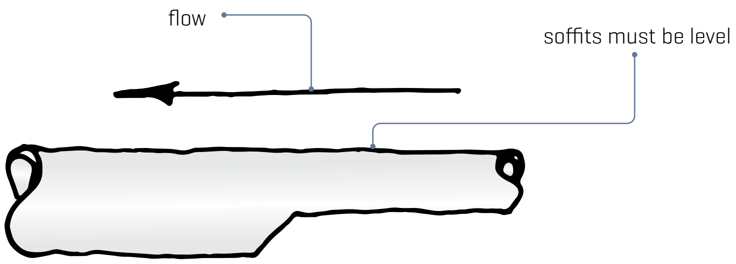


Figure 72. Level soffits in changing pipe sizes.

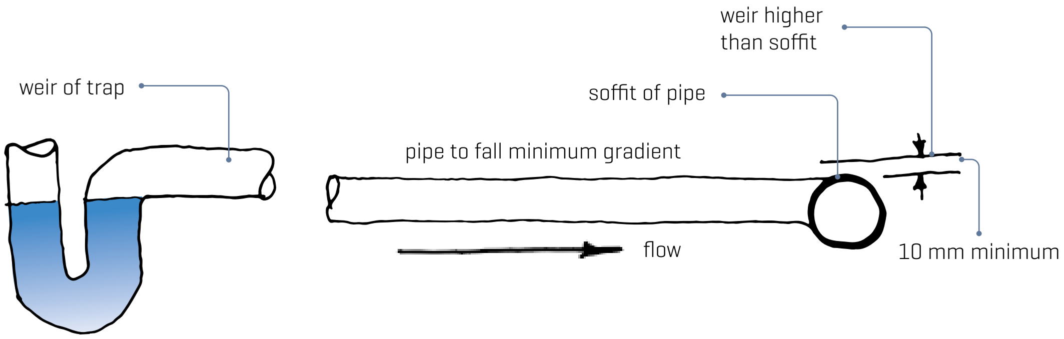


Figure 73. The weir of the trap must be higher than the soffit of the pipe to which it is connected.

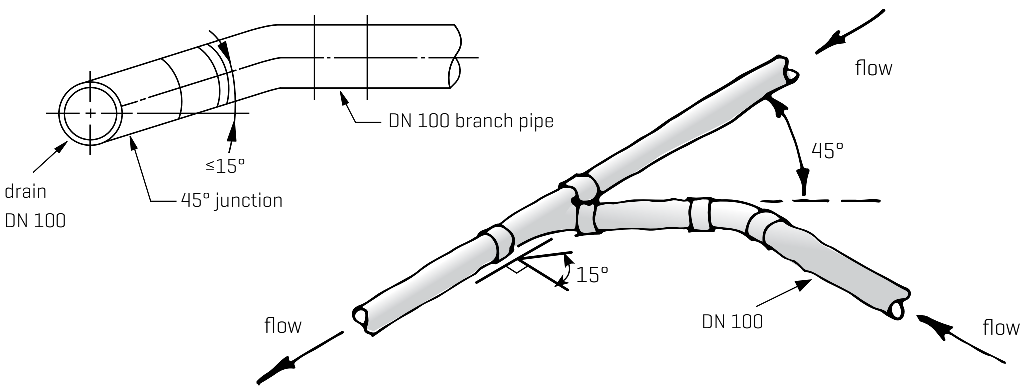


Figure 74. 100 mm branch pipe to 100 mm pipe on grade.

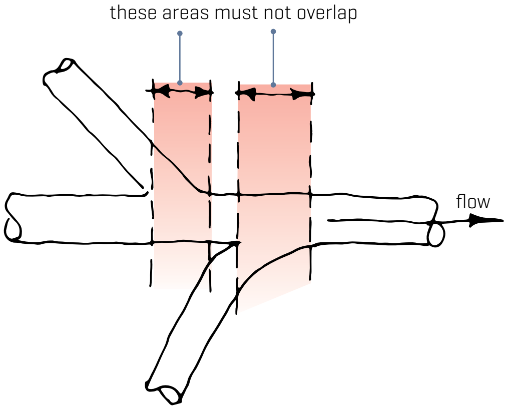


Figure 75. Junctions must not overlap.

4.1.7 Connections to stacks

Junctions between discharge pipes and stack pipes may be:

- 45° junctions
- swept junctions
- entry at grade with a throat radius (all branch pipes 80 mm and over entering at grade must have a throat radius)
- entry at grade without a throat radius (for branch pipes smaller than 80 mm).

Note: Where a discharge pipe less than 500 mm long enters a stack at grade:

- fixtures may have S traps only if there is a dropper in the discharge pipe
- fixtures may have P traps only if the gradient of the discharge pipe is not less than 6.65%.

Limitations are placed on the positions at which connections can be made to a stack. To prevent the flow from one pipe entering another directly opposite, two connections entering a stack at the same level must be formed with swept entries or be a double Y junction (Figure 76).

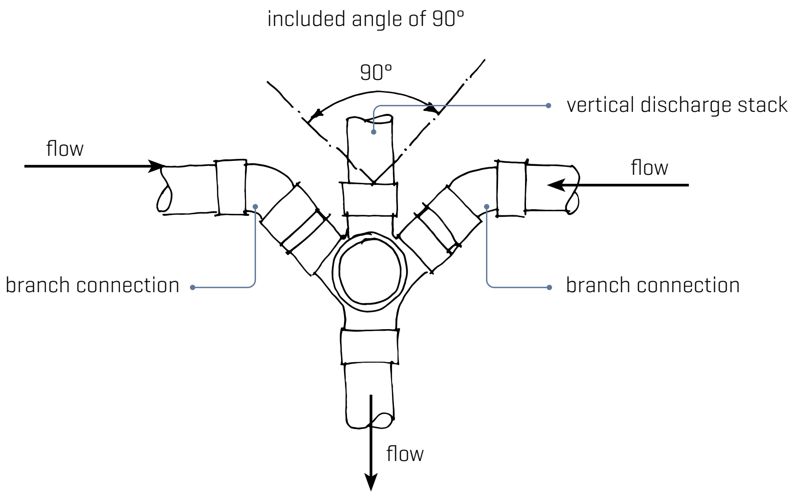


Figure 76. Acceptable opposite connections at the same level.

There is a restricted area for connections below and on the opposite side of the stack from another connection. Connections must not be made in the restricted area, as shown in Figures 77–78 and Table 8 (except with a 45° entry as shown in Figure 79).

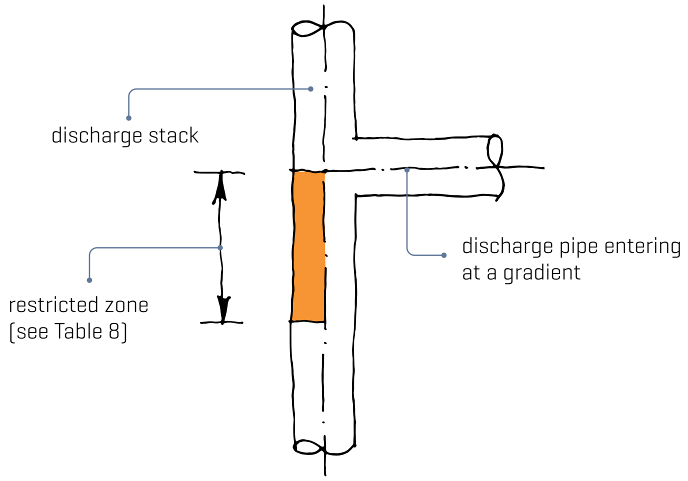


Figure 77. Restricted zone for connections – discharge pipe entering at a gradient.

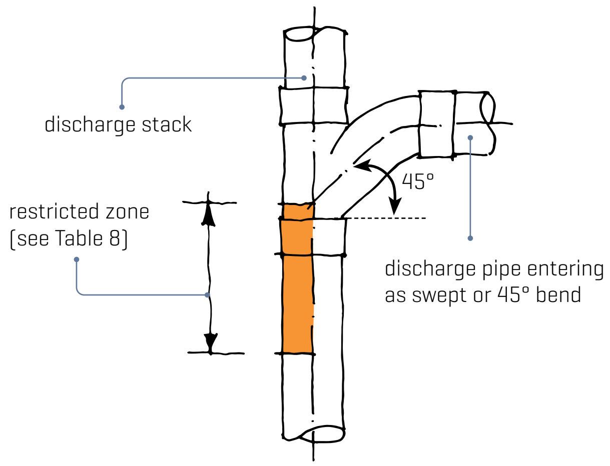


Figure 78. Restricted zone for connections – discharge pipe entering as swept or 45° bend.

Table 8. Restricted entry zone dimensions.

Discharge pipe size (DN)	Stack size (DN)	Depth of restricted zone (mm)
40, 50, 65	40, 50, 65, 80	90
40, 50, 65	100	110
40, 50, 65	125	210
40, 50, 65	150	250
80 or greater	80 or greater	200

Adapted from AS/NZS 3500.2:2021 Table 6.7.3.2.

Branch connections opposite and below another connection must be made:

- by a 45° entry (Figure 79)
- at 90° to the other connection on the centreline of the stack (Figure 80)
- by a dropped entry connection (Figure 81).

Connections near the base of a stack are restricted in order to avoid junctions in positive pressure zones and:

- in stacks of two levels or fewer, connections must not be made in the area shown in Figure 82
- in stacks of three levels or more, connections must not be made in the area shown in Figure 83.

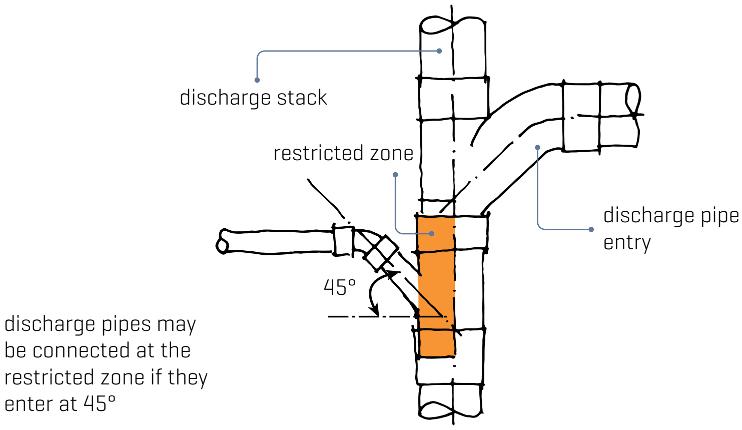


Figure 79. Type of connection allowed in restricted zone – 45° entry.

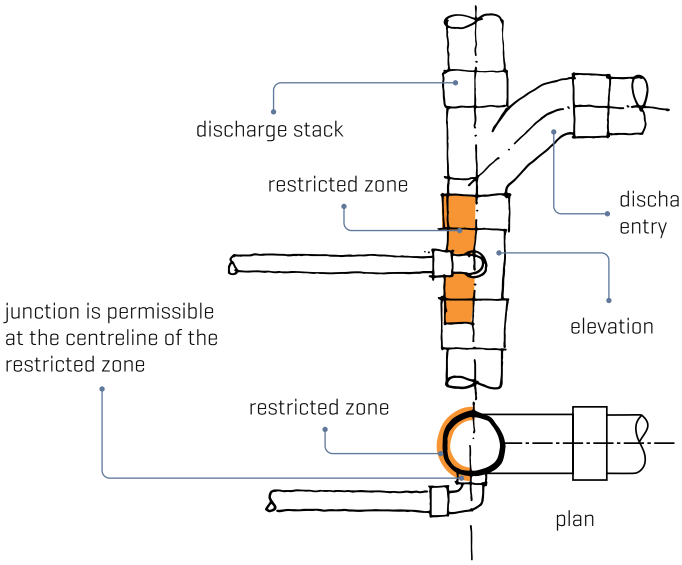


Figure 80. Type of connection allowed in restricted zone – 90° entry on centreline.

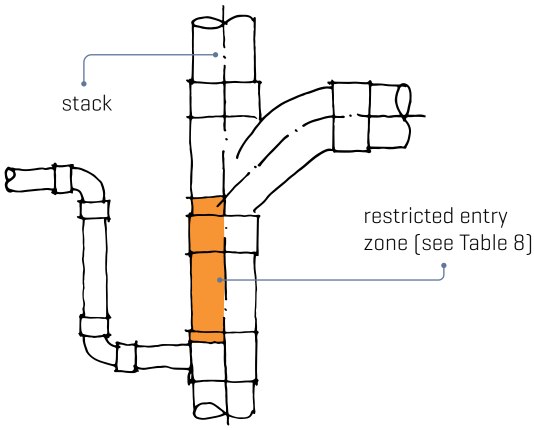


Figure 81. Dropped entry connection.

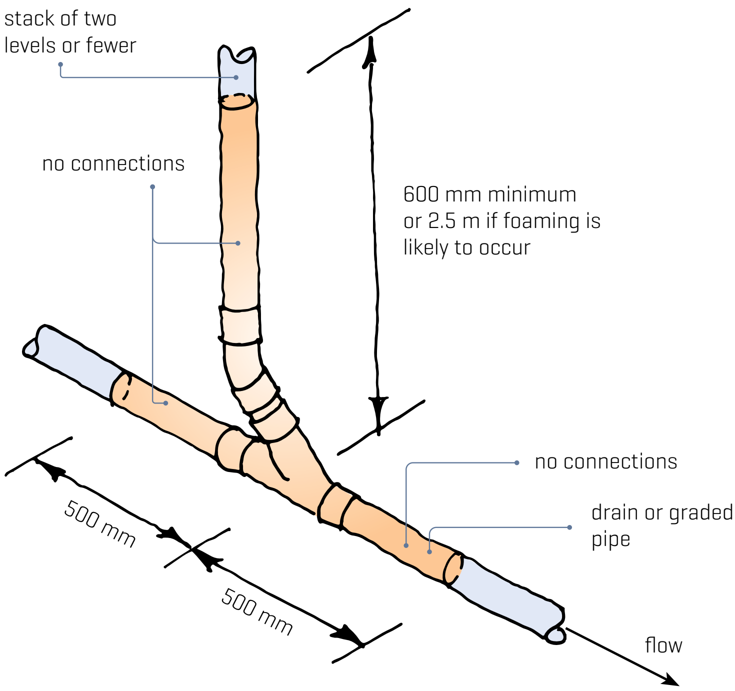


Figure 82. Restrictions on connections in pressure areas at the base of a stack of two levels or fewer.

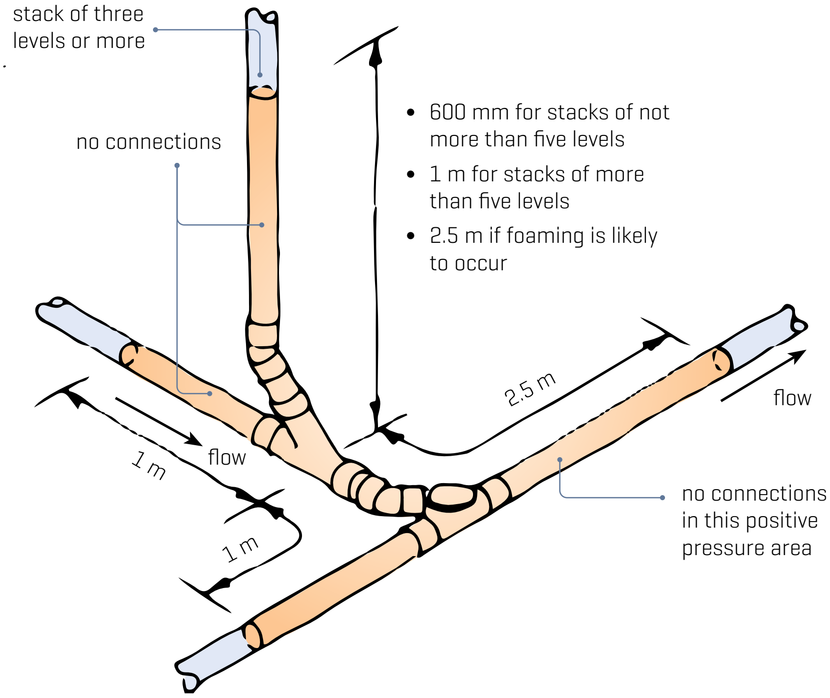


Figure 83. Restrictions on connections in pressure areas at the base of a stack of three levels or more.

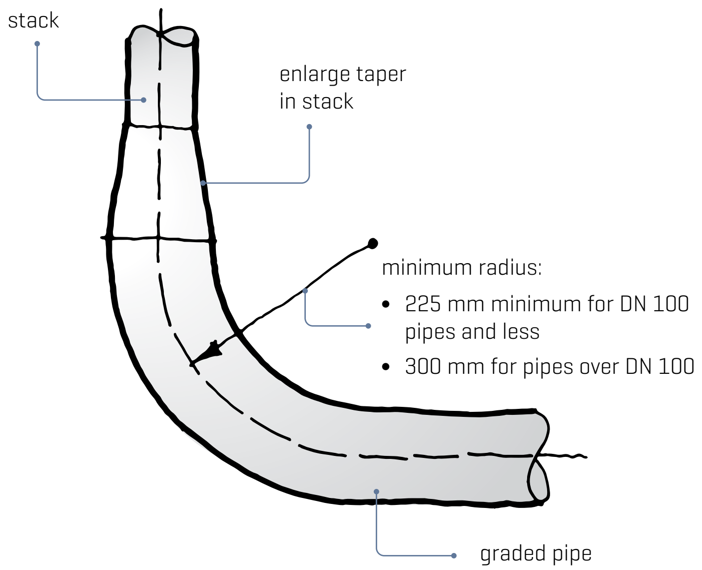


Figure 84. Bend at the base of a stack graded pipe larger than the stack.

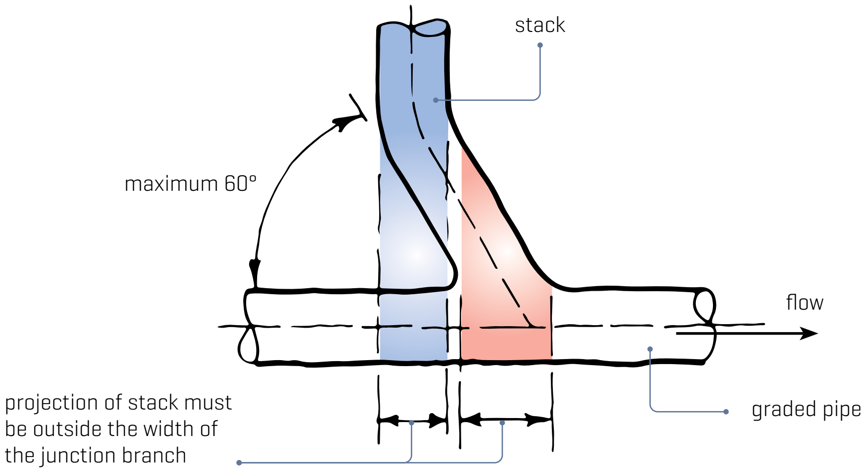


Figure 85. Junction of stack with graded pipe or drain.

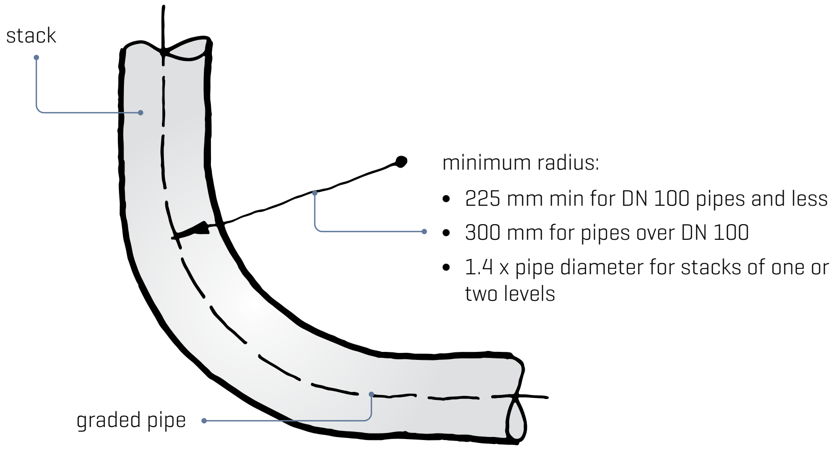


Figure 86. Bend at the base of a stack – large radius bend.

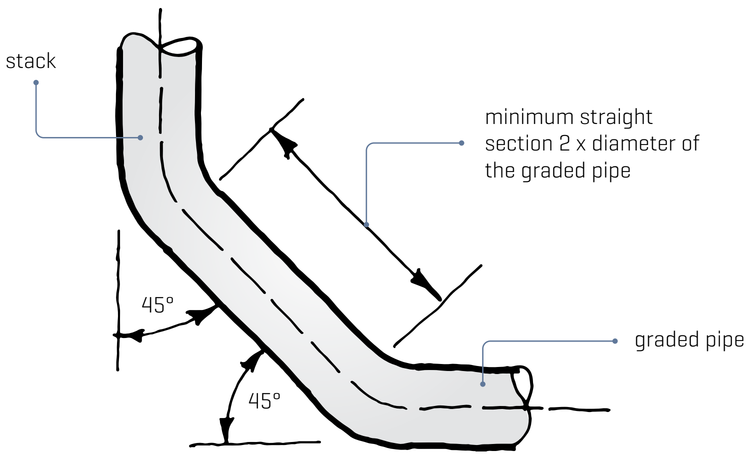


Figure 87. Bend at the base of a stack – two 45° bends.

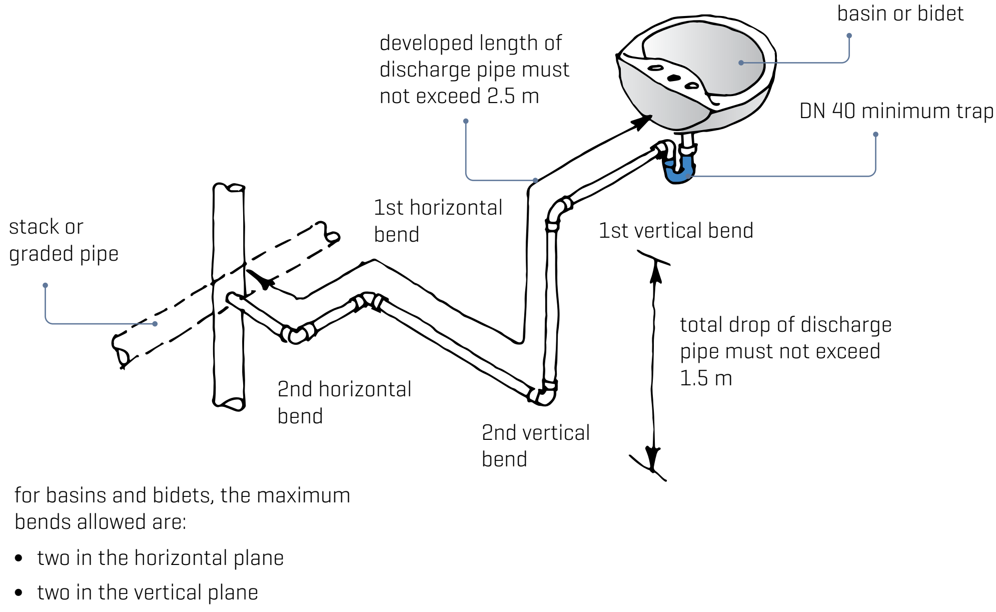


Figure 88. Connection of basins and bidets to a group-vented branch pipe or single stack.

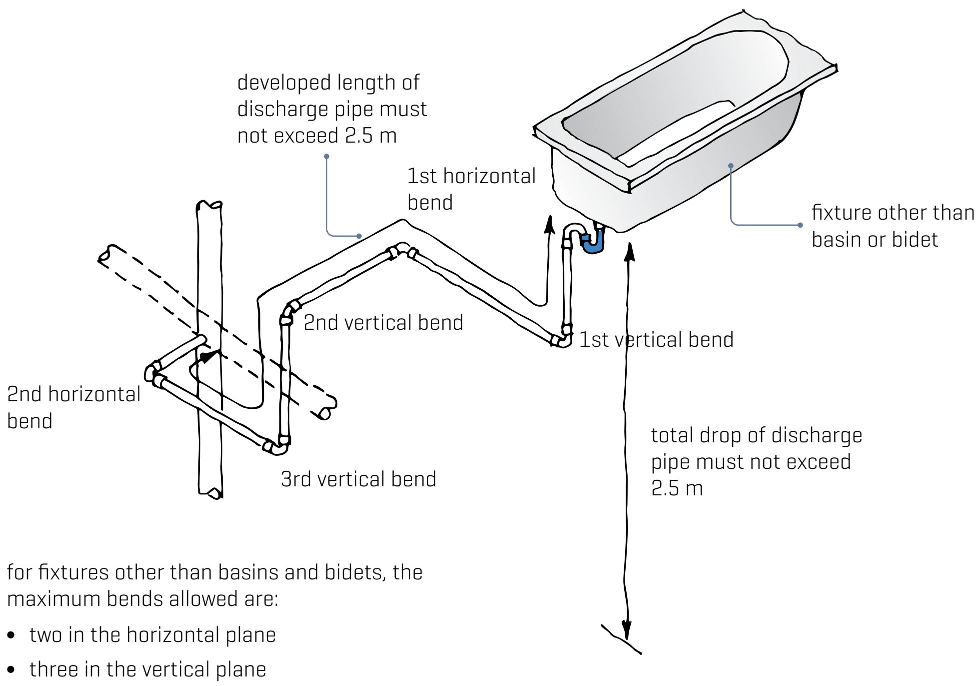


Figure 89. Connection of fixtures other than basins and bidets to a group-vented branch pipe or a single stack.

Connection of stacks to drains or graded pipes above ground (see AS/NZS 3500.2:2021 clause 6.8.3) must have:

- an enlarged taper fitting where necessary (Figure 84)
- a junction with a horizontal graded pipe complying with Figure 85
- either a radius bend complying with Figure 86 or two 45° bends complying with Figure 87.

Note that a bend refers to a 90° change in direction – the use of 45° fittings does not imply a bend. For junctions in drains below ground, see section 6.2.

4.1.8 Connection of fixtures

Fixture discharge pipes from basins and bidets must be connected to a stack, a branch pipe or an unvented branch drain (Figure 88). Fixture discharge pipes from all fixtures other than basins and bidets must be connected to a stack or a branch pipe (Figure 89).

4.1.9 Vent pipes

Vent pipes must:

- ascend at a minimum gradient of 1:80 (1.25%) so that any condensation will drain away
- only be interconnected with other vents above the flood level of the highest fixture served as per AS/NZS 3500.2:2021 clause 6.9.3.

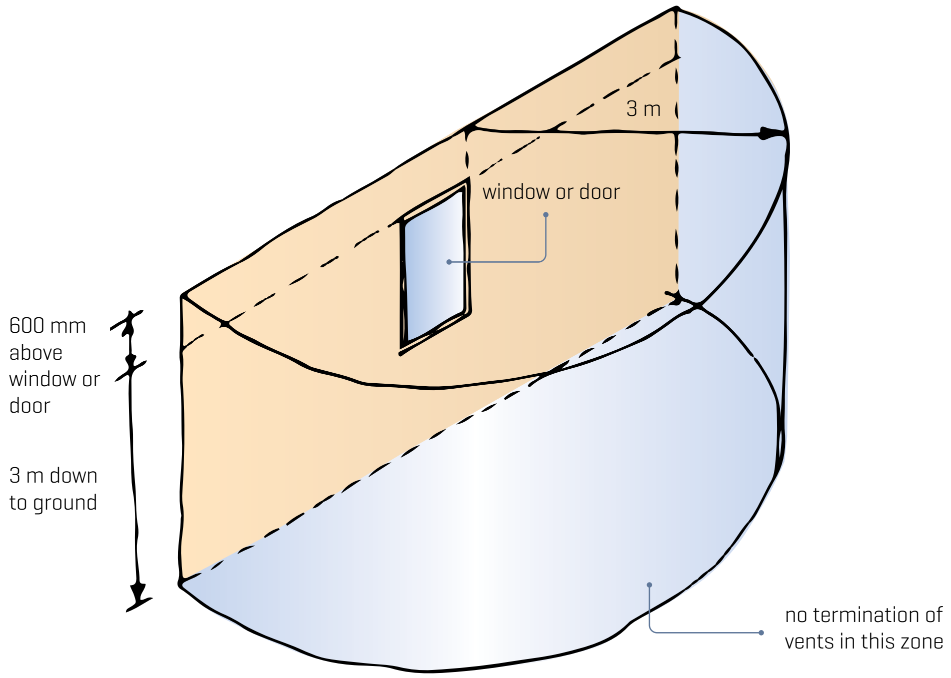


Figure 90. Termination point of vent 600 mm above and 3 m horizontally from a window, door or roof light.

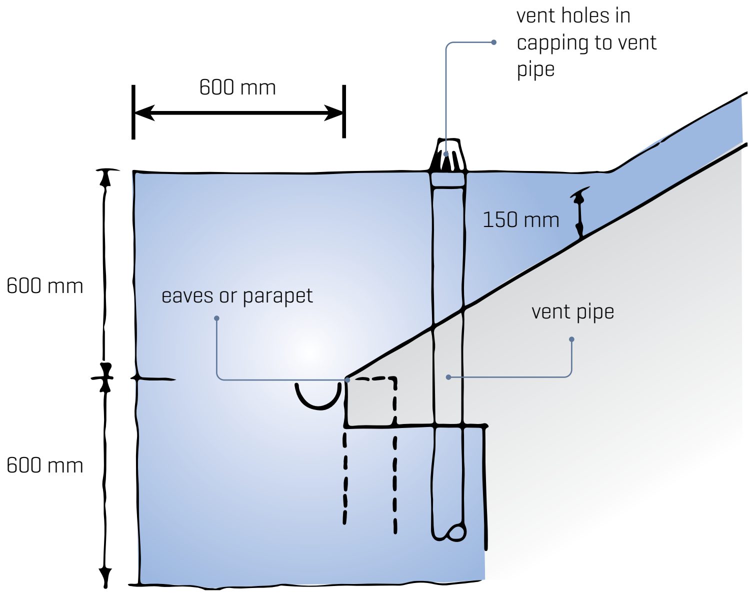


Figure 91. Termination point of vent 600 mm above an eave or parapet, 150 mm above roof.

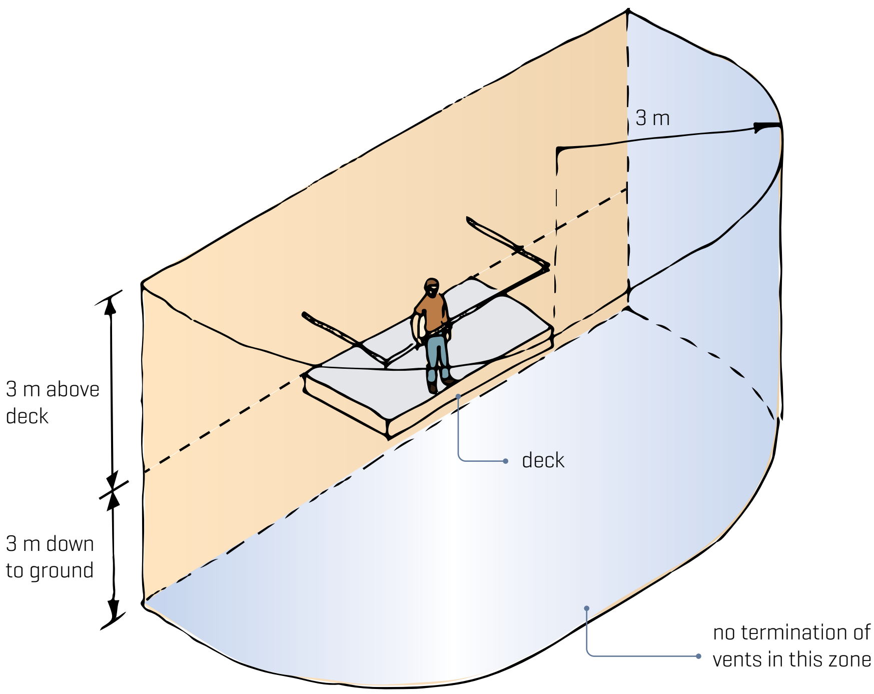


Figure 92. Termination point of vent 3 m above and 3 m horizontally from a deck.

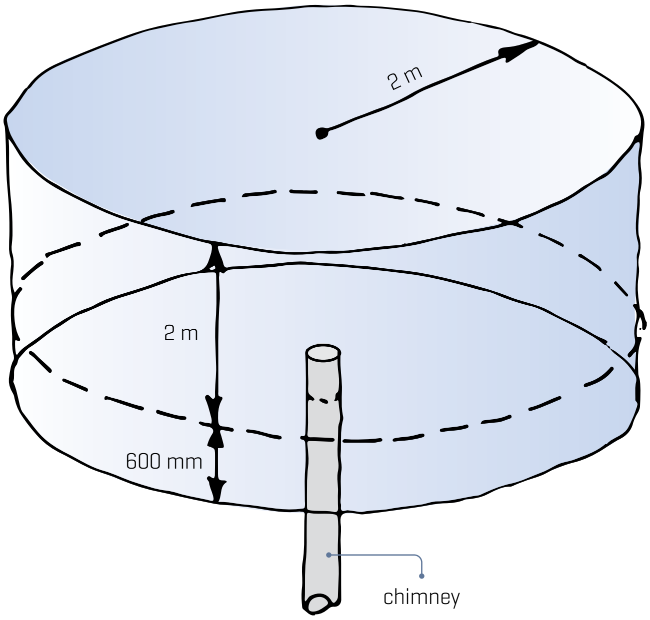


Figure 93. Termination point of vent 2 m above, 600 mm below and 2 m horizontally from a chimney or flue.

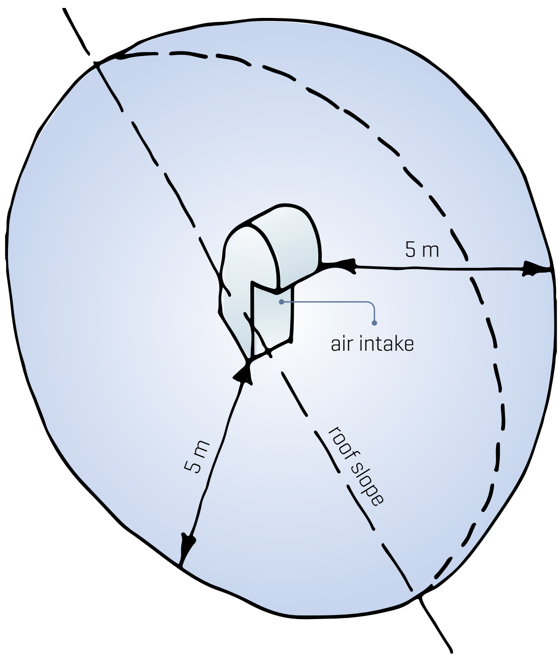


Figure 94. Termination point of vent 5 m from an air intake in any direction.

Termination of vent pipes should be in a position such that foul air does not enter buildings or cause a nuisance or a health hazard. This will be achieved if the termination point is more than:

- 600 mm above the head of an opening, including windows, roof lights or doors and 3 m away horizontally (Figure 90)
- 150 mm above the roof and 600 mm above the eaves or 600 mm above eaves or parapet level (Figure 91)
- 3 m above a deck and 3 m away horizontally (Figure 92)
- 2 m above, 600 mm below and 2 m away horizontally from a chimney or flue (Figure 93)
- 5 m from any air intake (Figure 94).

4.1.10 Air admittance valves

An alternative to running vent pipes to the outside of the building is to use an air admittance valve (AAV). These valves are designed to open automatically to admit fresh air into the sanitary plumbing system if there is a reduction in air pressure within the system. The valve automatically closes to prevent the discharge of foul air whenever the pressure in the system is equal to or greater than the external pressure (Figures 95–96).

Air admittance valves must:

- be used strictly in accordance with the manufacturer's instructions
- comply with the requirements of AS/NZS 4936:2002 *Air admittance valves (AAVs) for use in sanitary plumbing and drainage systems*
- have a minimum airflow capacity complying with AS/NZS 3500.2:2021 Tables 6.10.2(A) and 6.10.2(B)
- only be used on systems that have at least one open upstream vent off the main drain – each building must have at least one high-level open vent
- have a minimum of 100 mm vertical rise and the connection position must be as for trap vent pipe connections (see section 4.9.3) – note that, in some instances, this requirement may be at odds with the design of proprietary fittings
- be installed in an accessible ventilated space and protected from vandalism, sunlight and freezing
- be fitted in an upright position – they may fail if they are not vertical (Figures 97–98).

4.2 GROUND FLOOR PLUMBING

Unvented branch drains are included in this section because they form an integral part of the system.

Ground floor fixtures are connected to the drain via traps and discharge pipes.

Fixtures must have individual discharge pipes with the exception of:

- fixture pairs – see section 4.1.4
- floor waste gullies, which can receive the discharge from several fixtures and discharge it through a single discharge pipe – see section 4.1.5.

Minimum single fixture discharge pipe requirements are shown in Table 9.

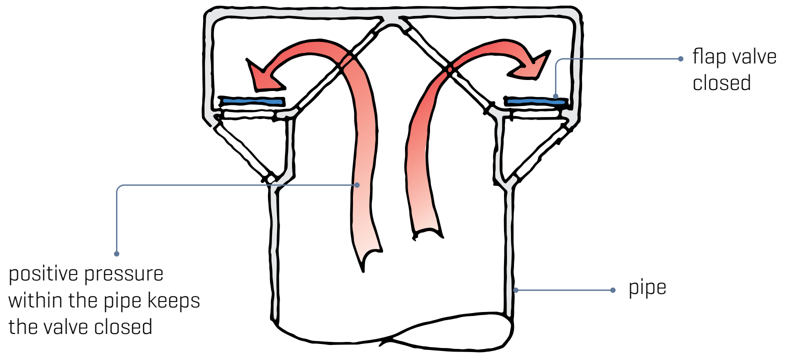


Figure 95. Air admittance valve – closed.

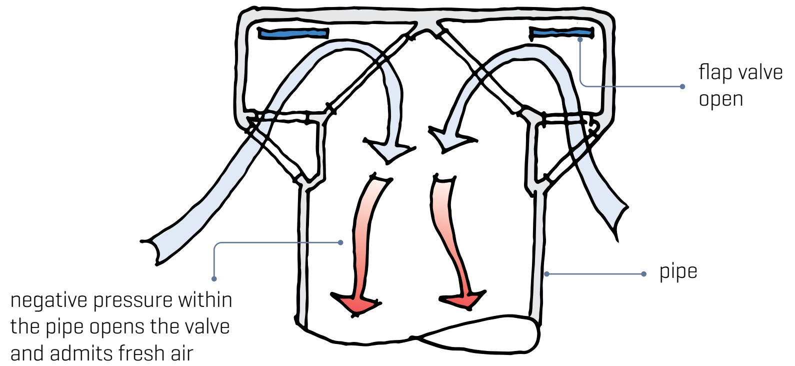


Figure 96. Air admittance valve – open.

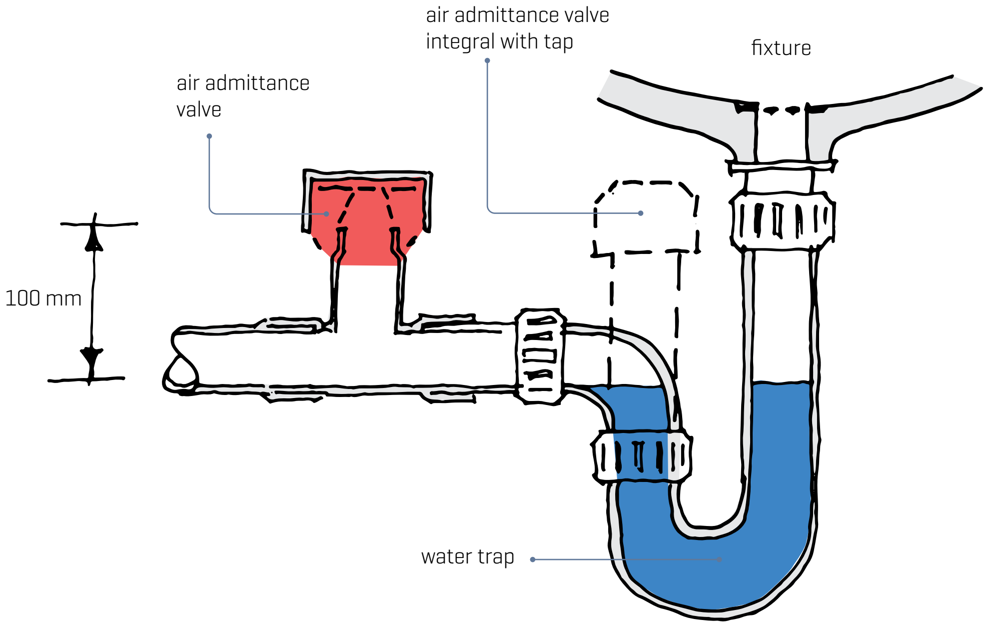


Figure 97. Air admittance valve fitted to discharge pipe.

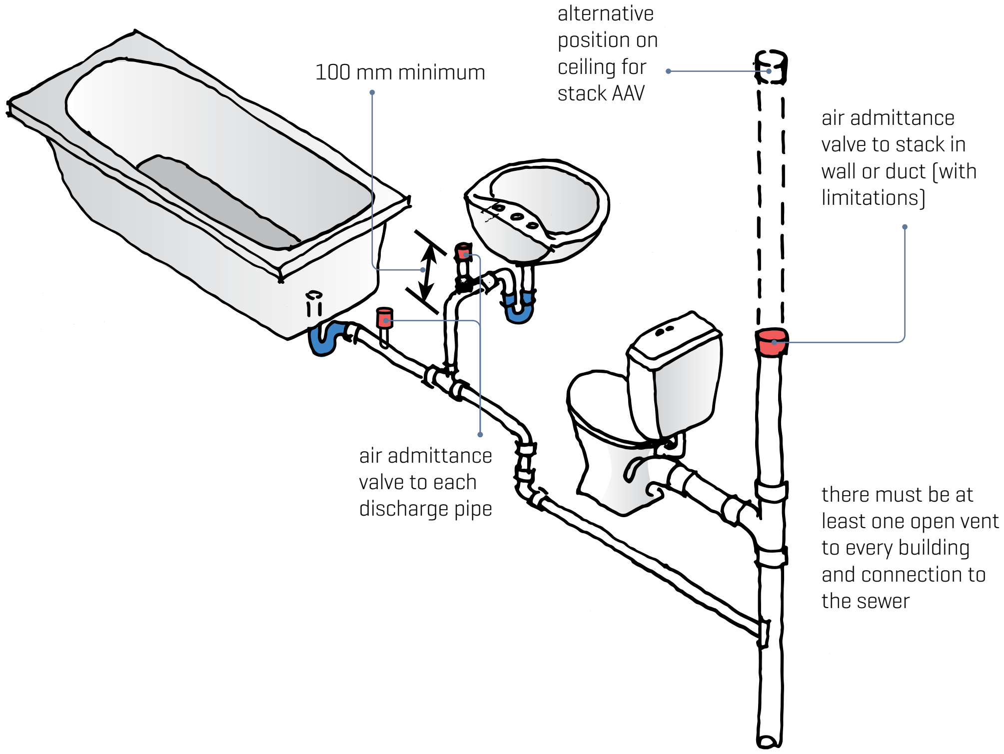


Figure 98. Typical air admittance valve installation.

If the maximum allowable length of an unvented discharge pipe is exceeded it must be vented – see section 4.9.3.

Fixtures may discharge to:

- a drain
- a branch drain
- a floor waste gully (wastewater only)
- a stack
- a gully (wastewater only).

Figure 99 illustrates the principal types of ground floor discharge.

The maximum permitted combined length of a fixture discharge pipe and an unvented branch drain is 10 m measured from a ventilated drain to the weir of the fixture trap, as shown in Figure 100.

Figure 101 shows the principles of discharge from the floor waste gully via an unvented branch drain.

Figure 102 shows the principles of the connection of a group of fixtures to an unvented branch drain. When the fixture discharge pipe is the same size as the unvented branch drain, the maximum permitted vertical drops are shown in Figure 103.

Table 9. Minimum single discharge pipe sizes, gradients and lengths for ground floor plumbing.

Fixture	Minimum size (DN)	Minimum gradient %	Ratio	Maximum unvented length of fixture discharge pipe (m)
Basin	40 32 NZ	2.5 5	1:40 1:20	2.5 2.5
Bidet	40 32 NZ	2.5 5	1:40 1:20	2.5 2.5
Drinking fountain	40	2.5	1:40	2.5
Cleaning sink	50	2.5	1:40	2.5
Urinal (single bowl)	50 32 NZ	2.5 5	1:40 1:20	2.5 2.5
Shower (single)	40	2.5	1:40	2.5
Sink (single or double)	50 40 NZ	2.5 2.5	1:40 1:40	2.5 2.5
Bath	40	2.5	1:40	2.5
Laundry tub	40	2.5	1:40	2.5
WC pan	80 100	1.65	1:60	2.5 6.0

Notes:

For floor waste gullies, see section 4.1.5. See Table 6 for fixture unit ratings. Refer to AS/NZS 3500.2:2021 Appendix B.

The size of unvented branch drains is calculated as follows:

- From Table 6, add the total number of fixture units that the pipe will carry.
- From Table 10, select the pipe size.

A minimum DN 100 discharge pipe from WC pans is considered prudent.

For fixture discharge pipes connected to unvented branch drains, see:

- Figure 88 for basins and bidets
- Figure 89 for all fixtures other than basins and bidets.

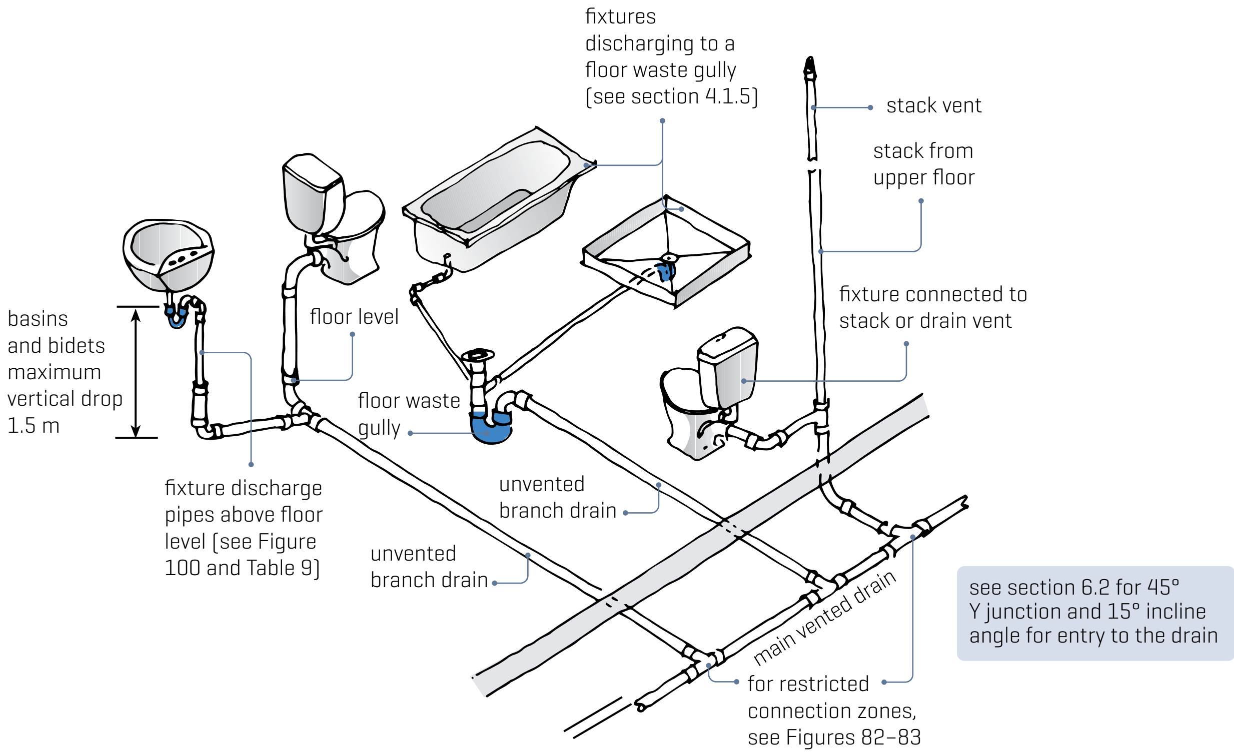


Figure 99. Unvented ground floor fixture connections.

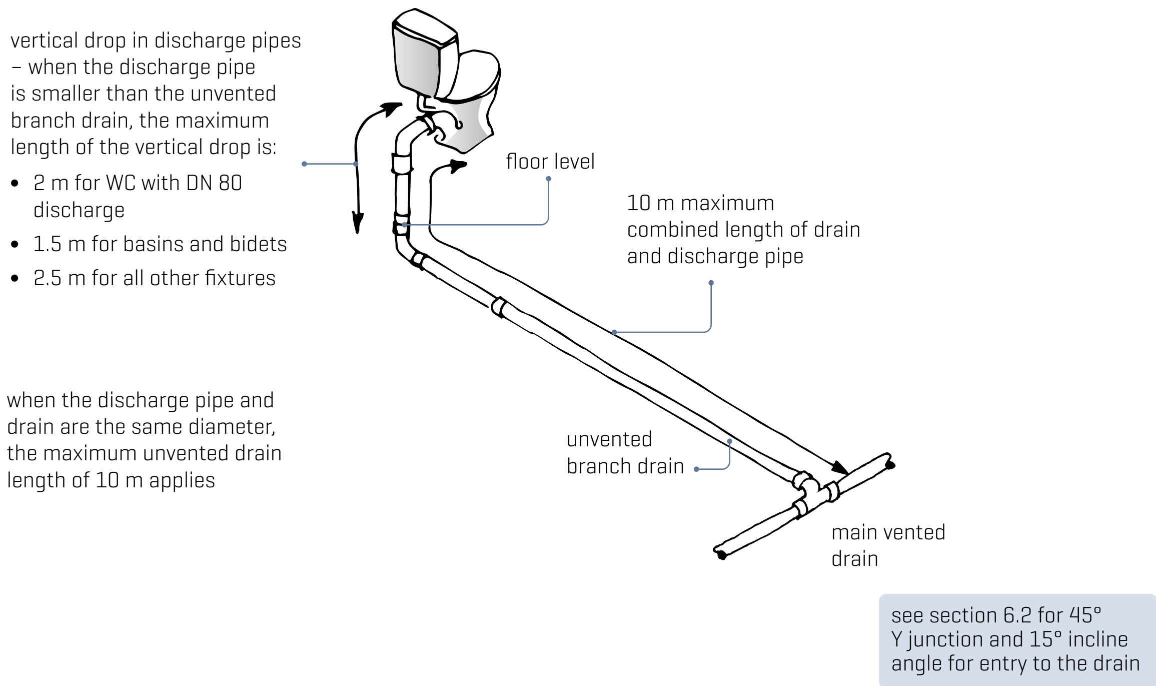


Figure 100. Maximum length of unvented branch drain and fixture discharge pipe.

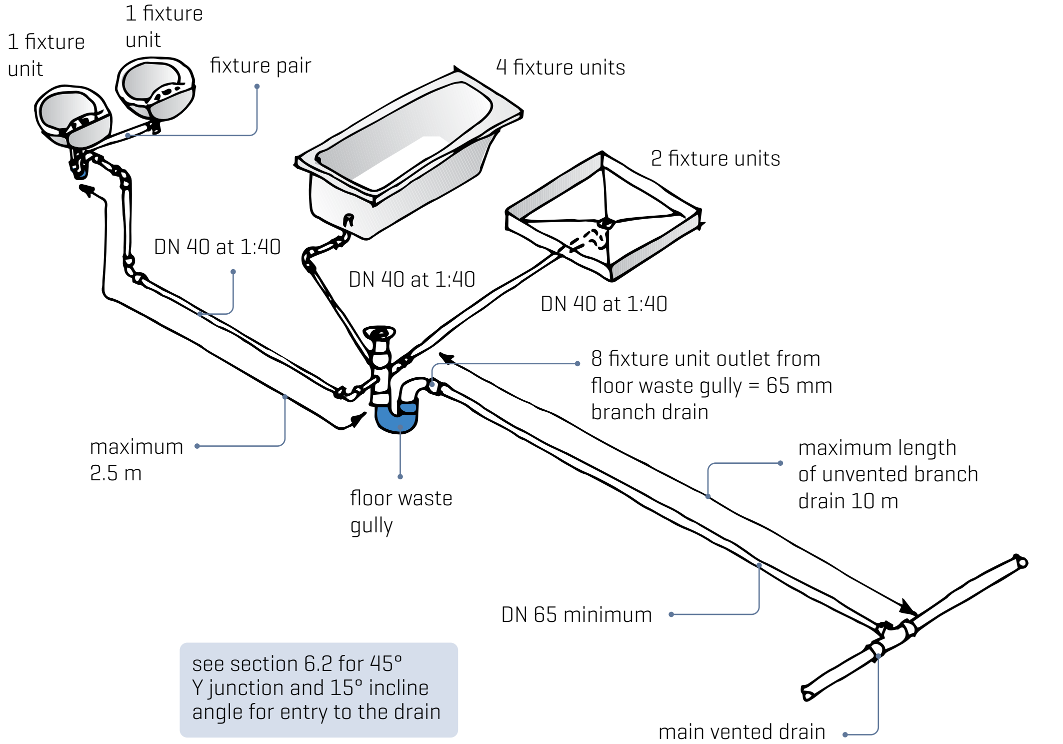


Figure 101. Maximum length of unvented branch drain receiving discharge from a floor waste gully.

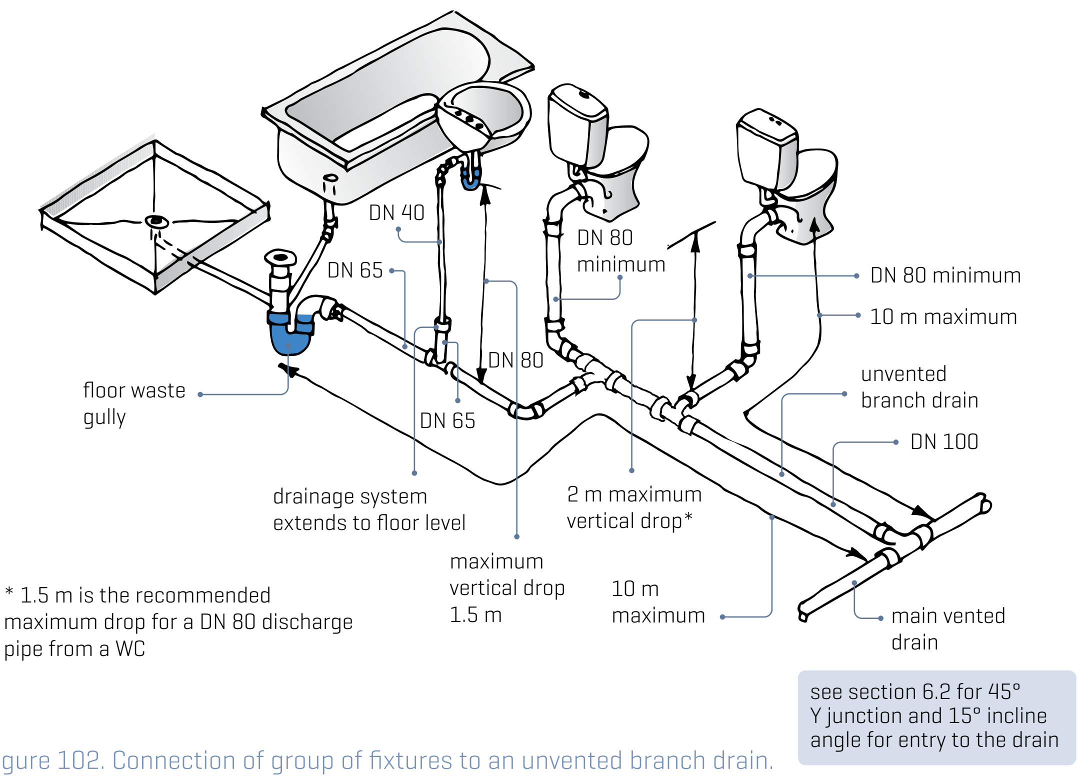


Figure 102. Connection of group of fixtures to an unvented branch drain.

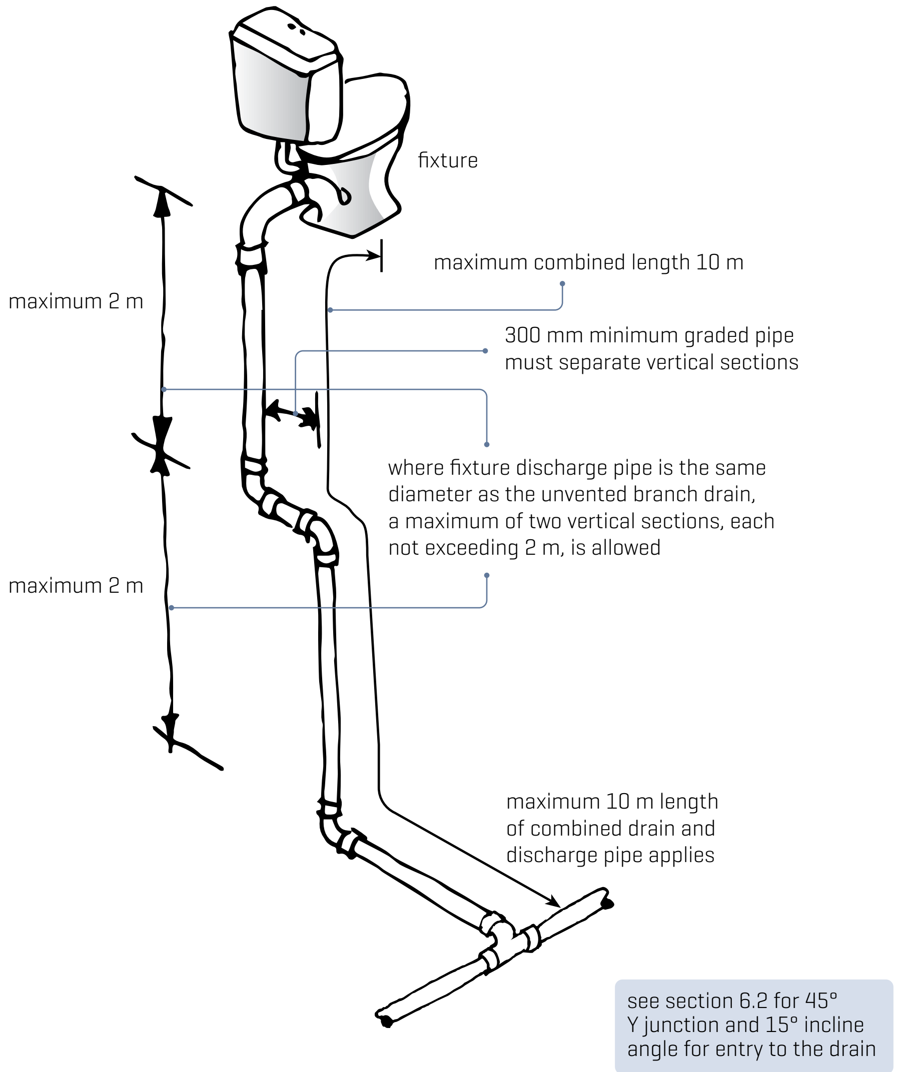


Figure 103. Limitation on vertical sections of unvented branch drain.

Table 10. Unvented branch drain size.

Drain diameter (DN)	Maximum fixture unit loading allowed in an unvented branch drain
65	5 – WCs not permitted 10 – if from one floor waste gully
80	12 – one WC permitted
100	30 – maximum of two WCs permitted

Adapted from AS/NZS 3500.2:2021 Table 3.10.2.

4.3 SINGLE STACK SYSTEMS

If a multi-storey residential type building can be designed within the parameters of a single stack system, this will usually be the simplest and most economic method of providing sanitary plumbing. However, fixtures need to be positioned close to the stack.

A single stack system:

- is generally designed around stacks of 100 mm diameter but there are variations to this
- is based on the principle that there is sufficient air within the system for a number of fixtures to be connected to the stack without the need for individual discharge pipes to be vented
- has limitations on the length of unvented discharge pipes
- has limitations on how and where connections can be made
- has limitations on how fixture discharge pipes can be configured
- has limitations on the number and type of fixtures connected at any one floor level
- requires a relief vent to be installed when loadings or floor levels are exceeded.

Table 11. Single stack residential building (maximum fixture loading and number of floor levels).

Stack size (DN)	Maximum fixture unit loading	Maximum number of floors
100	260	10
125	390	15
150	780	30

Adapted from AS/NZS 3500.2:2021 Table 9.7.1(A).

Table 12. Single stack residential building (maximum fixtures discharging on any one floor).

2 bidets	2 dishwashers	2 WC pans
2 basins	2 kitchen sinks	2 floor waste gullies
2 baths	2 laundry tubs	2 bar sinks
2 clothes washing machines	2 showers	

Adapted from AS/NZS 3500.2:2021 clause 9.4.1.

Table 13. Length and gradients of unvented fixture discharge pipes connected to a single stack.

Fixture type	Maximum length (m)	Permitted gradient	
		%	Ratio
Wastewater fixtures	2.5	2.5–5.0	1:40–1:20
WC pan DN 100	6.0	1.65–5.0	1:60–1:20
WC pan DN 80	2.5	1.65–5.0	1:60–1:20
Urinals DN 50–80	2.5	2.5–5.0	1.40–1:20
Urinals DN 100	6.0	1.65–5.0	1:60–1.20

Adapted from AS/NZS 3500.2:2021 Table 9.5.1.

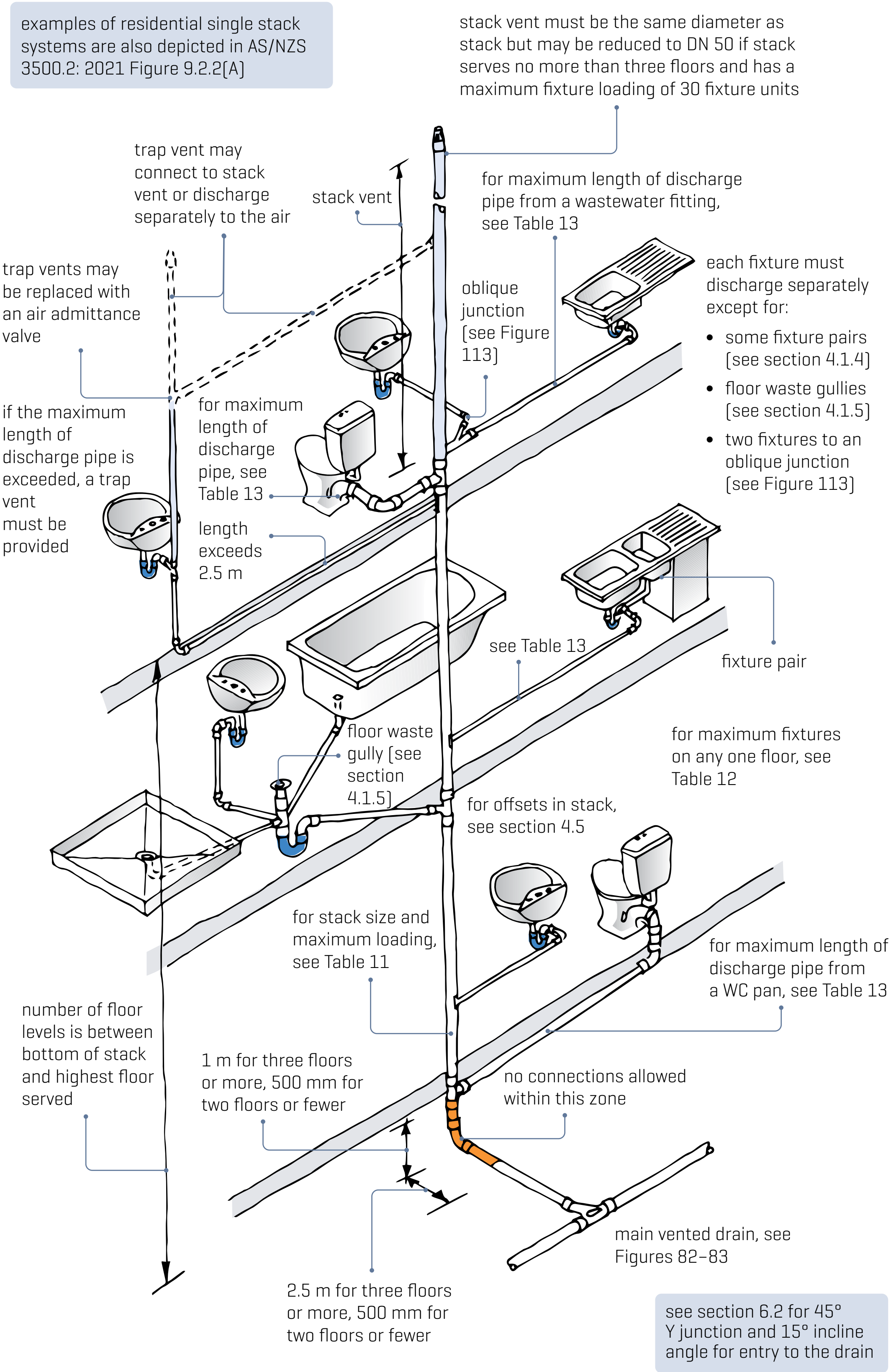


Figure 104. Basic principles for single stack system in a residential building.

4.3.1 Single stack systems – residential buildings

The maximum number of levels through which the stack may pass is shown in Table 11. If the point at which the stack connects to the drain is more than 2.4 m below the lowest floor level, that length of pipe must be counted as a floor level. Figure 104 illustrates the basic principles.

The maximum number and type of fixtures that can be connected to a single stack from any floor of a building is shown in Table 12. The total number of fixture units in the stack is calculated by adding the fixture unit ratings (taken from Table 6) of all fixtures discharging to the stack. Maximum lengths and minimum gradients of unvented discharge pipes from fixtures are shown in Table 13. Discharge pipes that exceed the length given in Table 13 must be vented.

4.3.2 Single stack systems – commercial and industrial buildings (non-residential)

The maximum number of levels through which the stack may pass and the maximum fixture

Table 14. Single stack commercial building (maximum fixture loading and number of floor levels).

Stack size (DN)	Maximum fixture unit loading	Maximum number of floors
100	60	4
125	100	6
150	200	8

Adapted from AS/NZS 3500.2:2021 Table 9.7.1(B).

Table 15. Single stack commercial buildings (maximum fixtures and discharges).

Maximum fixtures with separate discharge pipes to stack on any one floor	
5 basins	1 cleaning sink
5 single urinals	1 drinking fountain
1 x 3 m urinal	1 kitchen sink
5 WC pans	2 bar sinks
2 showers	
Maximum discharge from all floor waste gullies on any one floor	
5 basins	1 drinking fountain
1 cleaning sink	2 showers
Maximum ranges of fixtures with common discharge pipes to stack on any one floor	
5 basins	5 WC pans
5 wall-hung urinals	

Adapted from AS/NZS 3500.2:2021 clause 9.4.2.

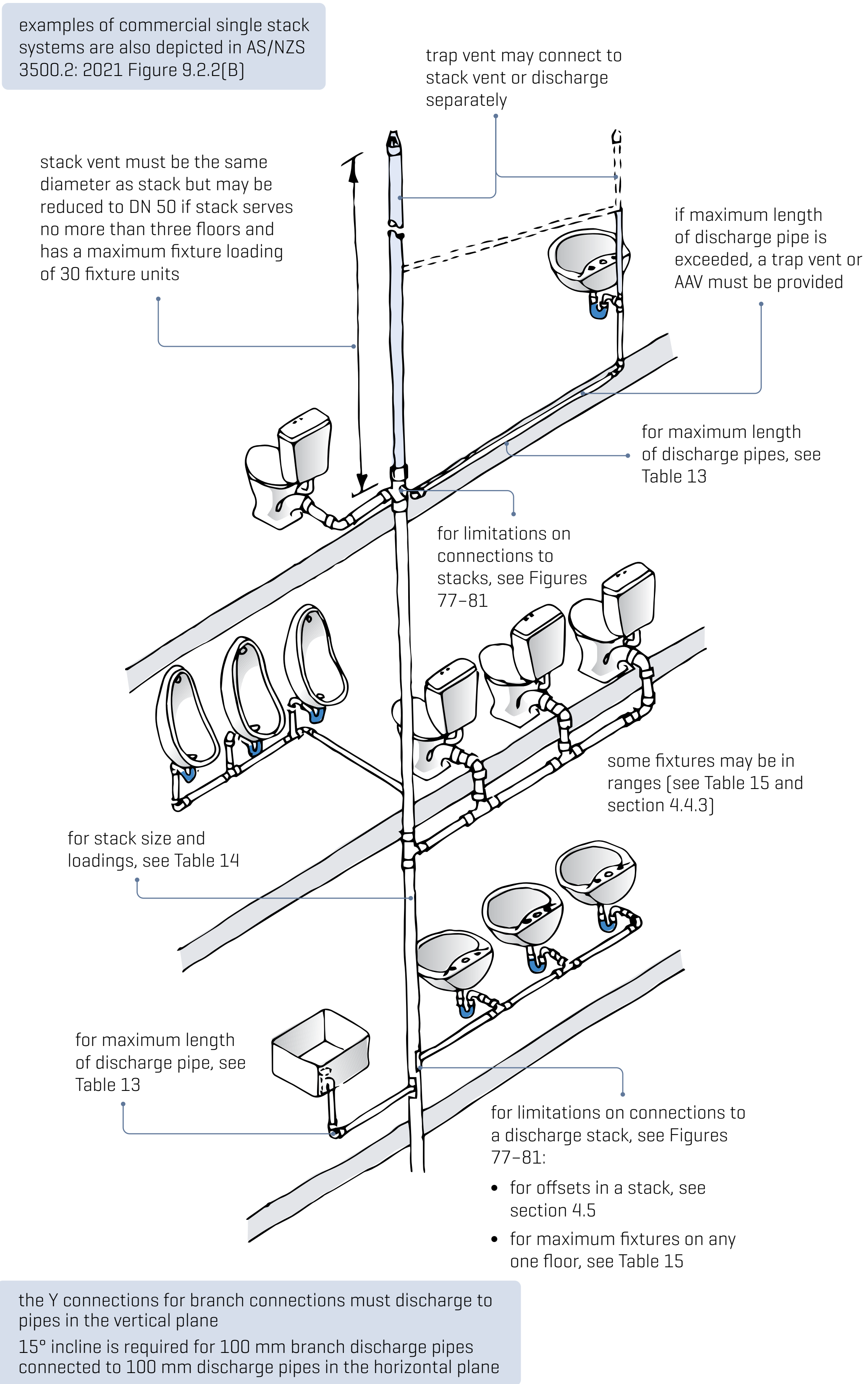


Figure 105. Basic principles for single stack system in a commercial building.

unit loading is shown in Table 14. If the point at which the stack connects to the drain exceeds 2.4 m below the lowest floor level, that length of pipe must be counted as a floor level. Figure 105 illustrates the basic principles.

The maximum number and type of fixtures that can be connected to a single stack from any floor of a building is as shown in Table 15. The total number of fixture units in the stack is calculated by adding the fixture unit ratings (taken from Table 6) of all fixtures discharging to the stack.

The limitations on the lengths of unvented discharge pipes from fixtures are as shown in Table 13.

4.4 SINGLE STACK MODIFIED SYSTEMS

Single stack systems can be modified by the addition of a relief vent (see section 4.9.5) and cross-vents to allow the stack to receive a higher discharge and/or to serve more floors without an increase in size.

4.4.1 Single stack modified systems – residential buildings

The maximum number of levels through which the stack may pass is shown in Table 16. If the point at which the stack connects to the drain exceeds 2.4 m below the lowest floor level, that length of pipe must be counted as a floor level. Figure 106 illustrates the basic principles.

The maximum number and type of fixtures that can be connected to a single stack from any floor of a building is shown in Table 12.

The total number of fixture units in the stack is calculated by adding the fixture unit ratings (taken from Table 6) of all fixtures discharging to the stack.

The limitations on the lengths of unvented discharge pipes from fixtures are shown in Table 13.

Cross-venting

Cross-vents are detailed in AS/NZS 3500.2:2021 clause 9.6.2.2. Requirements include:

- being located 50–600 mm above the flood level rim of a fixture at floor level
- being omitted where the horizontal section of toilet pan discharge is vented and connects above the pan flood level or a graded pipe of less than 80 mm is vented as above.

4.4.2 Single stack modified systems – commercial and industrial buildings (non-residential)

The maximum number of levels through which the stack may pass and the relief vent requirements are shown in Table 17. If the point at which the stack connects to the drain exceeds 2.4 m below the lowest floor level, that length of pipe must be counted as a floor level. Figure 107 illustrates the basic principles.

The maximum permitted length of unvented discharge pipes is not changed by the addition of a relief vent and is as shown in Table 13. The maximum number of fittings permitted on any floor is not changed by the addition of a relief vent and is as shown in Table 15.

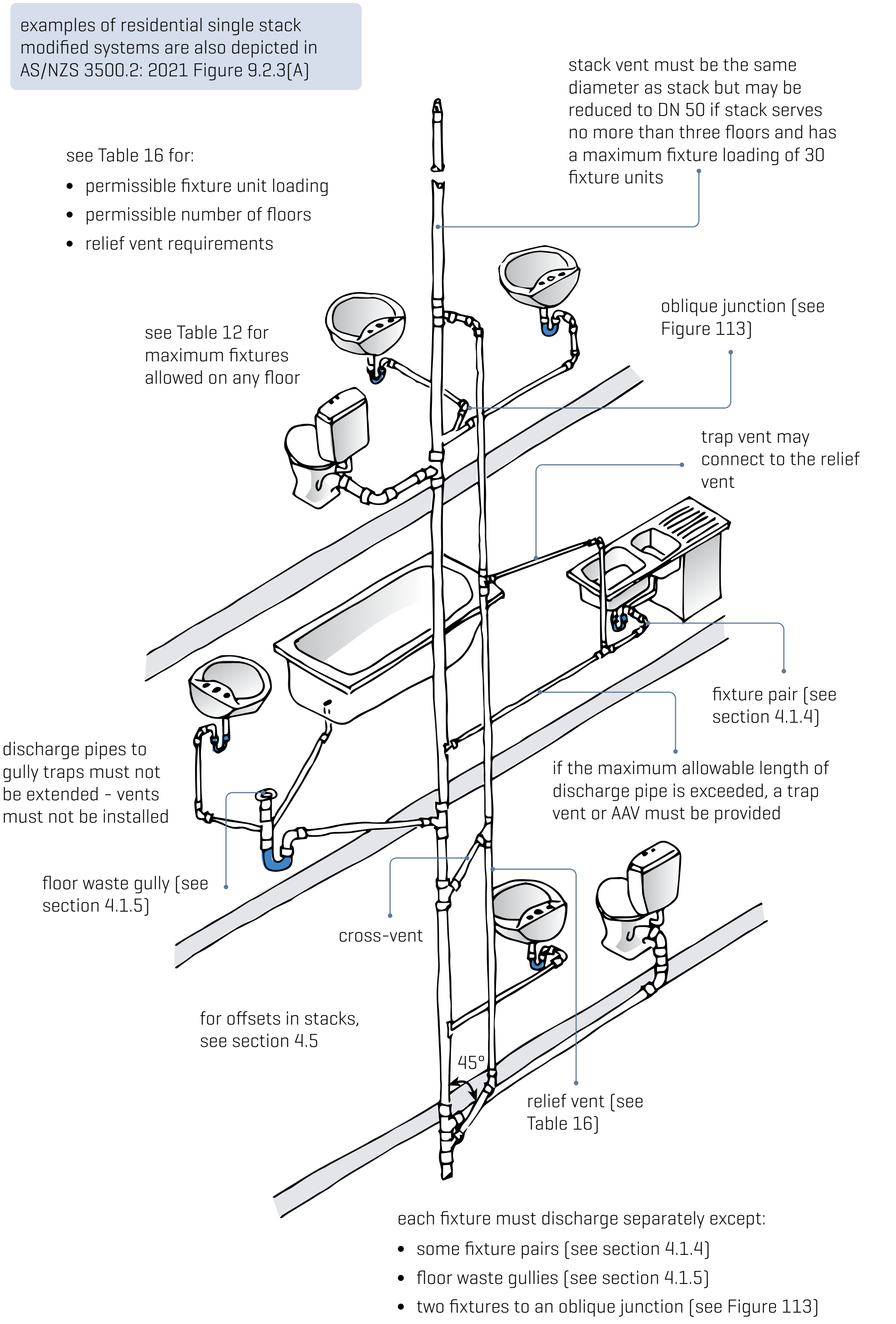


Figure 106. Basic principles for single stack modified system in a residential building.

Table 16. Single stack modified system residential building (fixture loading, number of floors and relief vent requirements).

Stack size (DN)	Maximum fixture unit loading	Number of floors	Relief and cross-vent size (DN)	Cross-vent location
100	290	Up to 15	50	Alternate floors
100	390	Up to 15	50	Every floor
100	320	16–20	65	Alternate floors
100	500	16–20	65	Every floor

Adapted from AS/NZS 3500.2:2021 Table 9.7.2(A).

Table 17. Single stack modified system commercial building (fixture loading, number of floors and relief vent requirements).

Stack size (DN)	Maximum fixture unit loading	Number of floors	Relief and cross-vent size (mm)	Cross-vent location
100	120	5–12	50	Every floor
125	250	13–18	65	Every floor
150	600	19-24	80	Every floor

Adapted from AS/NZS 3500.2:2021 Table 9.7.2(B).

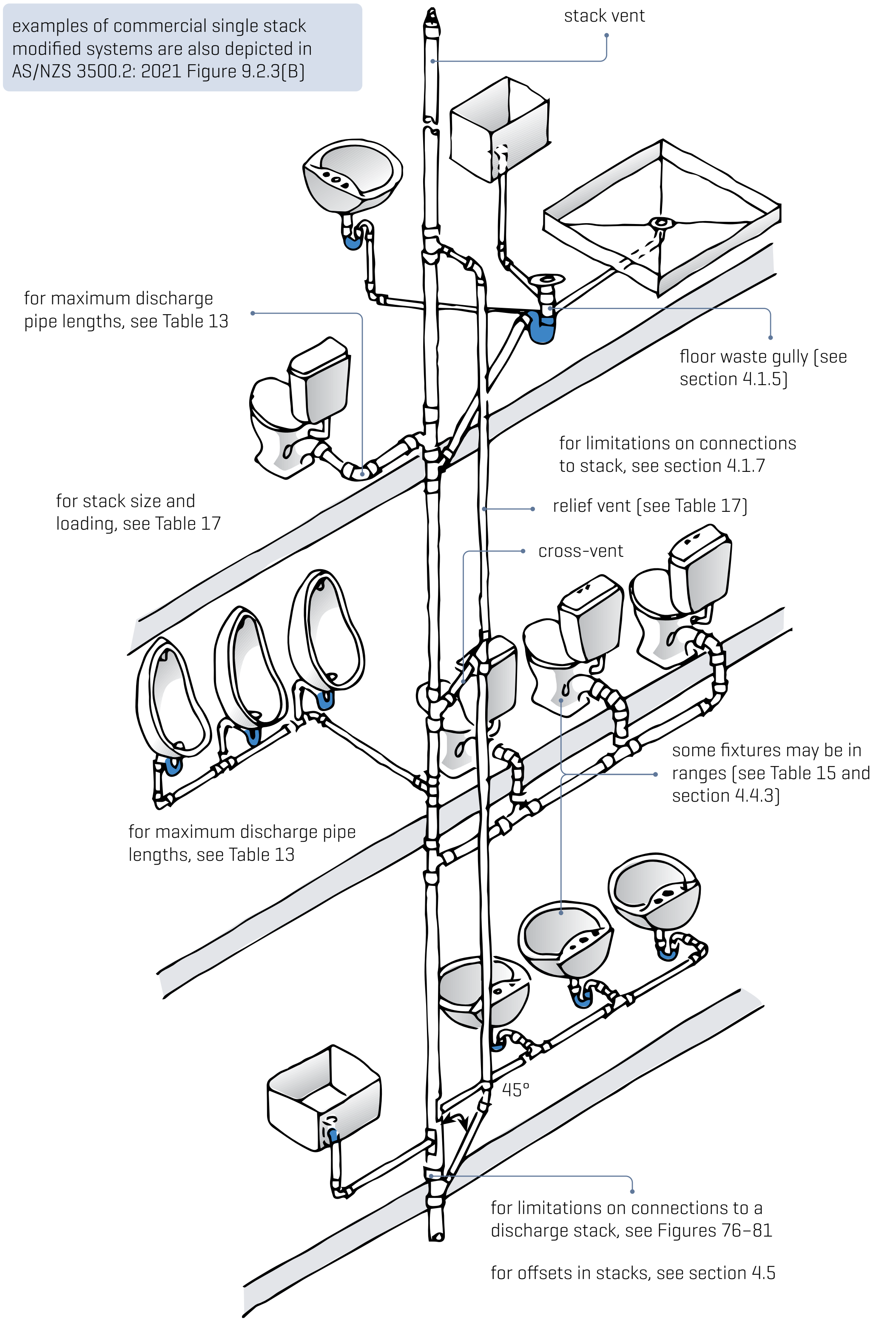
4.4.3 Ranges of fixtures in commercial buildings

Ranges of fixtures of the same type may be connected to a single stack and/or modified system without venting provided:

- the building is commercial or industrial
- the stack size is between DN 100 and DN 150.

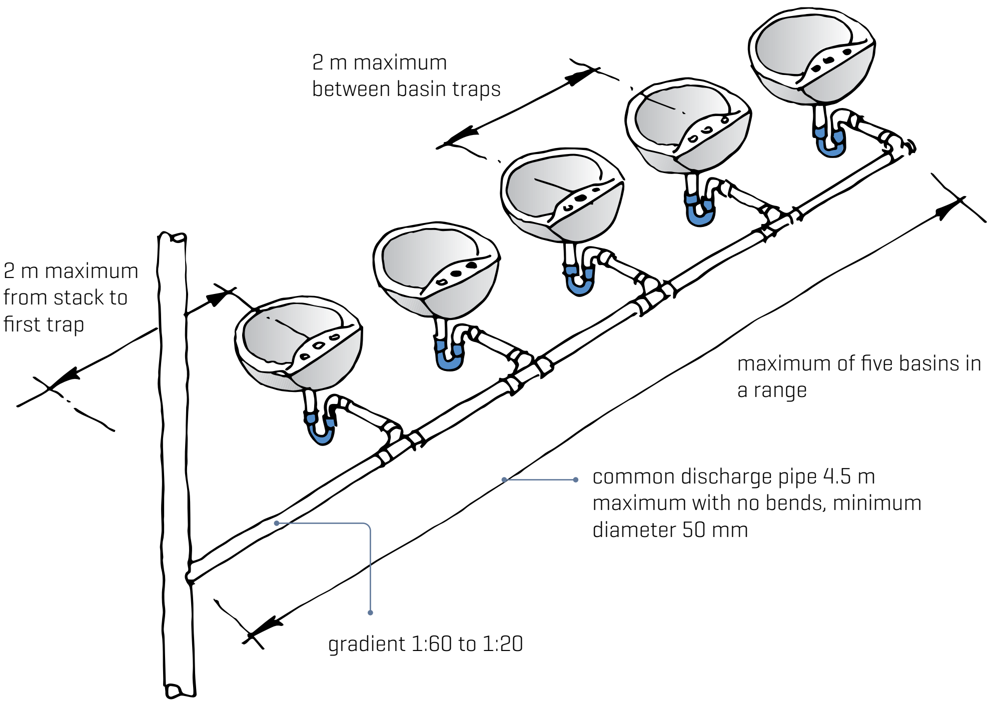
The following ranges of fittings are allowed:

- A range of five basins in accordance with Figures 108–109.
- A range of five WC pans:
  - for P traps in accordance with Figure 110
  - for S traps in accordance with Figure 111.
- A range of five urinals in accordance with Figure 112.



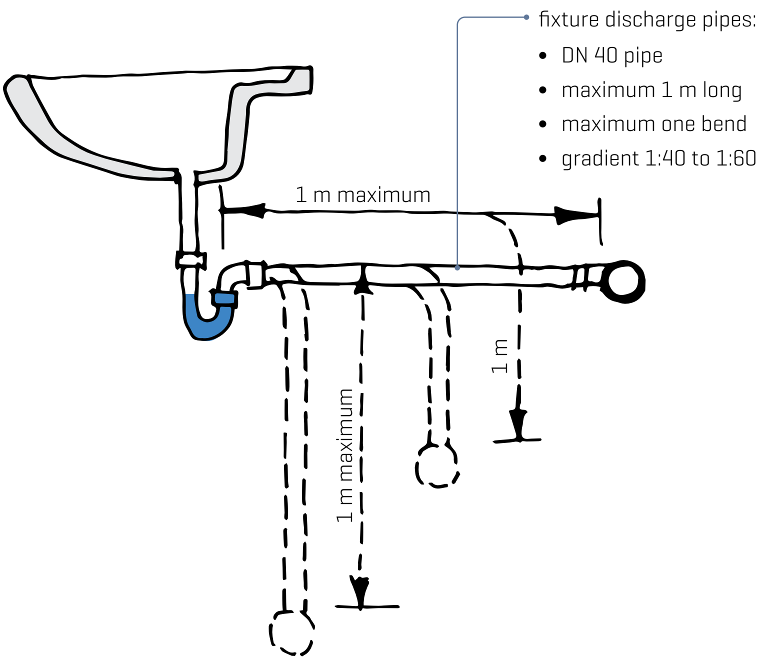
the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 107. Basic principles for single stack modified system in a commercial building.



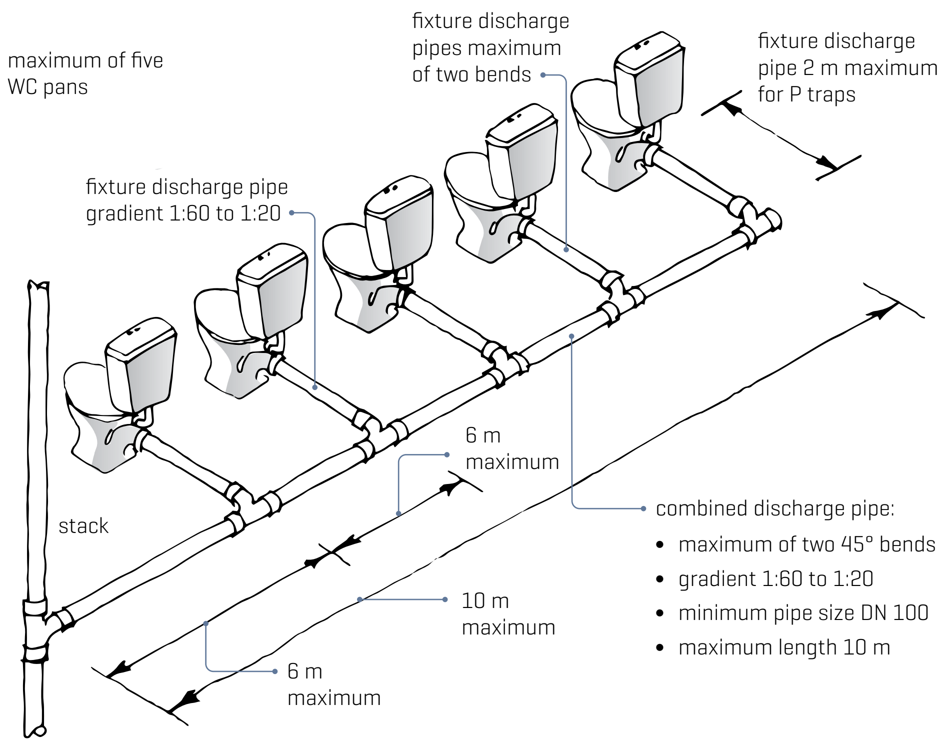
the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 108. Connection of a range of basins.



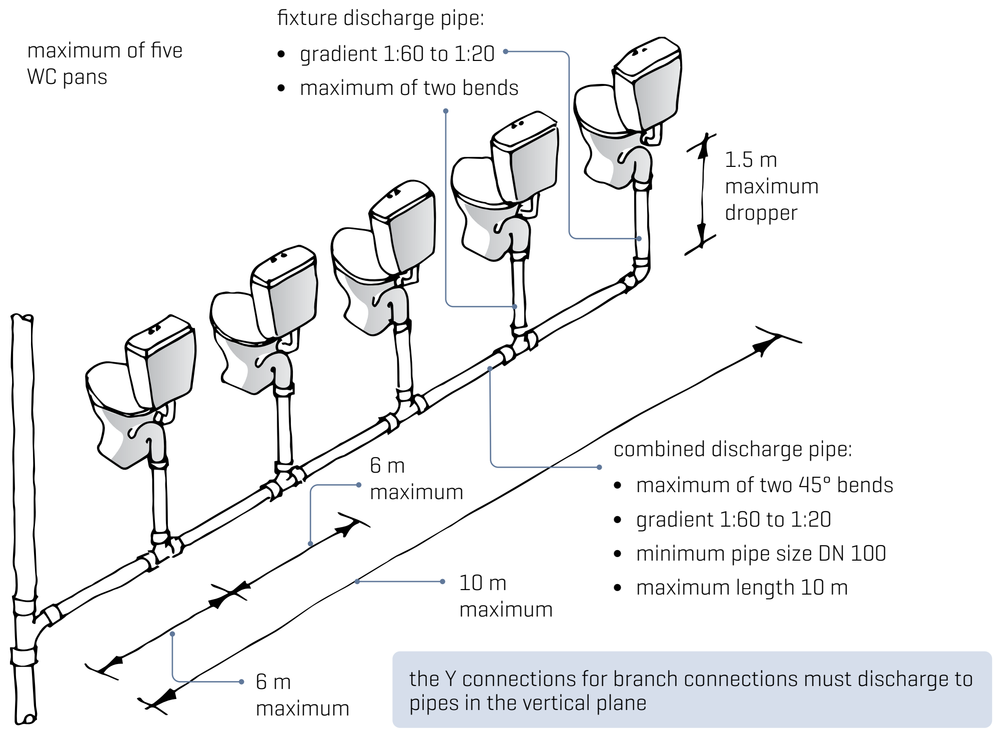
the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane

Figure 109. Connection of hand basins in a range.



the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 110. Connection of WC pans in a range – P trapped WCs.



the Y connections for branch connections must discharge to pipes in the vertical plane

Figure 111. Connection of WC pans in a range – S trapped WCs

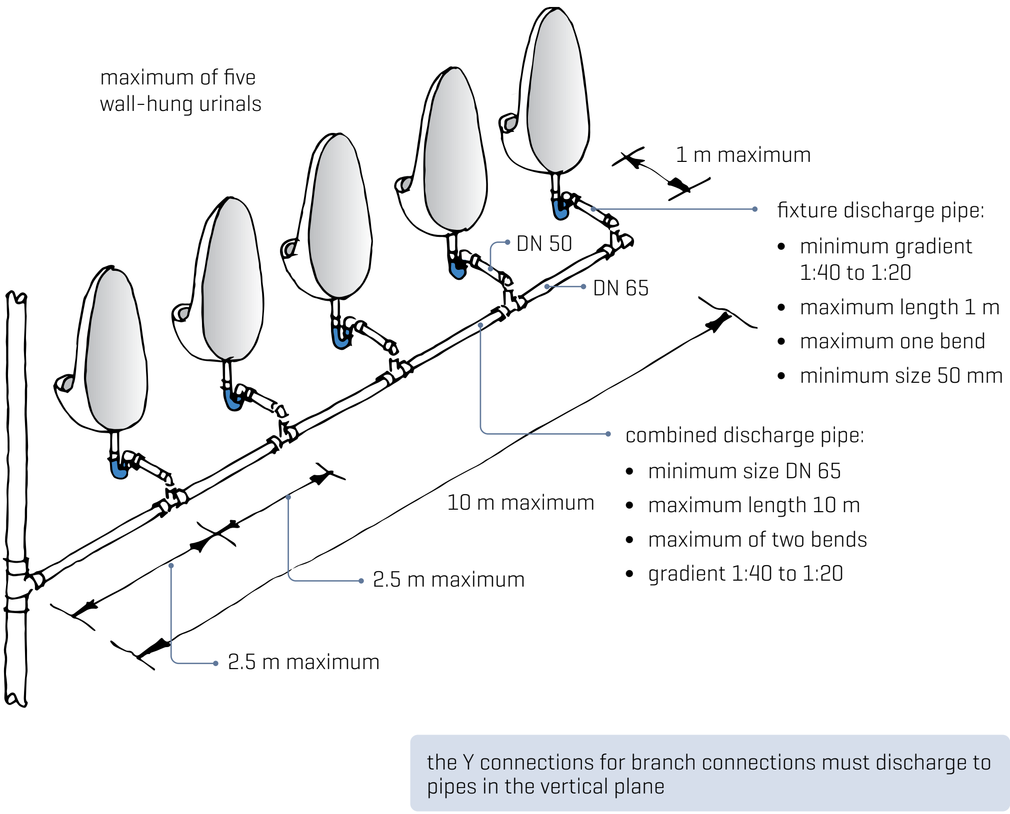


Figure 112. Connection of wall-hung urinals in a range.

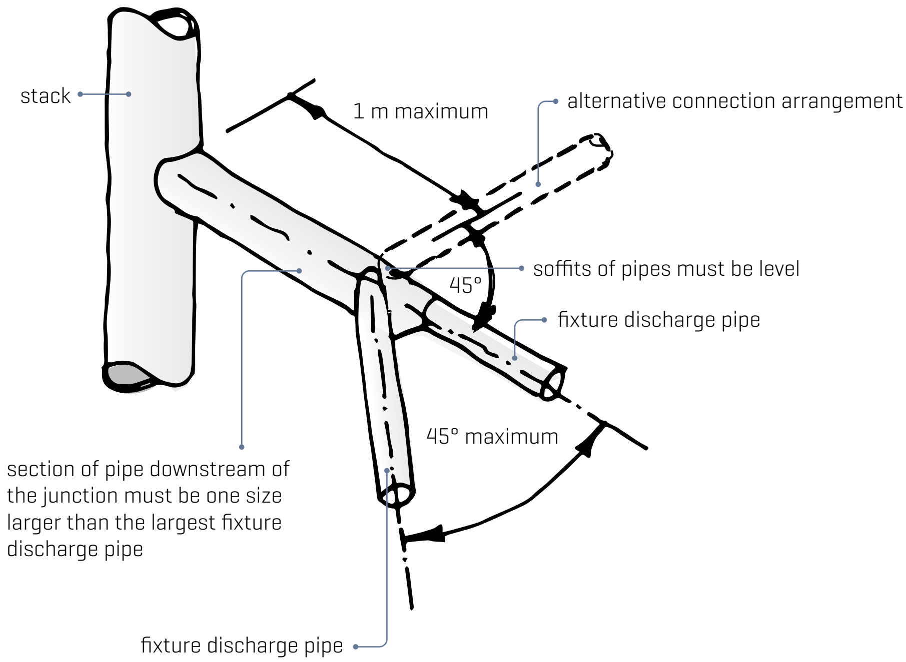


Figure 113. Unequal oblique stack junction.

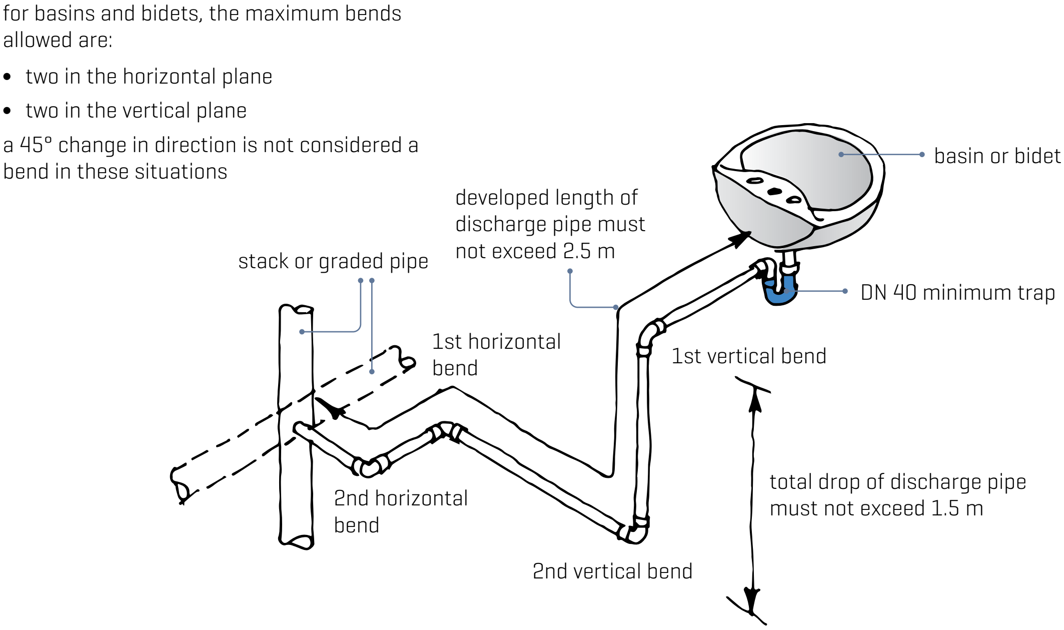


Figure 114. Connection of basins and bidets to a branch pipe or stack.

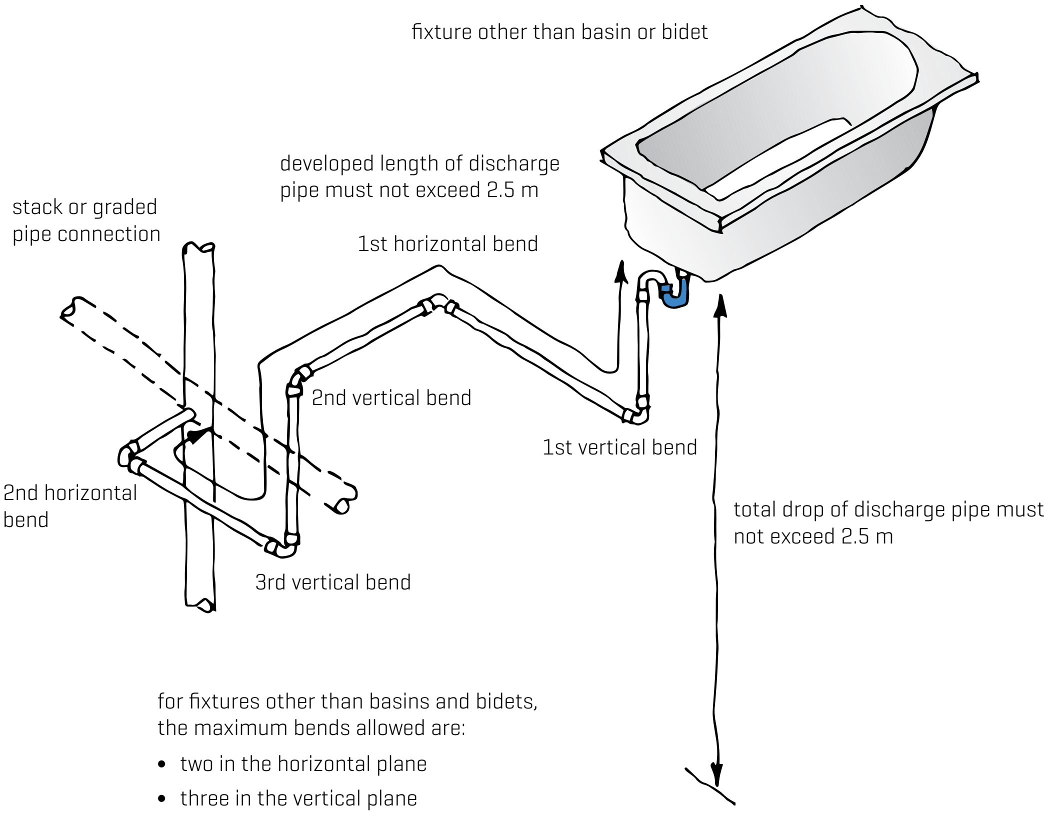


Figure 115. Connection of fixtures other than bidets and basins to a branch pipe or stack.

4.4.4 Connection of fixtures without trap vents to all single stack systems

Generally, each fixture must be connected to the stack by a separate unvented fixture discharge pipe in accordance with Table 13.

The exceptions to this are:

- a range of unvented fixtures permitted in a commercial or industrial system with a modified single stack system (see section 4.4.1)
- fixture pairs in accordance with Figures 66–67 discharging jointly into DN 65, DN 80 and DN 100 stacks
- waste fixture discharge pipes connected by an unequal oblique junction in accordance with Figure 113
- connections via a floor waste gully.

Discharge pipes exceeding the length allowed in Table 13 must be vented by a trap vent or an air admittance valve. Connection of basins and bidets to a single stack must comply with Figure 114. A 45° change in direction is not considered a bend in these situations. Connection to fixtures other than basins and bidets to a single stack must comply with Figure 115.

4.5 OFFSETS IN SINGLE STACK SYSTEMS

Offsets are permitted in single stack systems and enable a stack to be stepped to a more advantageous position above the point of the offset.

An offset may be either:

- a steep offset that is made at an angle of more than 45° to the horizontal, or
- a graded offset that is made at an angle of less than 45° to the horizontal but to a minimum gradient.

4.5.1 Steep offsets in DN 100 single stacks

Figure 116 illustrates the general principles.

DN 100 pipes may have steep offsets between the base of the stack and the highest connection and:

- the total height of the stack must not exceed 10 floor levels
- if laundry tubs are connected above the upper offset bend, the maximum fixture loading on the stack must not exceed 50 fixture units
- the proximity of connections to the upper and lower offset bends must be in accordance with Table 18.

Where a steep offset occurs below the lowest connection, the distance between the upper bend and the lowest connection may be reduced to DN 100 in accordance with Figure 117.

4.5.2 Graded offsets in 100 mm single stacks

100 mm pipes may be offset between the base of the stack and the highest connection in accordance with Figure 118.

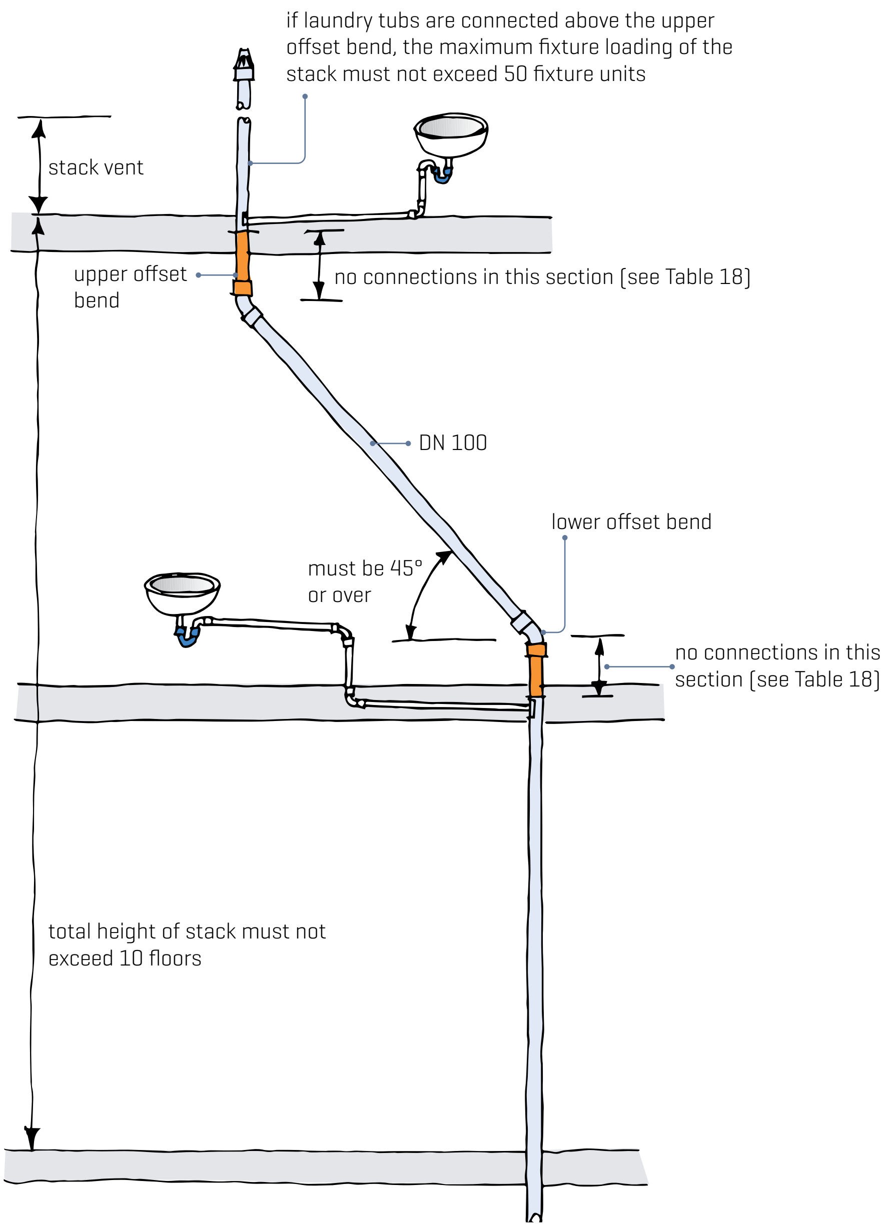


Figure 116. Steep offset in a single stack system.

Table 18. Restrictions on connections to steep (45°) offsets.

Maximum number of floor levels above upper offset bend	Minimum distance between upper bend and connection (mm)	Minimum distance between lower bend and connection (mm)	Maximum fixture unit loading
5	450	600	90
10	600	600	150
10	900	600	260

Adapted from AS/NZS 3500.2:2021 Table 9.9.2.

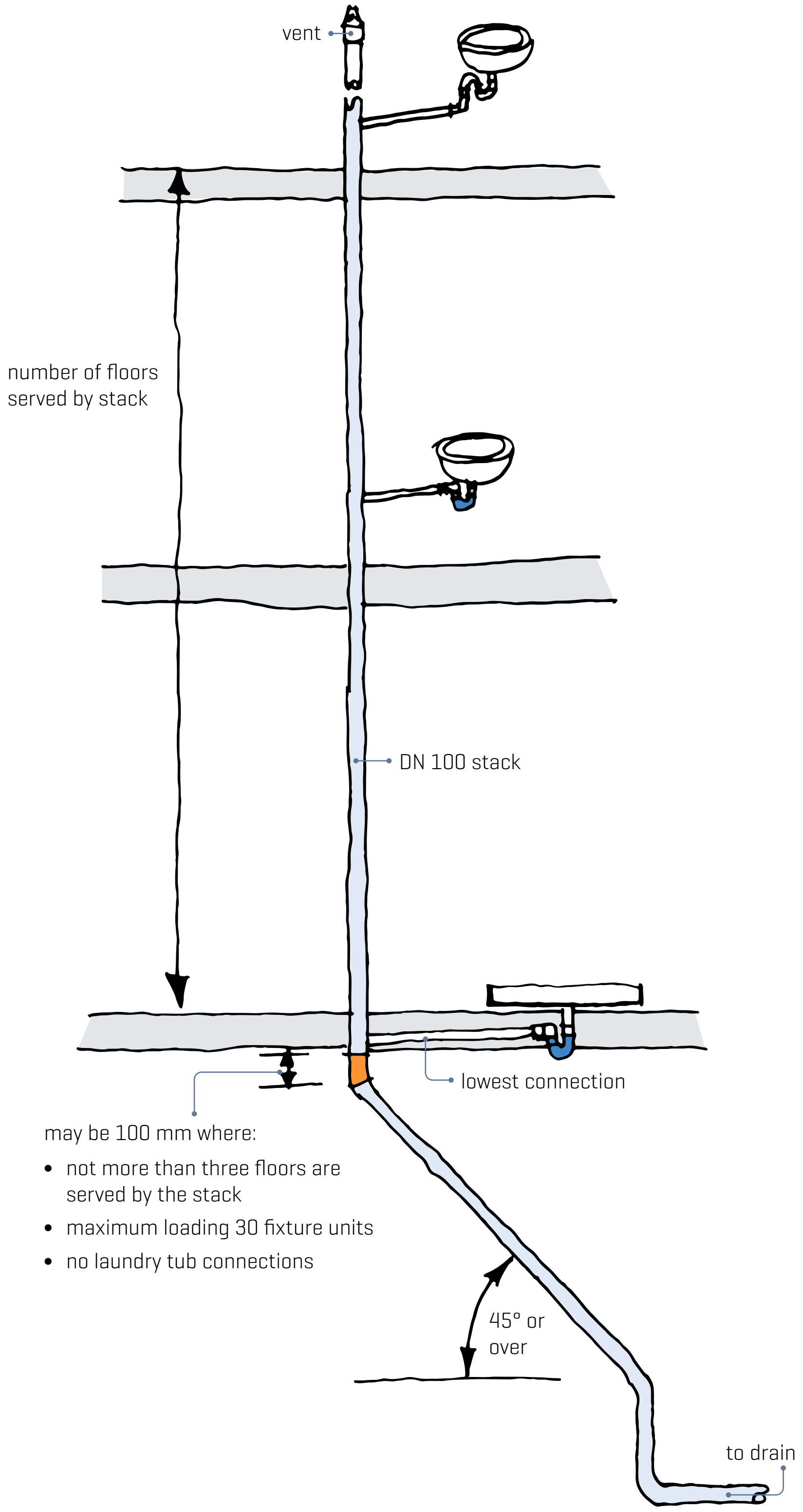


Figure 117. Steep offset below the lowest connection in 100 mm stack.

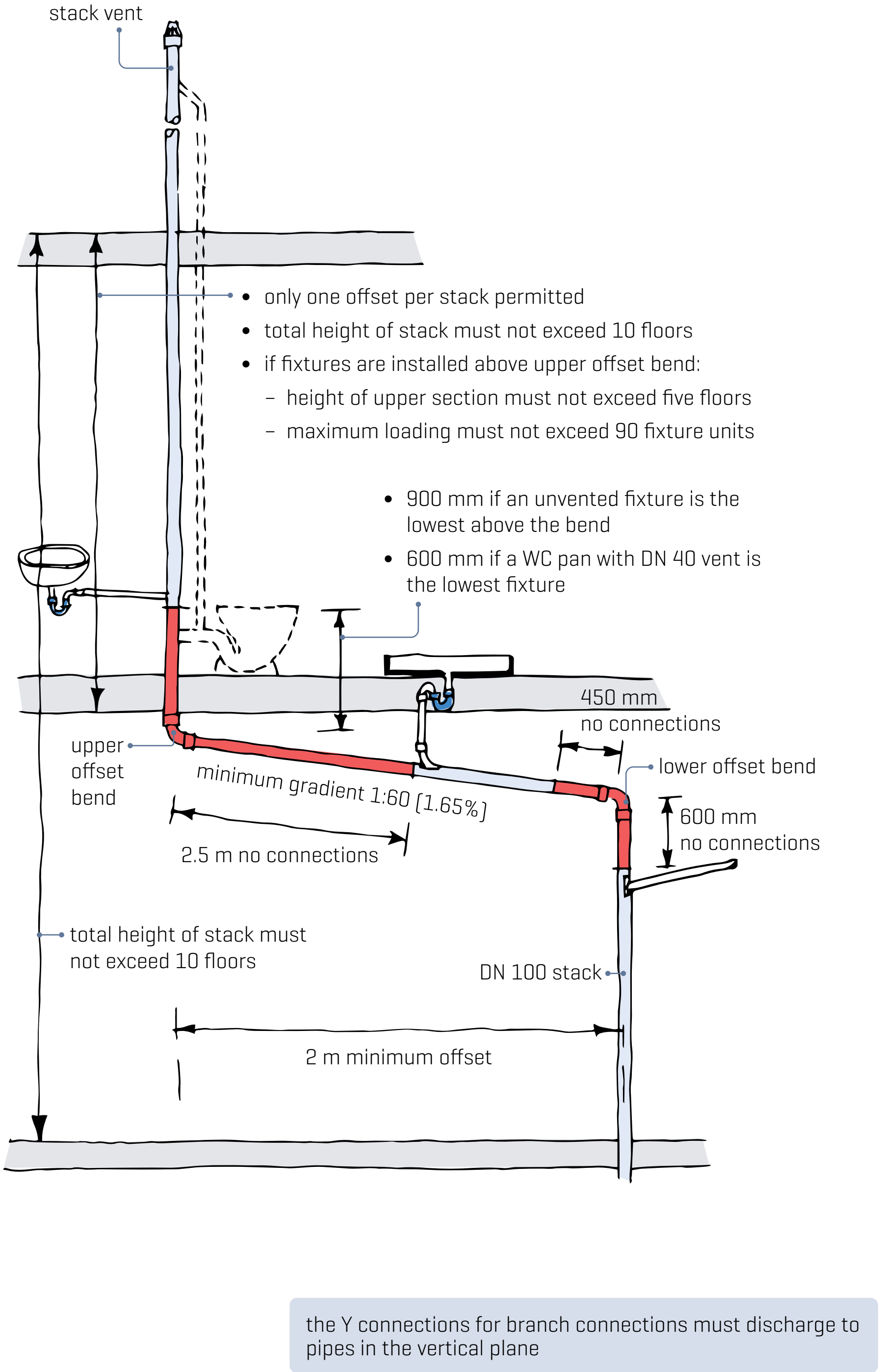


Figure 118. Offsets in single stack system graded offset (less than 45°) in 100 mm pipe.

4.6 VARIATIONS TO SINGLE STACK SYSTEMS

The variations included in this section are derived from actual installations that have performed satisfactorily. While they have limitations and are specific to each case, there are situations where they will be applicable.

4.6.1 DN 80 straight stack in a residential building

A DN 80 stack may receive discharge pipes in accordance with Figure 119.

4.6.2 DN 80 stack with graded section at the upper floor of a 3-storey residential building

A DN 80 stack with an offset at the top floor of a residential building may receive discharges in accordance with Figure 120.

4.6.3 DN 100 stack with graded section at the upper floor of a 3-storey residential building

A DN 100 stack with an offset at the top floor of a 3-storey residential building may receive discharges in accordance with Figure 121.

4.6.4 DN 100 stack with graded section at the upper floor of a 2-storey residential building

A DN 100 stack with an offset at the first-floor level of a 2-storey residential building may receive discharges in accordance with Figure 122.

4.6.5 Connection of multiple fixtures into or below a graded offset

Multiple fixtures located on a floor above a graded offset may be connected by means of a common discharge pipe into the stack on either side of the restricted zone in accordance with Figure 123.

4.7 WASTEWATER STACKS

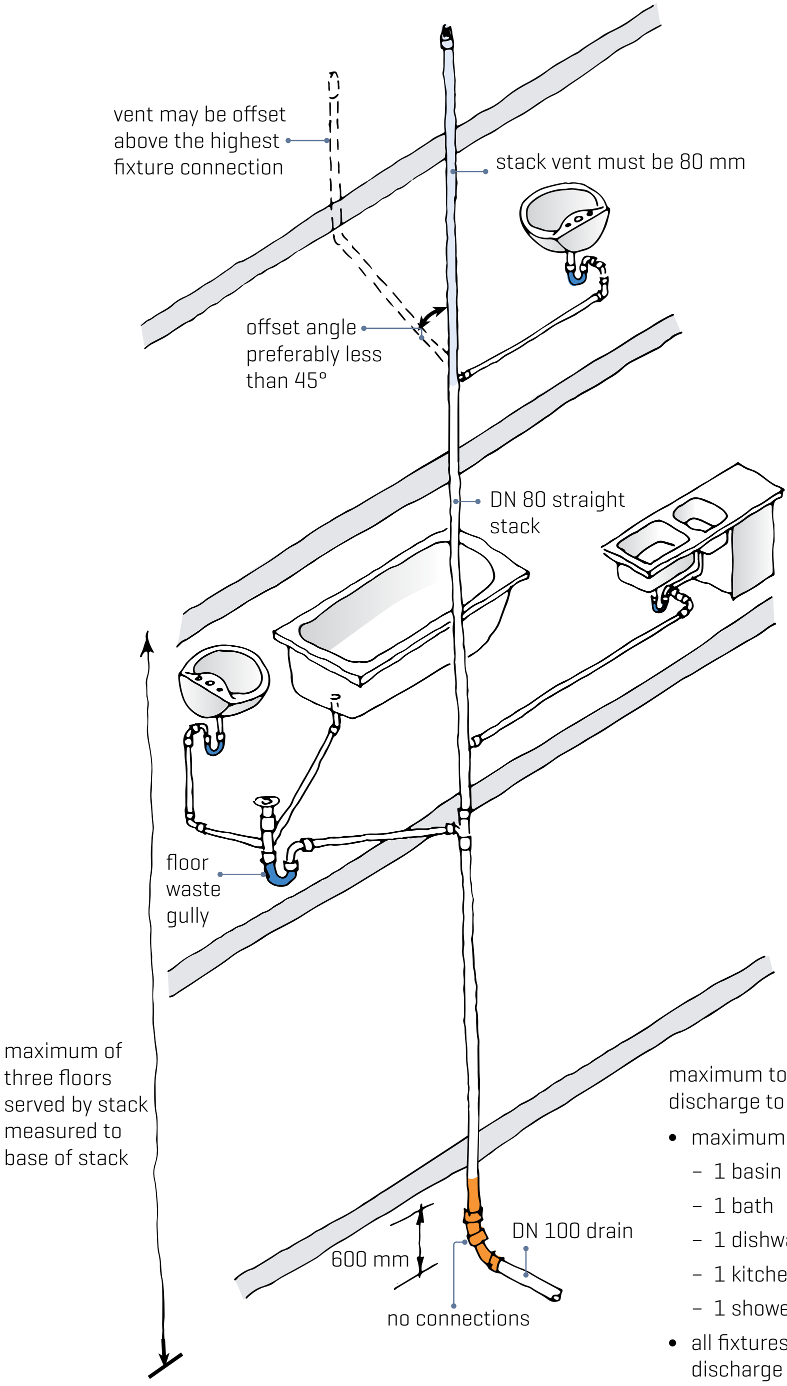
Stacks that receive the discharge from waste fittings only are called waste stacks. They must not receive discharge from WCs, urinals or slop hoppers. Figure 124 illustrates the general principles.

Unvented fixture discharge pipes connected to waste stacks must:

- have a maximum length of discharge pipe of 2.5 m
- be sized in accordance with Table 6
- have a minimum gradient in accordance with Table 7.

Waste stacks without offsets are sized according to the total fixture unit loading (obtained from Table 6) as shown in Table 19. Waste stacks may:

- receive discharge pipes from two fixtures joined close to the stack by an oblique junction (Figure 113)
- be offset (see section 4.8).



maximum total of 30 fixture units to discharge to stack

- maximum fixtures per floor
  - 1 basin
  - 1 bath
  - 1 dishwasher
  - 1 kitchen sink
  - 1 shower
- all fixtures must have individual discharge pipes
- no laundry tubs, washing machines or WCs may be connected to the stack
- no offsets permitted in the stack

Figure 119. DN 80 straight stack serving a residential building.

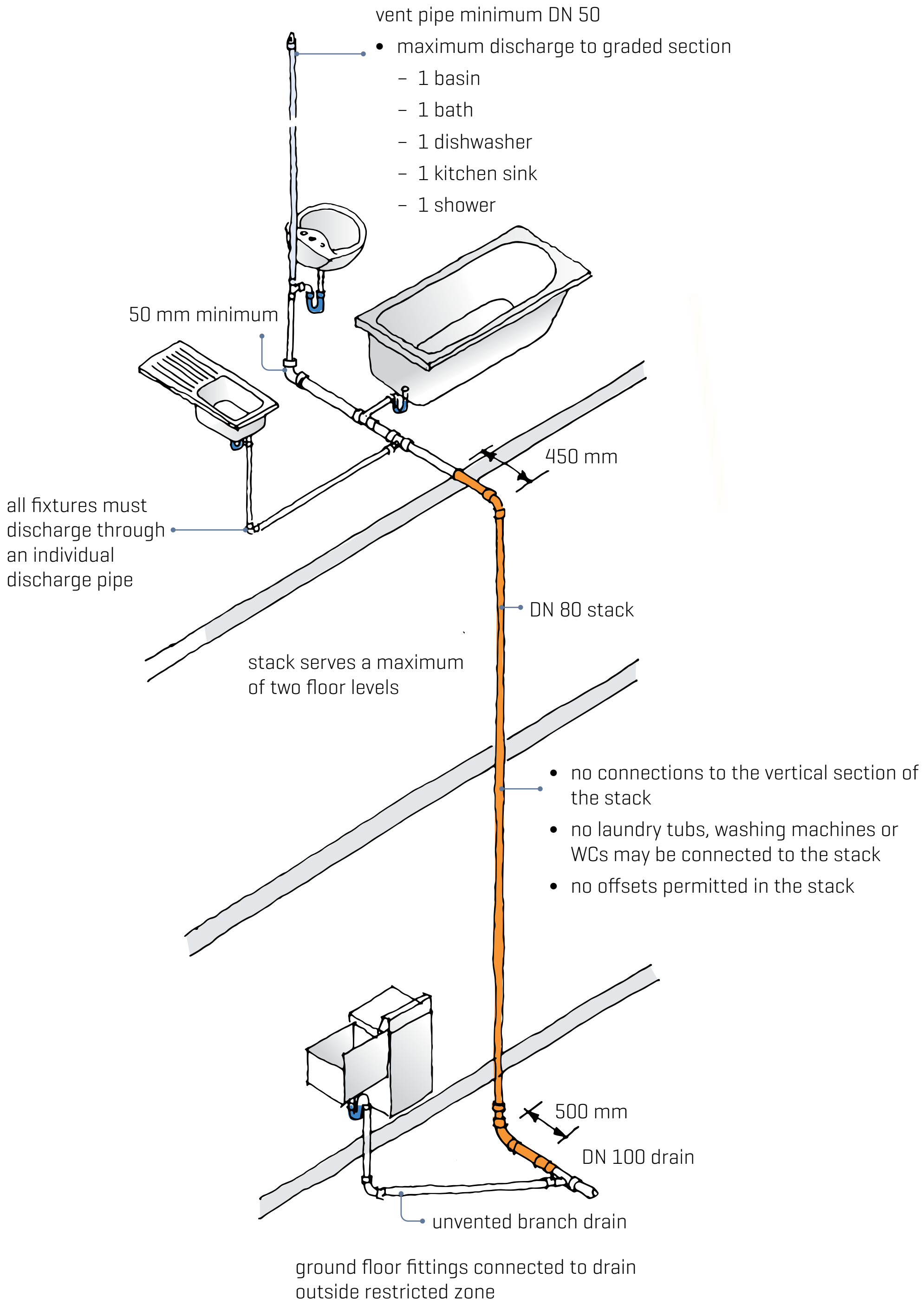
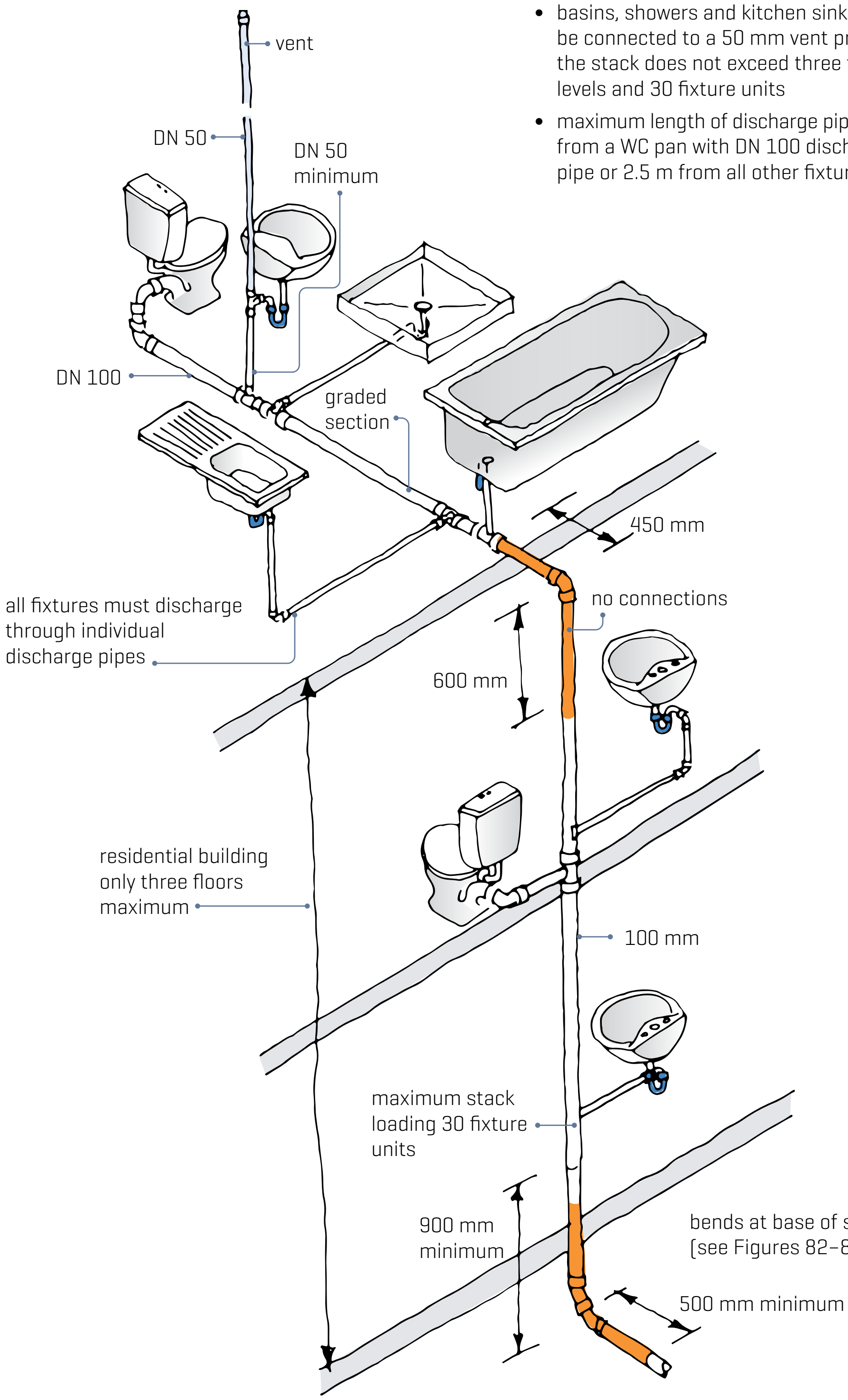


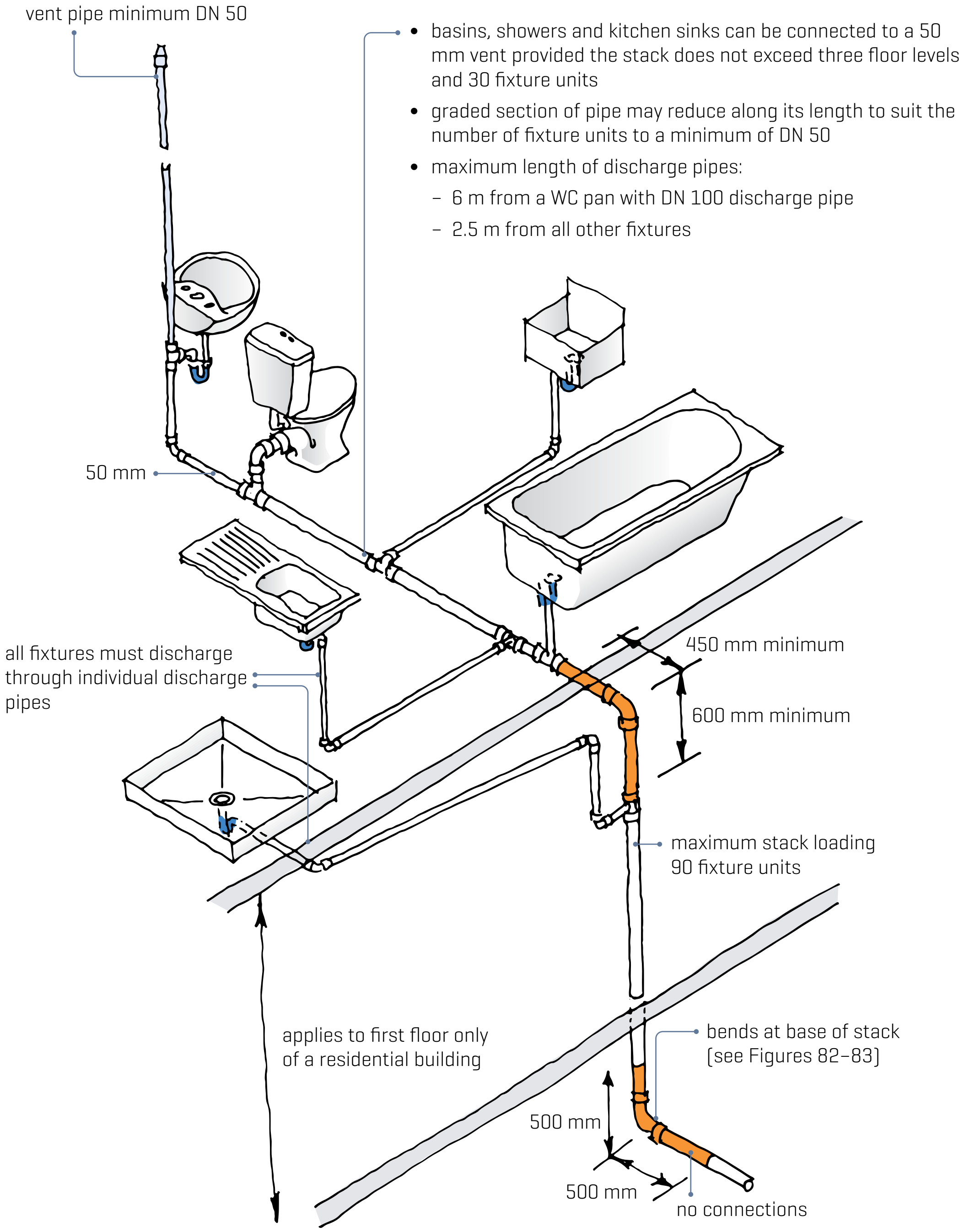
Figure 120. DN 80 stack with graded section at the upper floor of a residential building.



- basins, showers and kitchen sinks can be connected to a 50 mm vent provided the stack does not exceed three floor levels and 30 fixture units
- maximum length of discharge pipes 6 m from a WC pan with DN 100 discharge pipe or 2.5 m from all other fixtures

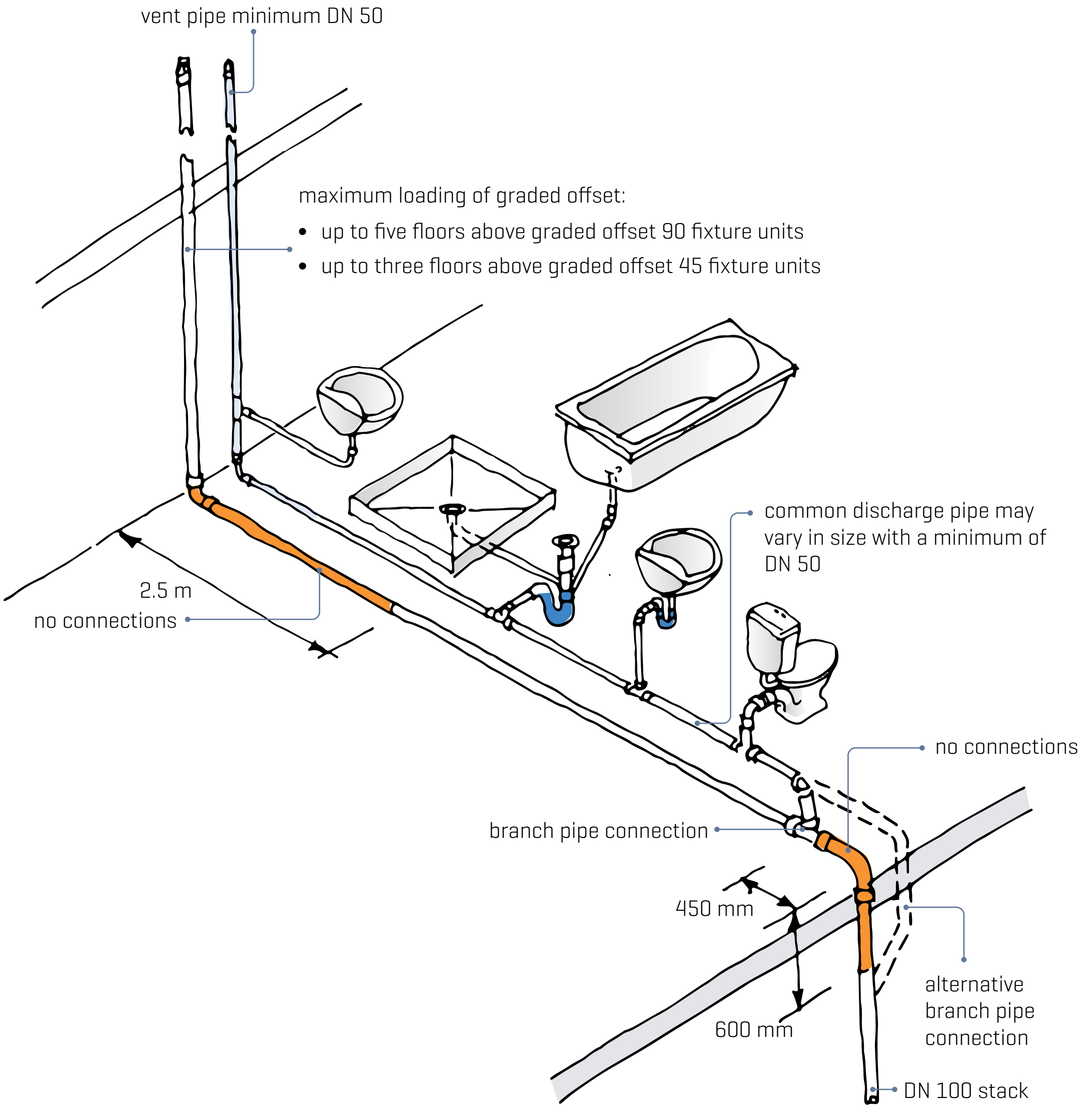
the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 121. 100 mm stack with graded section at the upper floor of a 3-storey residential building.



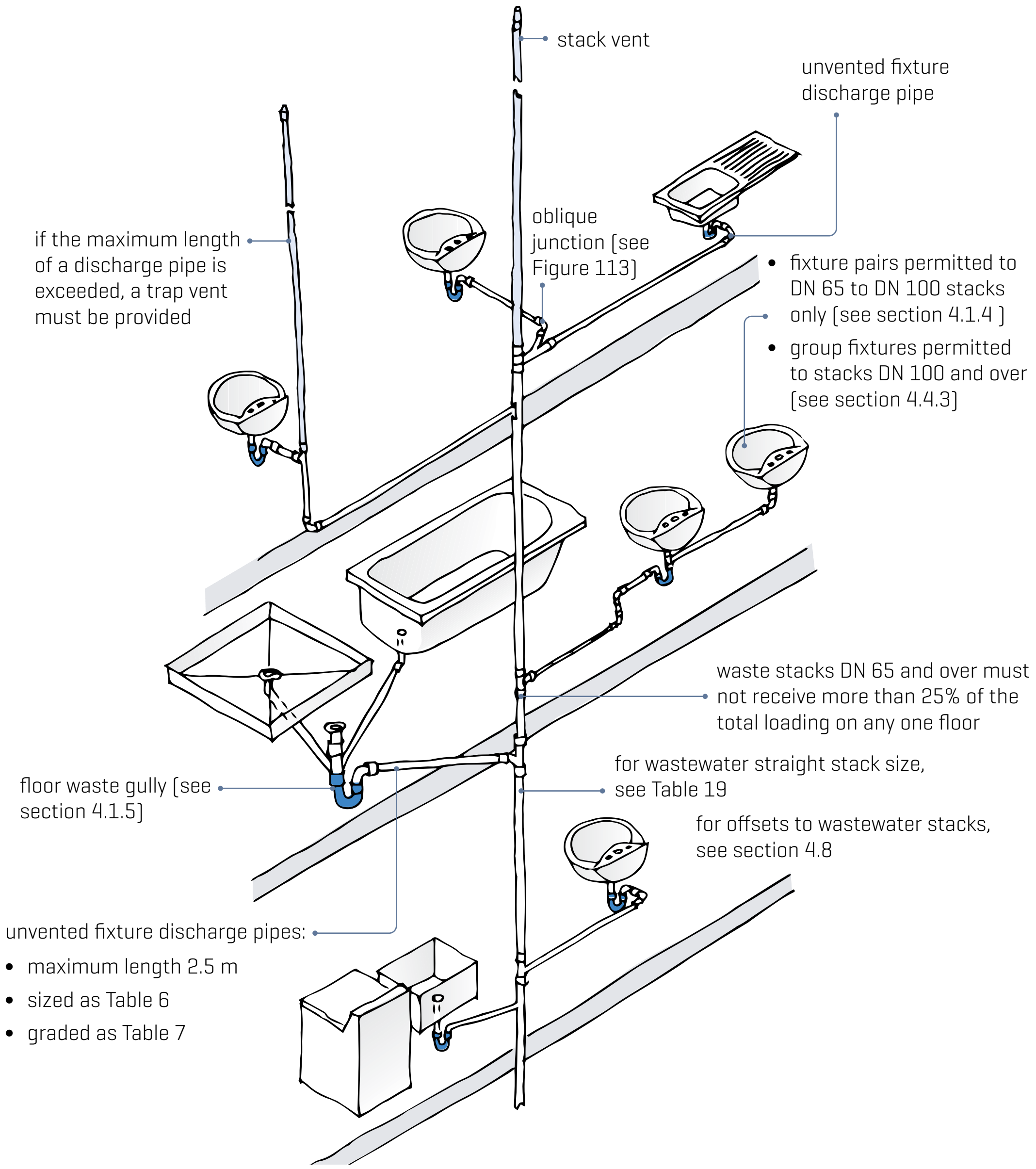
the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 122. 100 mm stack with graded section at the upper floor of a 2-storey residential building.



the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 123. Connection of multiple fixtures into or below a graded offset of a DN 100 single stack.



the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 124. Wastewater stacks.

Table 19. Size of wastewater stacks.

Size of stack (DN)	Maximum fixture unit loading
40	2
50	6
65	15
80	30
100	120

Adapted from AS/NZS 3500.2:2021 Table 9.5.2.

For a DN 65 mm waste stack, not more than two kitchen sinks or one sink and laundry can be connected at any one floor level of a single stack of no more than 2 storeys.

Waste stacks 65 mm and over must not receive more than one-quarter of the total loading (from Table 19) on any one floor. Only waste stacks 65 mm and over may receive discharge pipes connected to fixture pairs (Figures 66–67). Only waste stacks 100 mm and over in commercial type buildings may receive discharge pipes from groups of waste fixtures of the same type (see section 4.4.3).

4.8 OFFSETS IN SINGLE STACK WASTEWATER SYSTEMS

Offsets are permitted in single stack systems carrying only wastewater and enable a stack to be stepped to a more advantageous position above the point of the offset.

An offset may be either:
- a steep offset, which is made at an angle of more than 45° to the horizontal or
- a graded offset, which is made at an angle of less than 45° to the horizontal but to a minimum gradient.

4.8.1 Steep offsets in wastewater stacks

Figure 125 illustrates the general principles.

Wastewater stacks up to DN 100 may have steep offsets between the base of the stack and the highest connection if:
- the maximum unit discharge loading is 120 fixture units
- connections to steep offsets at more than 60° to the horizontal are restricted as shown in Figure 125
- connections to steep offsets between 45° and 60° to the horizontal are restricted as shown in Figure 126.

4.8.2 Graded offsets in wastewater stacks

Figure 126 illustrates the general principles.

Wastewater stacks up to DN 100 may have graded offsets between the base of the stack and the highest connection. The minimum gradient is:

- for a DN 100 pipe – 1:60 (1.65%)
- for a DN 80 pipe or smaller – 1:40 (2.5%).

If connections are made below the lower offset bend, the offset and the stack above the offset must comply with Table 20 and the fixture unit loading for the whole stack must comply with Table 21. If no connections are made below the lower offset bend, the maximum discharge through the offset shall be as shown in Table 19, and the offset section of the pipe (and the stack below) must be increased to the next size.

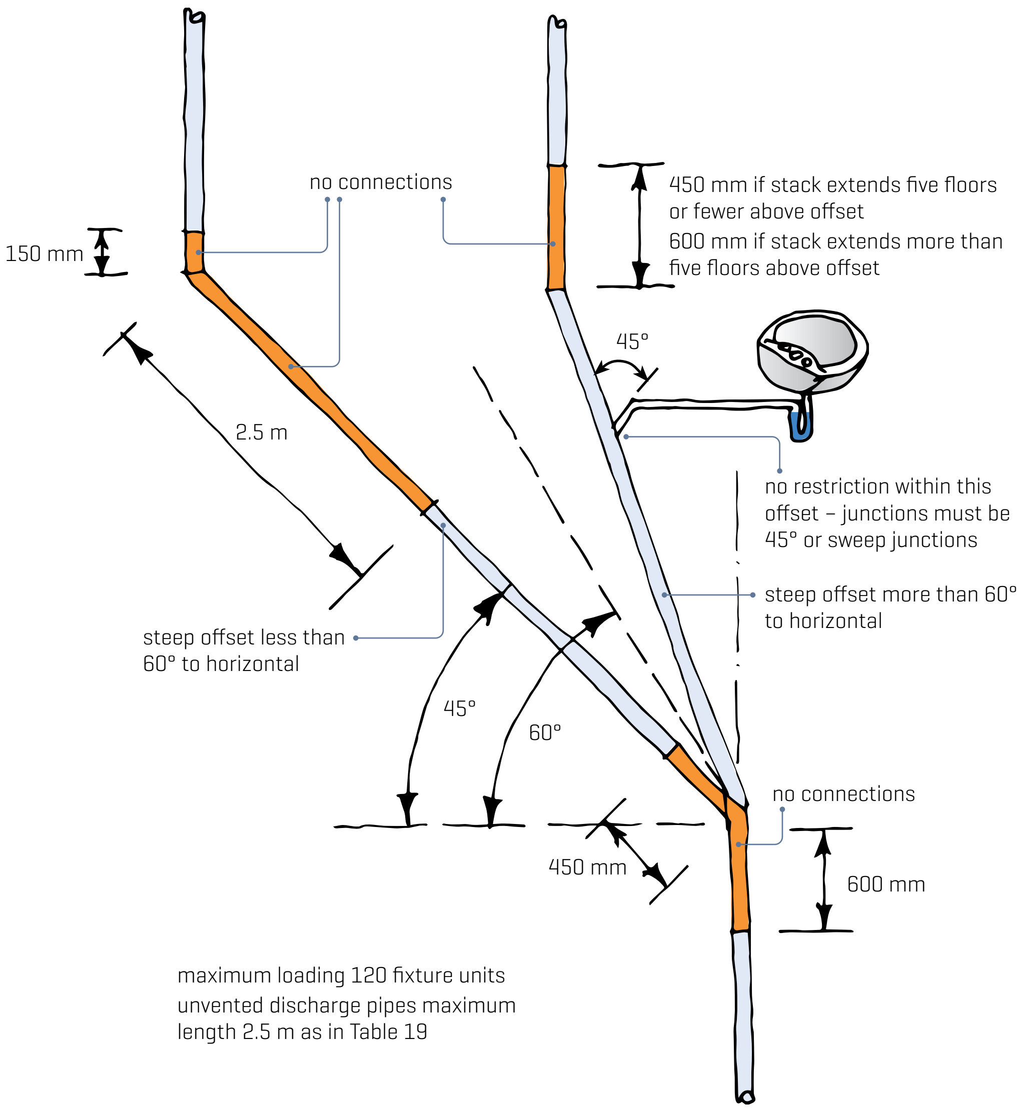


Figure 125. Steep offsets in wastewater stacks up to DN 100 diameter.

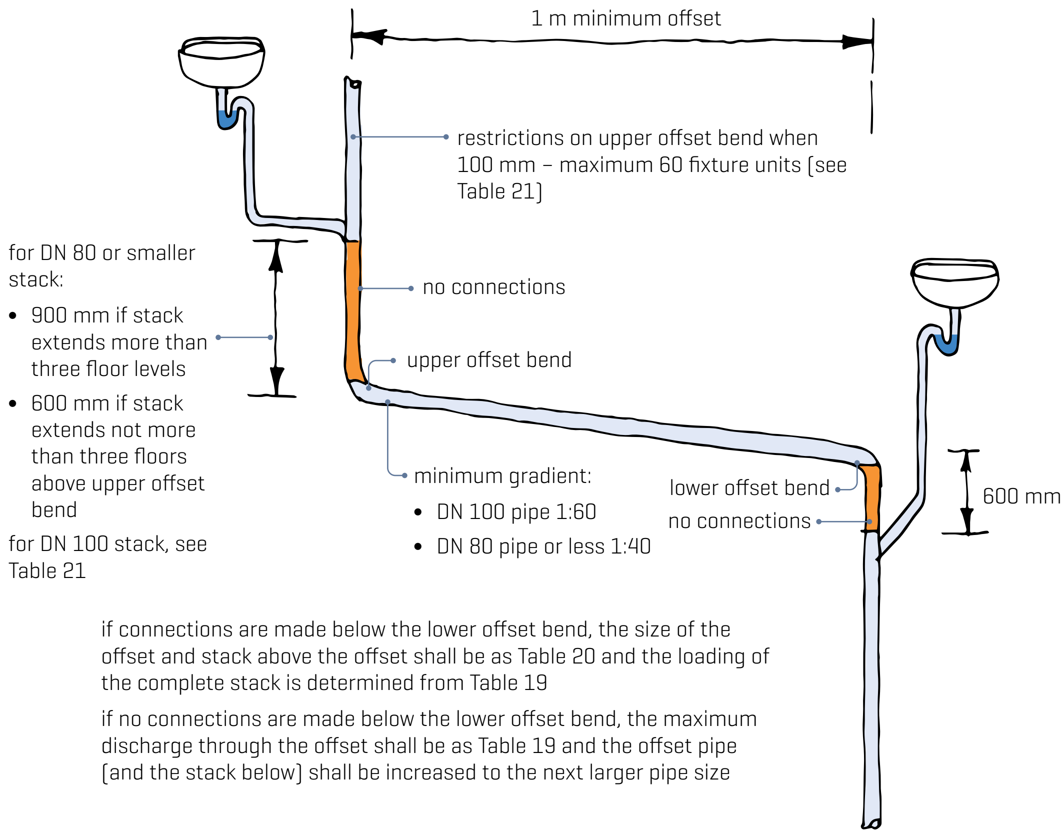


Figure 126. Graded offsets in wastewater stacks up to DN 100.

Table 20. Loading through the graded offsets in waste stacks.

Pipe size through offset (DN)	Maximum fixture unit loading
40	1
50	3
65	8
80	24
100	60

Adapted from AS/NZS 3500.2:2021 Table 9.8.7.1(A).

Table 21. Restrictions on connections near upper graded offset bend of DN 100 wastewater stacks.

Maximum number of floor levels above upper offset bend	Minimum distance between upper bend and connection (mm)	Maximum fixture unit loading
5	450	60
10	600	60

Adapted from AS/NZS 3500.2:2021 Table 9.8.7.1(B).

4.9 FULLY VENTED SYSTEMS

AS/NZS 3500.2:2021 describes both a fully vented system and a fully vented modified system. Both systems are described together in this section.

A fully vented system is one where all fixture traps are individually vented (except for traps discharging to a floor waste gully) normally by way of a trap vent or an air admittance valve.

A fully vented system is applicable to all types of buildings and allows flexibility of layout. It enables fixtures to be arranged at longer distances from the stack because venting the fixture trap eliminates the chance of trap siphonage on long discharge pipes.

A fully vented modified system differs from a fully vented system in that some individual fixture trap vents may be omitted when groups of fixtures are vented by means of a group vent. Because of the additional vent piping, fully vented systems tend to be more expensive than single stack systems.

Figure 127 shows the basic principles of a fully vented modified system including group vents, branch vents and relief vents.

4.9.1 Discharge pipe size

Discharge pipes:

- must not be smaller than the fixture trap
- must have no more than two WC pans connected to them for DN 80 pipes
- must have a size and gradient as in Table 7
- must not be oversized for the purposes of lowering the gradient.

4.9.2 Stack size

The stack size is related to the allowed fixture unit rating, which varies with the number of floors in the building (Figure 128).

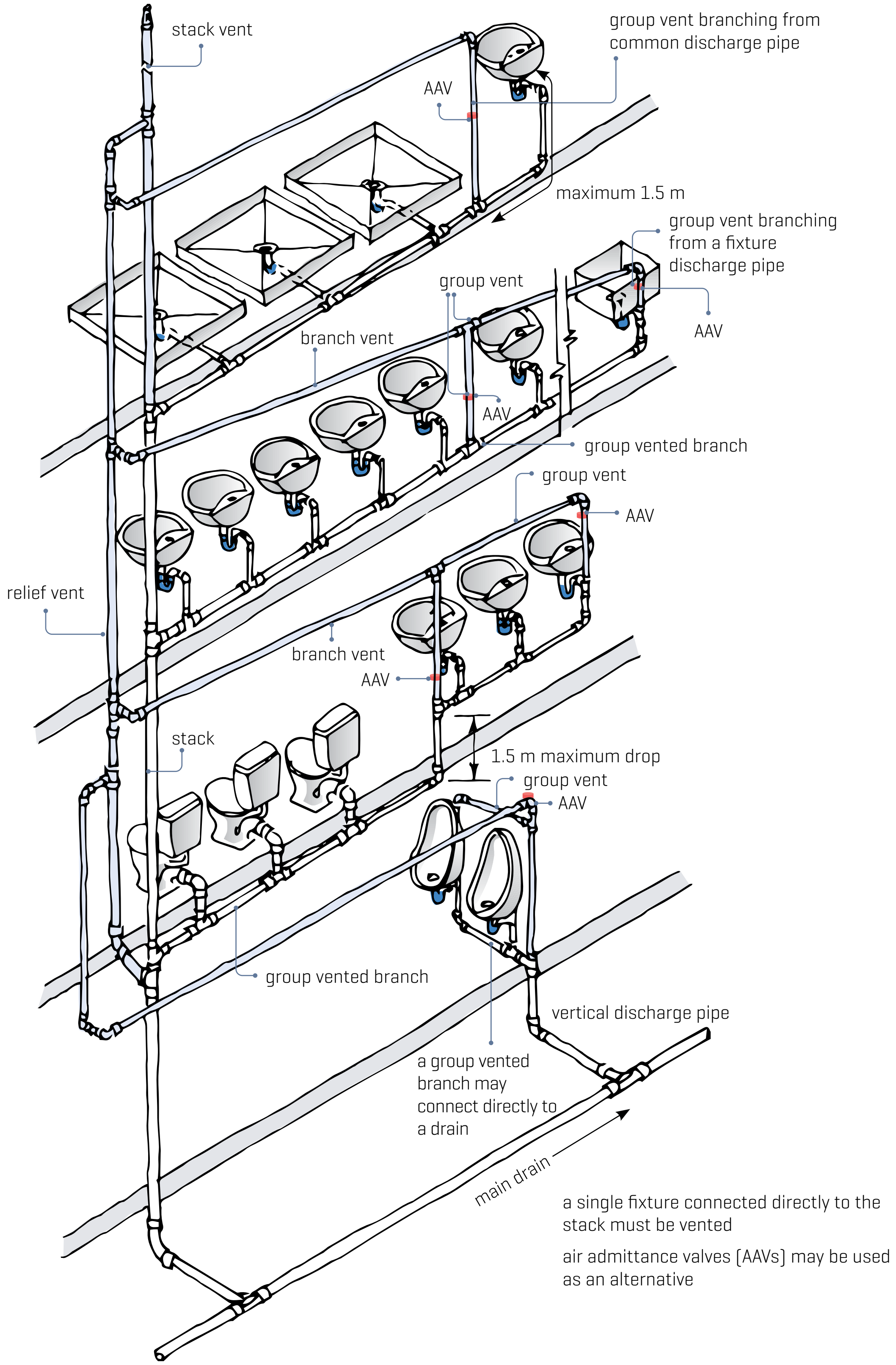
The total fixture unit rating on the stack is reached by adding together the fixture unit ratings (from Table 6) of all fixture discharges that pass through the stack.

For buildings of three floor levels or fewer, the stack size and maximum discharge loadings are calculated from Table 22. For buildings of four floor levels or more, the stack size and maximum discharge loadings are calculated from Table 23.

4.9.3 Trap vents

Basins and bidets must have trap vents connected in accordance with Figure 129. All fixtures other than basins and bidets must have trap vents or air admittance valves connected in accordance with Figure 130.

Trap vents may be replaced with an air admittance valve (see section 4.1.10).



the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected

the Y connections for branch connections must discharge to pipes in the vertical plane

15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 127. Basic principles for a fully vented modified system – the principles apply to all types of fixtures.

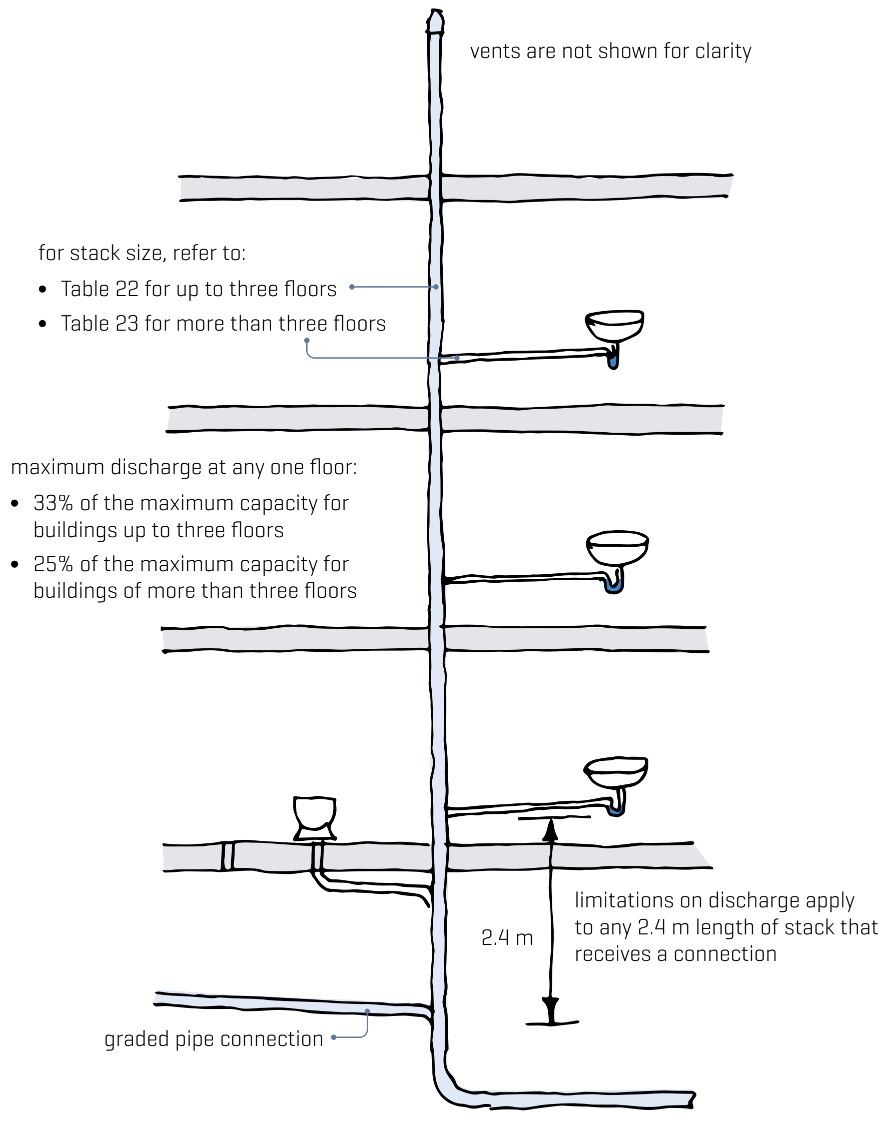


Figure 128. Stack size and discharge limitations.

Table 22. Maximum loading on stacks in a fully vented system – three floor levels or under.

Stack size (DN)	Maximum loading per floor	Maximum loading on the stack
40	2	6
50	5	15
65	6	18
80	13	40
100	65	195

Adapted from AS/NZS 3500.2:2021 Table 8.2.2(B).

Table 23. Maximum loading on stacks in a fully vented system – four or more floor levels.

Stack size (DN)	Maximum loading per floor	Maximum loading on the stack
40	4	16
50	9	36
65	14	56
80	20	80
100	125	500

Adapted from AS/NZS 3500.2:2021 Table 8.2.2(B).

On the topmost fixture only of a fully vented system, the separate trap vent may be dispensed with (the fixture is vented by the stack) and:

- waste fixtures and bidets may be installed in accordance with Figure 131
- WC pans in the topmost position may be installed in accordance with Figure 132.

The minimum size of fixture trap vents must be as shown in Table 24.

Trap vents:

- must be extended upwards to a point above the flood level of the fixture (Figure 133)
- must ascend at a minimum gradient of 1:80 (1.25%)
- may incorporate vertical and graded sections (Figure 134)
- must terminate to the open air by:
  - ascending as a separate vent to the open air
  - connecting to a branch vent (Figure 135)
  - after rising above the flood level of the fixture, looping downwards on a gradient of at least 1:80 (1.25%) to connect with another vent (Figure 136)
  - connecting to a relief or stack vent (Figure 137)
- may be replaced by an air admittance valve (Figures 95–96).

A common vent may ventilate the traps of any two fixtures that are connected to a vertical discharge pipe (Figure 138).

4.9.4 Branch vents

The basic principles of a branch vent are shown in Figure 139.

Branch vents are used to connect two or more trap vents or group vents:

- They must ascend as a separate vent to the open air.
- They must connect to a relief vent or stack vent.
- The point of connection with any other vent must be above the flood level of the highest fixture served.
- Any enlargement of the vent must occur before the junction with another trap vent or group vent.

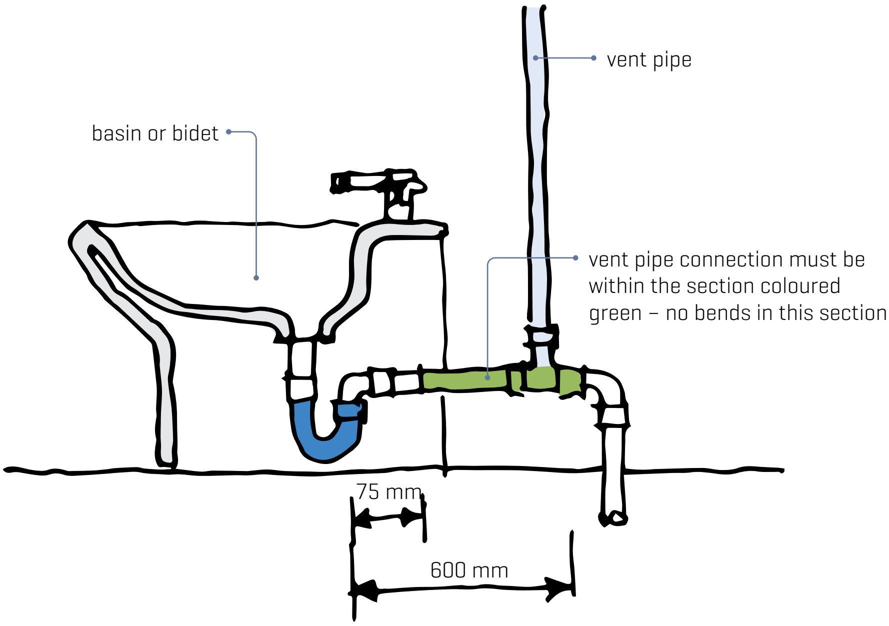


Figure 129. Connection position of vent to basins or bidets.

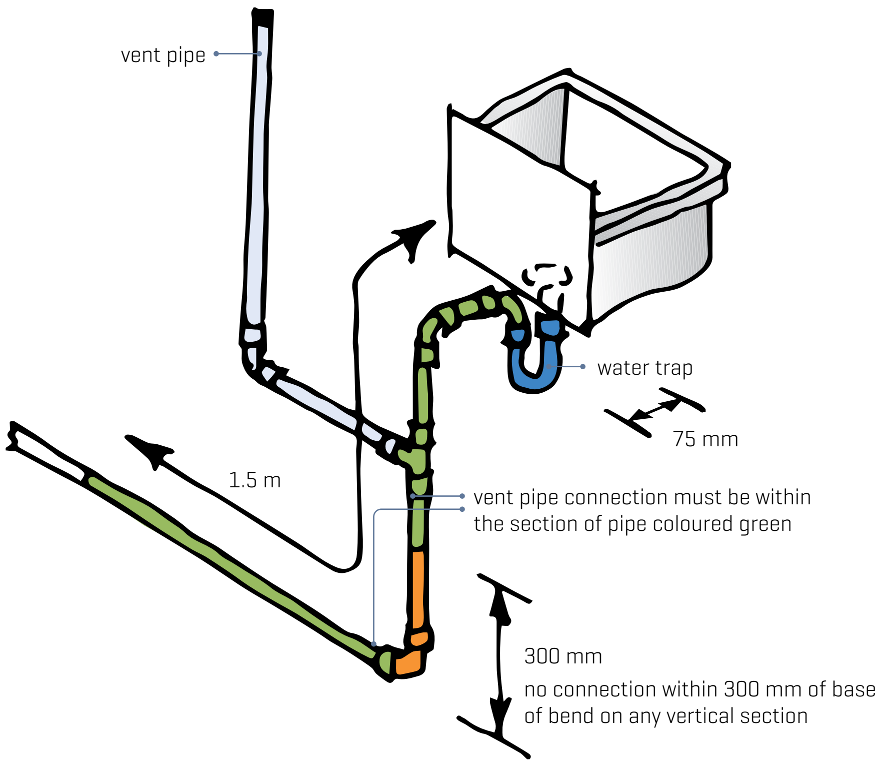


Figure 130. Connection position of vent to all fixtures other than basins or bidets.

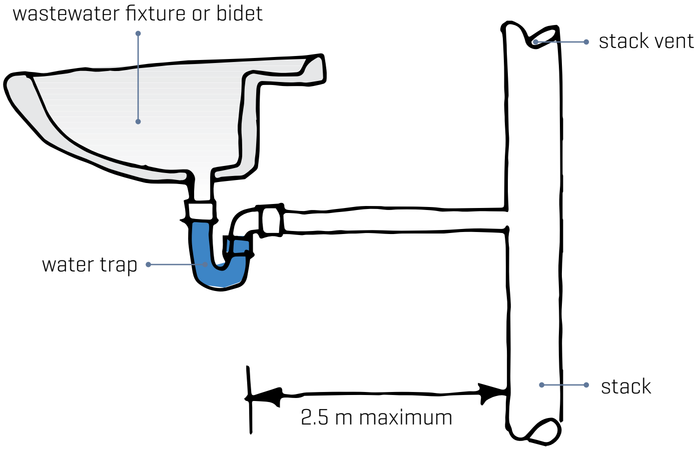


Figure 131. Connection of topmost fixture only to a stack without a separate trap vent – wastewater fixtures and bidets.

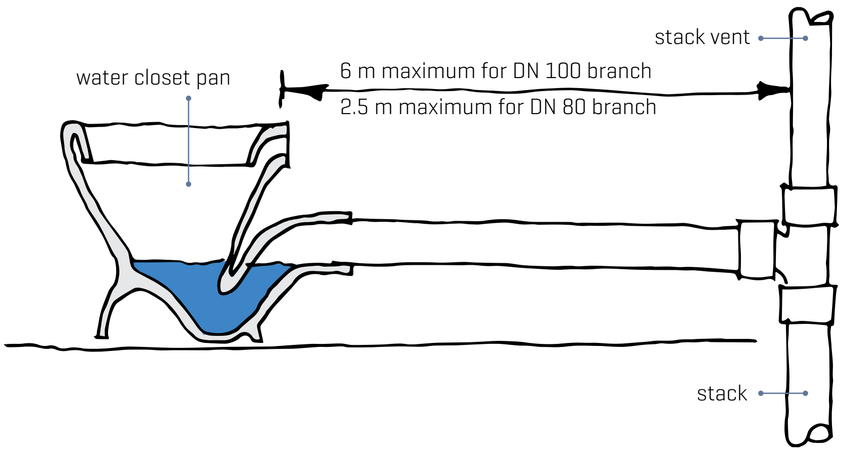


Figure 132. Connection of topmost fixture only to a stack without a separate trap vent – WC pans.

Table 24. Minimum size of fixture trap vents.

Trap size (DN)	Minimum trap vent size (DN)
40	32
between 50 and 100	40

Adapted from AS/NZS 3500.2:2021 Table 8.5.1.3.

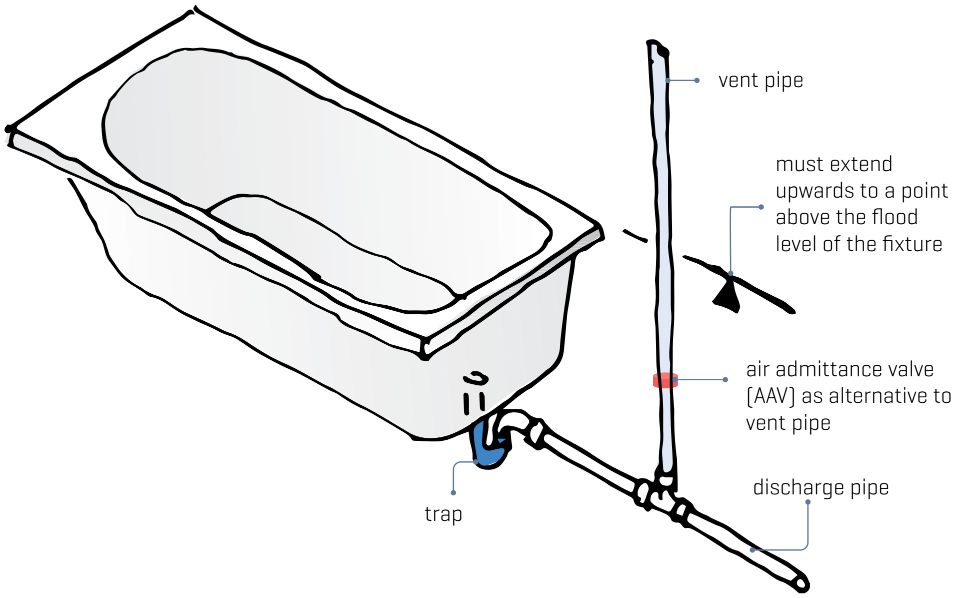


Figure 133. A vent pipe must extend upwards to a point above the flood level of the fixture.

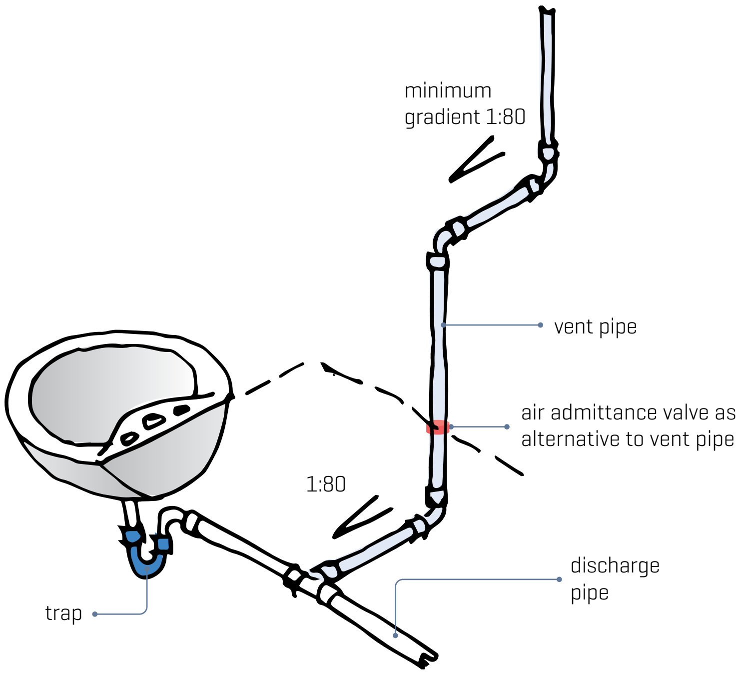


Figure 134. A vent pipe may incorporate vertical and graded sections.

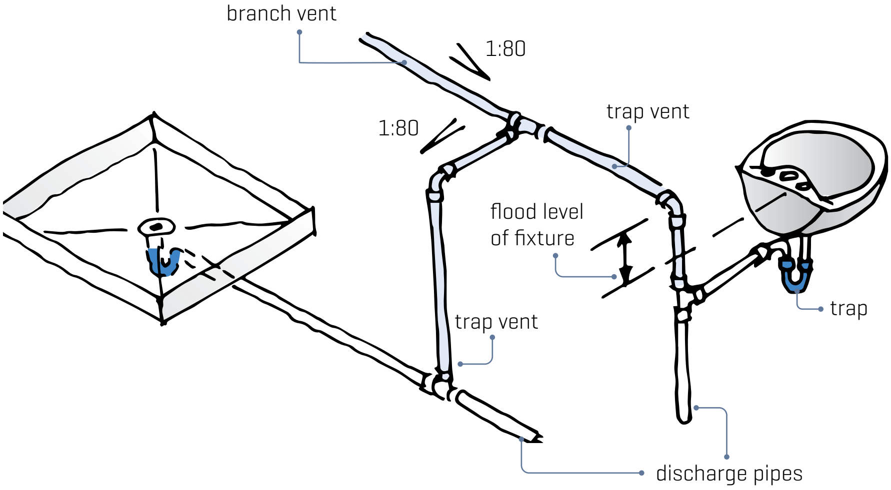


Figure 135. A vent pipe may connect to a branch vent.

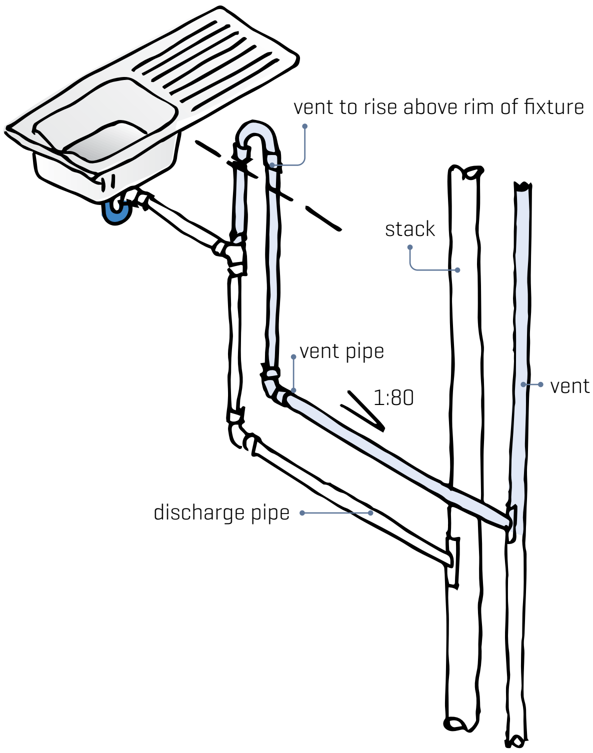


Figure 136. A vent may rise above the rim level of the fixture and then descend to connect at a lower level.

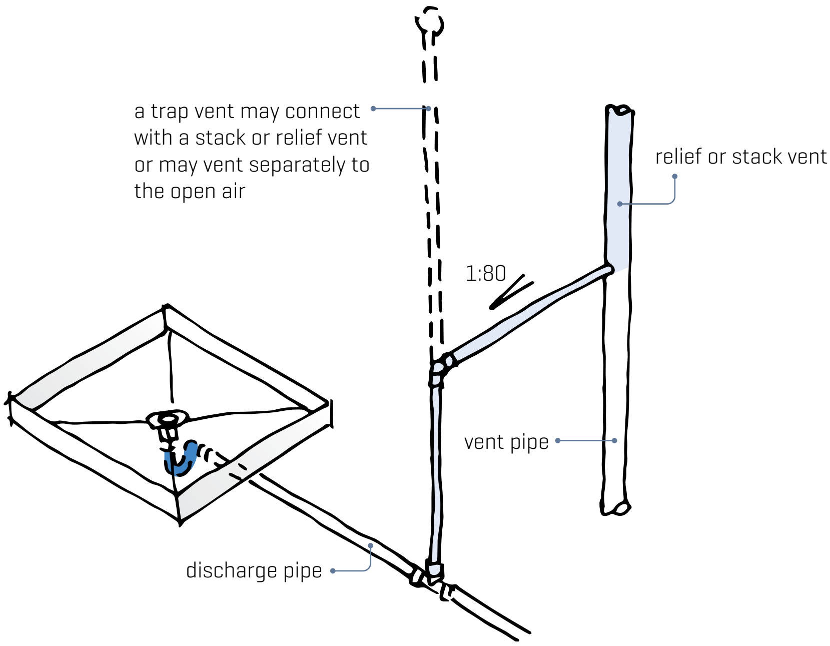


Figure 137. A vent pipe may connect to a stack or relief vent or may discharge separately to the open air.

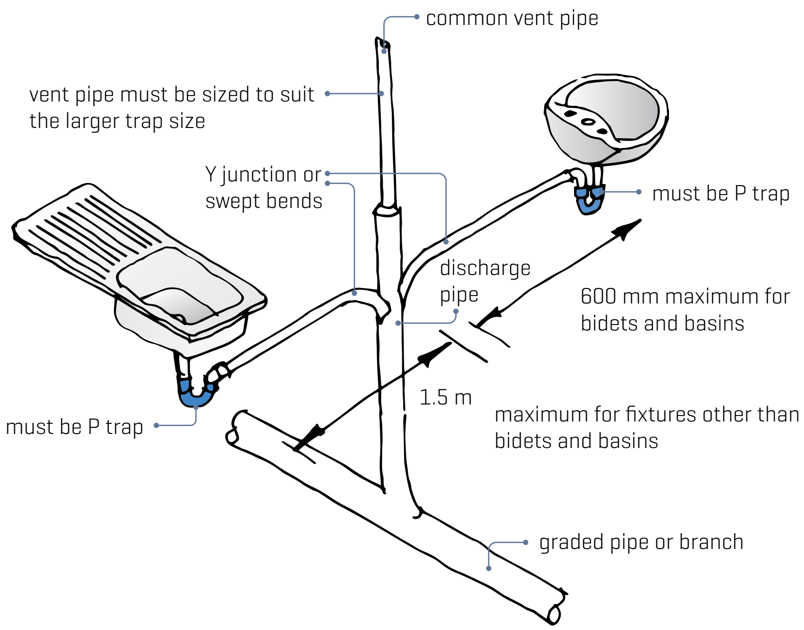
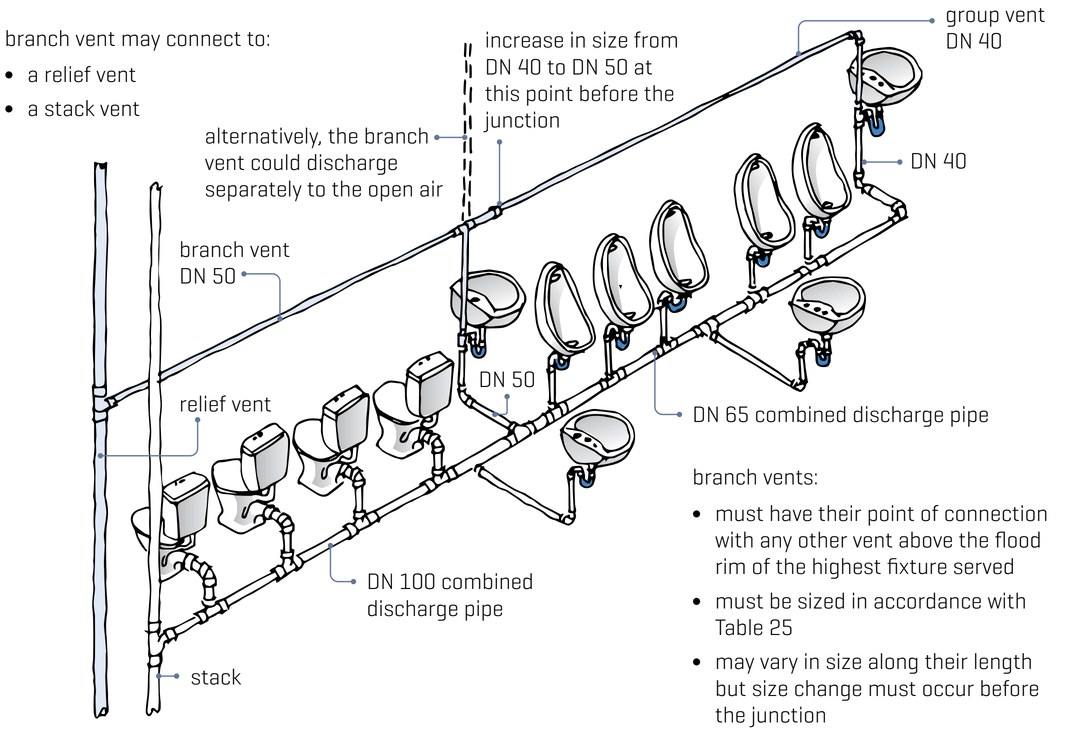


Figure 138. Single vent for any two fixtures connected to a common vertical discharge pipe.



the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 139. Example of a branch vent – the principles apply to all types of fixtures.

Branch vents must be sized in accordance with Table 25.

4.9.5 Relief vents and stack vents

Relief vents provide additional ventilation to stacks limiting the build-up of positive and negative pressures and preventing a loss of trap seals by compression and siphonage respectively.

A relief vent must be provided to fully vented systems and fully vented modified systems if one or more floors separate the floor levels on which the highest and lowest connections are made to the stack and must:

- be connected to the stack below the lowest connection
- be connected at 45% to the horizontal
- extend to the open air by:
  - connection to the stack vent at a minimum gradient of 1:80 (1.25%)
  - connection to a header vent (see section 4.9.8) or another relief vent
  - rising independently to the open air (Figure 140).

All stacks must continue from the highest connection to the open air as a stack vent. Stack vents may have relief vents, header vents, branch vents, group vents or trap vents connected to them.

Table 25. Minimum size of branch vents.

Size of branch discharge pipe (DN)	Size of branch vent (DN)
40	32
50	40
65	40
80	50
100	50

Adapted from AS/NZS 3500.2:2021 Table 8.5.2.1.

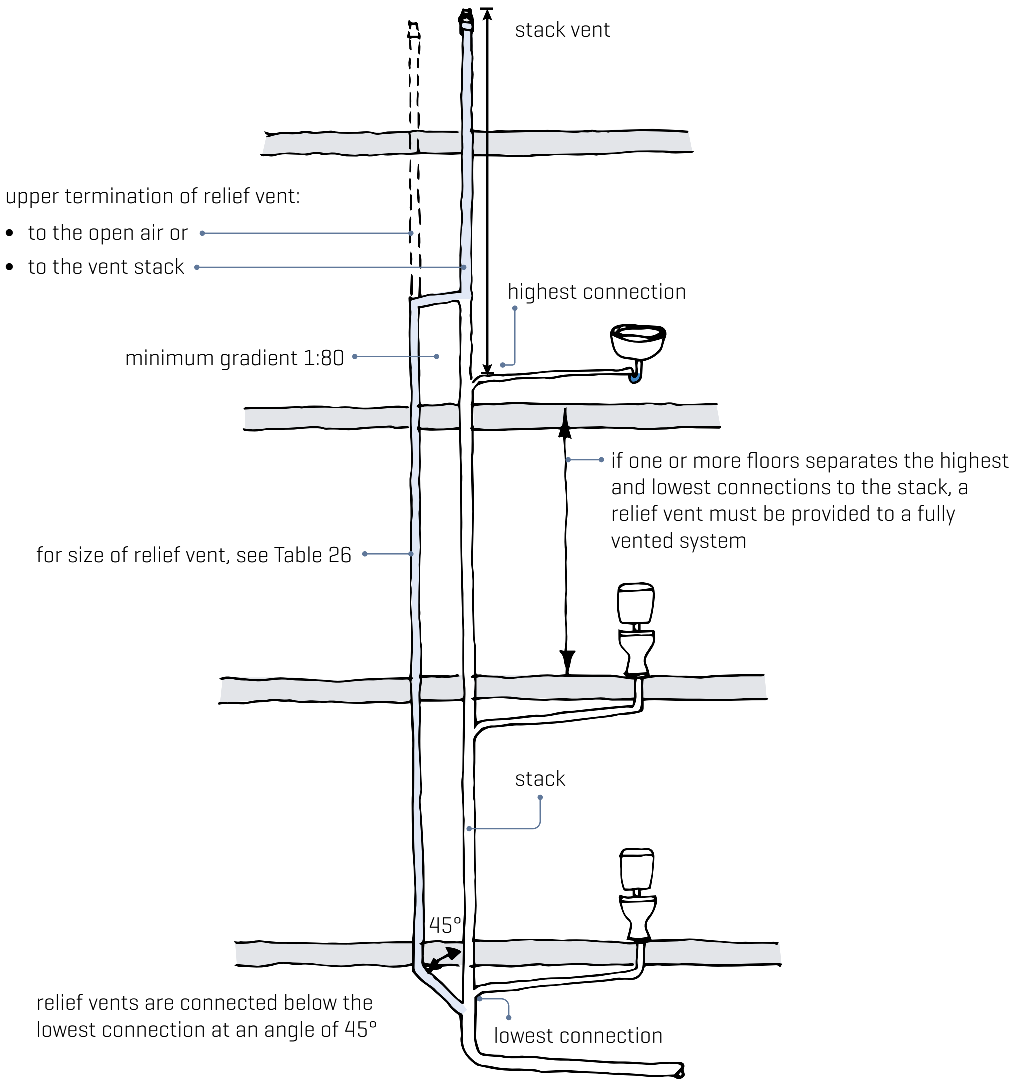


Figure 140. Provision of relief vents.

Table 26. Size of relief vents and stacks.

Stack size (DN)	Fixture unit load	Vent size (DN)					
		32	40	50	65	80	100
		Length of vent in metres					
40	16	6	15				
50	20	8	15	46			
50	36	6	10	30			
65	20		12	40	110		
65	56		7	24	80	170	
80	20		8	27	70	110	
80	80			12	20		
100	150			9	25	70	280
100	300			8	22	60	216
100	500			6	19	50	197

Adapted from AS/NZS 3500.2:2021 Table 8.5.3.5.

The permitted diameter and length of relief vents and stack vents is limited by:

- the diameter of the stack served
- the number of fixture units carried by the stack.

The size and allowable length of relief vents and stack vents is ascertained from Table 26.

The length of vents is the developed length:

- For relief vents, the developed length is measured along the pipe from its lower point of connection to the stack to its termination point (Figure 141).
- For stack vents with a relief vent, the developed length is the length of the relief vent.
- For stack vents without a relief vent, the developed length is measured from the lowest connection on the stack to its termination point (Figure 142).

4.9.6 Relief vents on offset stacks

A stack that is offset at an angle of less than 45° to the horizontal must be provided with a relief vent:

- on the straight section of stack below the offset if one or more floors separate the lowest and highest connection to the total length of stack (Figure 143)
- on the straight sections of the stack both above and below the offset if one or more floors separate the lowest and highest connection to the straight section of stack above the offset (Figure 144).

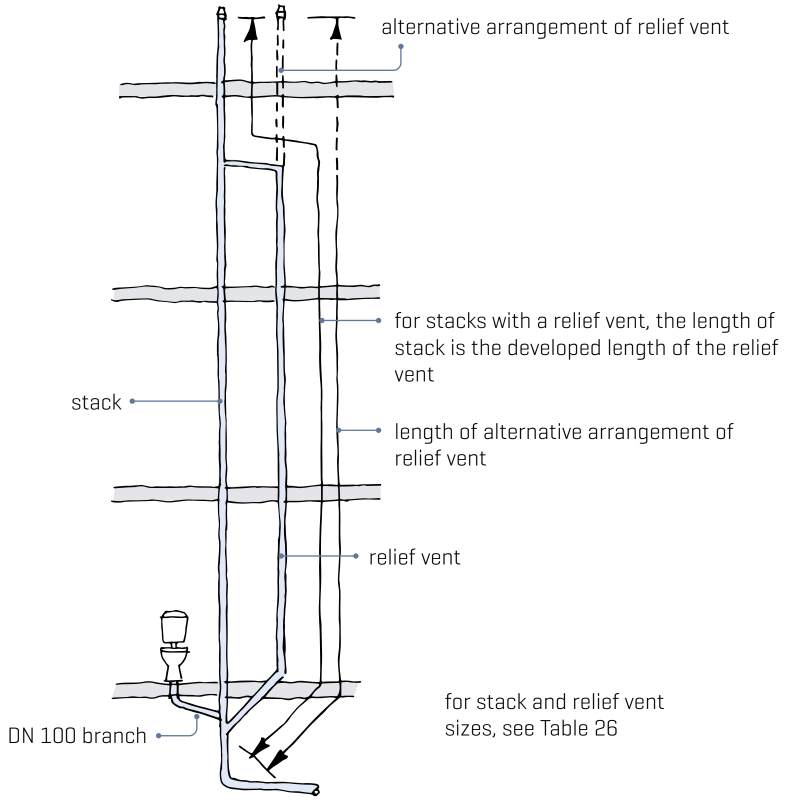


Figure 141. Length of stack and relief vent.

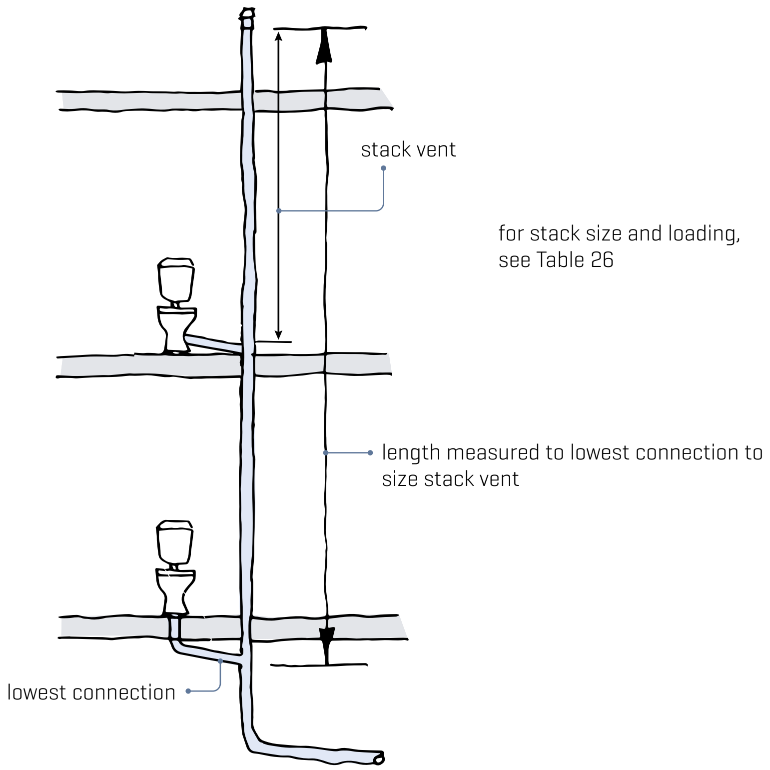


Figure 142. Sizing stack vent – length of stack.

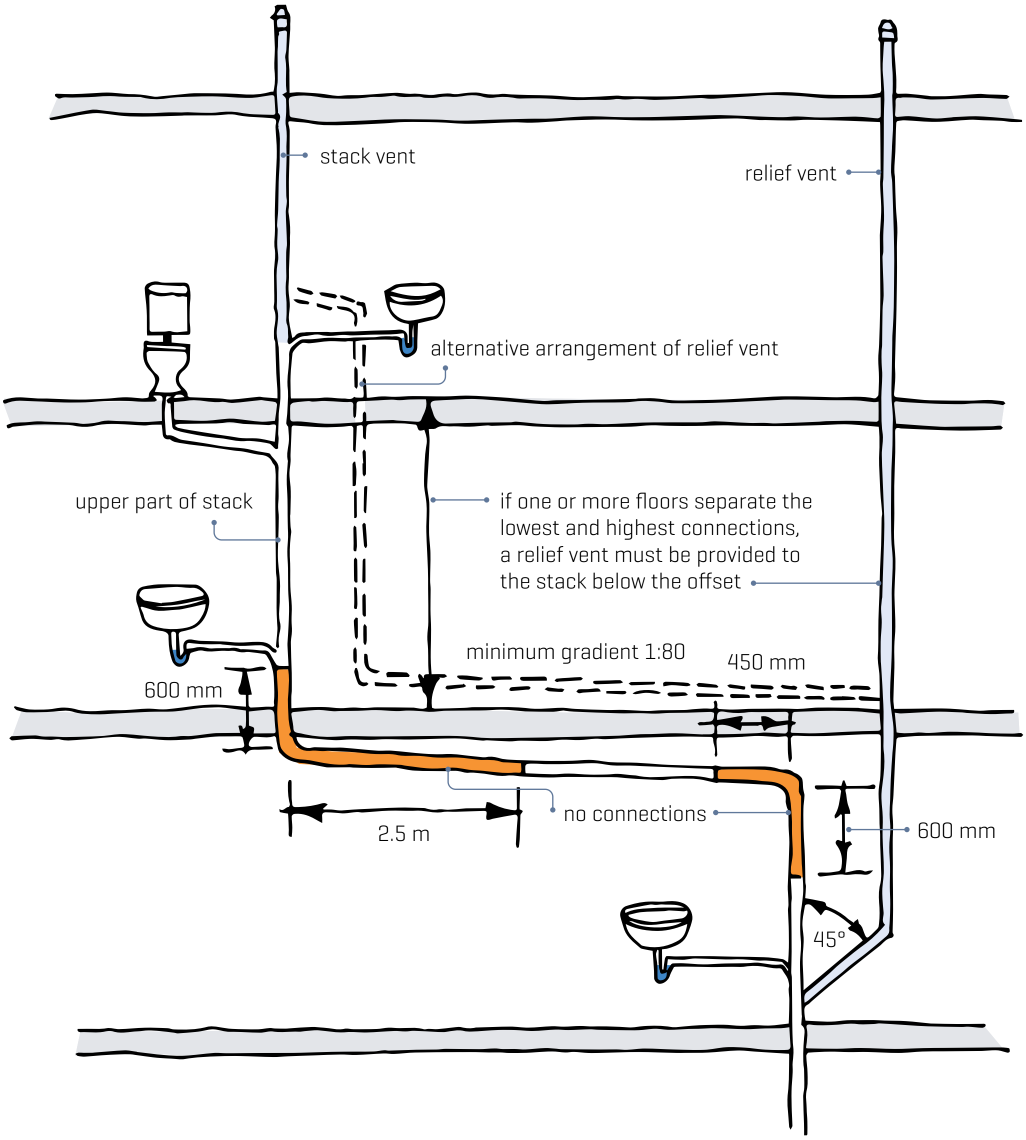


Figure 143. Typical relief vent requirement at graded offset.

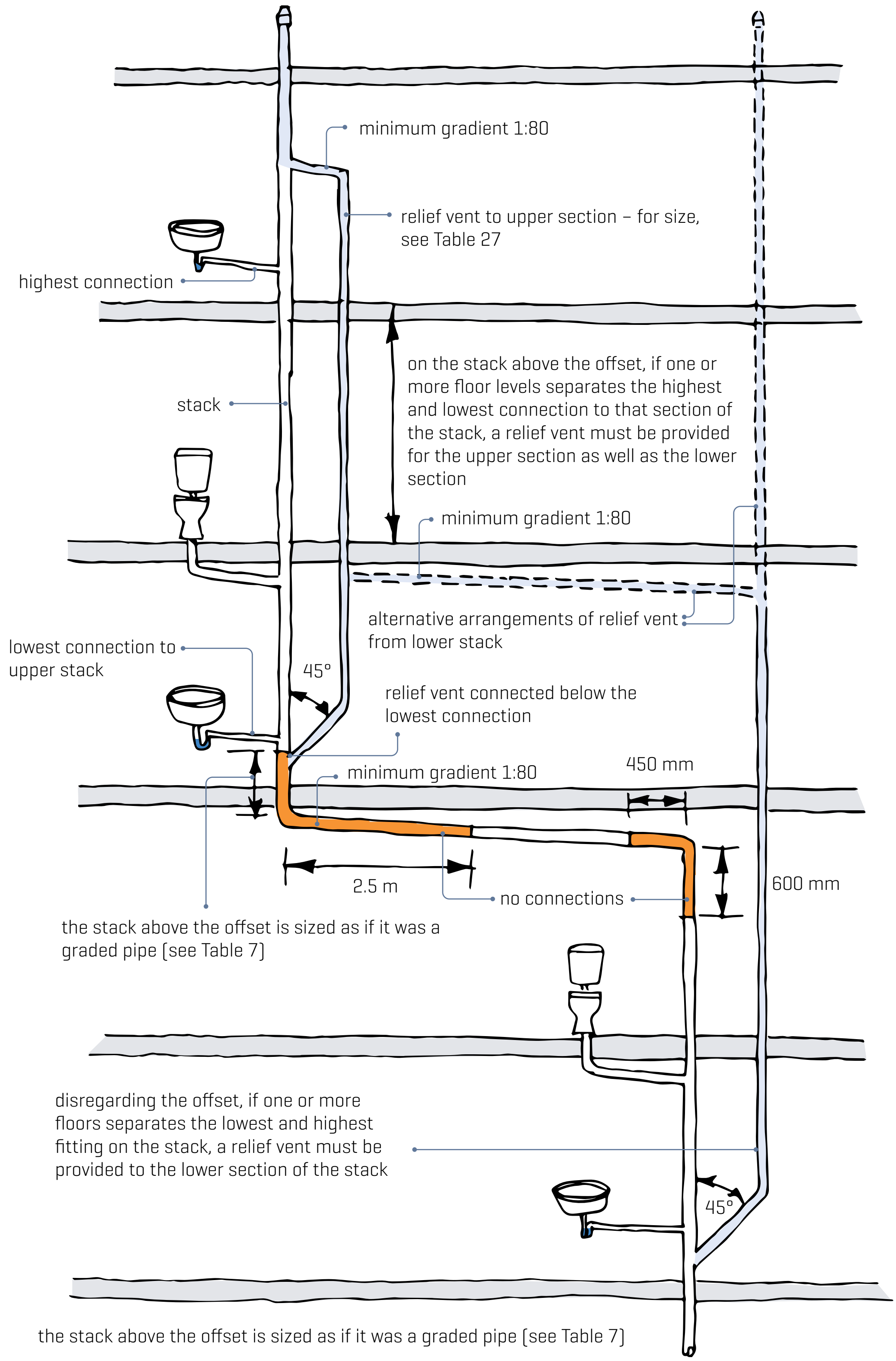


Figure 144. Typical relief vent requirement at graded offset.

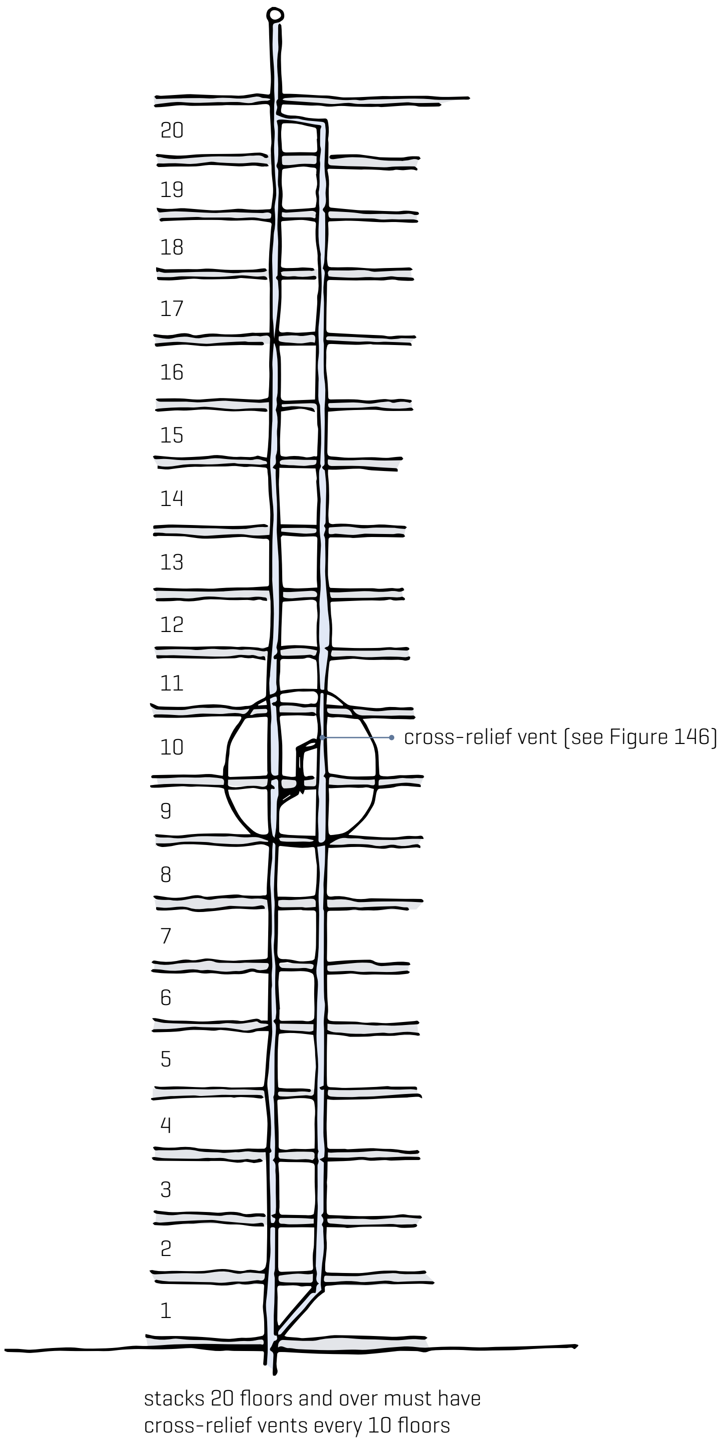


Figure 145. Provision of cross-relief vents.

4.9.7 Cross-relief vents

Cross-relief vents provide additional ventilation to avoid pressure build-up in taller stacks and in fully vented systems. They must be:

- provided at intervals of 10 floor levels in buildings of 20 floor levels or more (Figure 145)
- the same size as the relief vent or the stack, whichever is smaller
- connected as indicated in Figure 146.

4.9.8 Header vents

Header vents are used to connect and collect together a series of stack or relief vents so that there is a single termination point (Figure 147).

Header vent size is determined by using Table 27:

- Find the vent unit value of every stack or relief vent that is connected to the header vent – each unit is the equivalent of one 50 mm vent pipe.
- Total the vent units obtained to identify the header vent size required.
- Repeat the process for each section of header pipe.

4.9.9 Group vents

A fully vented modified system allows unvented fixtures to discharge into a common discharge pipe that is vented by a group vent.

Fixtures that are group vented must be arranged so that:

- no more than 10 fixtures are included in a group (Figure 148)
- when there are more than 10 fixtures, they must be divided into approximately equal groups (Figure 149)
- each group of fixtures is vented.

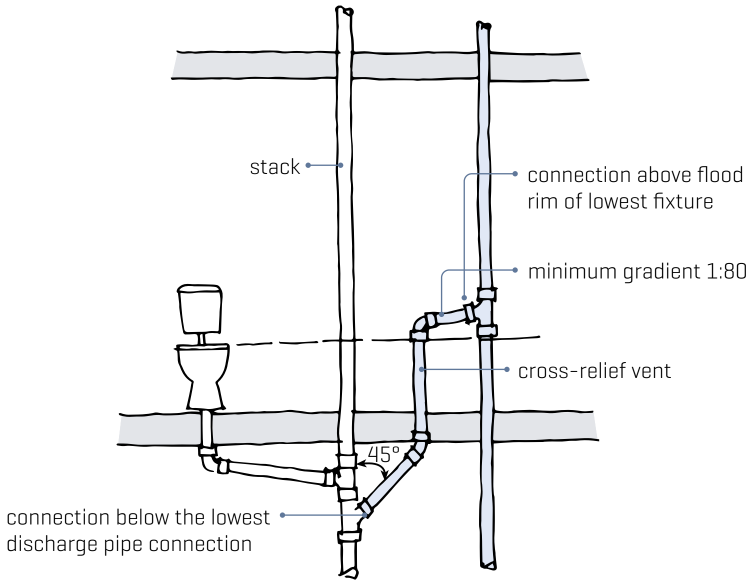


Figure 146. Typical relief vent requirement at graded offset.

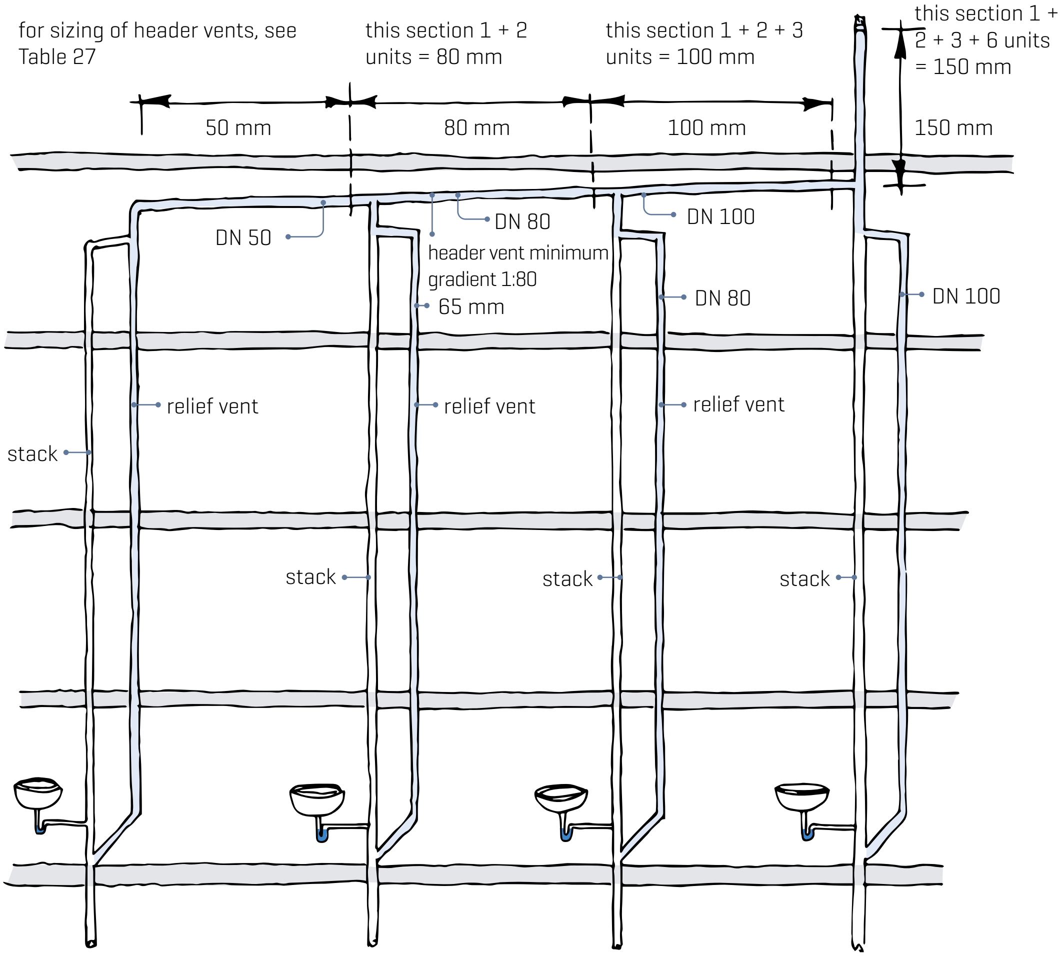


Figure 147. Principle and sizing of header vents.

Table 27. Sizing of header vents.

Size of stack or relief vent (DN)	Number of vent units for each vent	Size of header vent (DN)
50	1	50
65	2	65
80	3	80
100	6	100
125	11	125
150	18	150

Adapted from AS/NZS 3500.2:2021 Table 8.5.6.2.

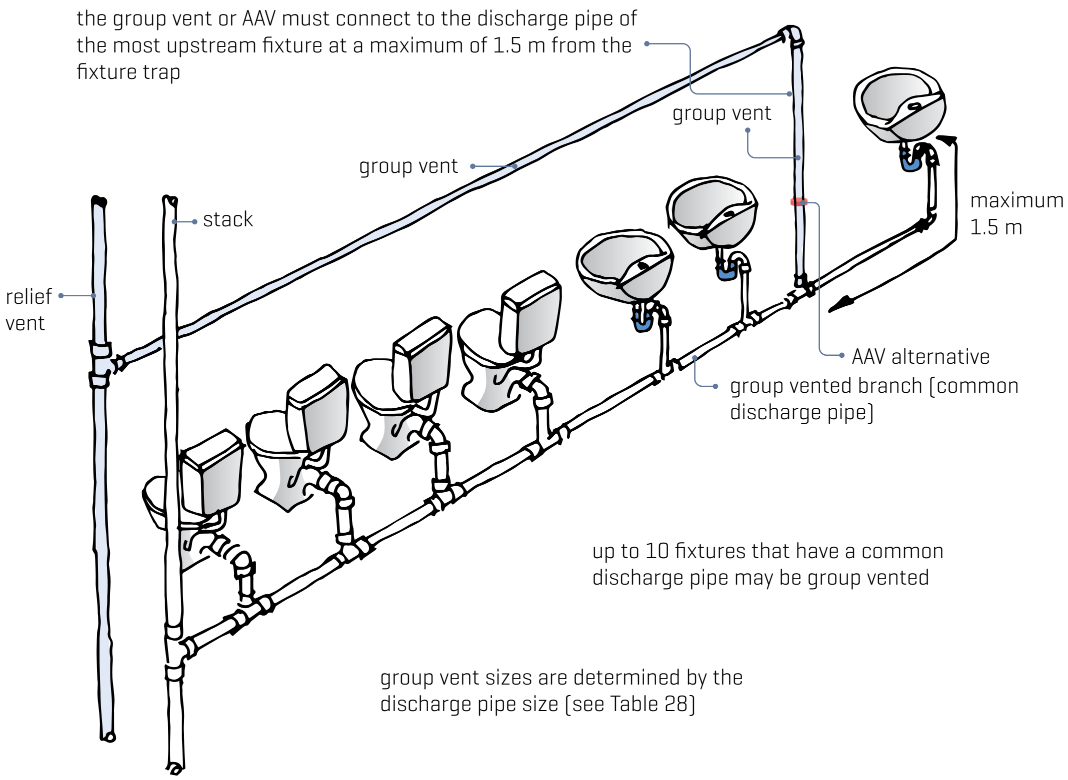


Figure 148. Group venting up to 10 fixtures.

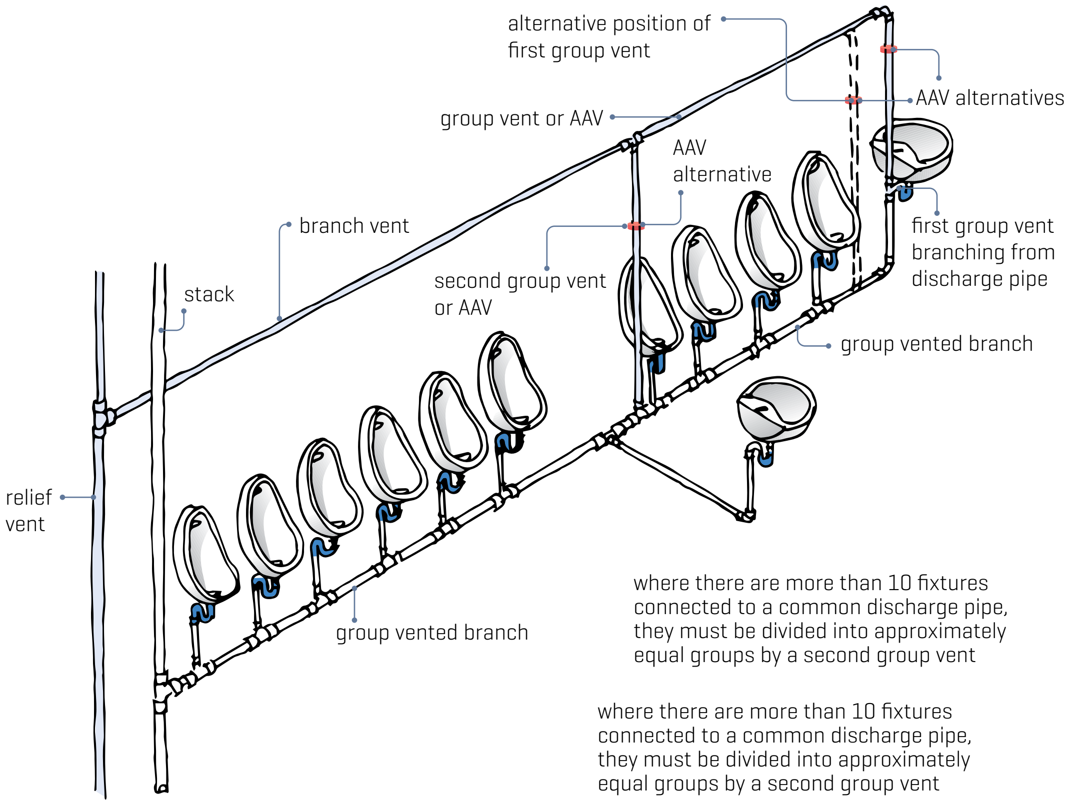


Figure 149. Group venting more than 10 fixtures – the principles apply to all types of fixtures.

Group vents must be installed so that:

- the first group vent connects to the discharge pipe at a maximum distance of 1.5 m from the trap of the top fixture
- the second group vent and any further group vents must connect to the discharge pipe to divide the fixtures into approximately equal groups
- where a drop in the discharge pipe occurs, a vent must be provided as shown in (a), (b) or (c) in Figure 150.

The group vent size is related to the size of the largest section of the common discharge pipe being served, as given in Table 28.

Table 28. Size of group vents.

Size of common discharge pipe (DN)	Size of group vent (DN)
40	32
50	40
65	40
80	50
100	50

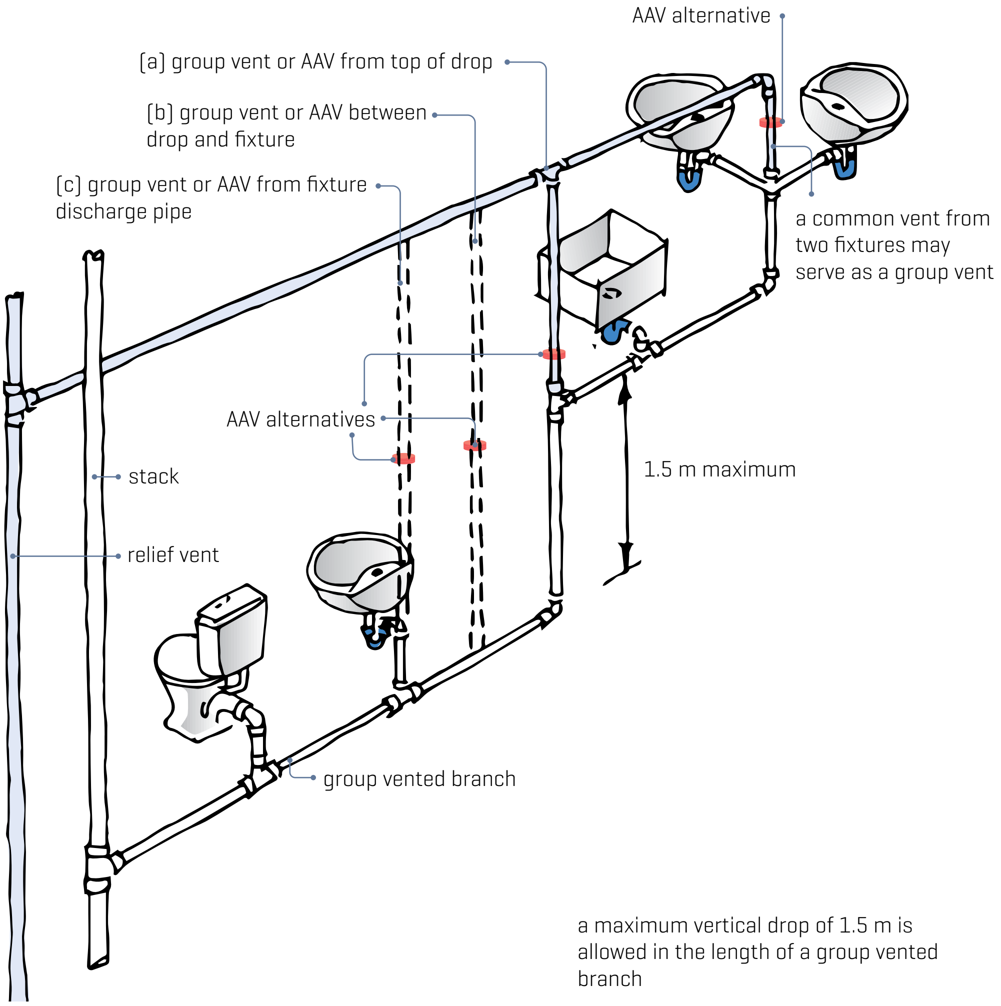
Adapted from AS/NZS 3500.2:2021 Table 8.5.7.3.

4.9.10 Group vented branches

Group vented branches must:

- be sized in accordance with Table 28 (if a group vent is larger than the discharge pipe to which it connects, the discharge pipe must be increased to the size of the group vent)
- be to grade wherever possible, but a maximum drop of 1.5 m is permitted
- connect directly to:
  - a stack
  - another common discharge pipe
  - a drain
  - a disconnector gully (Figure 151).

Connection of basins and bidets to a group vented branch must comply with Figure 88. Connection of fixtures other than basins and bidets must comply with Figure 89. A trap vent must be installed if the fixture discharge pipe does not comply.



a maximum vertical drop of 1.5 m is allowed in the length of a group vented branch

where fixtures are connected downstream of the drop, a group vent must be provided:

- at the top of the vertical drop [a] or
- between the drop and the first downstream fixture [b] or
- from the first downstream fixture discharge pipe [c]

Figure 150. Group venting – common vents and drops.

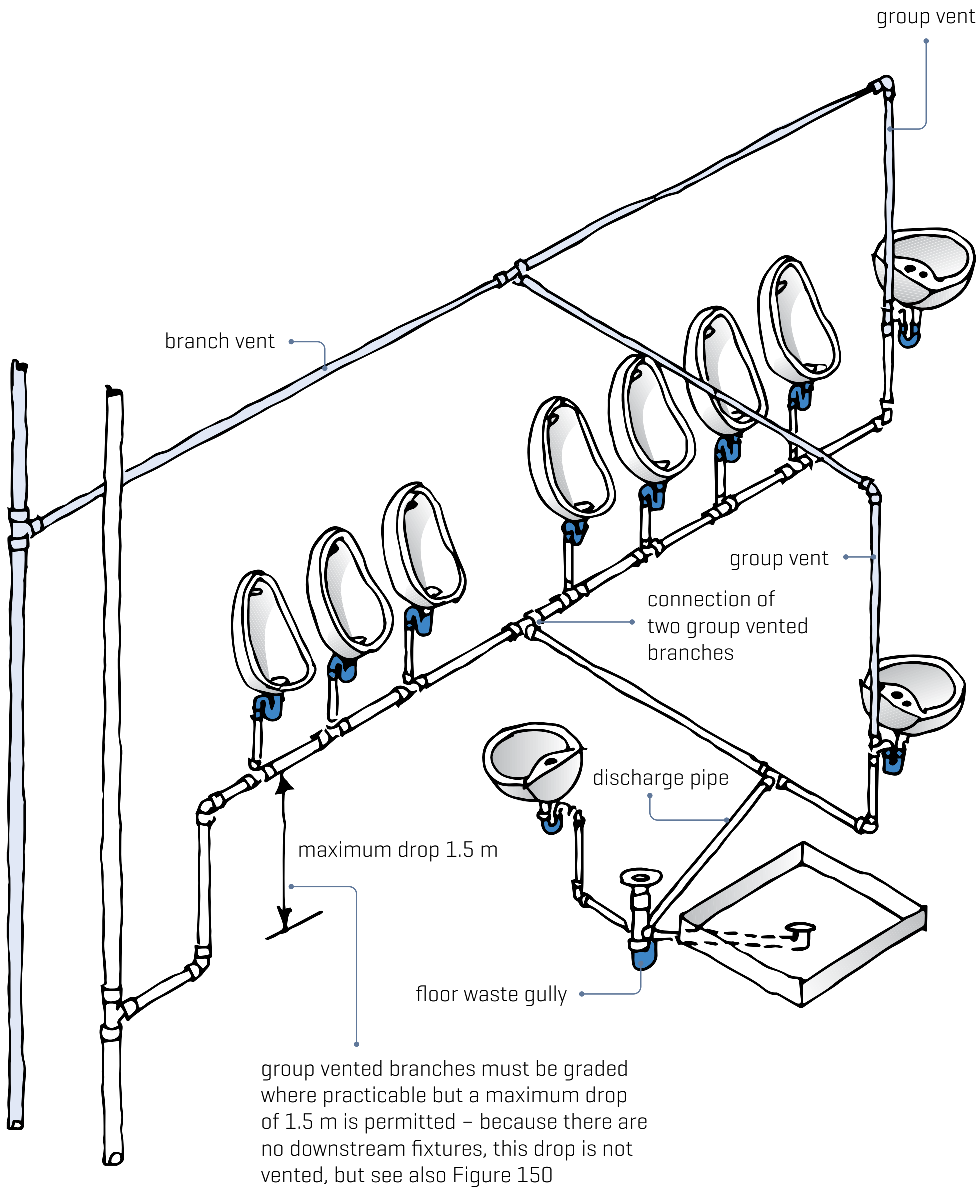


Figure 151. Group venting and connection of group vented branches.

4.10 SYSTEMS USING DRAINAGE PRINCIPLES

Pipework above ground level (elevated drains) may be installed within buildings using the same rules that are used for below-ground drainage.

The main reason for using this system is that:

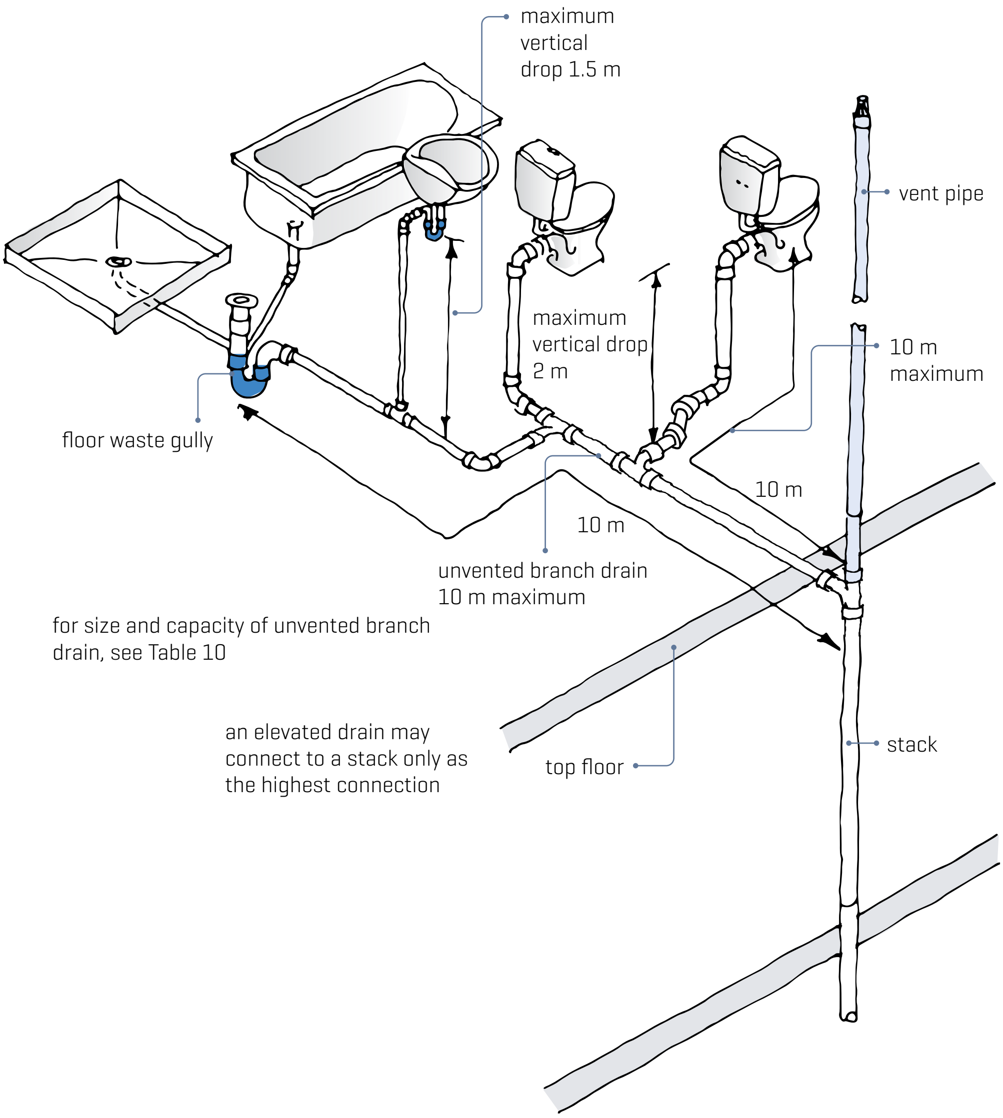
- longer unvented branches may be used
- horizontal branches may be combined before connection to the main branch.

Elevated drains may be used:

- above ground as a horizontal drain
- to serve the topmost floor when connected to stacks (Figure 152)
- in a multi-storey building using drainage principles to the horizontal pipes only up to no more than 4 storeys (Figure 153).

Restrictions on elevated drainage systems are as shown in Figure 153:

- The length of a combined fixture discharge pipe and unvented branch drain must not exceed 10 m.
- The size of unvented branch drains must comply with Table 10.
- Fixture discharge pipes must not exceed:
  - 2 m long for DN 80 WC pans
  - 10 m long for DN 100 WC pans
  - 2.5 m long for all other fixtures.
- Connection of fixtures must comply with Figures 88–89.
- In multi-storey buildings, connection of fixtures and branch drains may only be made to the graded sections of the first four floors of the system.
- In multi-storey buildings on the top floor only, drainage rules may be used and a branch drain connected to the stack.
- The connection of fixture discharge pipes without the need for venting is subject to limitations on their length.



the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 152. Pipework using drainage principles applied to the top floor only.

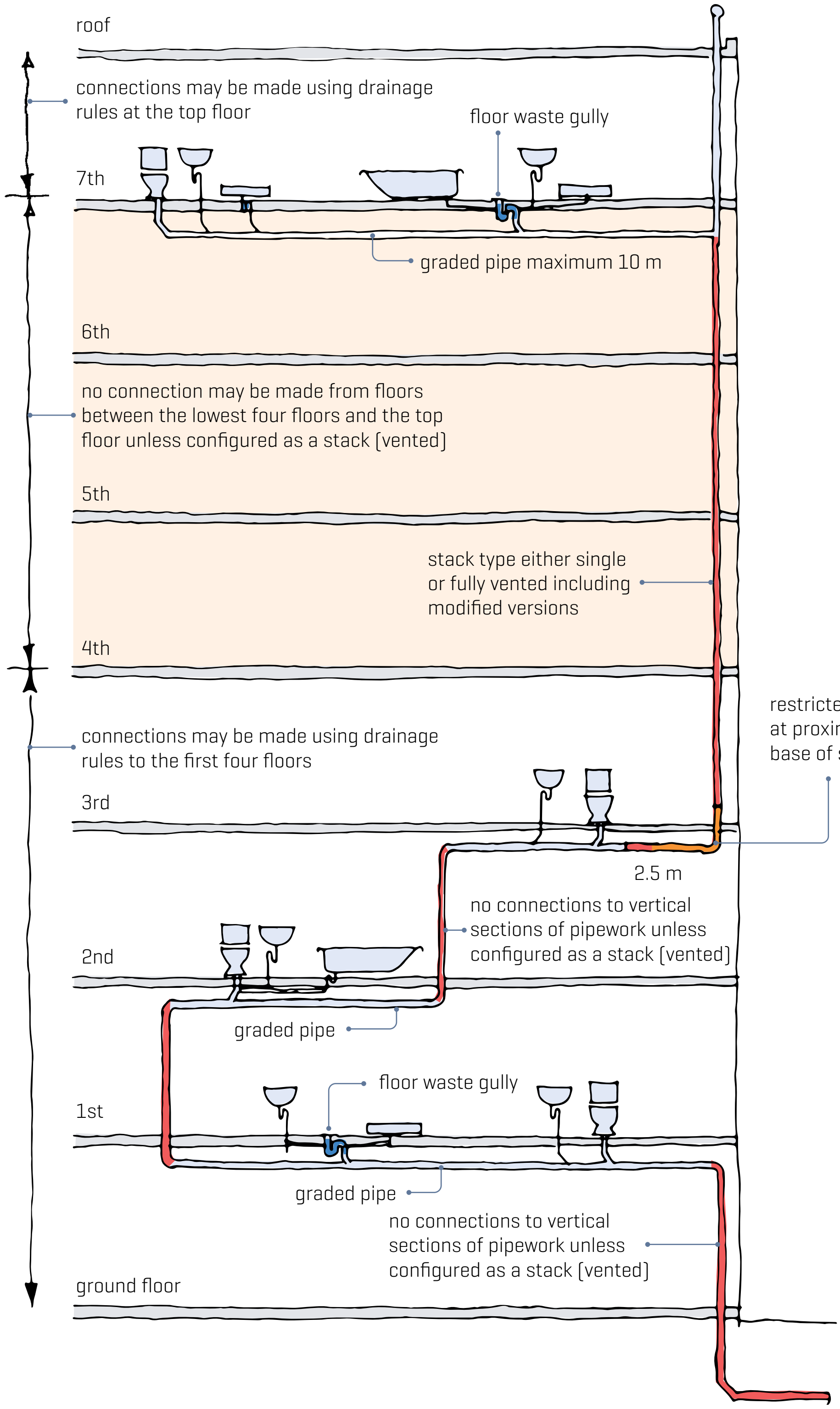


Figure 153. Pipework using drainage principles applied to a multi-storey building.

4.11 EXPANSION JOINTS

All above-ground pipe installations are subject to thermal movement, and provision must be made to accommodate this. In designing for thermal movement, refer to the appropriate standards and the manufacturer's recommendations.

G13/AS1 *Foul water* requires copper and uPVC pipework to have expansion joints and requires uPVC to meet the provisions in AS/NZS 2032:2006 *Installation of PVC pipe systems* section 6.4.

AS/NZS 3500.2:2021 requires copper and copper alloy pipework to be installed in accordance with clauses 10.6.3.2, 10.6.3.3 and 10.6.3.4, as appropriate.

uPVC pipework must be installed in accordance with AS/NZS 2032:2006 and following the requirements of AS/NZS 3500.2:2021.

4.11.1 Basic rules for expansion joints

Expansion joints are required on uPVC vertical stacks (Figure 154) at:

- a minimum spacing of 4 m for hot pipelines
- a minimum spacing of 6 m for cold pipelines
- each floor level, either:
  - immediately above the highest discharge branch entry
  - if there is no branch entry, at 300 mm above that floor level
- 300 mm above floor level at the base of the stack
- the centre of any hot zone where the distance between the top and bottom discharge branches in the zone is greater than 1 m.

A hot zone is a section of pipe carrying discharges greater than 60°C such as that from a dishwasher or steriliser.

Expansion joints are required on uPVC graded pipes (Figure 155) at:

- a minimum spacing of 4 m
- each branch entry to a vertical stack (except a branch of less than 2 m with provision for movement will not require an expansion joint)
- the first fitting downstream of each bend
- the first fitting downstream of a junction into the graded pipe (except that where two expansion joints are provided within 1 m of any junction will not require an expansion joint).

Expansion joints are required on uPVC vent pipes (Figure 156) at:

- a minimum spacing of 4 m
- each floor of the stack
- every second junction on a graded vent pipe
- the entry of a graded vent pipe to a vertical vent stack or discharge vent stack
- the highest junction into the vent stack or discharge vent stack.

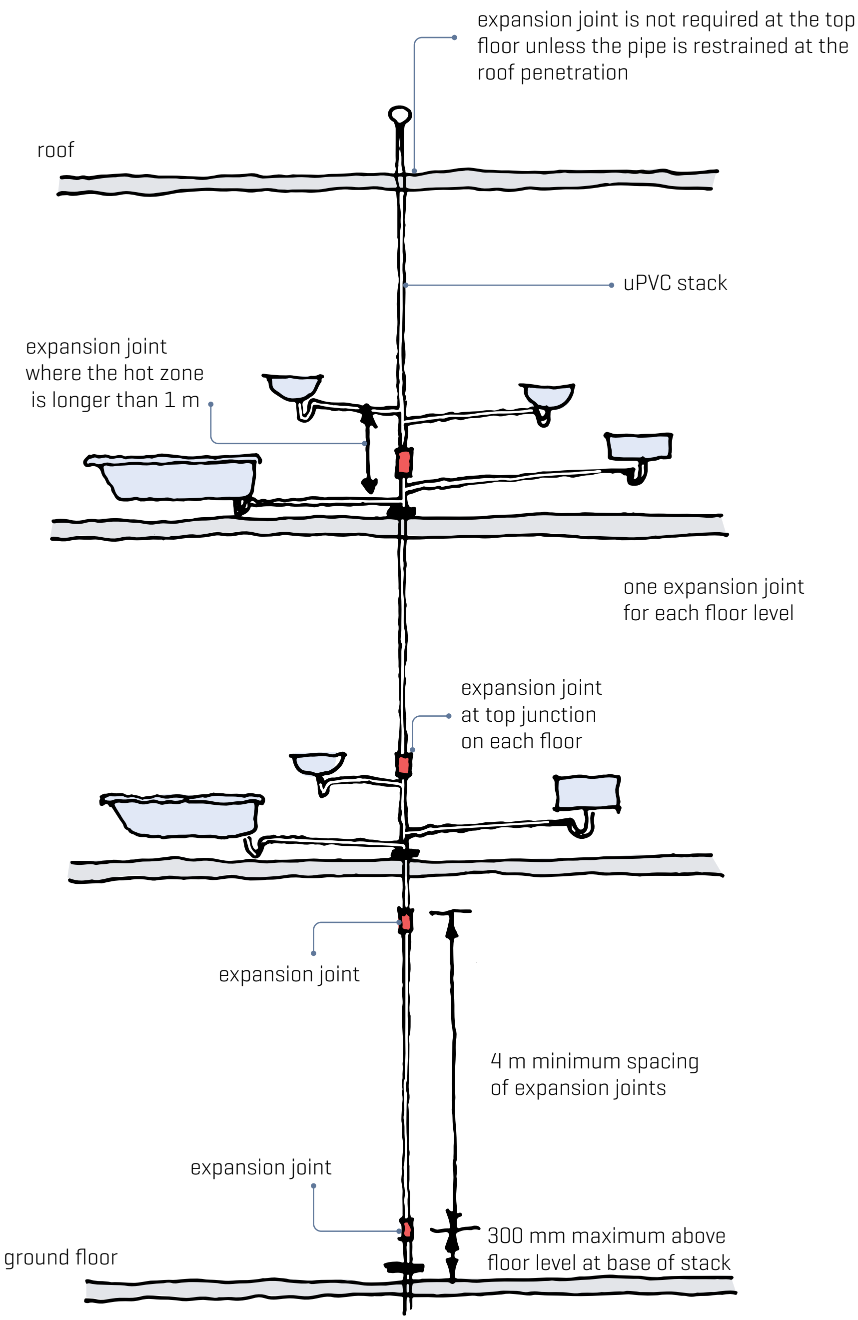


Figure 154. Basic rules for expansion joints on uPVC (PVC-U) vertical stacks.

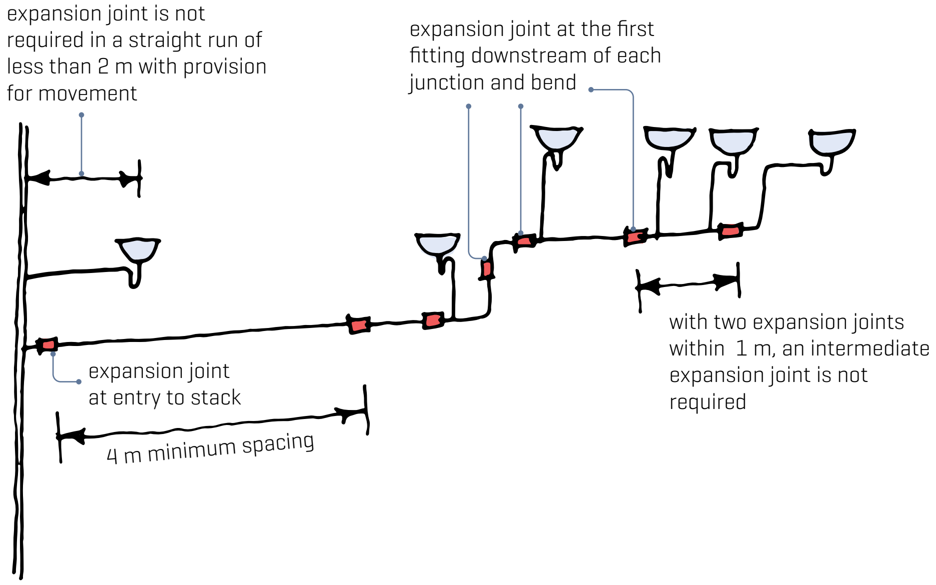


Figure 155. Basic rules for expansion joints on uPVC (PVC-U) graded pipes.

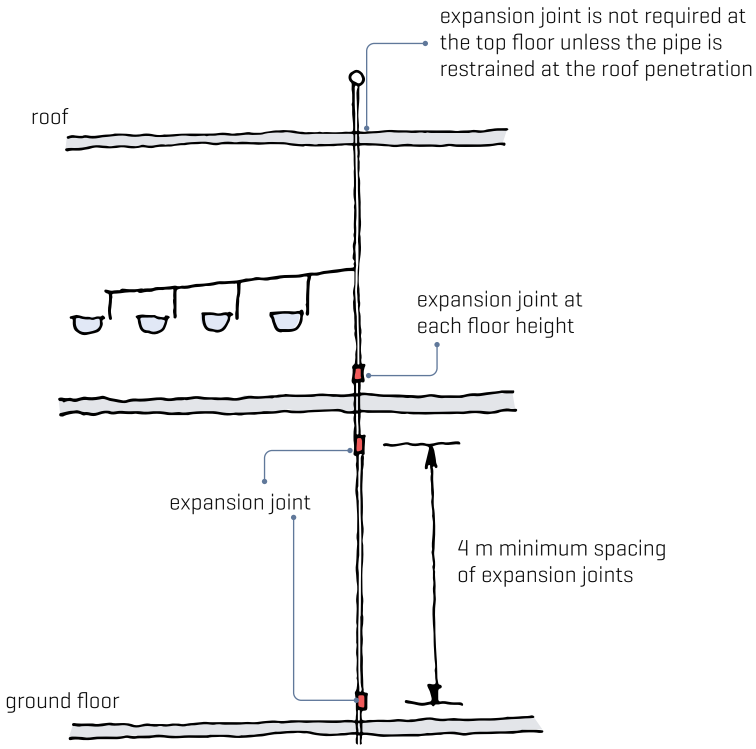


Figure 156. Basic rules for expansion joints on uPVC (PVC-U) vent pipes.

Expansion joints are required in copper vertical stacks of more than two floors (Figure 157) at:

- the base of the stack
- alternate floors – at a point above the junction of the highest discharge pipe on that floor
- every floor if the stack is subjected to discharge above 60°C.

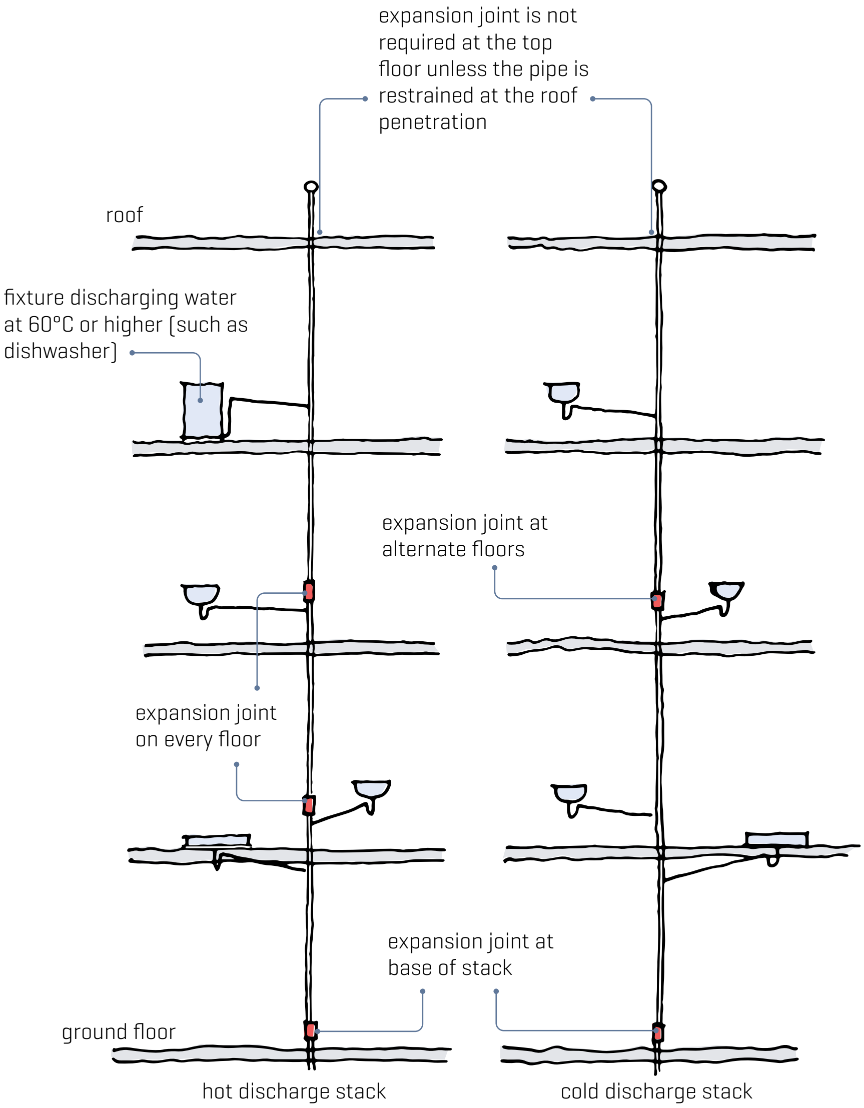


Figure 157. Basic rules for expansion joints in copper vertical stacks of more than two floors.

4.12 RESIDENTIAL GREYWATER SYSTEMS

Greywater – the wastewater from laundry and bathroom basins, showers, baths and sometimes clothes washing machines – can be reused for subsurface garden irrigation. Treated greywater can be used for flushing toilets.

Greywater must not be used as a potable source of water (for drinking, cooking, food preparation or mouth hygiene) or for washing, bathing or swimming.

The wastewater from kitchen sinks and dishwashers is not collected or reused as it can contain fat, grease and oils, harsh cleaning chemicals, high levels of sodium from some detergents and *Campylobacter* bacteria from raw meat.

4.12.1 Sanitary plumbing and drainage

The discharge pipes from baths, showers, laundry tubs and clothes washing machines connect to an independent pipe system for greywater collection. Discharge pipes larger than 80 mm diameter must be labelled greywater at intervals not exceeding 1 m.

Proprietary greywater systems are available, depending on the intended water use and the required water quality. Most greywater systems have the following components (Figures 158–159):

- A manual or electronic diverter so that the household can choose whether to divert water to the greywater system or to the sewer via a disconnector gully trap with a grating.
- Greywater runs by gravity into a surge tank. This collects the outpouring of water and then controls how it is delivered for use. (The simplest systems divert wastewater directly into the garden for irrigation without a surge tank.)
- Water supply from the surge tank driven by gravity or pump (a submersible pump that pumps the greywater automatically once it enters the surge tank).
- Access to treat the system to control unwanted bacteria and other micro-organisms.
- Filtering to remove solids such as lint and hair to reduce the likelihood of the system clogging. Some filters are partially self-cleaning.
- Greywater for toilet flushing will need additional treatment that may include chemical and/or ultraviolet disinfection.
- An approved place to use the water.
- An overflow to the sewer or an on-site blackwater system (with protection from sewage surcharge by installing a reflux valve).

4.12.2 Building Code and other compliance

Discharge pipes and the drain to surge and storage vessels must comply with clause G13 *Foul water*. Water supply pipework to the toilet must comply with clause G12 *Water supplies*.

Discharges to land must comply with the Resource Management Act 1991 and may require a resource consent. Some regional councils may set conditions or prohibit the discharge of untreated wastewater. Some may not have any set rules for greywater discharge. If considering installing a greywater system, always consult with local and regional authorities at the outset.

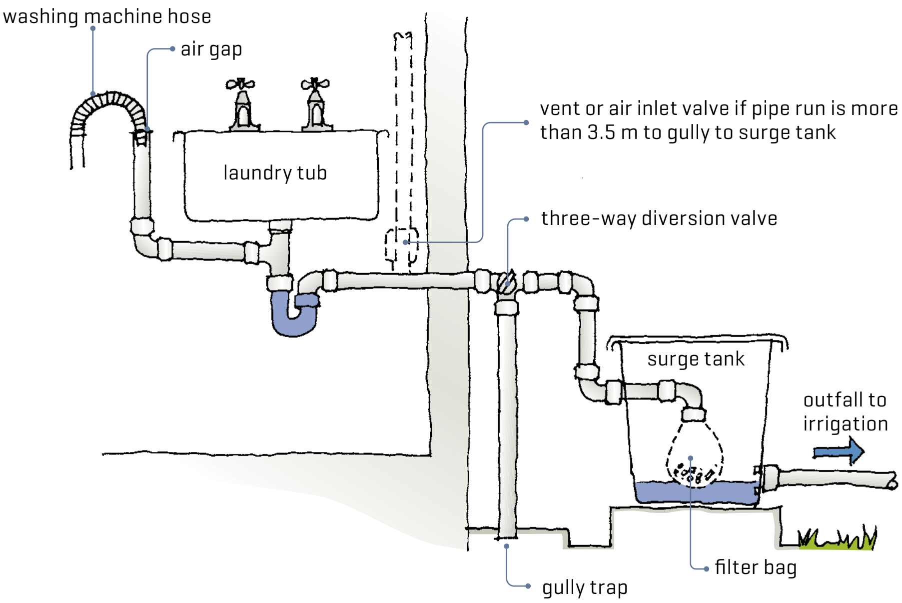


Figure 158. Gravity-fed greywater system.

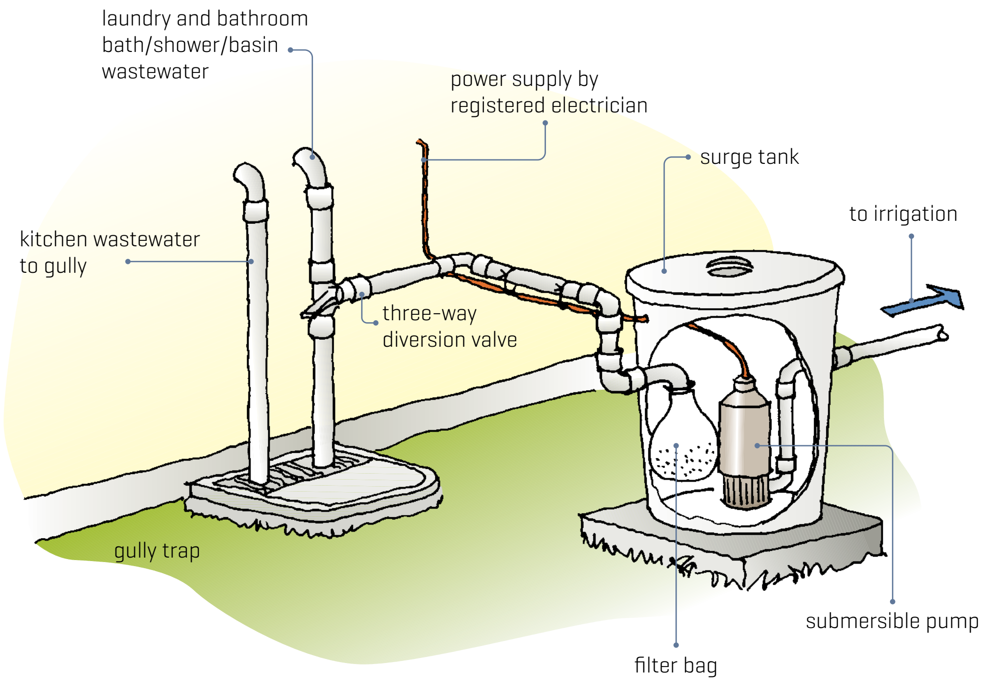


Figure 159. Pumped greywater system.

5

GUIDE TO G13/AS2 FOUL WATER DRAINAGE

Acceptable Solution G13/AS2 covers below-ground gravity-flow foulwater drains up to 150 mm diameter. It does not cover systems for the discharge of industrial or toxic wastes, which may not be discharged into a sewer.

The objective of G13/AS2 is to produce a system in which blockages are unlikely to occur, but if they do, they can be cleared with minimum disruption.

This is achieved by:

- keeping the layout simple with the minimum number of bends and junctions
- having radius bends and junctions that are unlikely to block
- having straight pipes between bends and junctions
- using pipes of adequate size laid to suitable gradients
- having adequate access points to deal with blockages.

5.1 JUNCTIONS

Junctions in pipes must be made with 45° junctions complying with Figure 160 for horizontal graded junctions and Figure 161 for the connection between a vertical and a horizontal pipe.

5.2 GULLY TRAPS

Gully traps receive the discharge from wastewater fixtures. In the event of a drainage system becoming blocked, gullies also provide a point at which sewage can overflow outside a building instead of building up inside the pipe system and overflowing at a fixture inside the building.

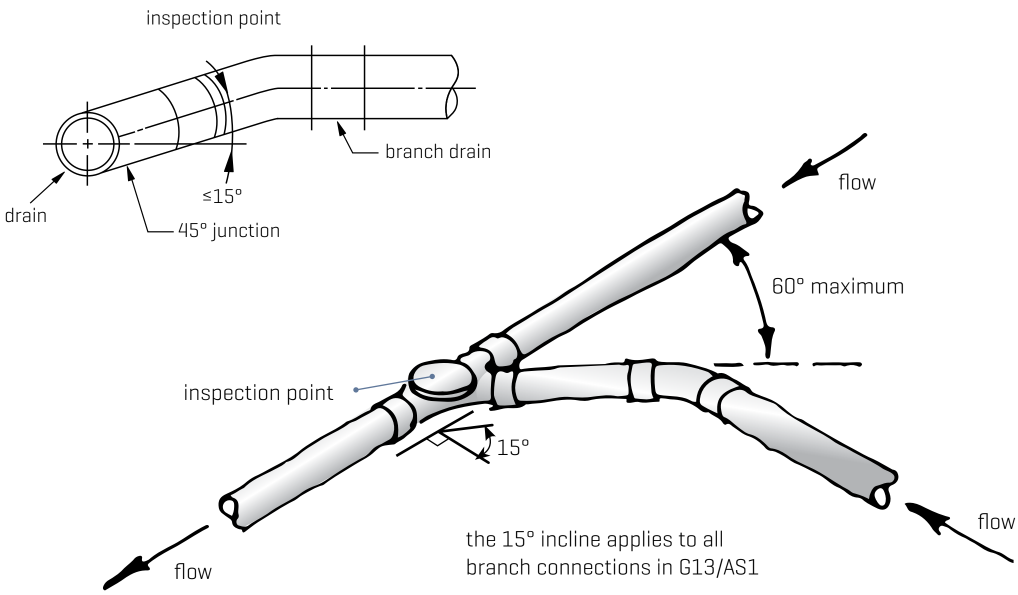


Figure 160. Connection between horizontal pipes.

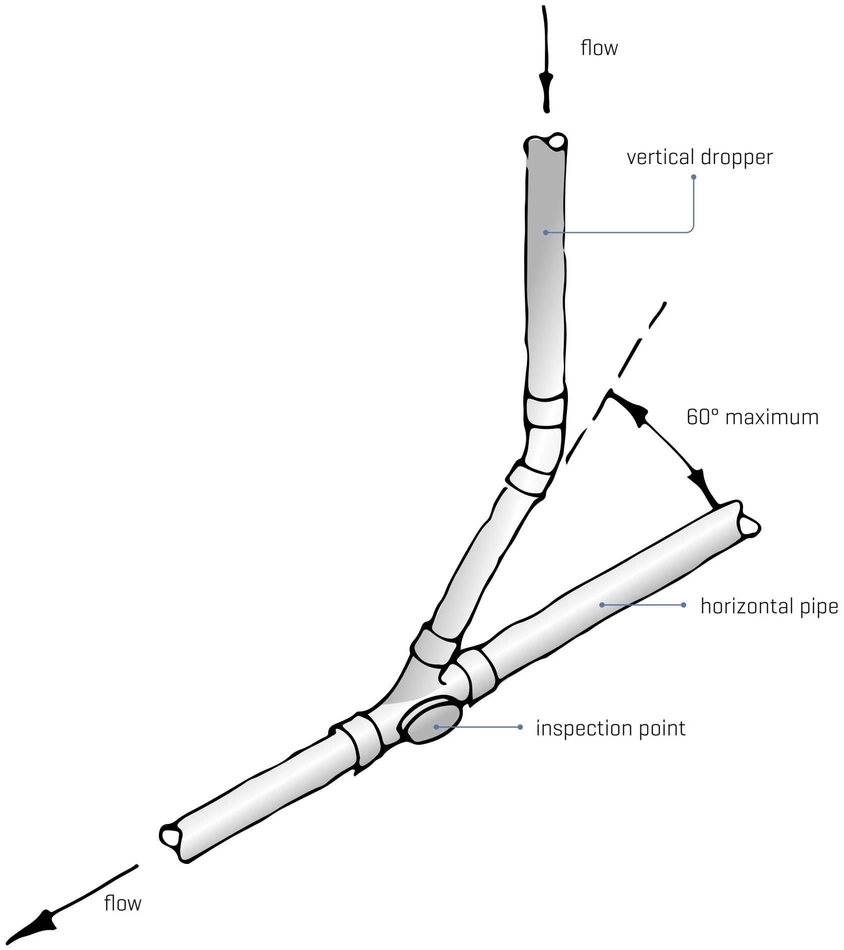


Figure 161. Connection of vertical and horizontal pipes.

Every residential building must have at least one gully trap that:

- has its overflow rim at least 150 mm below the overflow level of the lowest fixture served by the system
- is located within the legal boundary of the land on which the building stands.

The construction and layout of gully traps must comply with Figures 162–163.

Gully traps must be constructed:

- to prevent surface water from entering
- so that the grate will lift to allow surcharge
- with at least one discharge pipe to maintain the water seal.

5.3 PIPE SIZE AND GRADIENT

Pipe gradients are given as a ratio between a pipe length and the amount of fall over that length (Figure 164). The amount of fall is usually given the value of 1 – for example, a pipe with a gradient of 1:100 falls at a rate of 1 metre in every 100 metres.

The size and gradient of a drain is based on the total of all discharge units that each section of pipe carries. Each fixture type is given a rating derived from its expected discharge as shown in section 3.2.

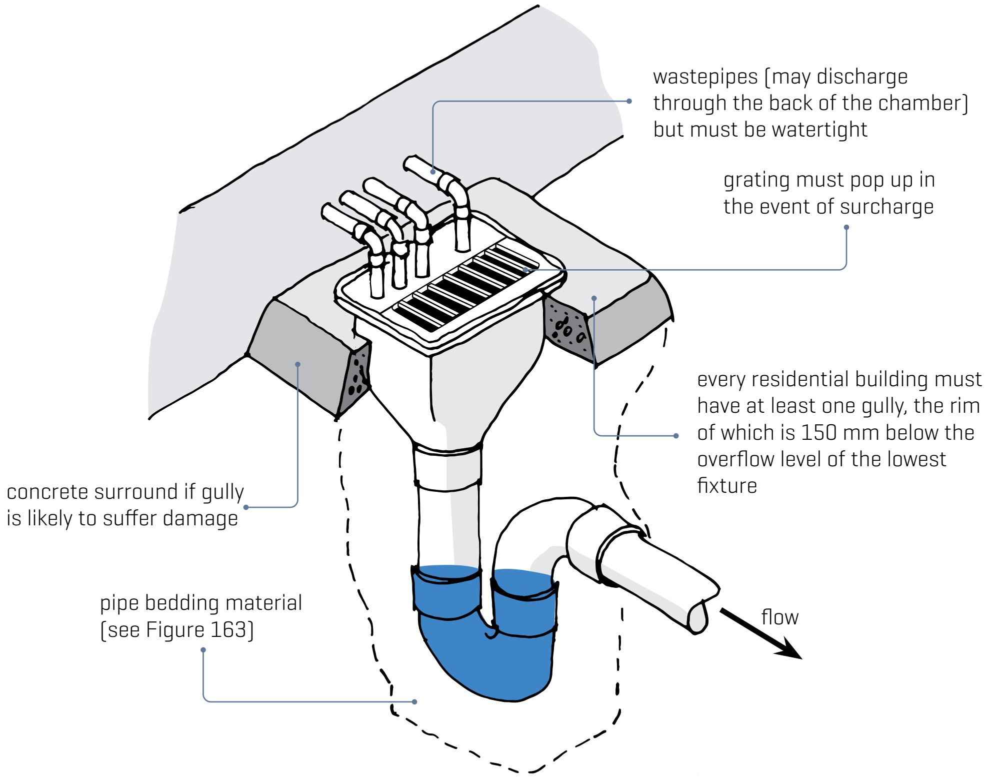


Figure 162. Gully trap.

Drains must:

- be laid at even gradients
- be laid to the maximum practicable gradient
- have a minimum gradient as shown in Table 29
- not decrease in diameter in the direction of flow
- have a minimum diameter of 100 mm unless they carry discharge from wastewater fixtures only, in which case the minimum diameter is 80 mm
- have a maximum discharge unit loading in accordance with pipe size and gradient as given in Table 30.

5.4 VENTILATION OF DRAINS

Figures 165-166 illustrate drainage ventilation.

Drainage systems must be vented to reduce the build-up of foul air within the drains:

- Every main drain must be ventilated by a pipe of 80 mm minimum diameter that terminates in accordance with termination of vent pipes to the open air (see section 3.12).
- Every branch drain longer than 10 m must be ventilated by a vent pipe sized as Table 4.
- Vent pipes must be located so that the length of drain upstream of the vent is less than 10 m.
- Vent pipes must be located so that they are downstream of the discharge pipe that is closest to the head of the drain to allow for regular flushing at the point where the vent connects with the drain.
- A plumbing discharge stack that is within 10 m of the head of the drain may be used as a drain vent pipe.

5.5 MATERIALS FOR DRAINS

Pipes and joints for drainage must:

- comply with the requirements of Table 31
- have flexible joints so that the pipes are not damaged by differential settlement.

5.6 DRAIN INSTALLATION

Acceptable methods of bedding and backfilling are shown in Figures 167–169.

These apply except where:

- drains are located in unstable soil or peat
- the drain is closer to the foundation than shown on Figures 170–171
- the cover over the pipe is more than 2.5 m.

In these instances, specific design may be necessary.

The bottom of the trench excavations must not be nearer to the foundation of a building than shown on Figures 170–171.

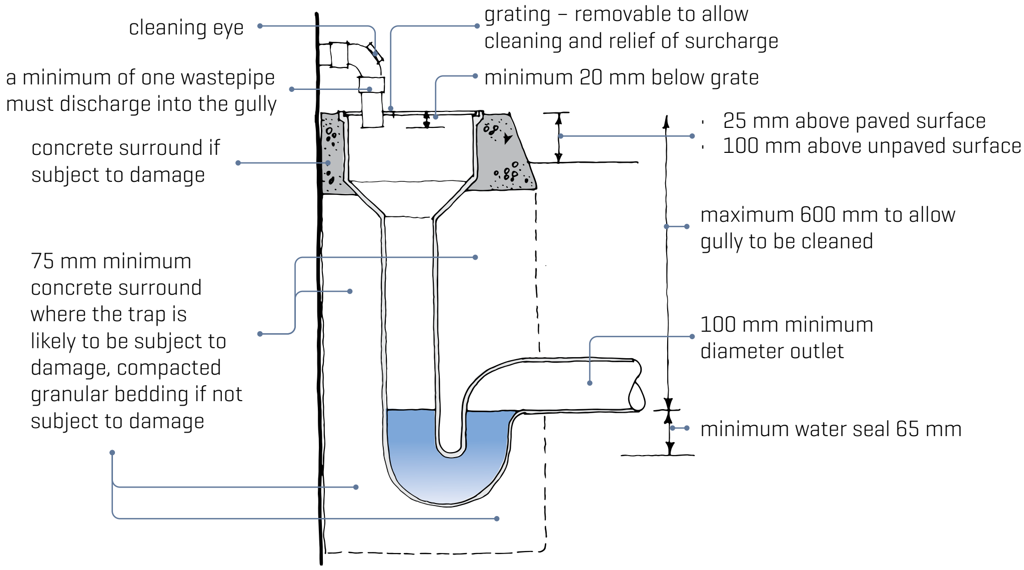


Figure 163. Gully trap dimensions and requirements.

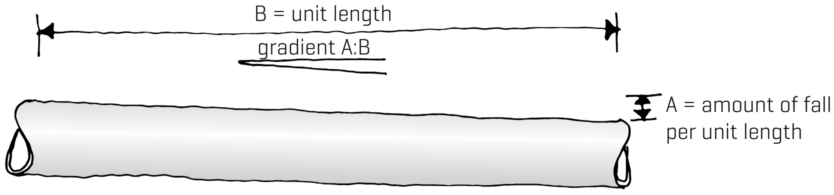


Figure 164. Gradient of pipe laid to fall expressed as a ratio.

Table 29. Minimum drain gradients.

Drain diameter (mm)	Minimum gradient
80	1:100
100	1:120
150	1:120

Table 30. Minimum drain size and gradients related to the discharge units carried.

Drain diameter (mm)	Minimum gradient									
	1:20	1:40	1:60	1:80	1:100	1:120	1:140	1:160	1:180	1:200
	Total discharge units carried by pipe (obtained from Table 3)									
80	215	100	61	44	34					
100	515	255	205	149	122	104				
150	2,920	1,790	1,310	1,040	855	760	677	611	558	515

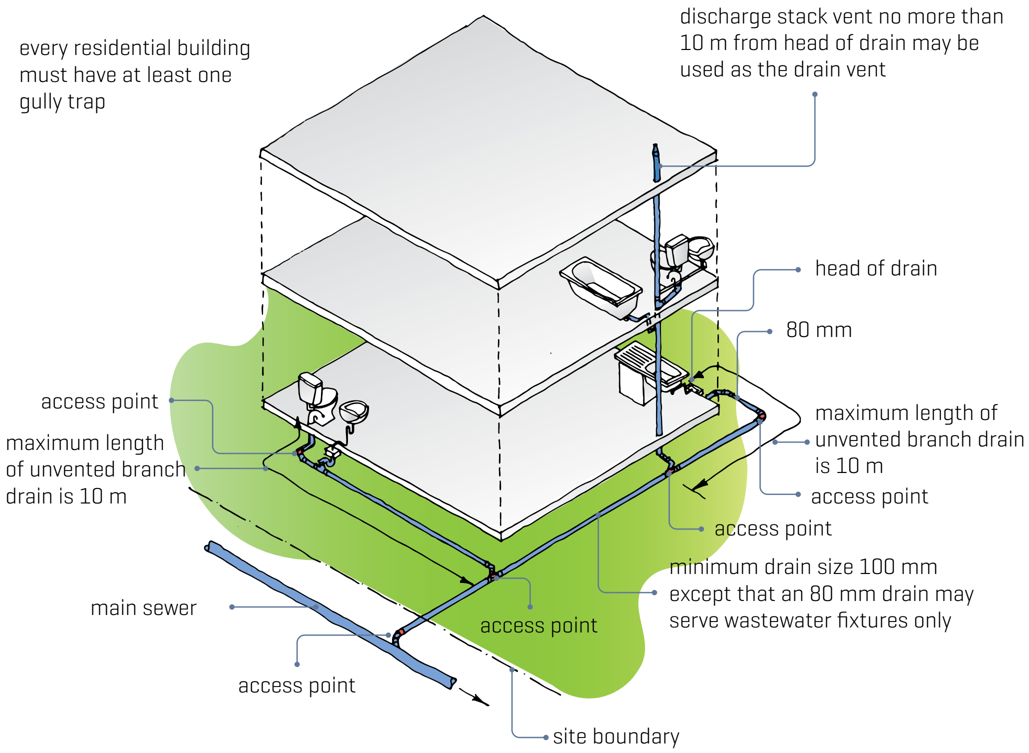


Figure 165. Main drain venting – fixture vents not shown.

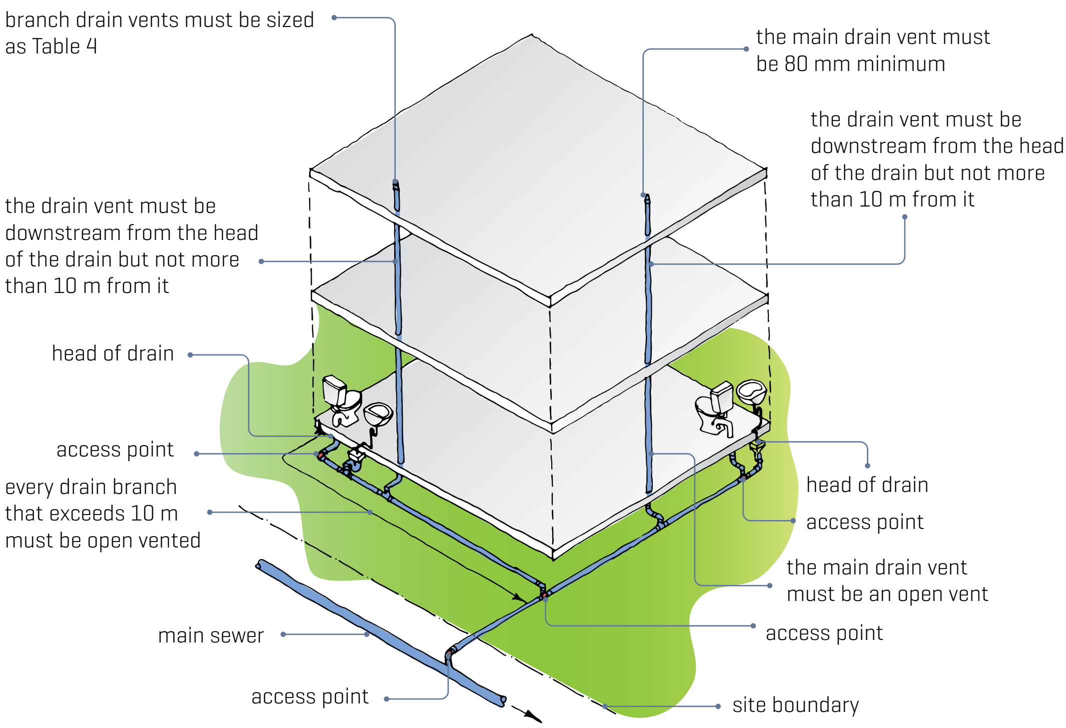


Figure 166. Branch drain venting – fixture vents not shown.

Table 31. Materials and standards for drainage pipes.

Cast iron	BS 437:2008 *Specification for cast iron drain pipes and fittings and their joints for socketed and socketless systems*
Concrete	AS/NZS 4058:2007 *Precast concrete pipes (pressure and non-pressure)*
Steel	NZS 4442:1988 *Welded steel pipes and fittings for water, sewage and medium pressure gas* AS 1579-2001 (R2018) *Arc-welded steel pipes and fittings for water and waste-water*
uPVC	AS/NZS 1260:2017 *PVC-U pipes and fittings for drain, waste and vent applications*, see also 2009 amendments 1 and 2 to G13/AS2
Ductile iron	AS/NZS 2280:2014 *Ductile iron pipes and fittings*
Copper	NZS 3501:1976 *Specification for copper tubes for water, gas, and sanitation*
Polyethylene	AS/NZS 5065:2005 (Reconfirmed 2016) *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications*

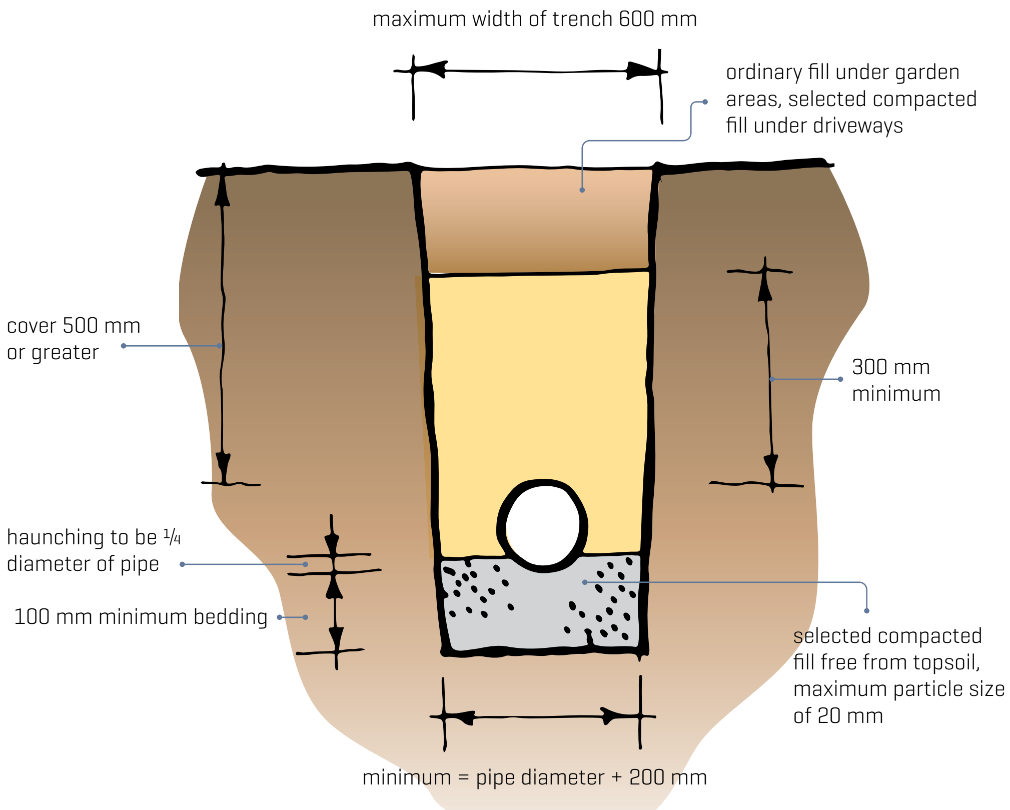


Figure 167. Bedding and backfilling where cover over drain is 500 mm or greater.

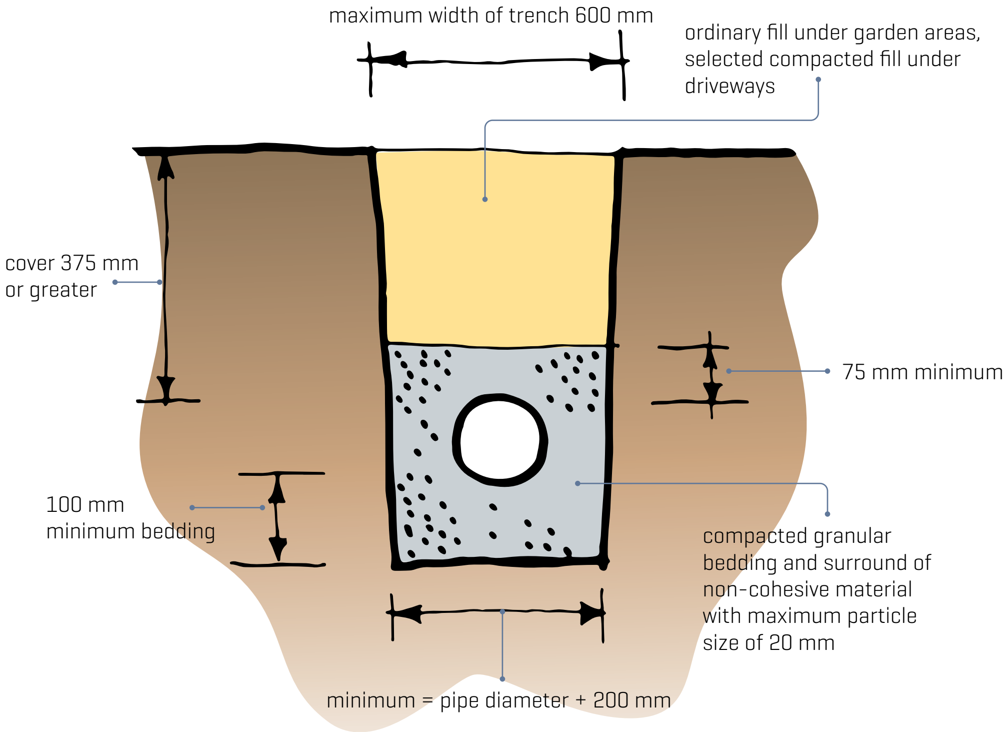


Figure 168. Bedding and backfilling where cover over drain is 375 mm or greater.

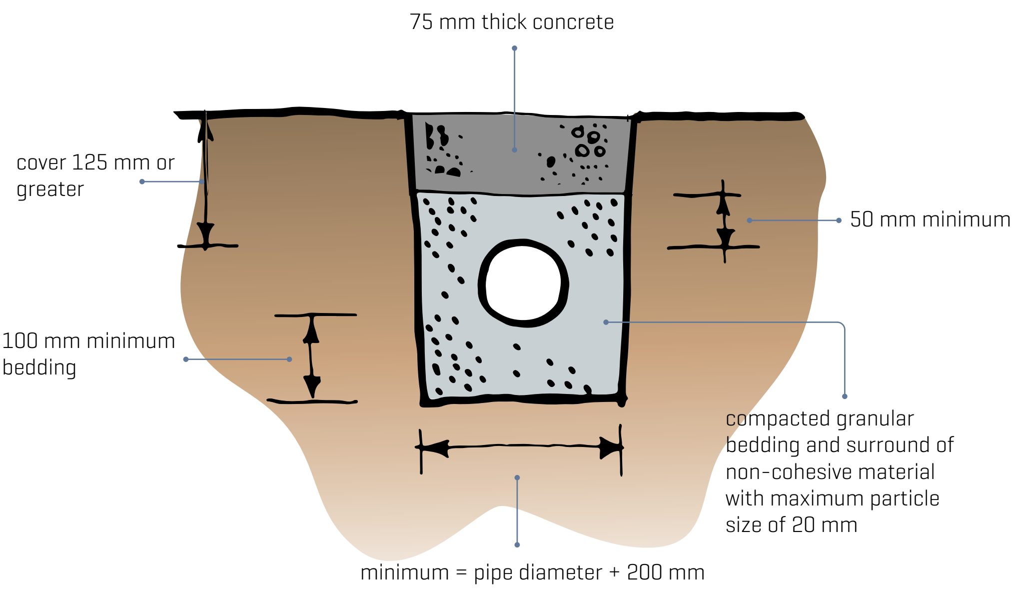


Figure 169. Bedding and backfilling where cover over drain is 125 mm or greater.

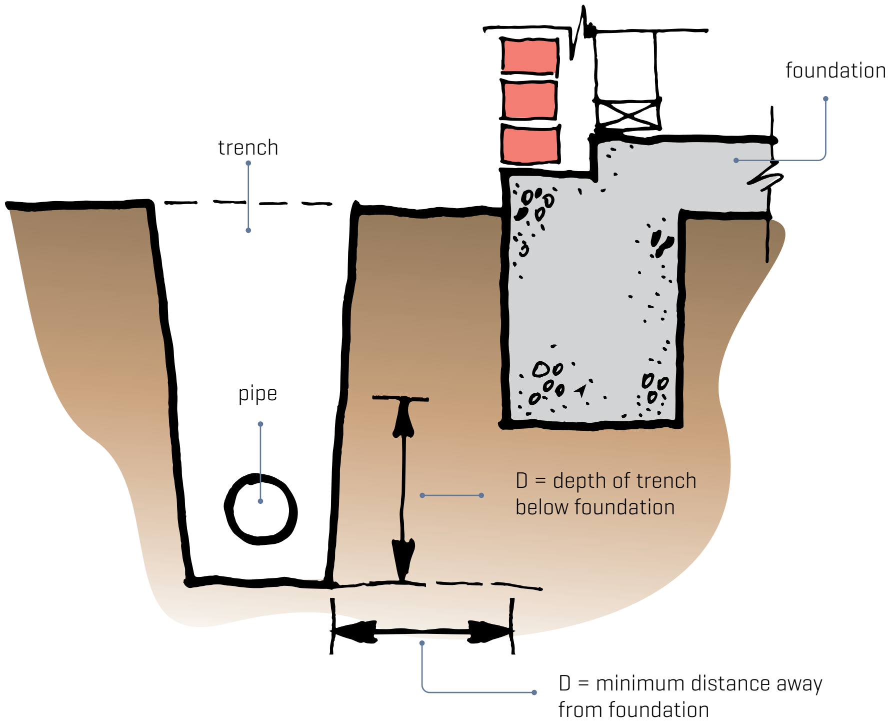


Figure 170. Relationship between trench depth and foundation for trenches remaining open for no longer than 48 hours.

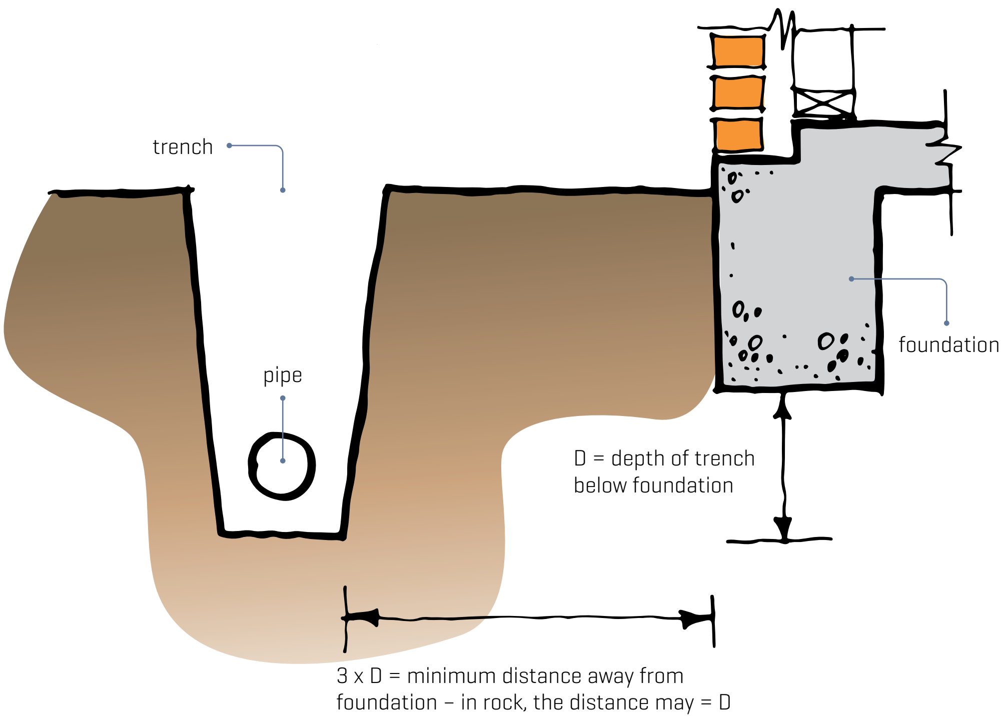


Figure 171. Relationship between trench depth and foundation for trenches remaining open for longer than 48 hours.

5.7 ACCESS FOR MAINTENANCE

Access points to allow cleaning or rodding of the drains must be provided:

- immediately inside the boundary and at drainage outfalls for testing
- at every change in gradient more than 45°
- at every horizontal change in direction more than 45°
- at every junction that serves a soil fixture or any branch drain longer than 2 m
- on straight drains every 50 m if rodding points are used
- on straight drains every 100 m if inspection chambers, access chambers or inspection points are used (Figure 172)
- at both sides of the building where a drain passes under a building (see section 5.8).

An access point is required on any branch drain with more than one soil fixture and is located downstream of the highest fixture.

Access points may be:

- inspection points (Figures 173–174)
- rodding points (Figure 175)
- inspection chambers (Figures 176–177)
- access chambers (Figures 178–179).

5.8 DRAINS UNDER BUILDINGS

Drains may be laid under buildings provided that:

- branch drain junctions join the main drain at 45°
- where more than one soil fixture is connected to a branch drain, an access point is provided – this may be a rodding point that is sealed at floor level
- access points are provided immediately outside the building
- they meet the requirements of clause B2 *Durability* of not less than 50 years
- they are separated from the building foundation by 25 mm and wrapped in durable material.
- they have 50 mm minimum clearance from the soffit to underside of the concrete slab.

Any access point to a drain under a building must be in an isolated area complying with Acceptable Solutions G1/AS1 and G4/AS1.

Figures 180–181 illustrate the general principles.

5.9 REUSE OF EXISTING DRAINS

G13/AS2 paragraphs 6.1.4 and 6.1.5 state that, where a disused drain is being reinstated, the disused drain must be tested to verify that the drain is sound, and where a building is proposed to be built over an existing drain, the drain must be verified as being sound both before and after construction.

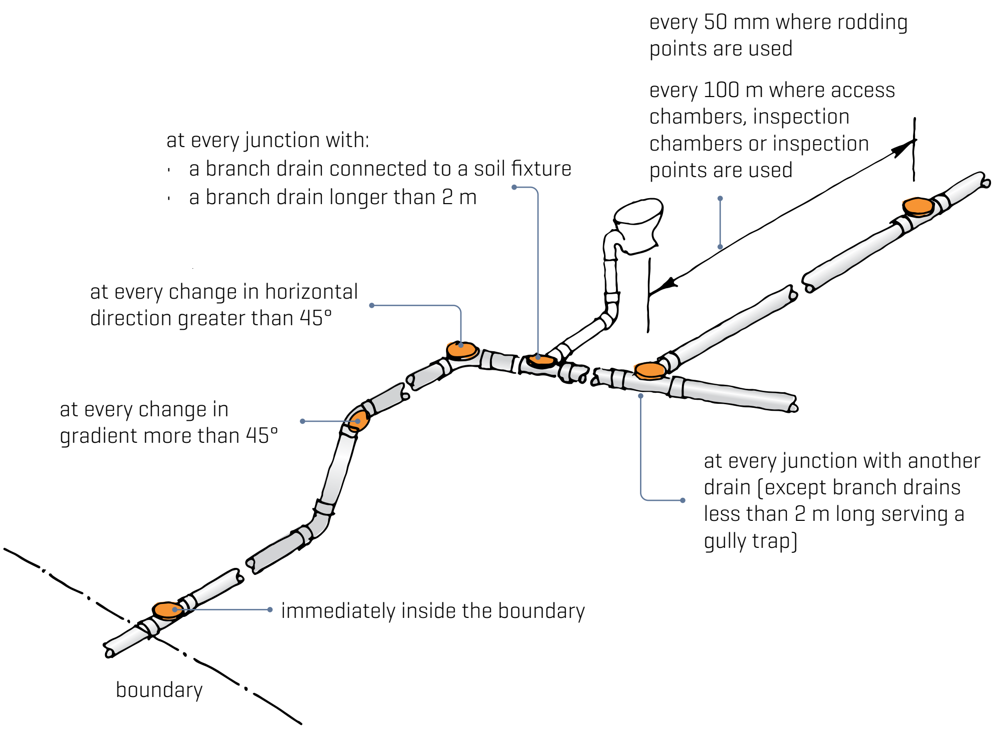


Figure 172. Locations at which access points must be provided to drains.

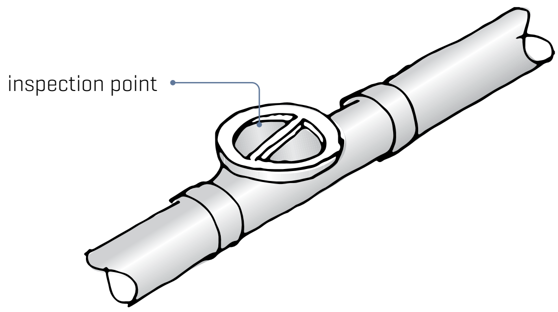


Figure 173. Access points – inspection point on a straight section.

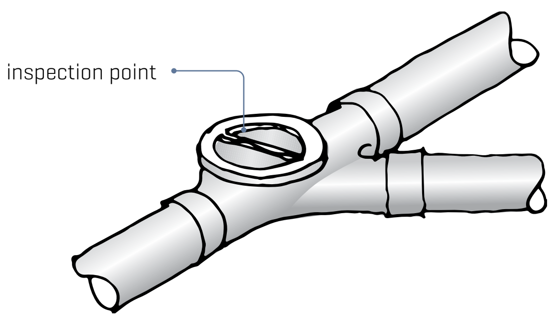


Figure 174. Access points – inspection point at junction.

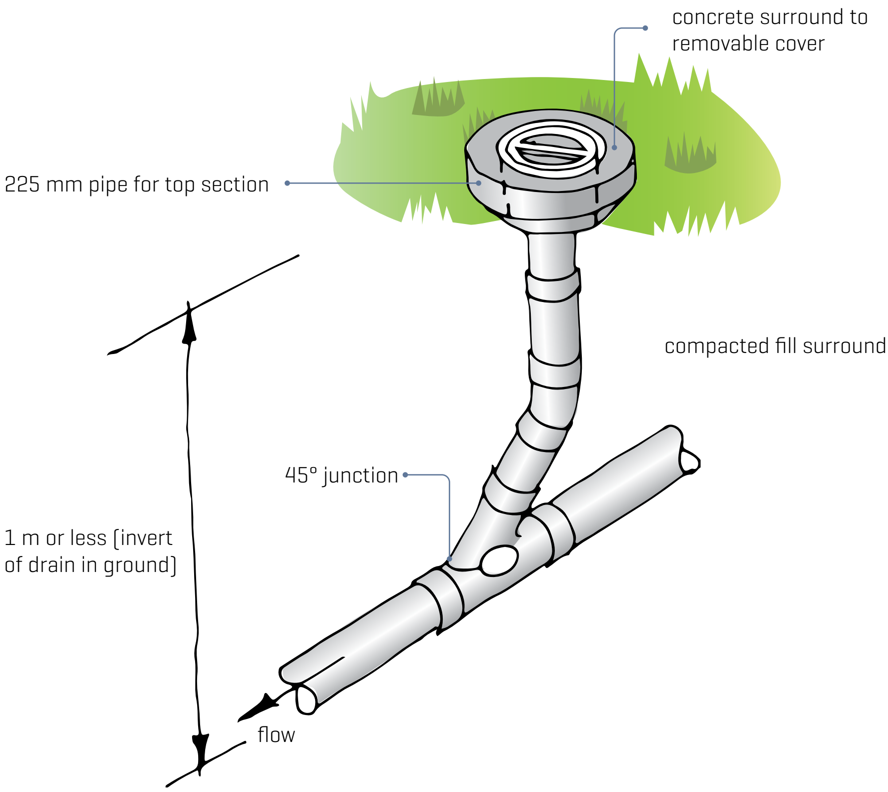


Figure 175. Access points – rodding point.

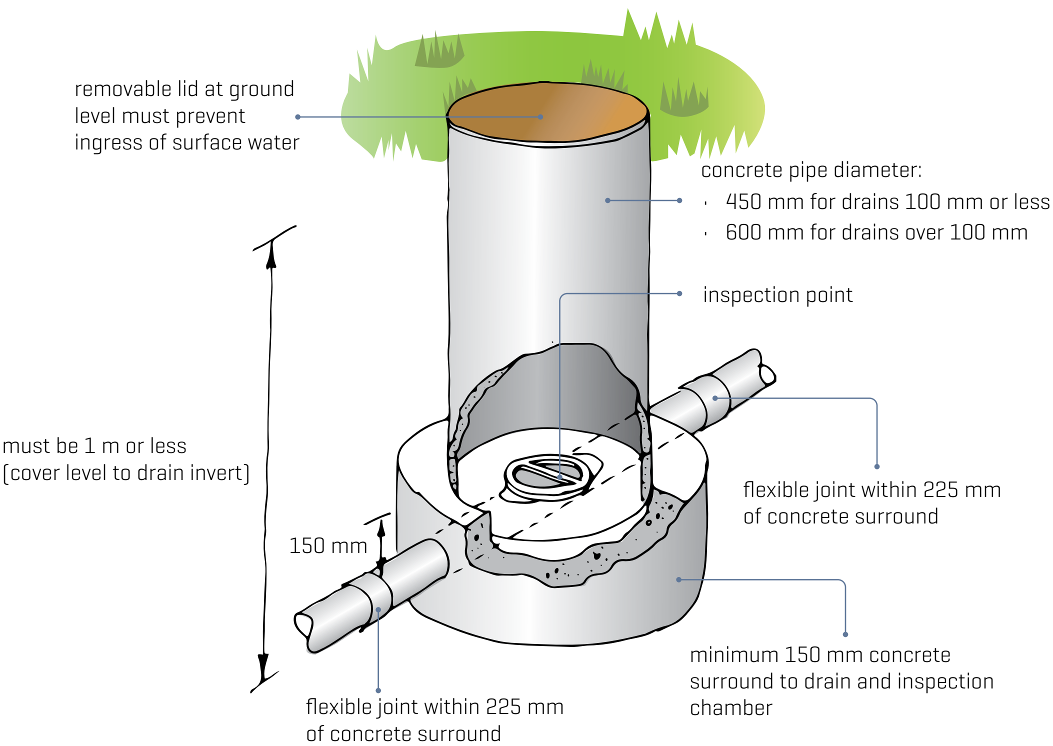


Figure 176. Inspection chamber with internal inspection point.

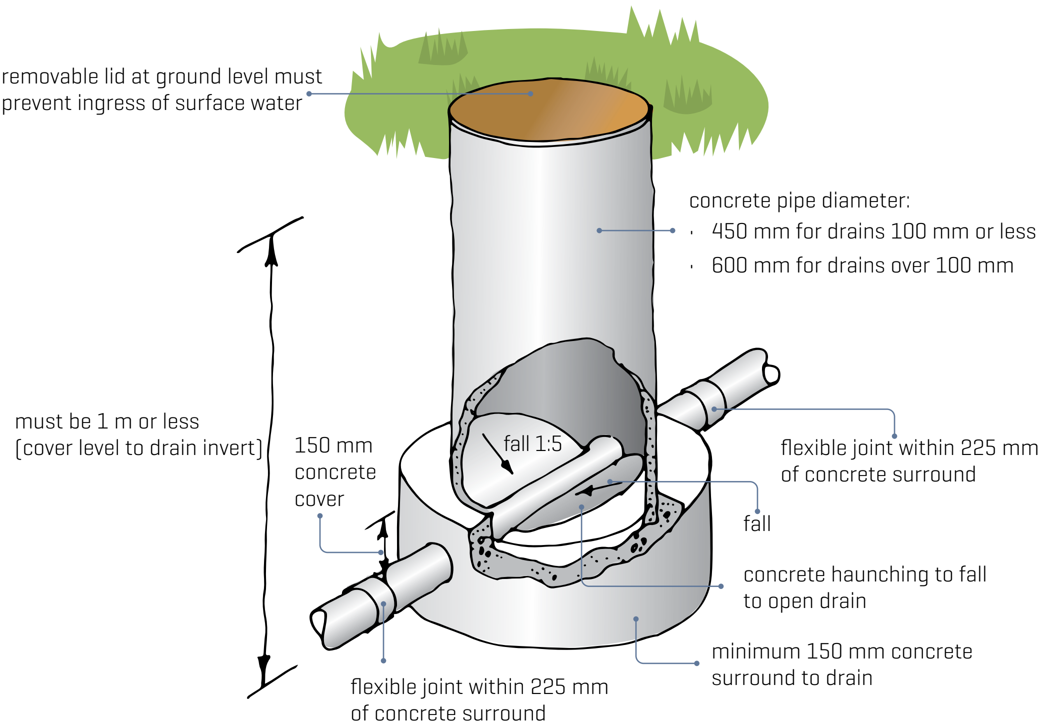


Figure 177. Inspection chamber with internal open drain – see also G13/AS2 page 47.

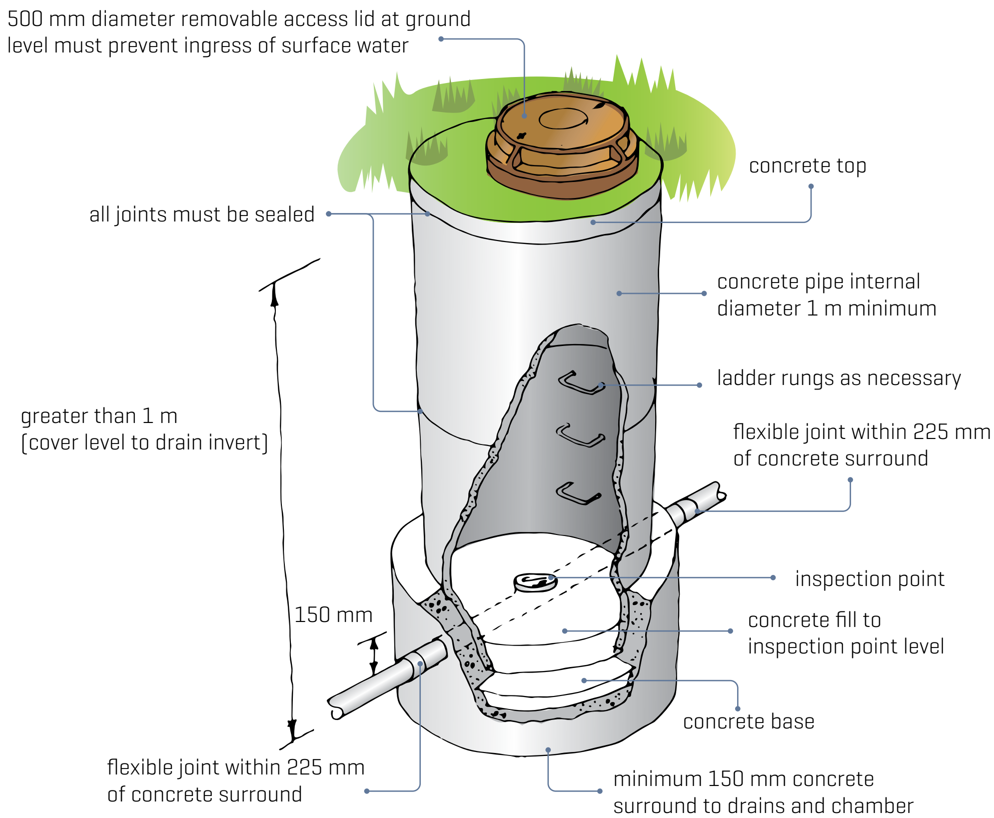


Figure 178. Access chamber with inspection point.

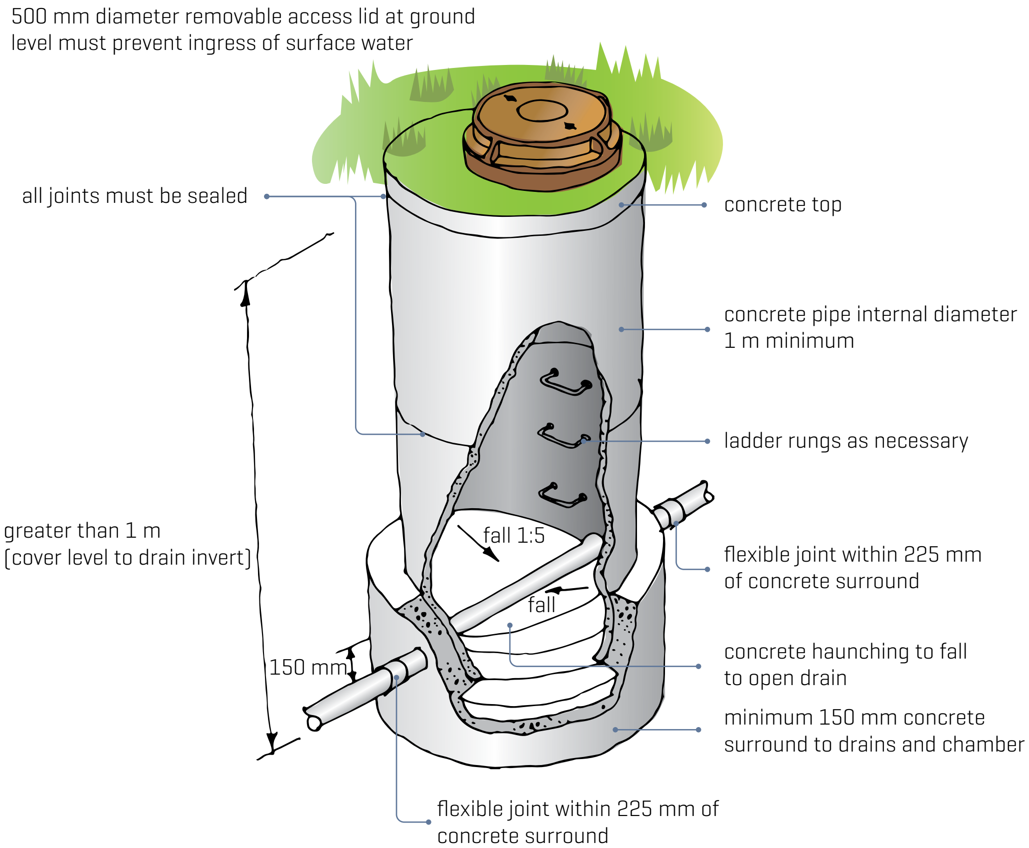


Figure 179. Access chamber with open drain.

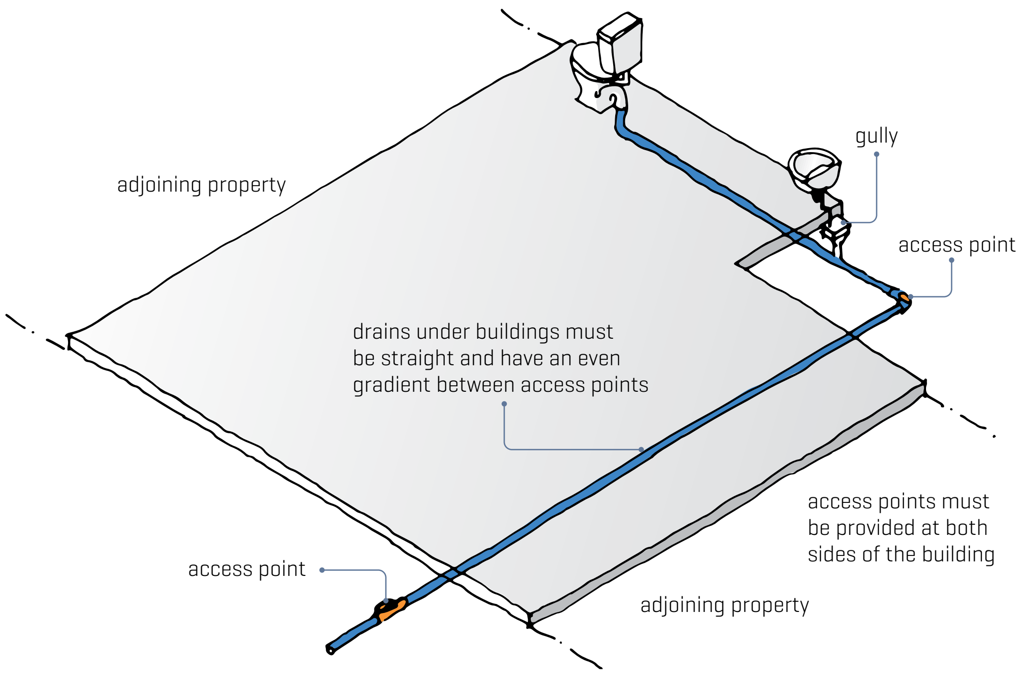


Figure 180. Drains under buildings.

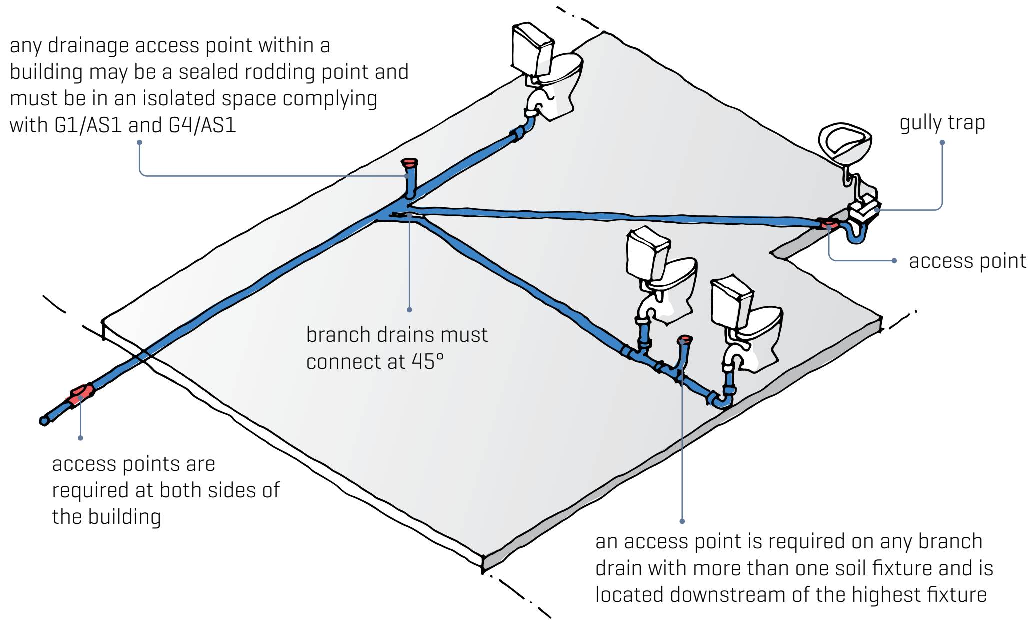


Figure 181. Drains under buildings – drainage access points.

6

GUIDE TO AS/NZS 3500.2 BELOW-GROUND, GRAVITY-FLOW OR PUMPED FOULWATER DRAINS

This interpretation of the standard covers below-ground, gravity-flow or pumped foulwater drains up to DN 150 diameter.

It assumes that a connection to a network utility operator's sewer is available and does not cover:

- the discharge of industrial or toxic wastes
- solid reduction units
- septic tanks or sullage wastes dumps/tanks.

The objective of the standard is to produce a system in which blockages are unlikely to occur, but if they do, they can be cleared with minimum disruption. This is achieved by:

- keeping the drainage layout simple with the minimum number of bends and junctions
- having radius bends and junctions that are unlikely to block
- having straight pipes between bends and junctions
- using pipes of adequate size, laid to suitable gradients
- having adequate access points to deal with blockages
- having drains external to buildings wherever possible.

6.1 PIPE SIZE AND GRADIENT

Pipe gradients are given as either:

- a ratio between a pipe length and the amount of fall over that length or
- a percentage of unit rise to horizontal distance.

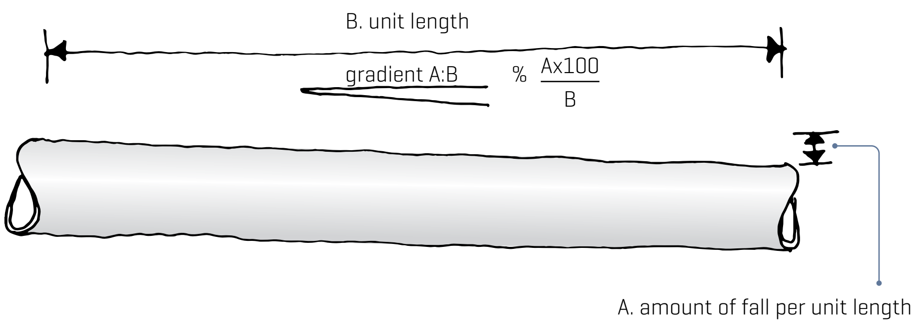


Figure 182. Gradient of pipe laid to fall expressed as a ratio or percentage.

If expressed as a ratio, the amount of fall is usually given the value of 1 – for example, a pipe with a gradient of 1:100 falls at a rate of 1 metre in every 100 metres (Figure 182). Table 32 shows the equivalent expression of gradients as ratios and percentages.

The size and gradient of a drain is based on the total of all fixture units (referred to as discharge units in G13/AS1) that each section of pipe carries. Each fixture type is given a rating derived from its expected discharge as shown in Table 6.

A larger drain can carry a greater discharge (more fixture units), and it can therefore be laid at a lower gradient because there is more liquid to flush it out. Drains must not be oversized (i.e. made larger than required for the number of fixture units they carry) in order to be able to use a lower gradient. The lower gradient and reduced flow will make them more susceptible to silting.

Table 33 shows materials and applicable standards for drainage pipe. Drains must:

- be laid to an even gradient, straight and with a smooth interior
- have as few changes in direction as possible
- have a minimum gradient as shown in Table 34
- have a diameter and gradient appropriate to the fixture loading as given in Table 34.

Reduced gradients are permissible where those gradients specified in Table 34 cannot be obtained. In these cases, drains may be laid to the gradients shown in Table 35 (which require a minimum fixture unit load).

Table 32. Gradients.

Ratio	Percentage
1:5	20.0
1:15	6.65
1:20	5.0
1:30	3.35
1:40	2.5
1:50	2.0
1:60	1.65
1:70	1.45
1:80	1.25
1:90	1.10
1:100	1.00
1:120	0.85
1:140	0.70
1:150	0.65
1:160	0.60
1:180	0.55
1:200	0.50
1:250	0.40
1:300	0.35

Adapted from AS/NZS 3500.2: 2021 Appendix C (figures have been rounded to the nearest 0.05%).

Table 33. Materials and standards for drainage pipes.

Cast iron	AS/NZS 2544:1995 *Grey iron pressure fittings*
Concrete (FRC)	AS 4139-2003 (R2018) *Fibre reinforced concrete pipes and fittings*
Steel	AS/NZS 2280:2014 *Ductile iron pipes and fittings*
UPVC	AS/NZS 1260:2017 *PVC-U pipes and fittings for drain, waste and vent applications*
Ductile iron	AS/NZS 2280:2014 *Ductile iron pipes and fittings*
Copper	NZS 3501:1976 *Specification for copper tubes for water, gas, and sanitation* AS 1432-2004 *Copper tubes for plumbing, gasfitting and drainage applications*
Polyethylene **Polypropylene**	AS/NZS 5065:2005 (Reconfirmed 2016) *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications*
Polypropylene	AS/NZS 7671:2010 *Plastics piping systems for soil and waste discharge (low and high temperature) inside buildings – Polypropylene (PP)*
Polyethylene	AS/NZS 4401:2006 (Reconfirmed 2016) *Plastics piping systems for soil and waste discharge (low and high temperature) inside buildings – Polyethylene (PE)*
Stainless steel	ASTM A270/A270M-15(2019) *Standard specification for seamless and welded austenitic and ferritic/austenitic stainless steel sanitary tubing*

Adapted from AS/NZS 3500.2:2021.

Table 34. Minimum drain size and gradients related to the fixture units they carry.

Gradient		Size of drain (DN)				
		65	80	100	125	150
Ratio	%	Fixture unit loadings				
1:20	5.00	60	215	515	1,450	2,920
1:30	3.35	36	140	345	1,040	2,200
1:40	2.50	25	100	255	815	1,790
1:50	2.00		76	205	665	1,510
1:60	1.65		61	165	560	1,310
1:70	1.45		(50)	(140)	485	1,160
1:80	1.25		(42)	(120)	425	1,040
1:90	1.10	These combinations not permitted			(380)	935
1:100	1.00				(340)	855

Note: Figures in brackets are the maximum fixture units under reduced gradient rules.

Adapted from AS/NZS 3500.2:2021 Table 3.3.1.

If soil fixtures are connected, either the load must be equal to or more than that given in Table 35 or provision must be made for flushing the drain.

6.2 JUNCTIONS

Junctions in pipes must be made with sweep connections:

- They must comply with Figure 183 for 100 mm drain to 100 mm branch drain in horizontal plane.
- They must comply with Figure 184 for connection between a vertical and horizontal pipe.
- Double Y or opposed junctions must not be used for horizontal connections.
- Vertical changes in level (jump-ups) must comply with Figure 185.

For junctions installed in a vertical plane, see AS/NZS 3500.2:2021 clause 4.9.2.

Also see G13/AS1 Figure 7, which shows connections at the base of a stack with a Y junction on grade and two 45° bends at the stack.

Table 35. Minimum fixture loadings for drains at reduced gradients.

Gradient		Size of drain (DN)			
		80	100	125	150
Ratio	%	Minimum fixture units			
1:70	1.45	9	10		
1:80	1.25	10	18		
1:90	1.10			27	
1:100	1.00			38	
1:120	0.85				75
1:150	0.65	These combinations not permitted			160

Adapted from AS/NZS 3500.2:2021 Table 3.4.2.

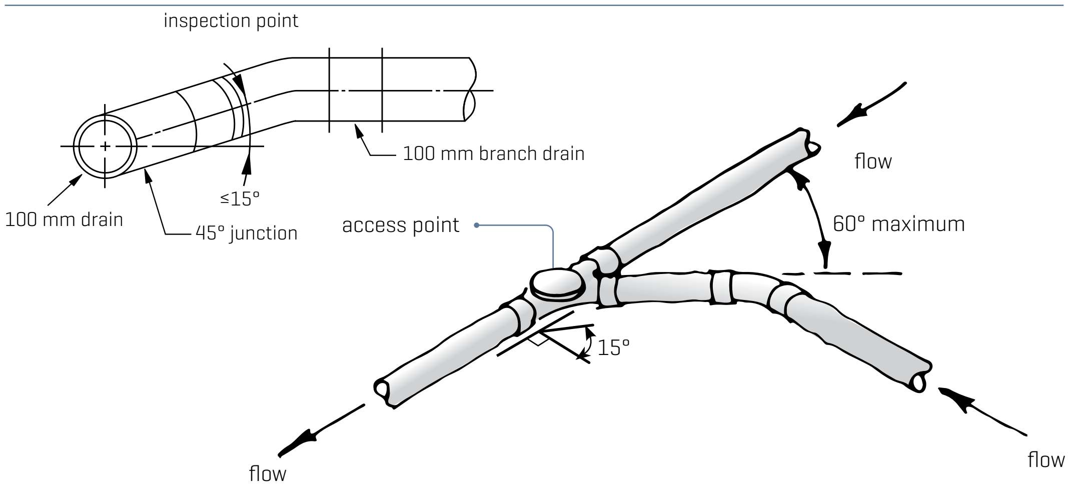


Figure 183. Connection between 100 mm horizontal pipes.

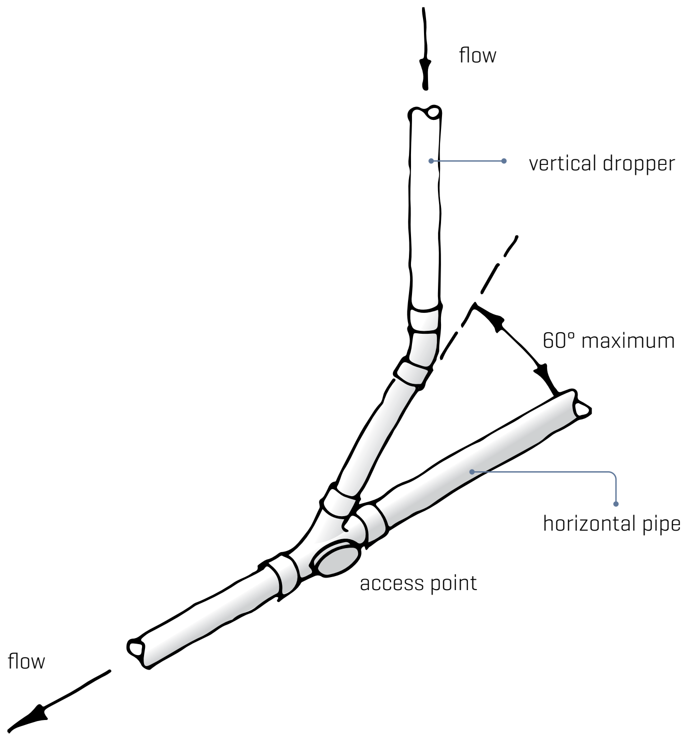


Figure 184. Connection of vertical and horizontal pipes.

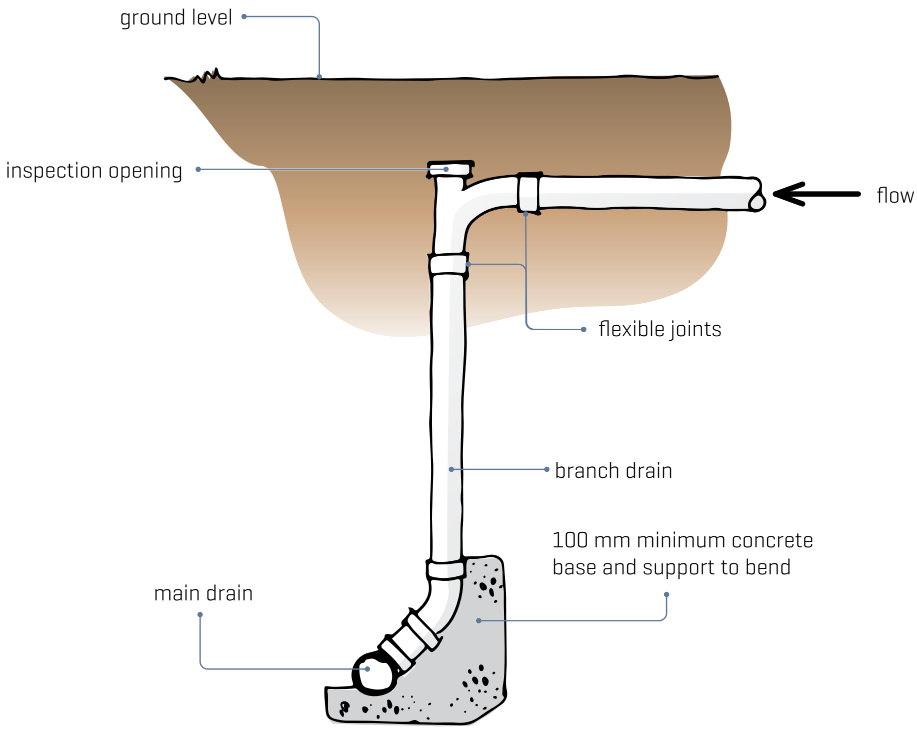


Figure 185. Jump-up to branch drain.

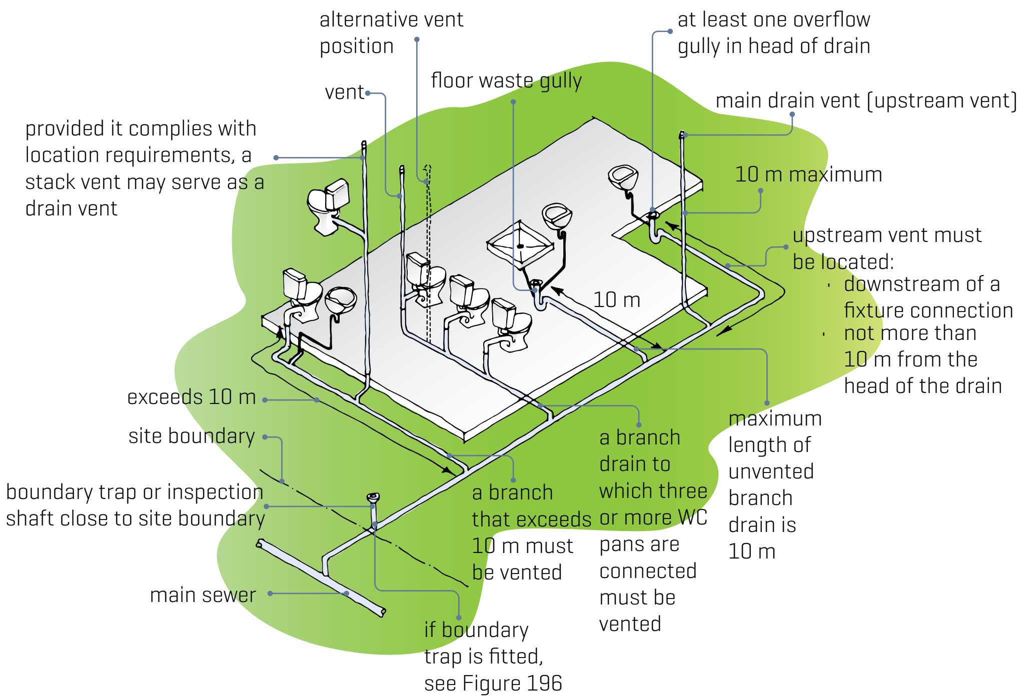


Figure 186. Drain vents.

6.3 VENTILATION OF DRAINS

Figure 186 illustrates the general principles for drain vents.

Drainage systems must be vented to reduce the build-up of foul air and gases within the drains. Vents must be provided:

- at both ends of drain systems where a boundary trap is provided (see section 6.7)
- at the upstream end of drain systems without a boundary trap
- to branch drains exceeding 10 m in length
- to branch drains receiving discharge from three or more WC pans.

Provided it complies with the location requirements, the vent of a discharge stack may serve as a drain vent.

Vents must be located in accordance with Figure 186.

The minimum size of any part of a drain that serves as a vent is 65 mm.

The amount of ventilation that must be provided for a drain is measured as vent rating units (given in 50 mm pipe equivalents).

Table 36. Size of drain vents

Fixture discharge units carried by drain (see Table 6)	Vent rating required	Pipe size (DN)
10 or fewer	0.5	40
11 to 30	1	50
31 to 175	2	65
176 to 400	3	80
More than 400	6	100

Adapted from AS/NZS 3500.2:2021 Table 3.9.3.1.

Table 36 gives the number of ventilating units required related to the discharge units passing through the drain and the necessary pipe size.

Two or more vents may serve a single drain. For example, if two vent rating units are necessary, this may be provided by a 65 mm vent or two 50 mm pipes.

The maximum permitted combined length of a fixture discharge pipe and an unvented branch drain is 10 m measured from a ventilated drain to the weir of the fixture trap.

The layout, sizing and principles of drainage using unvented branch drains is explained in section 4.2.

6.4 GULLIES

Overflow relief gullies provide an outlet if there is a surcharge of sewage in the system. Disconnector gullies provide a break (disconnection) between waste discharges and the sewage system.

Gullies must not receive discharge from soil fixtures.

At least one overflow relief gully must be provided in every drainage system. For exceptions where overflow gullies can be omitted, see AS/NZS 3500.2:2021 clause 4.6.6.2.

Overflow relief gullies must be external to the building if possible (Figure 187) or, if not, internal (Figure 188).

The vertical distance between the overflow of the gully and the lowest fixture connected to the system must not be less than 150 mm. The point of measurement to the fixture is:

- to the surface of the water seal on the trap of a soil fixture
- to the top of the grate (floor level) on a floor waste gully
- to the top surface of the outlet on waste fixtures.

The reason for this requirement is to eliminate the possibility of sewage backing up into a fixture in the event of a surcharge.

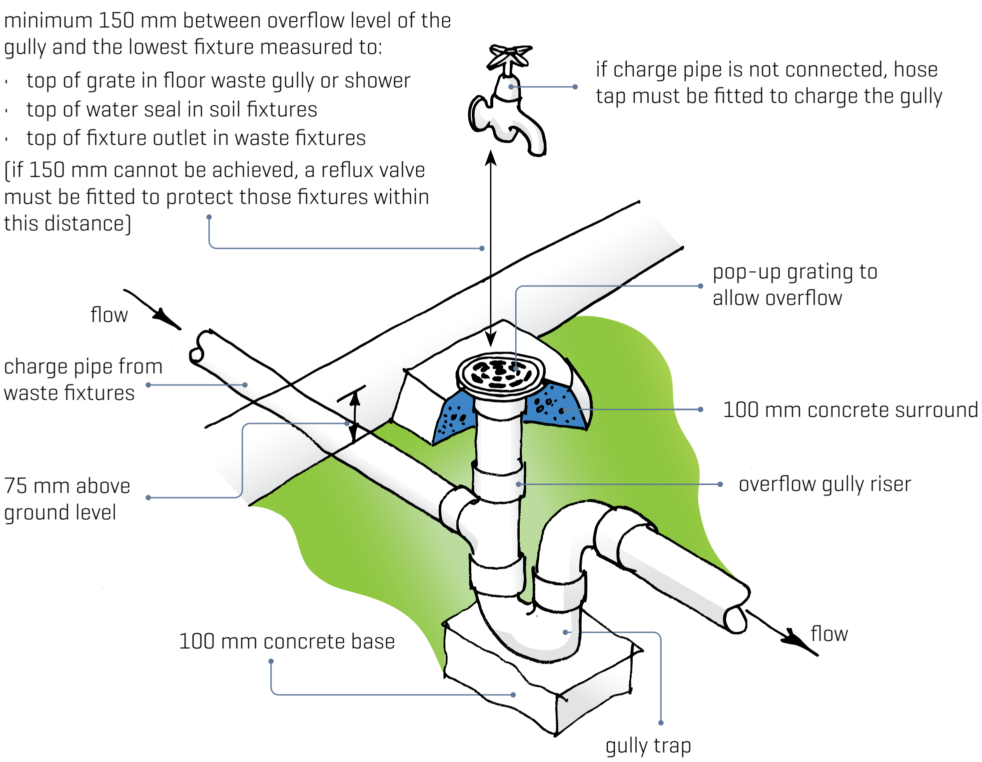


Figure 187. External overflow relief gully.

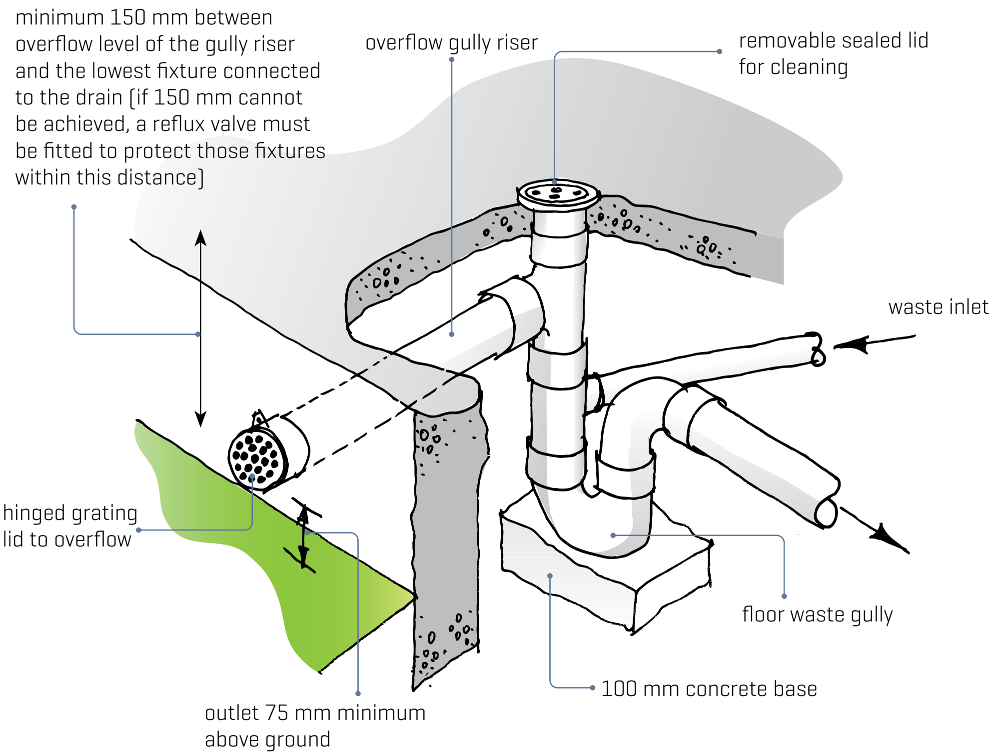


Figure 188. Internal overflow relief gully (disconnector gully).

The minimum height from ground level to the top of the overflow gully riser or the invert of the overflow pipe is 75 mm (see AS/NZS 3500.2:2021 clause 4.6.6.7 for exceptions).

Floor waste gully traps are described in section 4.1.5.

A disconnector gully (Figure 189) within a building may receive waste discharges from unvented discharge pipes in accordance with Table 37. If these lengths are exceeded, the fixture trap must be vented.

6.5 REFLUX VALVES

Reflux valves prevent the reversal of flow in a drain and must be fitted where the minimum height (150 mm) of the lowest fixture above the overflow relief gully cannot be achieved.

Table 37. Waste connections to disconnector gullies.

Fixture	Maximum length of unvented wastepipe (m)
Basin or bidets with DN 40 wastes	3.5
Floor waste gullies and fixtures with DN 50 wastes or smaller	6
Floor waste gullies and fixtures with DN 65 wastes or larger	10

Adapted from AS/NZS 3500.2:2021 Table 4.6.3.

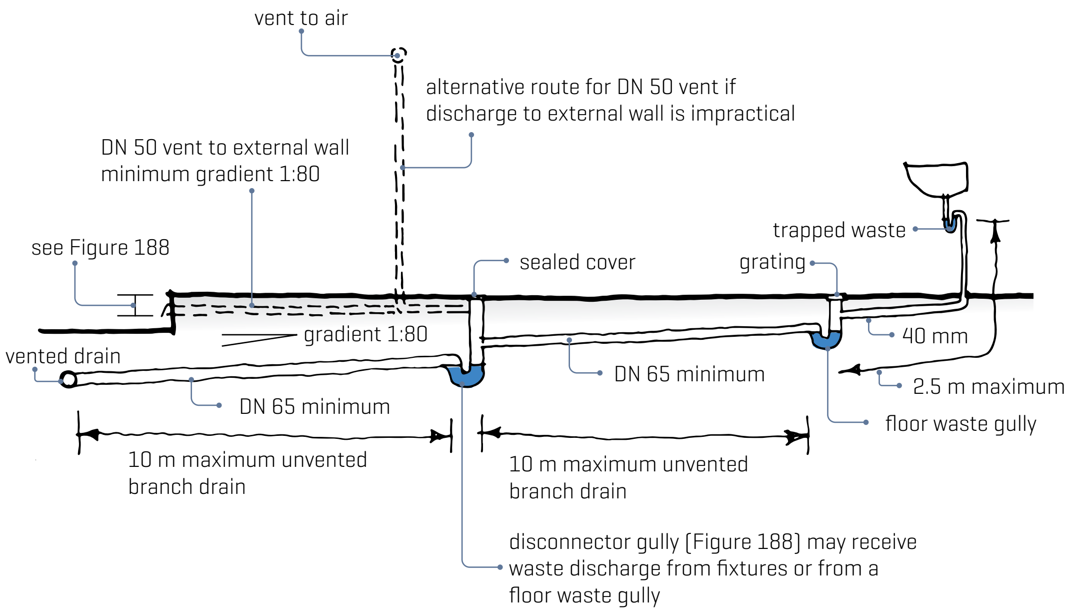


Figure 189. Floor waste gully discharging to a sealed disconnector gully.

This is to prevent sewage backing up into fixtures in the event of a surcharge. Reflux valves must be installed in an accessible position within the building or in an inspection chamber externally.

Floor waste gullies and showers can have this height reduced to 50 mm provided the discharge pipe has a non-return valve fitted.

6.6 ACCESS FOR MAINTENANCE

Inspection openings must be provided in accordance with Figure 190:

- on branch drains carrying soil waste as close as possible to the building but not further away than 2.5 m
- at intervals of not more than 30 m
- on the downstream end of a drain passing under a building
- at a jump-up
- at the connection with the sewer or an existing drain
- at changes of direction or gradient greater than 45°.

Inspection openings may be:

- inspection points
- inspection chambers
- reflux valves.

See Figures 191–195.

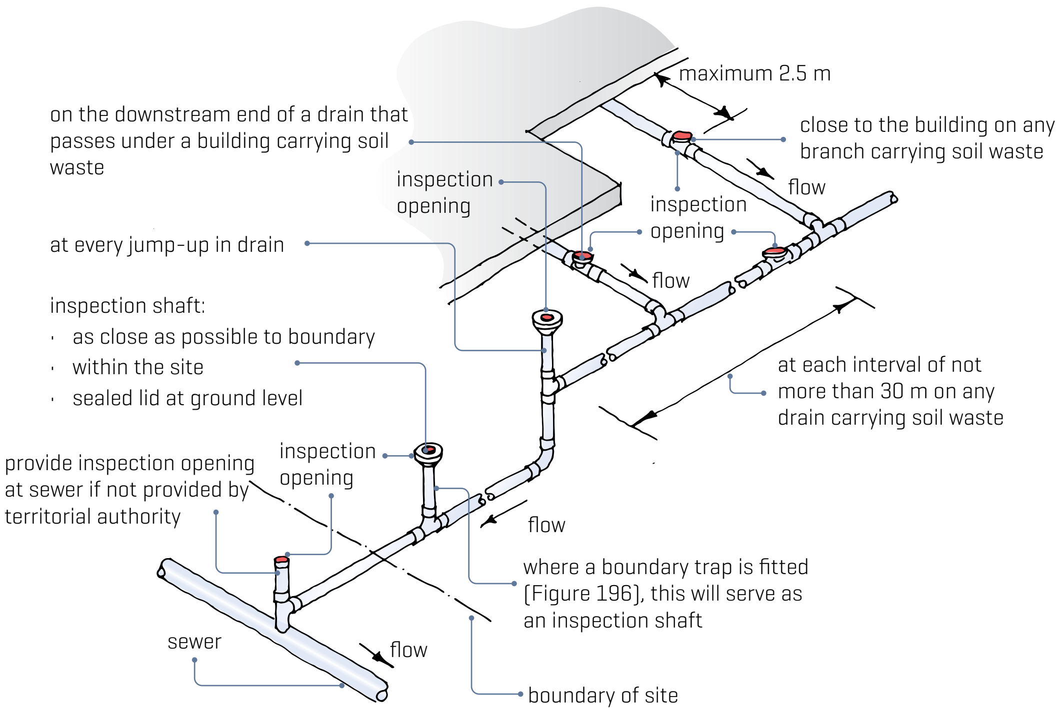


Figure 190. Locations at which inspection openings must be provided – refer to AS/NZS 3500.2:2021 clause 4.7.

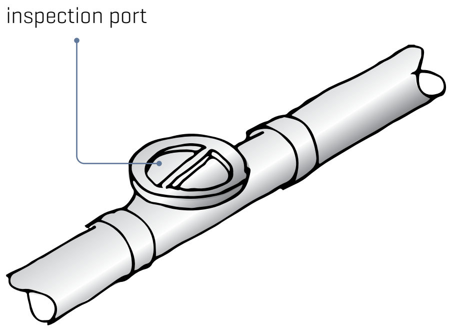


Figure 191. Inspection point.

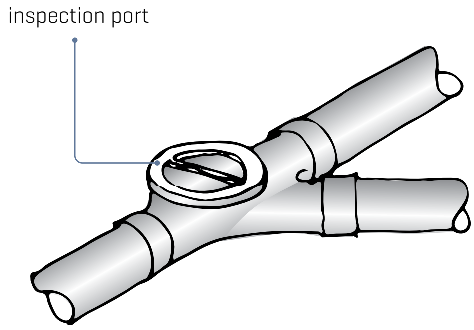


Figure 192. Inspection point at junction.

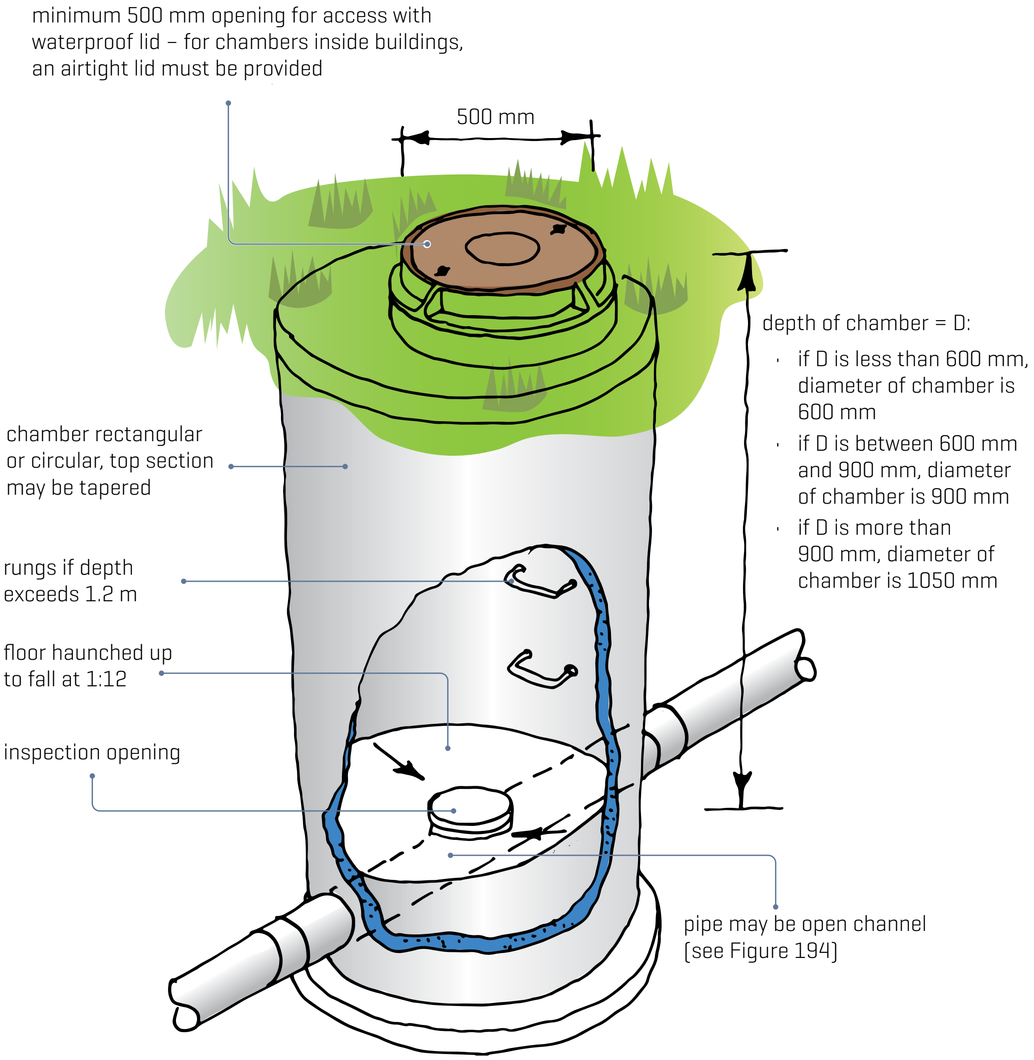


Figure 193. Inspection chamber with enclosed drain and inspection opening.

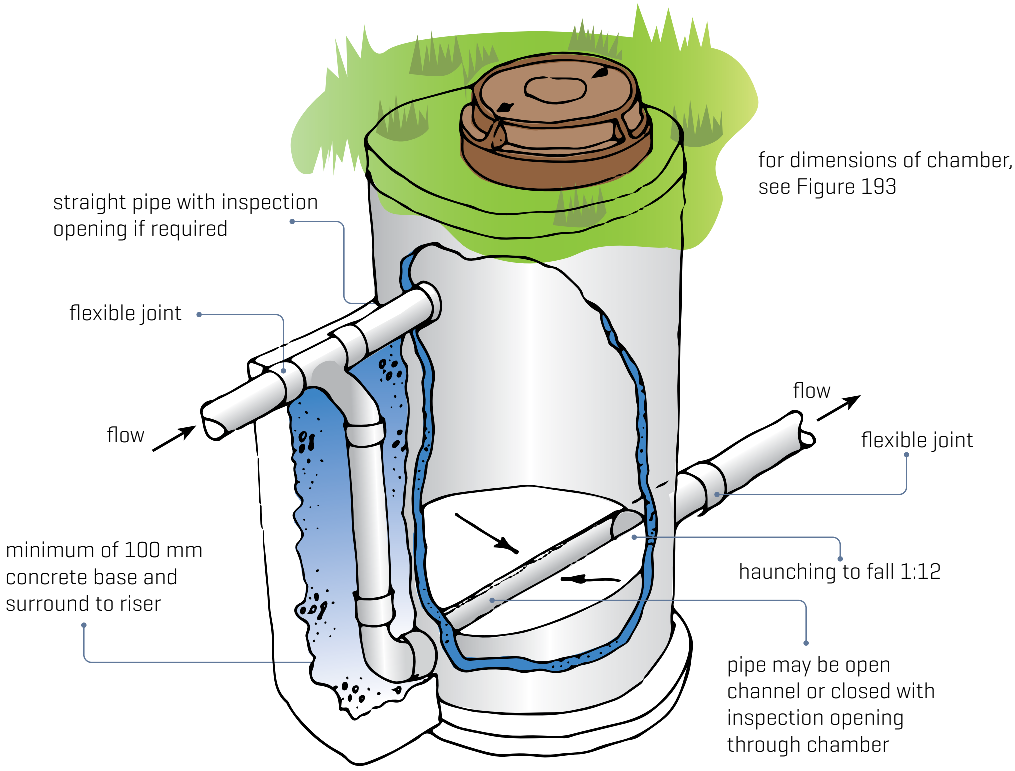


Figure 194. Jump-up in drain formed outside inspection chamber.

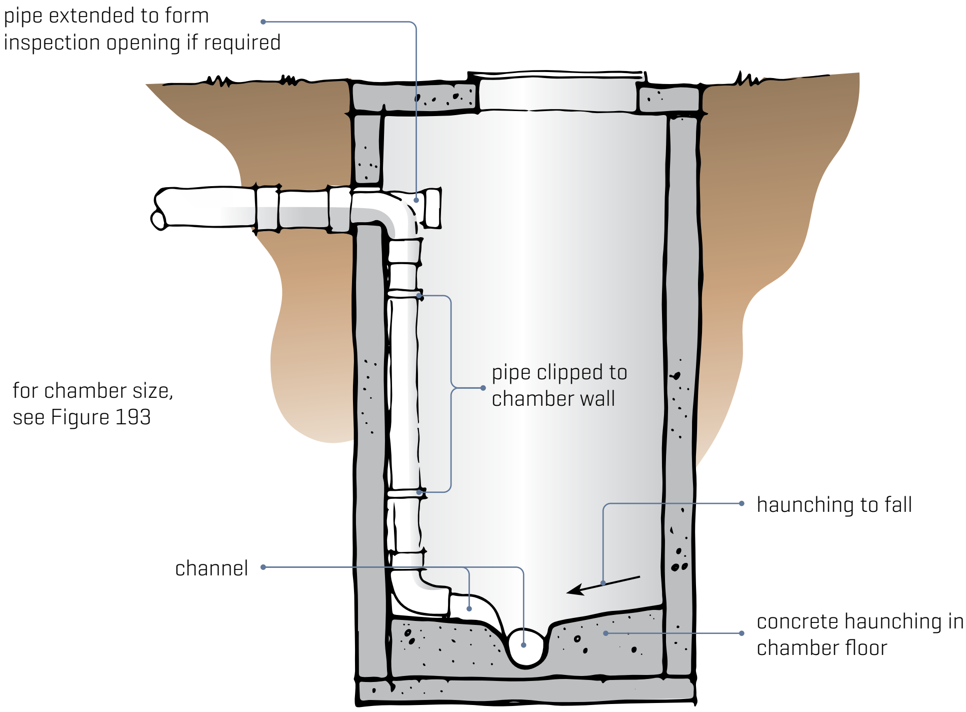


Figure 195. Jump-up in drain formed inside chamber.

6.7 BOUNDARY TRAPS

Some authorities require a boundary trap to be fitted to the main private drainage line within and as close as possible to the boundary (Figure 196). This trap is required when the authority considers that its sewer main may carry objectionable liquids or materials from commercial and industrial business areas.

The trap must be installed with:

- an inspection shaft with an airtight removable lid
- a vent, which may be:
  - a low-level vent
  - a high-level vent connected within 10 m of the boundary trap.

See section 4.1.9 for termination of vent pipes.

6.8 INSPECTION SHAFTS

Where a boundary trap is not required by the local authority, an inspection shaft must be installed with an airtight removable lid (Figure 197). The inspection shaft must be within and as close as practical to the boundary.

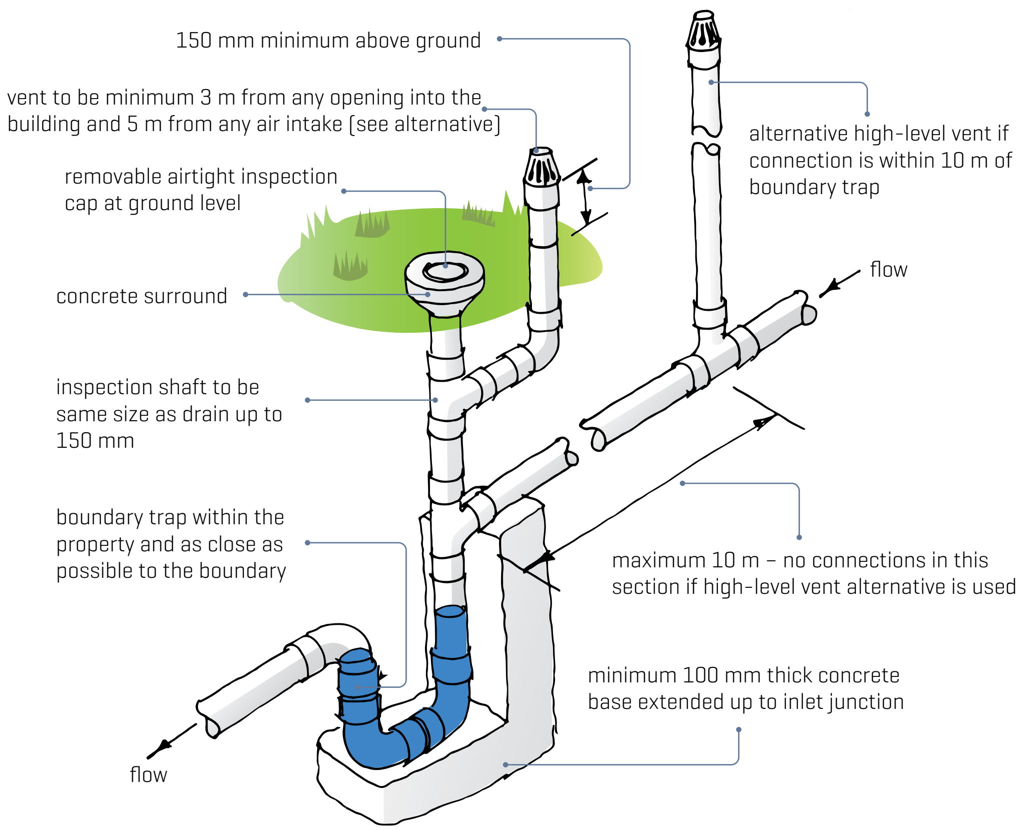


Figure 196. Boundary trap and venting.

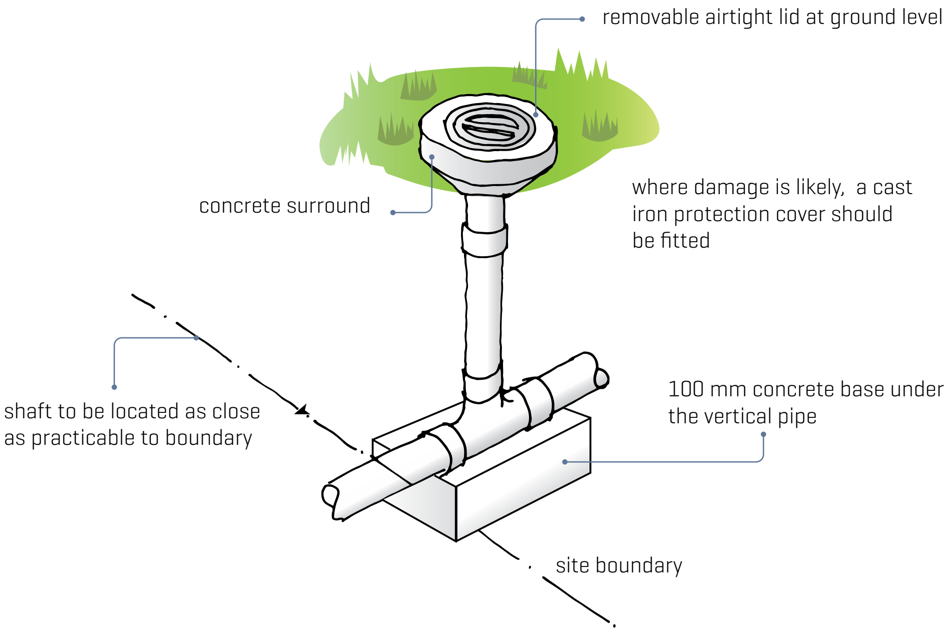


Figure 197. Inspection shaft.

6.9 DRAIN INSTALLATION

Drains laid on gradients steeper than 1:5 (20%) must have reinforced anchor blocks conforming with Figure 198.

Drains near other services must be laid so that:

- there is no potential hazard
- access for maintenance is not impaired
- any cross-over complies with Figures 199–200.

Drains near or passing under a strip footing must conform with Figures 201–202.

Drains passing through a foundation wall or footing must conform with Figure 203.

Drains passing through an external basement wall must conform with Figure 204.

Excavation for drains parallel to and below a footing must comply with Figure 205.

Drains below ground must have adequate cover. Minimum cover requirements are shown in Figure 206.

Where this cover cannot be achieved, cover protection must comply with Figures 207–208.

Backfilling and bedding of drains must comply with Figures 209–210.

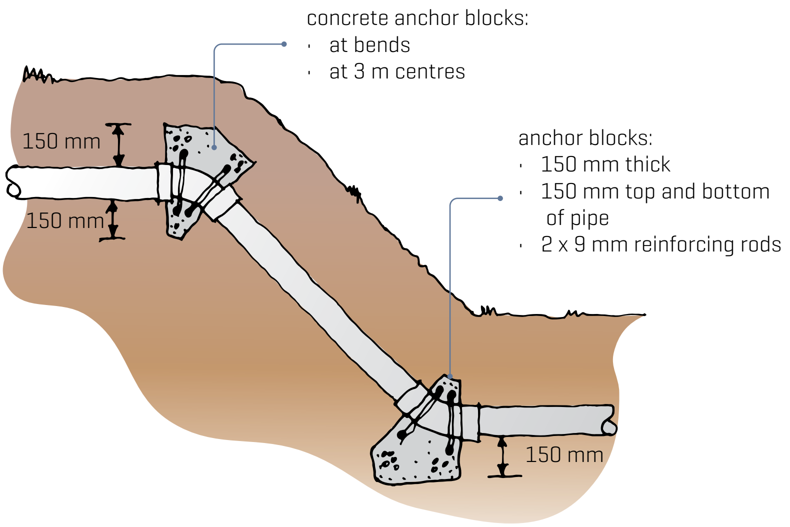


Figure 198. Drainage pipe on steep gradient (20° to vertical) – method of anchoring pipes up to 150 mm diameter.

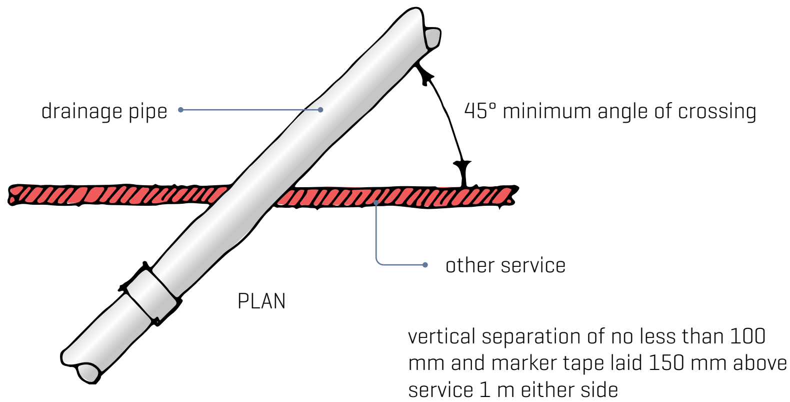


Figure 199. Proximity of drain crossing other services.

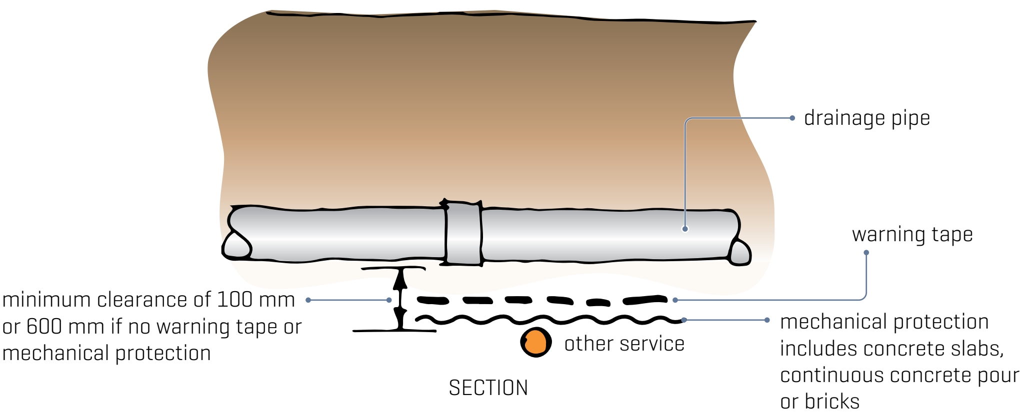


Figure 200. Proximity of drain to other services.

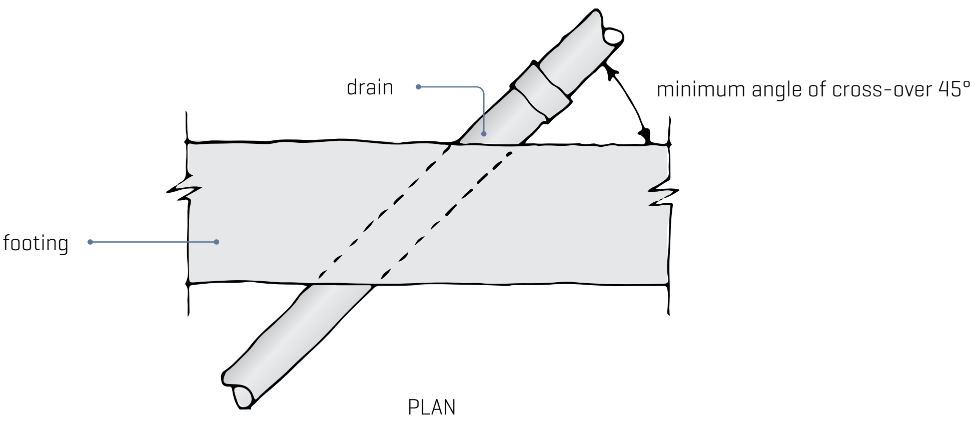


Figure 201. Drain passing under footing – plan view.

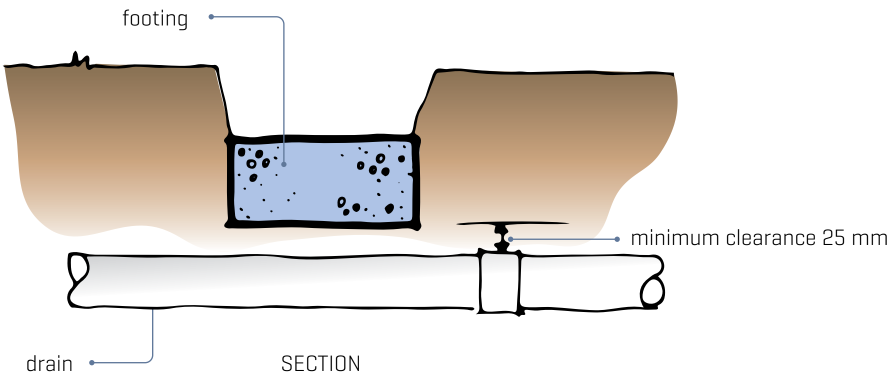


Figure 202. Drain passing under footing.

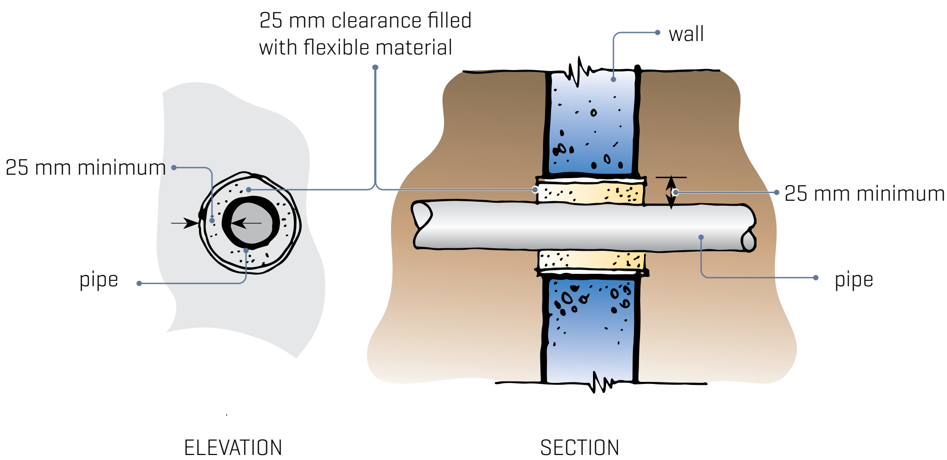


Figure 203. Pipe passing through a wall or footing.

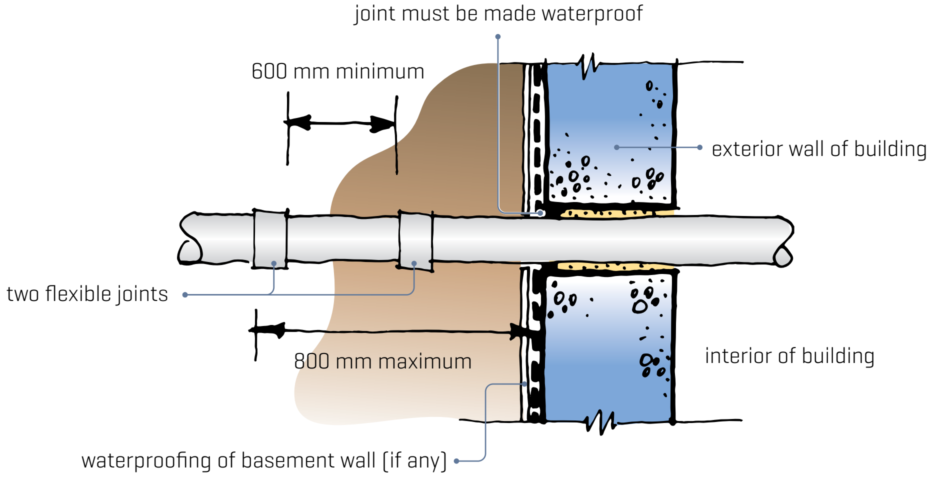
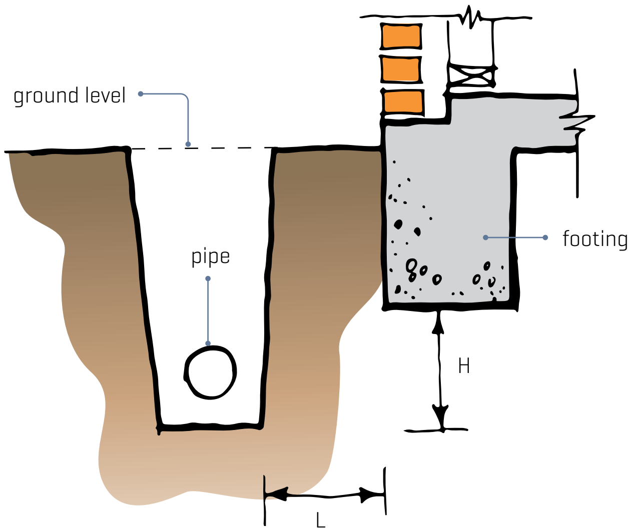
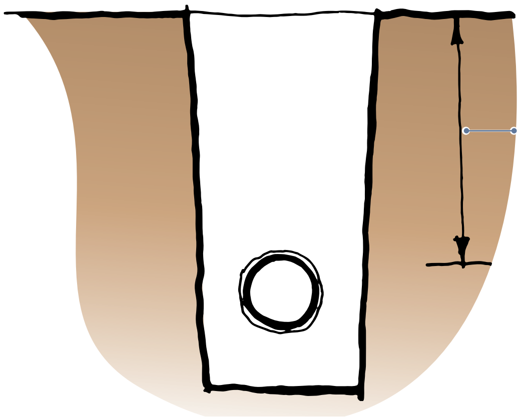


Figure 204. Pipe passing through below-ground external wall.



	Slope H:L	
Soil type	Compacted fill	Undisturbed ground
Stable rock	2:3	8:1
Sand	1:2	1:2
Silt	1:4	1:4
Firm clay	1:2	1:1
Soft clay	Not suitable	2:3
Soft soils	Not suitable	Not suitable

Figure 205. Proximity of trench excavation parallel to building footing.



Location	Cover
Subject to heavy vehicular traffic	300 mm for cast/ductile iron pipes 500 mm other pipe materials
Driveways	300 mm for cast/ductile iron pipes 450 mm other pipe materials
Other situations	Nil for cast/ductile iron pipes 300 mm other pipe materials

Figure 206. Drains with adequate cover.

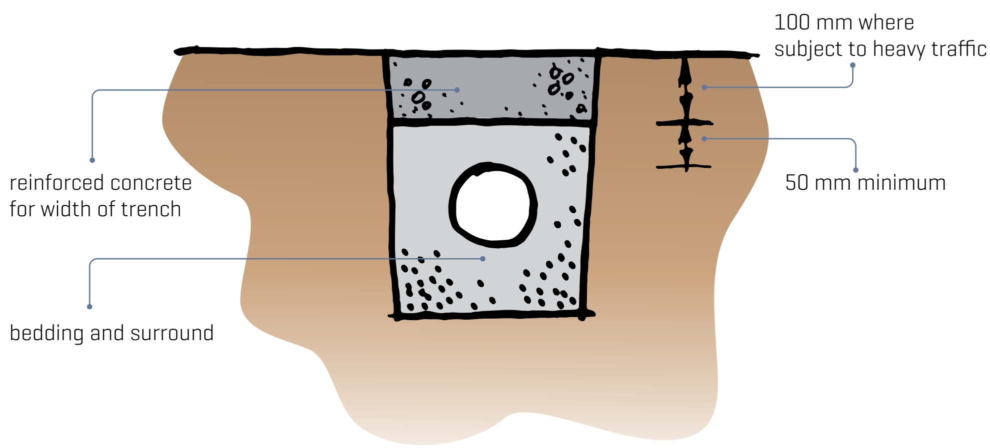


Figure 207. Protection of drains subject to heavy traffic where cover does not comply with Figure 206.

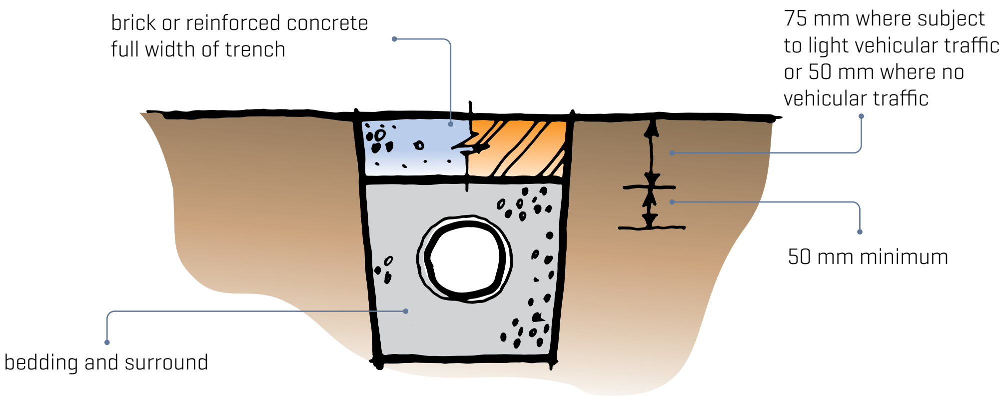


Figure 208. Protection of drains subject to light or no vehicular traffic where cover does not comply with Figure 206.

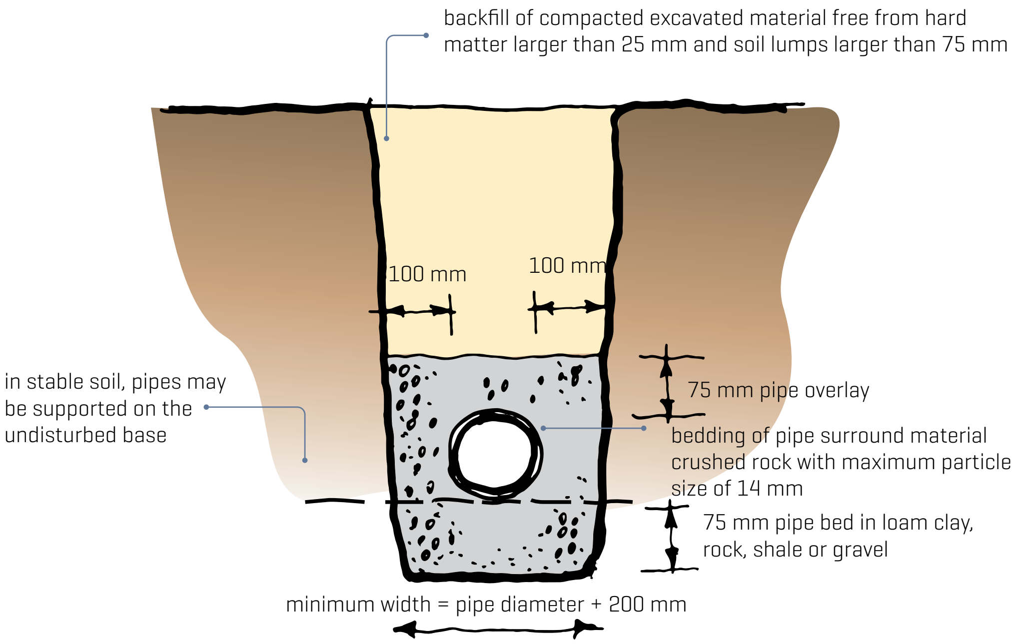


Figure 209. Pipe bedding surround generally.

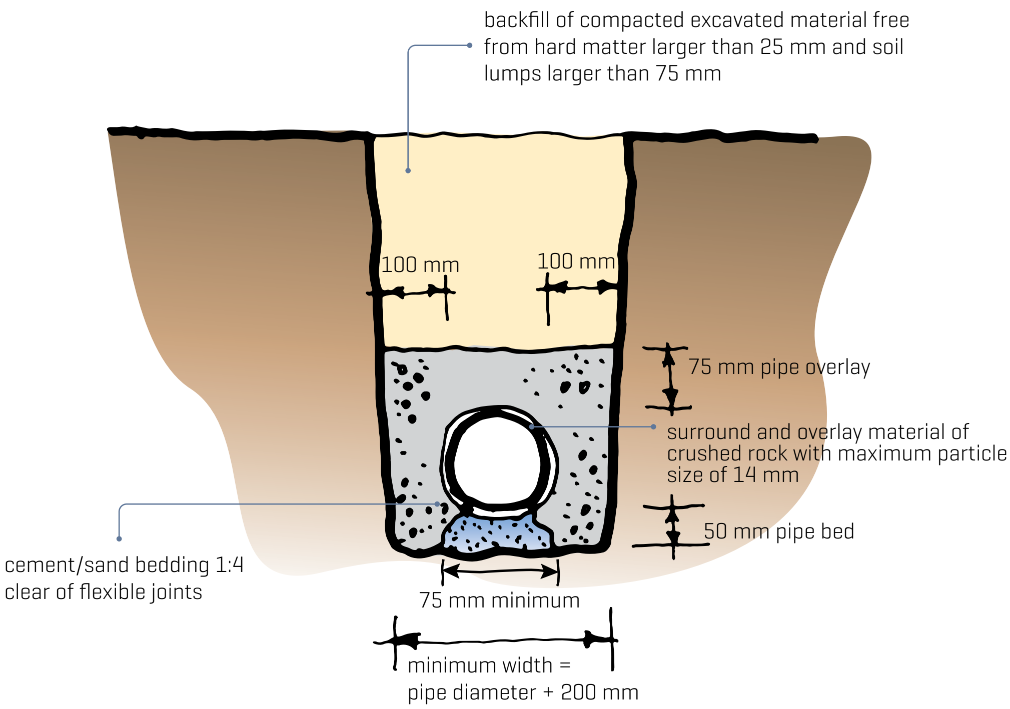


Figure 210. Pipe bedding surround on a rock or shale base with a gradient of 20% or greater.

6.10 PUMPED FOULWATER

Where gravity flow of foulwater is not possible, the flow to the sewer can be pumped via a chamber (wet well) containing at least one submersible pump or a small bore macerator/pump (Figure 211).

6.10.1 Design, construction and installation

A wet well and pump system should be designed and constructed as follows:

- Located in a position to enable access and maintenance.
- Constructed of materials for the tank, pump, fixings, pipes, controls and accessories that will resist corrosion from the foulwater, foulwater gases and aggressive soils (if buried).
- Constructed in situ or be purpose-made with a removable airtight cover for maintenance and access.
- Constructed with a ladder when access to the pump and associated pipes and controls cannot be safely reached through the removable cover.
- Be shaped to have a self-cleansing floor grade towards the pump inlet.
- Have submersible or externally mounted pumps that are suitable for use with unscreened foulwater, fixed with corrosion-resistant fixtures to enable removal for maintenance or replacement and operate on a cycle time compatible with the pump capacity.
- Have an isolating valve and a non-return valve on the discharge side of the pump.
- Have the invert of the incoming gravity discharge pipe located at least 100 mm above the highest working level and terminate with a square junction.
- Have penetrations through the wet well sealed with a compatible material.
- Be vented with an open vent – 80 mm diameter for unscreened foulwater wet wells and 50 mm diameter for wastewater wet wells.

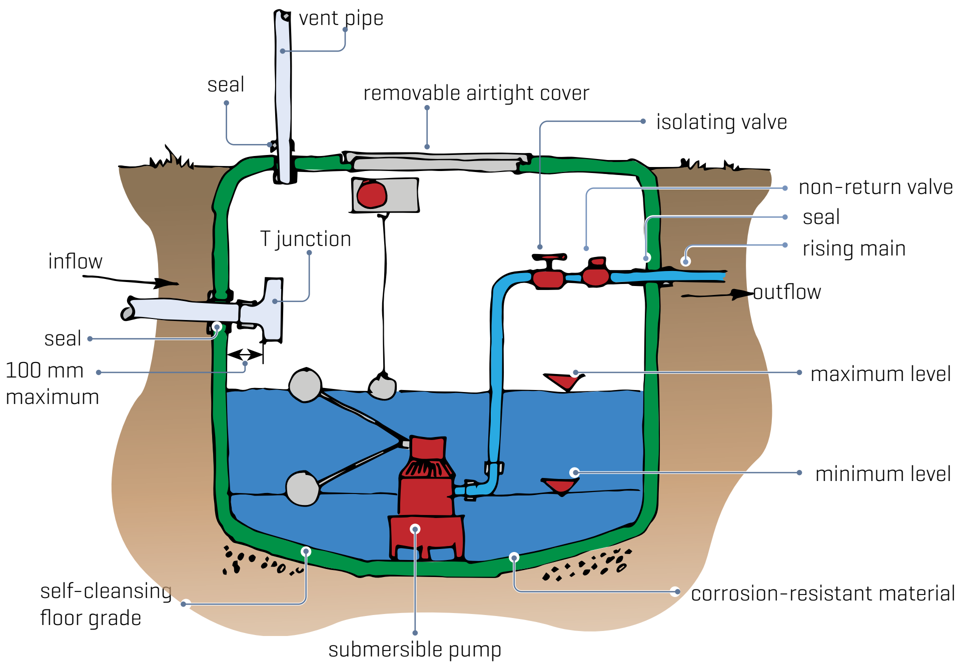


Figure 211. Wet well with a single submersible pump.

6.10.2 Rising mains

The pumped discharge from a wet well is called a rising main and should be designed and constructed to comply with AS/NZS 3500.1:2021 (Figure 212).

The rising main should discharge to:

- an inspection chamber
- a stack below the lowest connection on any floor
- a drain or combined discharge pipe provided the connection is at least 2.5 m from any other connection.

6.10.3 Pumped discharges from waste fixtures

Where gravity flow of foulwater from waste fixtures is not possible, discharge may be pumped when the pump is located in the same room.

Pumped discharges from wastewater systems should have a holding tank that complies with section 6.10.1, with the tank being purpose made, each waste inlet being 100 mm above the highest working level and having a 25 mm vent pipe.

The discharge from the rising main of the wastewater holding tank should discharge as described in section 3 or to a gully riser.

6.10.4 Small bore macerator pumps

Small bore macerator pumps should discharge as described in section 3. Vent pipes from macerator pumps must comply with the venting requirement of section 3.12.

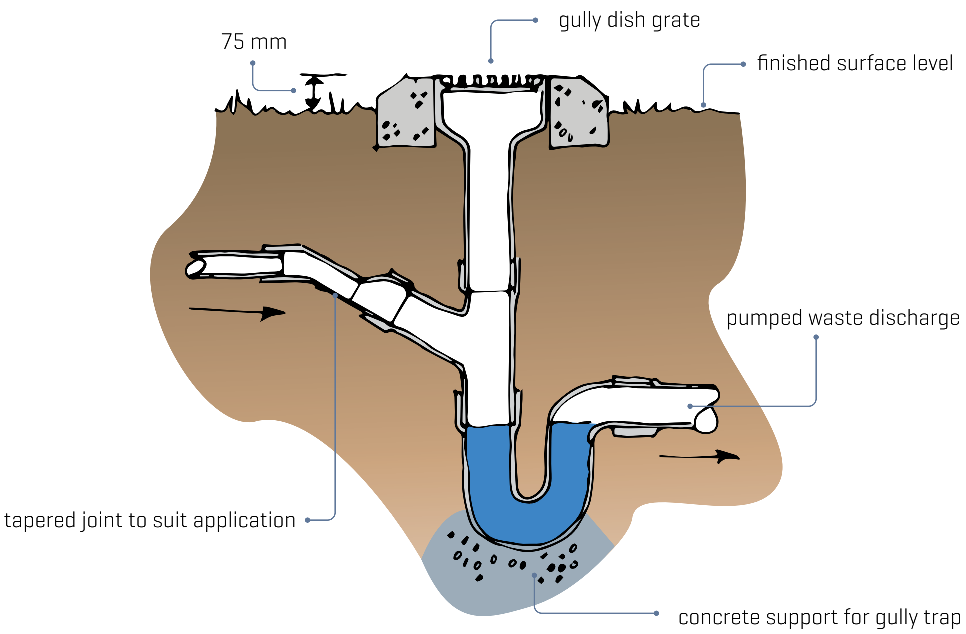


Figure 212. Connection of rising main from a pumped waste system.

7

SURFACE WATER DRAINAGE

This section covers the sizing of downpipes and surface water drains using E1/AS1 *Surface water*.

7.1 DOWNPIPE MATERIALS AND SIZING

Downpipes can be made to the following standards:

- PVC-U – AS/NZS 1260 or AS/NZS 1254
- Galvanised steel – AS 1397
- Copper – BS EN 1172
- Aluminium – AS/NZS 1734
- Stainless steel – NZS/BS 970
- Zinc aluminium – AS 1397

Downpipes can be sized using Table 38.

Table 38. Downpipe sizes for given roof pitch and area.

Downpipe size (mm) (minimum internal sizes)	Roof pitch			
	0–25°	25–35°	35–45°	45–55°
	Plan area of roof served by the downpipe (m²)			
63 mm diameter	60	50	40	35
74 mm diameter	85	70	60	50
100 mm diameter	155	130	110	90
150 mm diameter	350	290	250	200
65 x 50 mm rectangular	60	50	40	35
100 x 50 mm rectangular	100	80	70	60
75 x 75 mm rectangular	110	90	80	65
100 x 75 mm rectangular	150	120	105	90

Adapted from E1/AS1 Table 5.

Example: A monopitch roof house has a roof area of 150 m^2 and 20° pitch. Using Table 38, a single 100 mm diameter downpipe could drain the surface water from the roof. It is more likely that two 74 mm downpipes would be used to each drain half of the roof.

7.2 SIZING SURFACE WATER DRAINS

E2/AS1 describes a method for sizing surface water drains to remove the rainfall from a storm with a 10% probability of occurring annually using this formula to calculate the modified catchment area:

modified catchment area = 0.01 x A x I

where:

A = area being drained comprising plan roof area (m^2) plus paved area (m^2) – paved area includes paving blocks, concrete, asphalt or metalled surfaces

I = rainfall intensity for a storm with a 10% probability of occurring annually and a 10-minute duration (mm/hr).

Where possible, the rainfall intensity should be obtained from the territorial authority. If the territorial authority does not have the information, it can be determined by interpolation of E1/AS1 Appendix A *Rainfall intensities*.

Use the number obtained from the formula to size the drain from Figure 213.

Example:

A house in Wellington has:

- a roof plan area of 250 m^2
- a concrete driveway of 90 m^2
- a paved patio of 50 m^2.

Area A = 250 + 90 + 50 = 390 m^2.

Rainfall intensity for Wellington is 70 mm/hr.

Modified catchment area = 0.01 x 390 x 70 = 273.

Using 273 in Figure 213 gives:

- 85 mm ID drain at a minimum gradient of 1:30
- 100 mm ID drain at a minimum gradient of 1:60
- 150 mm ID drain at a minimum gradient of 1:200.

Choosing which pipe size and its corresponding gradient will depend on the topography of the site. For a flat site, a 200 mm drain may be required, or for a site that slopes in the direction of the outfall, an 85 mm drain will be adequate.

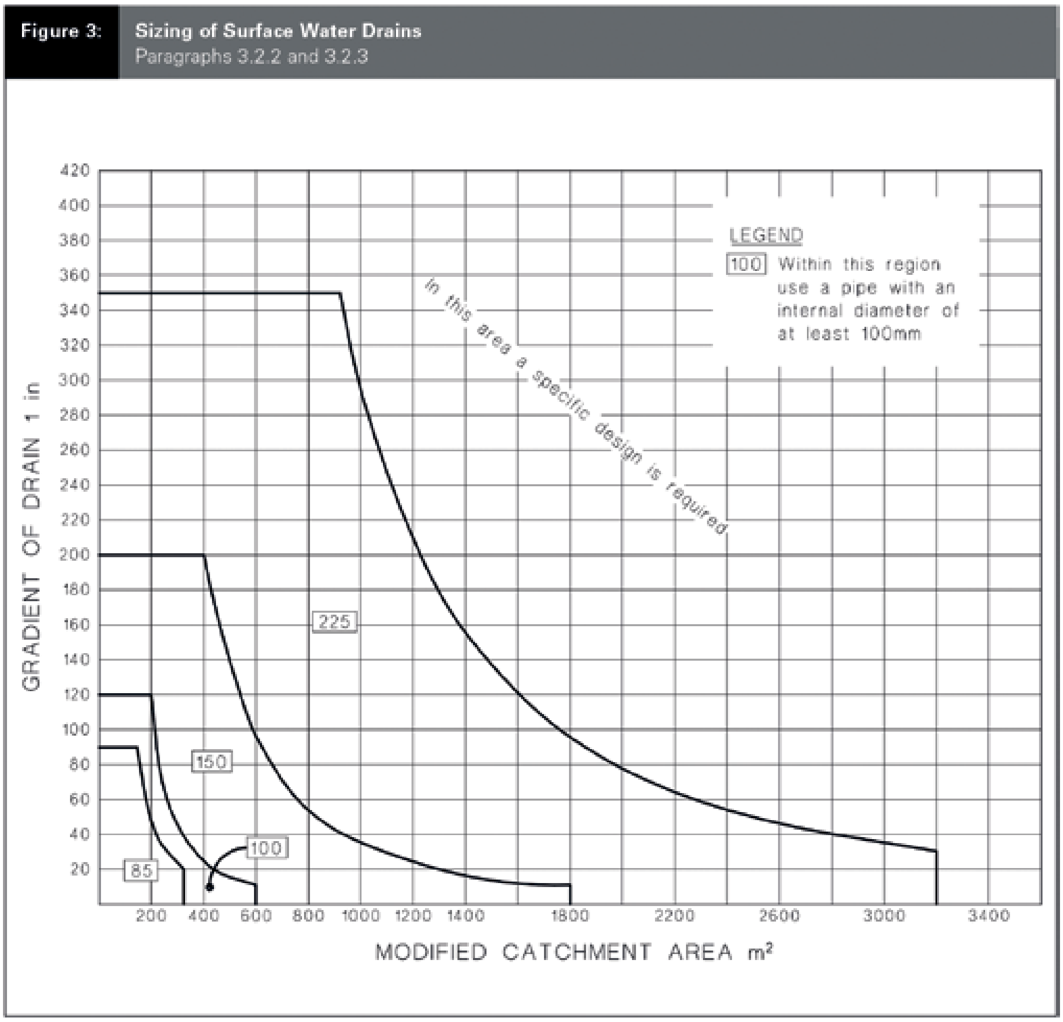


Figure 213. Sizing of surface water drains (E1/AS1 Figure 3). © The Crown.

7.3 INSTALLATION OF DRAINS

The installation of drains for surface water is largely the same as for foulwater drains:

- Both use minimum gradients.
- Foulwater drains use swept bends only, while surface water drains allow square junctions.
- Fewer inspection and access points are required for surface water drains.

7.4 AS/NZS 3500.3:2021

Acceptable Solution E1/AS2 references AS1/NZS 3500.3:2021, subject to the modifications in paragraph E1/AS2 1.0.4 and can be used for complying with Building Code clause E1 *Surface water.*

8

RAINWATER COLLECTION AND USE

The collection and use of rainwater in New Zealand is becoming increasingly popular for water conservation and sustainability reasons.

A rainwater collection and use system (Figure 214) comprises:

- gutters and downpipes collecting rainwater from the roof catchment
- debris diverter such as a leaf guard
- first-flush diverter
- calmed inlet
- valves, vents, meshes and tank gauges
- floating out-take
- filtration
- purification.

8.1 BUILDING CODE REQUIREMENTS

Building Code clause G12 *Water supplies* specifies in G12.3.1: “Water intended for human consumption, food preparation, utensil washing, or oral hygiene must be potable.” Uses not requiring potable water can be supplied with non-potable water such as rainwater if it is not harmful to the building occupants.

The Health Act 1956 uses the term ‘drinking water’ rather than ‘potable water’ to denote water that is suitable for human consumption.

Potable water is required for food preparation, utensil washing and human consumption (at the kitchen sink) and for oral hygiene (at the bathroom basin). Water uses such as clothes washing, bathing and showering do not require potable water, and these activities can be undertaken using safe rainwater.

8.2 CONTROLLING THE QUALITY OF WATER ENTERING THE RAINWATER TANK

There are a range of devices and materials that can be used to improve the water quality entering rainwater tanks.

8.2.1 Roofing, gutters and downpipes

Roofing and rainwater collection devices must be manufactured from materials that do not transmit harmful compounds into the collected water, particularly when the rainwater is intended for potable uses. Examples include lead from flashings and chemicals from unprotected treated timber.

8.2.2 Debris diverter such as a leaf guard

Preventing leaves and other debris from entering downpipes prevents leaves decaying in the downpipes, pipes to the tank and the rainwater tank.

8.2.3 First-flush diverter

These devices divert the initial flow of water from rainfall, which is more likely to contain dirt and other contaminants washed from the roof.

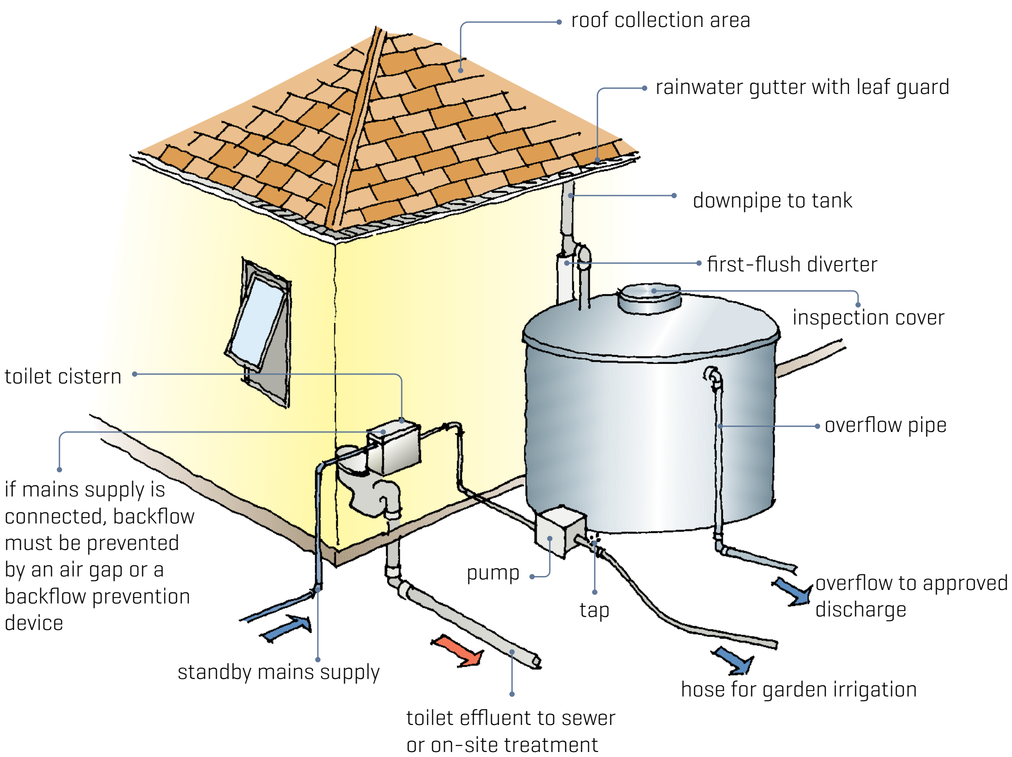


Figure 214. Rainwater harvesting system.

8.3 CONTROLLING THE QUALITY OF WATER FROM THE RAINWATER TANK

A range of devices are designed to increase the quality of the rainwater before it is used as either potable or non-potable water.

8.3.1 Calmed inlet

A calmed inlet allows the incoming water to gently discharge into the tank without disturbing the settled sediment layer at the bottom of the tank.

8.3.2 Vacuum overflow

Piping the overflow pipe to remove water from the bottom of the tank allows for the overflow to 'vacuum' stale water and some sediment from the bottom of the tank.

8.3.3 Valves, vents, meshes and gauges

Isolation valves located on water pipes and connections from the tank allow access to tank draining, cleaning and maintenance.

Air vents should be covered with mesh to prevent entry by vermin or insects.

Gauges can be installed to indicate water level.

8.3.4 Floating out-take

Using a floating out-take enables water from the tank to be drawn from just below the surface where the cleanest water lies.

8.3.5 Filtration

Filtering water greatly reduces the presence of bacteria, viruses, algae, pesticides and other contaminants but does not reduce them to a level where the rainwater can be used for potable uses. A range of filter types are often used together:

- Mesh filters can filter out sediment and dirt and some organisms such as *Giardia* cysts.
- Carbon filters reduce the quantities of chemicals, numbers of bacteria and unwanted odours.
- Reverse osmosis passes water through a semi-permeable membrane. This type of filter can filter out lead, pesticides and bacteria.

8.3.6 Treatment

Treatment or purification systems are installed after filtration:

- Ultraviolet systems expose water to the light from ultraviolet bulbs – this disrupts the DNA of micro-organisms such as bacteria and viruses, stopping them from multiplying.
- Ozone treatment kills micro-organisms and can reduce pesticide levels and remove unpleasant odours.

8.4 RAINWATER USE

8.4.1 Rainwater for potable uses

Where rainwater is intended for potable uses, all of the above features will need to be installed in the rainwater system together with an ongoing maintenance regime to ensure the water remains potable. This is more likely to occur where there is no network utility water supply scheme, such as on farms and some lifestyle blocks.

8.4.2 Rainwater for toilet flushing and garden watering

Treatment of rainwater for garden watering and toilet flushing will involve fewer of the steps described above but should still ensure the collected water remains clean and is less likely to clog valves and tapware and irrigation jets.

9

WATER SUPPLY

A public water supply system is provided by a network utility operator that undertakes to distribute a water supply that is potable (drinkable) and has adequate pressure.

This section explains the principles involved in:
- the installation of a potable (fit for human consumption) cold water supply and service
- the protection of potable water by preventing cross-connection and backflow
- water storage
- the protection of people from electric shock.

It assumes that an adequate potable water supply is available from a network utility operator. The section does not cover:
- alternative water supplies such as bores or wells – section 8 covers rainwater collection and use
- commercial, industrial or multi-storey installations
- solar hot water systems – see section 10.2.4
- hot water systems with uncontrolled heat sources – see section 10.2.5 for wetback water heaters.

It explains the broader principles of water installation design and, where appropriate, gives references to additional information available in:
- G12/AS1 *Water supplies*
- AS/NZS 3500.1:2021 *Plumbing and drainage – Part 1: Water services*
- AS/NZS 3500.4:2021 *Plumbing and drainage – Part 4: Heated water services.*

Note: The Water Services Act 2021 is the legislation covering water supplies and uses the term 'drinking water' instead of 'potable water'.

9.1 PUBLIC WATER SUPPLY

A public water supply system is provided by a network utility operator that undertakes to distribute a water supply that is potable (drinkable) and has adequate pressure. Potable water must be provided for human consumption, food preparation, utensil washing and oral hygiene.

The network utility operator is responsible for installation (though not necessarily the cost) of the property service (Figure 215) including:

- connection to the operator's water main
- the branch supply pipe to a private property
- a shut-off valve at the boundary
- a dual-check valve assembly (containment backflow protection) in some areas for residential connections
- provision of a water meter (Figure 216) in most but not all areas.

The building/land owner is responsible for the provision of water service pipework from the point of supply to the main within the boundary of the property. To allow for maintenance, the water supply to every separate dwelling unit within a single property must be provided with an isolating valve (also known as a toby).

9.2 WATER PIPING

Every sanitary fixture must be connected to the water supply by a pipe that provides an adequate flow rate of not less than that shown in Table 39. The methods of calculating adequate pipe size take into consideration:

- available water pressure – expressed in metres of head or kPa
- loss of water pressure contributed by the developed pipe length, bends and diameter (friction)
- the acceptable flow rate at the fixture outlet.

Water pipes should be adequately sized to ensure that the speed of the water (velocity) travelling in the pipe does not exceed 3 m/s.

Methods of calculating pipe sizes and available head are given in:

- G12/AS1 clause 5.4 – there are scope restrictions and limitations in the notes to G12/AS1 (Table 4)
- AS/NZS 3500.1:2021 section 3 including Appendix C and Appendix D.

Figures 217–218 demonstrate the concept of developed length and available head.

9.3 WATER PRESSURE

The working pressure must be no less than 30 kPa (3 m head) and the static pressure no more than 500 kPa (50 m head). Where adequate pressure cannot be obtained from the available supply, the pressure may be boosted by:

- providing a water storage supply tank in a position that will provide adequate head
- fitting an automatic pressurising pump to the supply system.

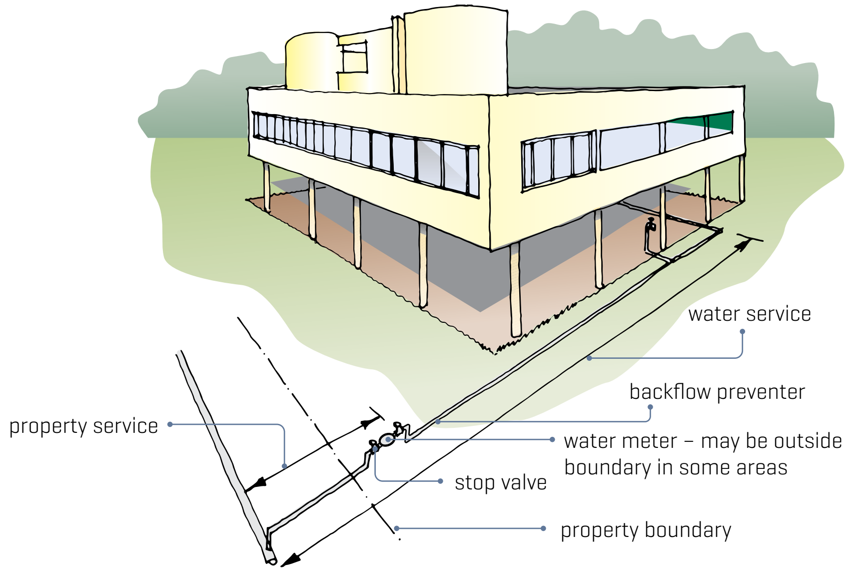


Figure 215. Property service and water service.

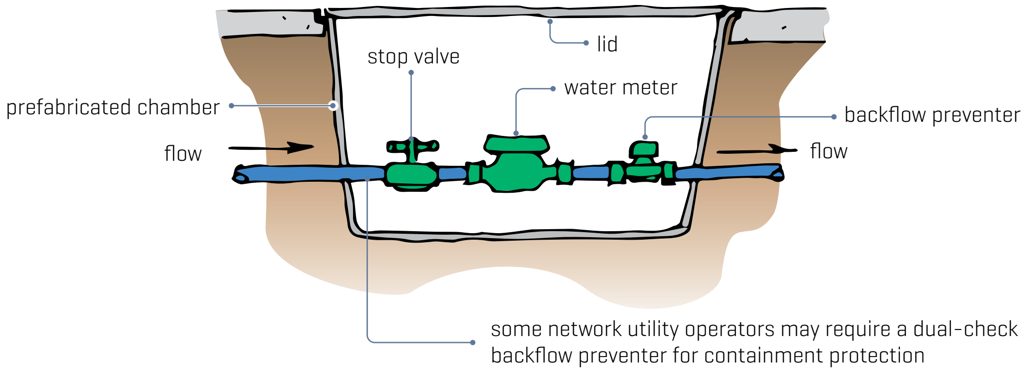


Figure 216. Typical below-ground water meter installation.

Table 39. Acceptable flow rates to fixtures (G12/AS1).

Sanitary fixture	Flow rate and temperature (l/s and °C)	How measured
Bath	0.3 @ 45°C	Mix hot and cold water to achieve 45°C
Sink	0.2 (hot) and 0.2 (cold)	Flow rates required at hot and cold taps but not simultaneously
Laundry tub	0.2 (hot) and 0.2 (cold)	Flow rates required at hot and cold taps but not simultaneously
Basin	0.1 @ 45°C	Mix hot and cold water to achieve 45°C
Shower	0.1 @ 42°C	Mix hot and cold water to achieve 42°C

Notes: The flow rates shall be capable of being delivered simultaneously to the kitchen sink and one other fixture. The temperatures given in this table are to assist with ensuring acceptable flow rates are achieved when hot and cold water are mixed. For maximum hot water temperatures, see section 10.1 and G12/AS1 6.14.1.

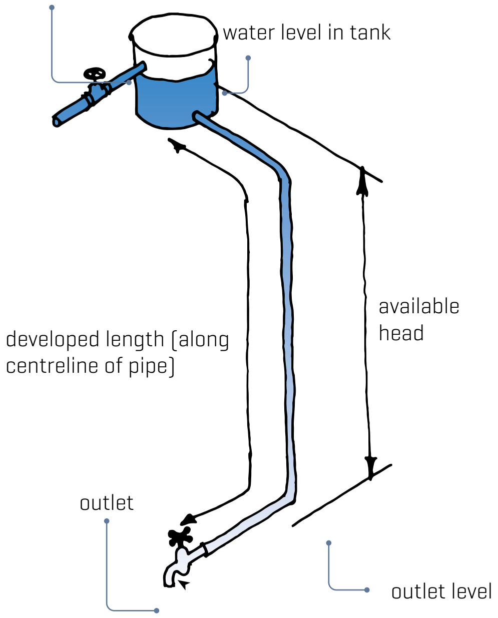


Figure 217. Developed length and available head from water storage tank.

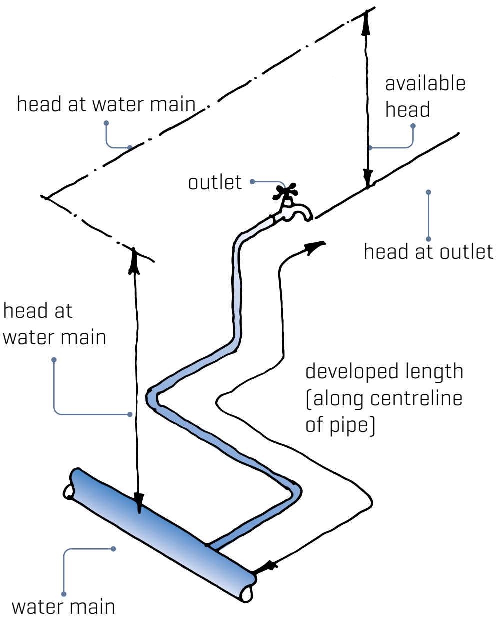


Figure 218. Developed length and available head from water main.

Where the supplied water pressure is too high (over 500 kPa or 50 m head) for normal purposes, a pressure-reducing valve may be fitted to the supply or a supply storage tank installed.

Requirements for the installation of pressurising pumps are given in AS/NZS 3500.1:2021 section 12.

9.4 PROTECTION OF POTABLE WATER

Water supplied by the network utility operator is potable and must remain uncontaminated to protect the community from illness.

Backflow into the main supply of water that has been drawn from it must be prevented.

A potential cross-connection occurs where a potable water supply is connected to a fixture, storage tank or equipment in such a way that contaminated water (or any other substance) could enter the potable supply.

Potential cross-connections can exist in a large number of circumstances such as:

- irrigation systems
- dishwashers
- swimming pools or ornamental pools filled by a hose pipe
- storage tanks
- medical, dental and veterinary equipment
- industrial installations.

Backflow is the reversal of flow into a potable water supply due to:

- back siphonage, which can occur when the pressure in the water main falls below

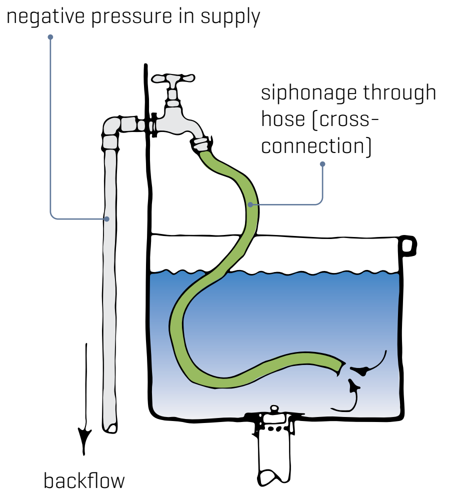


Figure 219. Back siphonage.

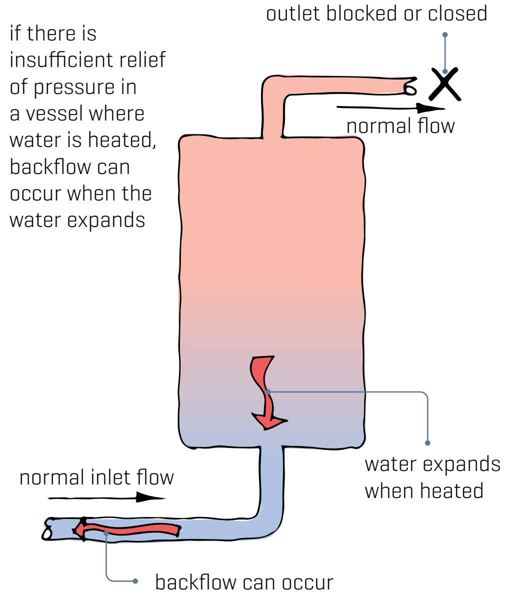


Figure 220. Principle of back pressure.

atmospheric pressure (Figure 219)
- back pressure, which can occur when the pressure in the water service is higher than in the main supply (Figure 220).

Cross-connections are rated according to the hazard level, taking into account the toxicity of the hazard and the likelihood of backflow occurring:
- High hazard – contamination of the supply has the potential to cause death.
- Medium hazard – contamination of the supply has the potential to endanger health.
- Low hazard – there is potential for nuisance but not a danger to health.

Water supply systems must be designed and installed so there is no likelihood of cross-connection or backflow.

Backflow is prevented by either:
- providing an air gap or a break tank in the system or
- installing a backflow prevention device in the system.

The principle of air gaps and break tanks is shown in Figures 221–222.

Backflow prevention devices must be appropriate to the level of hazard (Table 40).

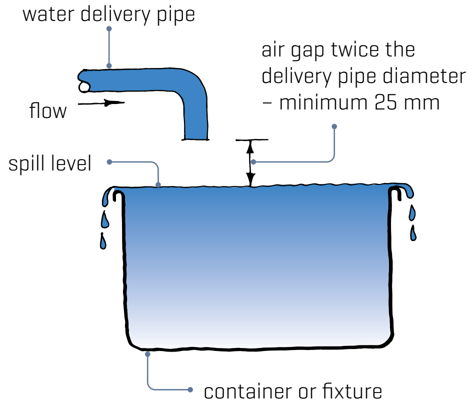


Figure 221. Air gap between potable water supply outlet and spill level of sanitary fixture – refer to G12/AS1 Figure 1.

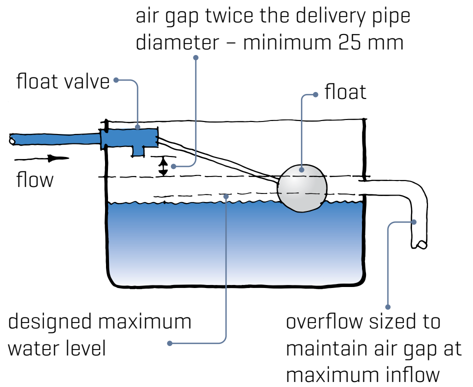


Figure 222. Air gap between potable water supply outlet at overflow level of storage tank.

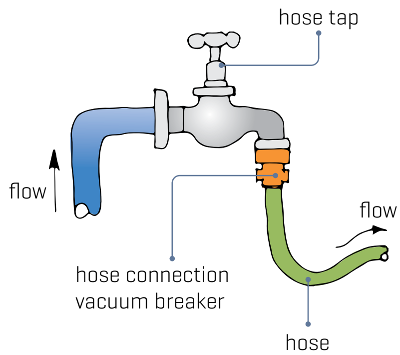


Figure 223. Typical hose connection – vacuum breaker installation.

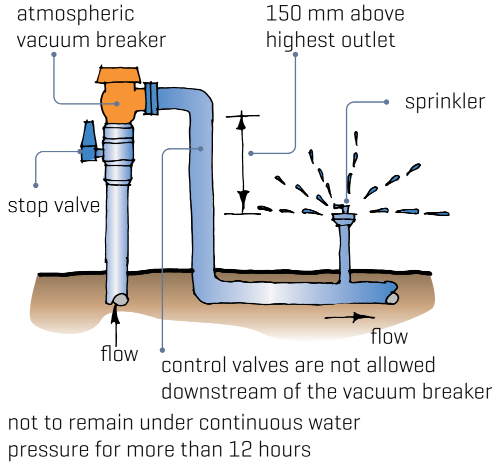


Figure 224. Typical atmospheric – vacuum breaker installation.

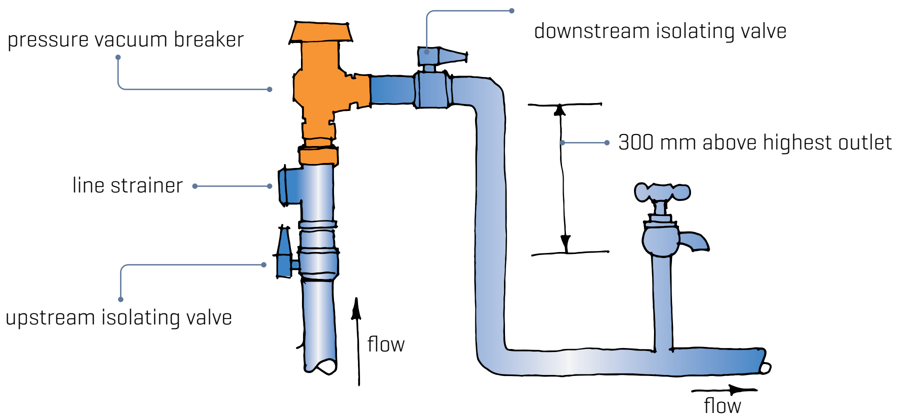


Figure 225. Backflow prevention device – pressure vacuum breaker.

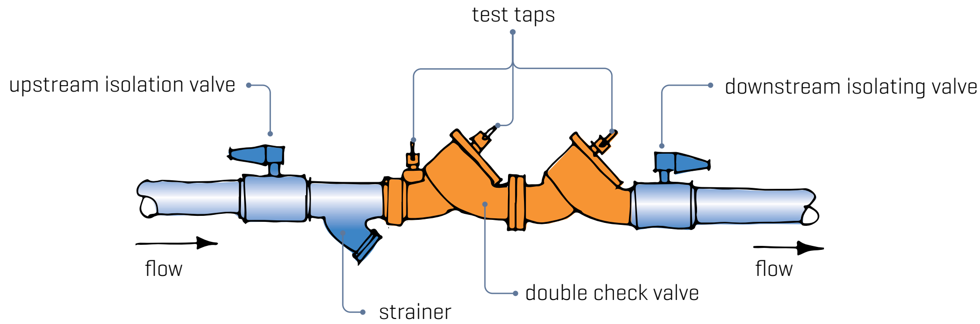


Figure 226. Typical double check valve installation.

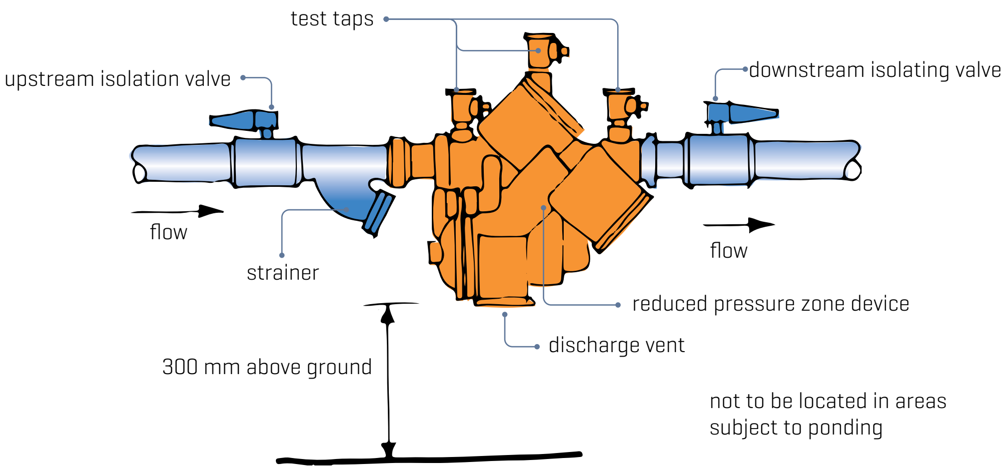


Figure 227. Typical reduced pressure zone device installation.

Table 40. Backflow prevention devices must be appropriate to the level of hazard.

	Low hazard	Medium hazard	High hazard	Back siphonage	Back pressure
Hose vacuum breakers [Figure 223]	•			•	
Atmospheric vacuum breakers [Figure 224]	•	•	•	•	
Pressure vacuum breakers [Figure 225]	•	•	•	•	
Double check valve assemblies [Figure 226]	•	•		•	•
Reduced pressure zone devices [Figure 227]	•	•	•	•	•
Break tanks [Figure 222]	•	•	•	•	
Air gaps [Figure 221]	•	•	•	•	

For selection of backflow protection, refer to G12/AS1.

Backflow prevention devices must be installed strictly in accordance with the manufacturer's instructions and:

- as near as practicable to the potential source of contamination
- where they are accessible for inspection, testing and maintenance where this is required
- where they are protected from damage
- where they open to unpolluted atmosphere
- so they are protected from freezing and flooding.

Backflow prevention devices may be testable or non-testable (depending on the applicable code or standard and the degree of hazard). Testable devices must be tested on installation and at the intervals and to the standard required by the appropriate code or standard. Non-testable devices should be checked at periods not exceeding 2 years.

Responsibility for backflow prevention may rest with:

- the network utility operator – a backflow prevention device (containment device) may be installed as part of the meter assembly
- the individual property owner whose responsibility it is to comply with the requirements of the network utility provider and the Building Code and to protect building users within the premises.

Requirements for the prevention of contamination of potable water supplies are given in G12/AS1.

9.5 CONTAINMENT PROTECTION

Containment backflow protection is required to protect the water main:

- if containment protection is not provided by the network utility operator
- for water services other than connections solely used for firefighting purposes
- for premises other than those that contain household units
- if the backflow prevention device is to be located as near as practicable to the point of supply
- if there are no branch connections between the point of supply and the containment backflow prevention device.

Water downstream of the containment backflow prevention device is considered potable unless there are unprotected cross-connections within the premises.

Backflow prevention devices for high and medium hazard premises are in G12/AS1 Table 2A.

9.6 NON-POTABLE WATER

Where a non-potable water supply is installed within a building, it must not be used for potable water uses and:

- non-potable pipelines must be lilac colour
- non-potable outlets must be clearly labelled as in Figures 228–229
- non-potable pipelines must be identified in accordance with AS/NZS 3500.1:2001 clause 9.6
- non-potable piping must not be located where food is processed or above potable water storage tanks.

Figure 228. Non-potable water sign [G12/AS1].

Figure 229. Non-potable water sign [AS/NZS 3500.1:2021].

Requirements for non-potable water supplies are given in G12/AS1 section 4.

9.7 WATER STORAGE TANKS

Water storage tanks may be necessary:

- to provide a reserve water supply
- to provide adequate pressure to a supply system – if the mains supply does not have sufficient pressure
- for low-pressure sanitary flushing systems or other purposes
- to provide a greater flow rate than the main supply
- where the main supply is insufficient for heavy peak demands
- to provide an air break.

Water storage of 50 litres per person must be provided in buildings in New Zealand that are classified for community care such as hospitals, homes for the elderly and prisons.

Because utility network operators cannot guarantee a continuous water supply, building owners should consider providing water storage in situations where it is not mandatory. This may be necessary to allow the business carried out in the building to continue in such places as hotels, nursing homes and clinics and for safety in hairdressing salons.

Cold water storage tanks for domestic purposes can comply with G12/AS1 section 5 [see Figure 230 and AS/NZS 3500.4:2021 Figures 5.4.5 and 5.5.1] and be positioned so they have adequate structural support. Tanks for commercial and industrial purposes may require specific design, Tanks must have seismic restraint.

Requirements for the provision, design and restraint of cold water storage tanks are given in G12/AS1 section 5.1. Safe trays are required by G12/AS1 clause 5.2.3, and the overflow of a minimum DN 40 as given in G12/AS1 must be readily visible.

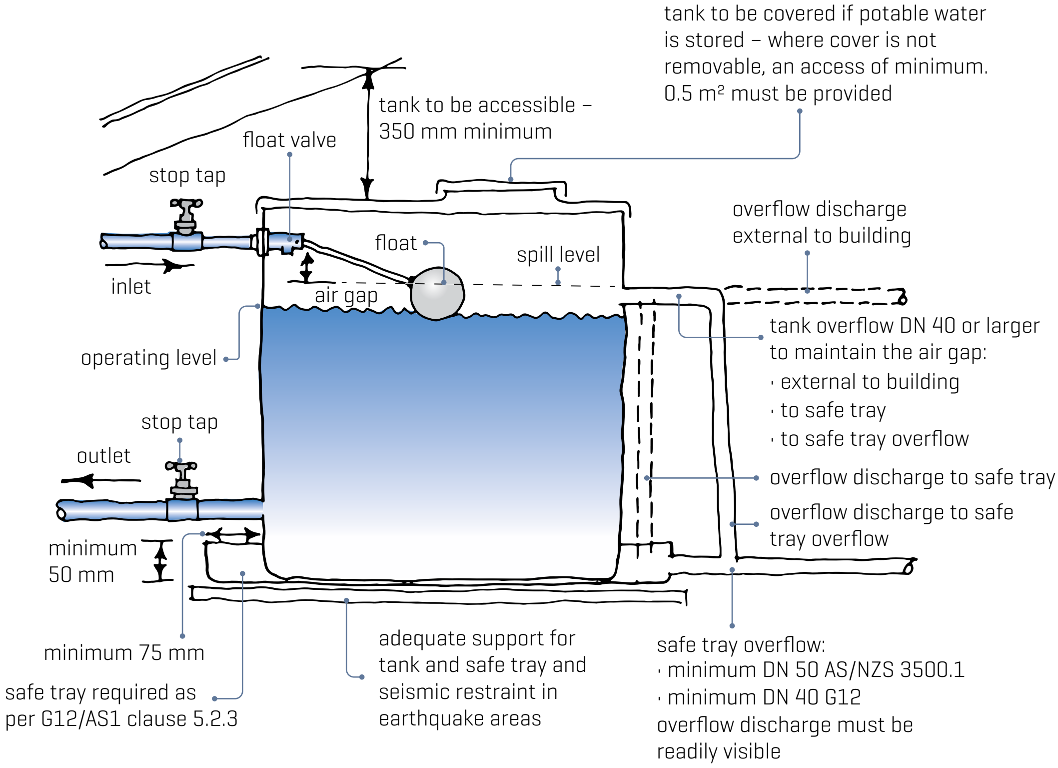


Figure 230. Water storage tank – typical installation.

9.8 FLUSHING OF SANITARY FIXTURES

Water for flushing must be provided to some sanitary fixtures including:

- WC pans
- urinals
- fixtures used in hospitals such as:
  - bed pan washers
  - flushing sinks
  - slop hoppers
  - flushing floor waste gullies.

Water for flushing must be provided from:

- a storage cistern (Figures 231–232) or
- a flushing valve connected directly to the supply system and incorporating backflow prevention (Figure 233) or
- a flushing valve supplied from a storage break tank (Figure 234).

9.9 EQUIPOTENTIAL BONDING

Equipotential bonding is the connection of metalwork electrically so that it is at the same voltage everywhere. Bonding is done where the distribution wiring enters the building to provide a connection to the incoming metal water and gas services to ensure that they are always at the same electrical potential.

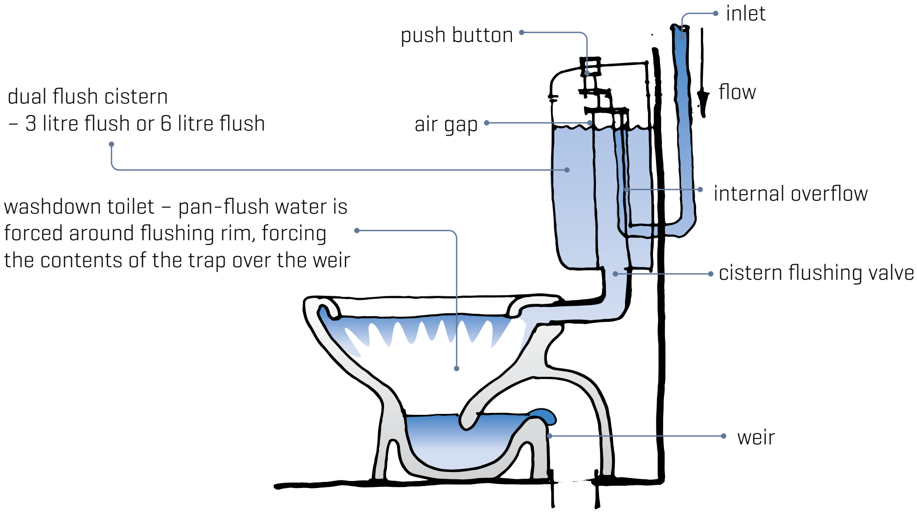


Figure 231. Principle of flushing cistern.

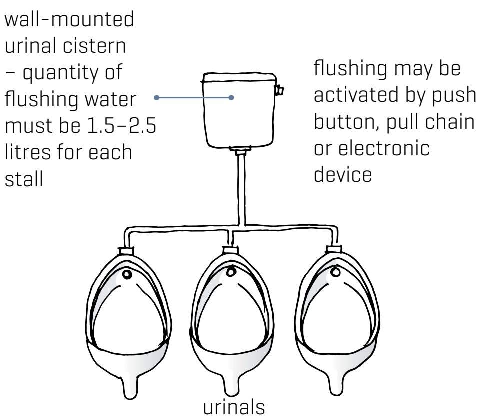


Figure 232. Principle of urinal flushing cistern.

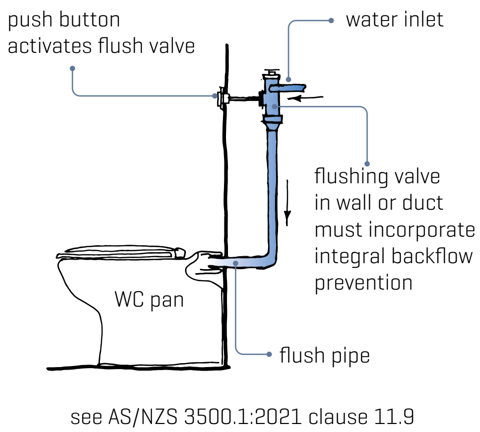


Figure 233. Principle of flush valve connected directly to mains pressure water supply.

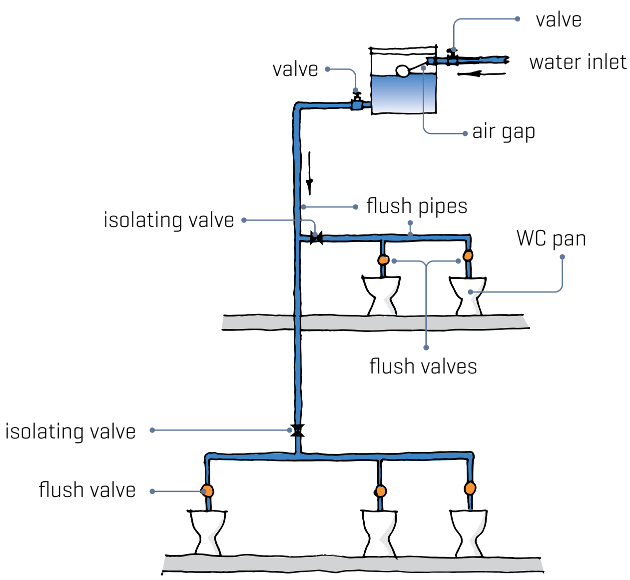


Figure 234. Principle of flushing system with storage tank and flush valves.

It is required in any building where:

- the water supply piping (or waste system) is metal and is in contact with the ground
- an electrical supply is provided in the building
- building users are able to make contact with exposed piping and the potential exists for an electrical fault, which will make the water piping a source of danger from electric shock.

To alleviate this potential danger:

- the piping must be connected to an earth electrode using earth-bonding conductors (Figure 235)
- metallic fixtures must be bonded to the pipework (Figures 236–237)
- care must be taken when cutting metal pipes (Figure 238).

Note that requirements may vary – check with the local authority.

When replacing an existing metallic water service with a new non-metallic service, contact an electrician to confirm earthing requirements are still met.

Generally, an earth stake will now be required to reinstate the electrical earth.

Requirements for equipotential bonding and safety precautions when working with metal piping are given in G12/AS1 section 9.

9.10 MATERIALS AND INSTALLATION

Pipework and components used in water supply systems must be selected to ensure that:

- they do not contaminate potable water
- they are sufficiently durable to ensure satisfactory service for the designed life of the installation – this is a requirement of clause B2 *Durability*
- they are suitable for the expected temperatures and pressures
- the potential for electrolytic corrosion is minimised.

Factors to be taken into account include:

- compatibility with the water supply – if in doubt, check to ensure that the chemical composition of the water will not cause corrosion or degradation of the material used
- the nature and chemical composition of the ground in which underground pipework will be buried to avoid corrosion of the exterior of the pipe
- the climate of the area – protection from freezing, salt and sulphur
- the amount of exposure to UV light – plastics deteriorate in sunlight.

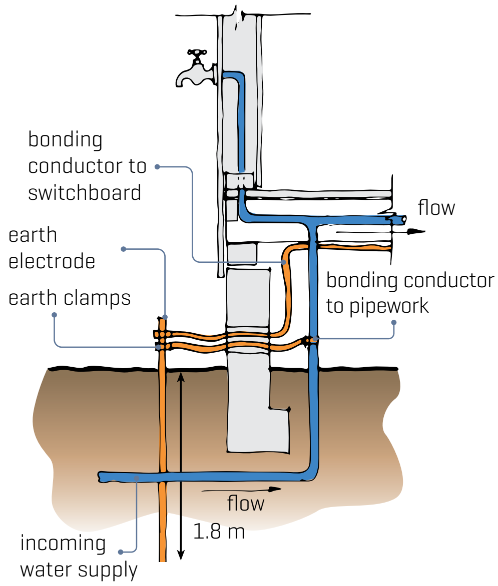


Figure 235. Earth bonding system.

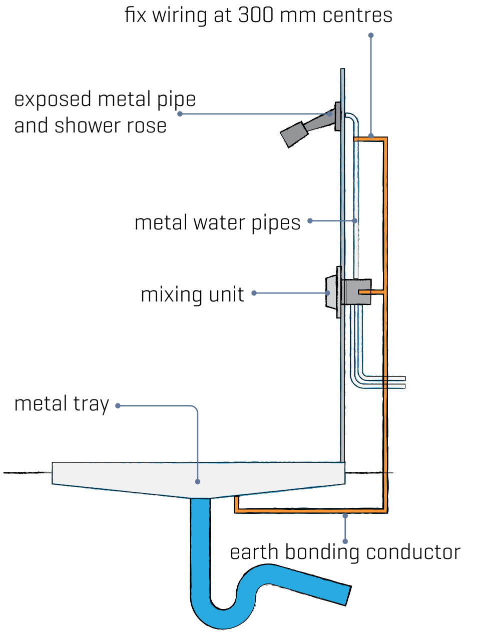


Figure 236. Equipotential bonding – metal shower tray.

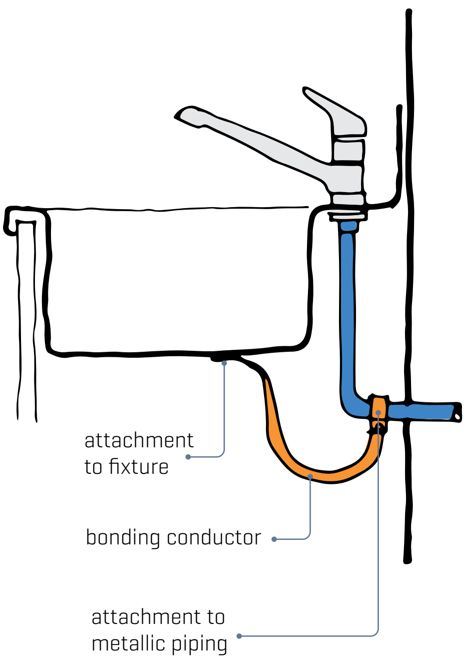


Figure 237. Equipotential bonding – metal sink.

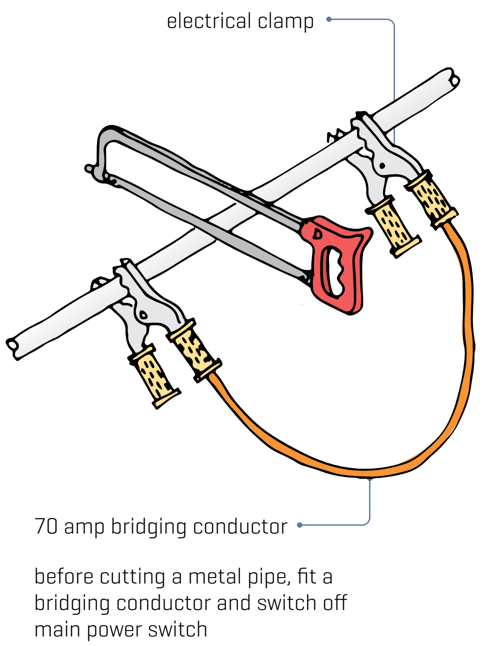


Figure 238. Safety precautions when cutting pipe that forms part of a metal piping system.

Lead in plumbing products

From 1 September 2025, any product that contains copper alloy and is intended for use in contact with potable water for human consumption shall have a weighted average lead content of no more than 0.25% verified in the form of a test report provided by a test facility with IANZ or equivalent accreditation in accordance with NSF/ANSI/CAN 372.

Evidence of meeting this requirement can come from:

- building product information requirements where the manufacturer or importer has to state how their product complies, in this case with G12.3.2(c)
- international product certification scheme marking such as a lead-free WaterMark or ANSI-certified lead-free mark
- an NSF/ANSI/CAN 372:2020 test report that verifies that a product has a weighted average lead content of ≤0.25%.

See G12/AS1 paragraph 2.1.3 for products and uses where this requirement applies.

Pipework must be installed so that:

- there is no potential hazard created from the proximity of other services – for gas and electrical services, a separation of at least 100 mm is required with identification tape and mechanical protection
- the possibility of physical damage is minimised
- it is protected against corrosion
- it is fixed firmly in place with allowance for lateral thermal expansion and contraction
- it is protected from freezing
- noise transmission to the building structure is minimised.

For holes and notches in timber and metal framing, see AS/NZS 3500.1:2021 clause 5.5.2.

Pipes crossing other services below ground must be laid so that:

- there is no potential hazard
- access for maintenance is not impaired
- any cross-over complies with Figure 239.

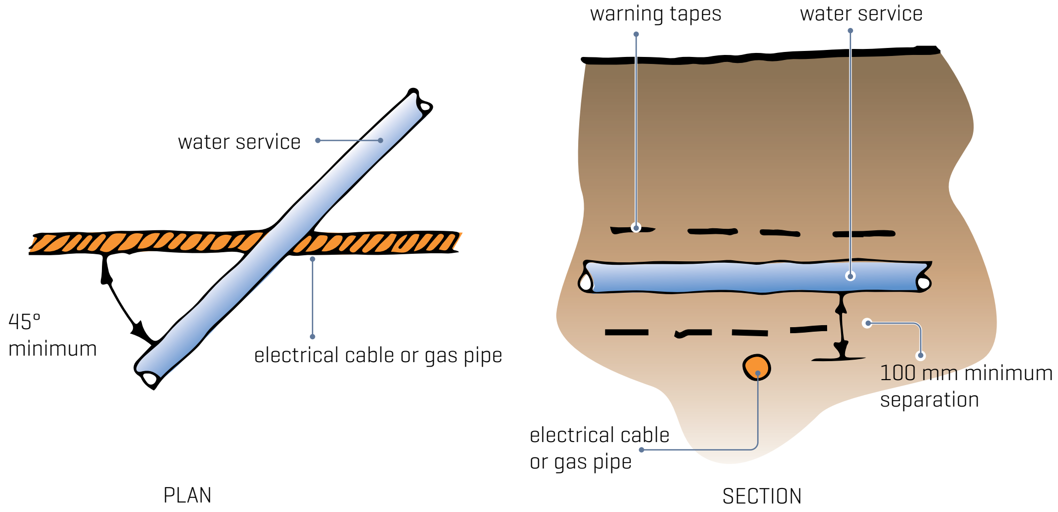


Figure 239. Water service pipe in proximity to electric cable or gas pipe.

Water services installed below ground must comply with Figure 240. Water service pipes may be laid in the same trench as a drain in accordance with Figure 241.

Water services with rubber ring joints below ground must be restrained by concrete thrust blocks in accordance with the manufacturer's instructions or design and have a minimum cover of 600 mm.

Water pipes under concrete slabs must comply with Figure 242 (AS/NZS 3500.1:2001), and pipes must not be rigidly fixed within structures – for example, cast into concrete or chased into brickwork and plastered.

To comply with clause B2 *Durability*, pipes in or under concrete floors must be as durable as the floor itself or be accessible. To achieve this, the manufacturer's recommendations should be ascertained and the pipes either sleeved or preferably ducted.

Water pipes installed above ground must be fixed in position by brackets, clips and hangers. Fixings that are purpose made and recommended by the pipe manufacturer are the most suitable. Supports must be provided at centres recommended by the pipe manufacturer or the appropriate standard and provision made for thermal movement.

Requirements for materials, jointing methods, installation and fixing are given in G12/AS1.

9.11 PROVISION OF ISOLATING VALVES

The flow of water within a service must be controlled by isolating valves placed in accessible positions so that maintenance and repairs can be carried out.

Isolating valves should be provided in accordance with Table 41. Requirements for isolating valves are given in AS/NZS 3500.1:2021 section 5.3.

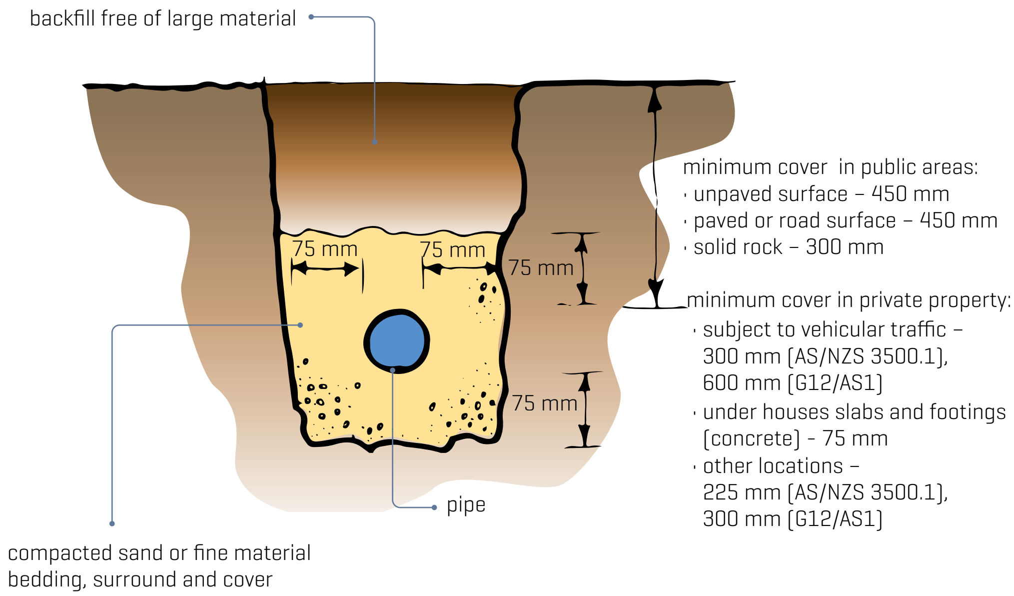


Figure 240. Underground installation of water service.

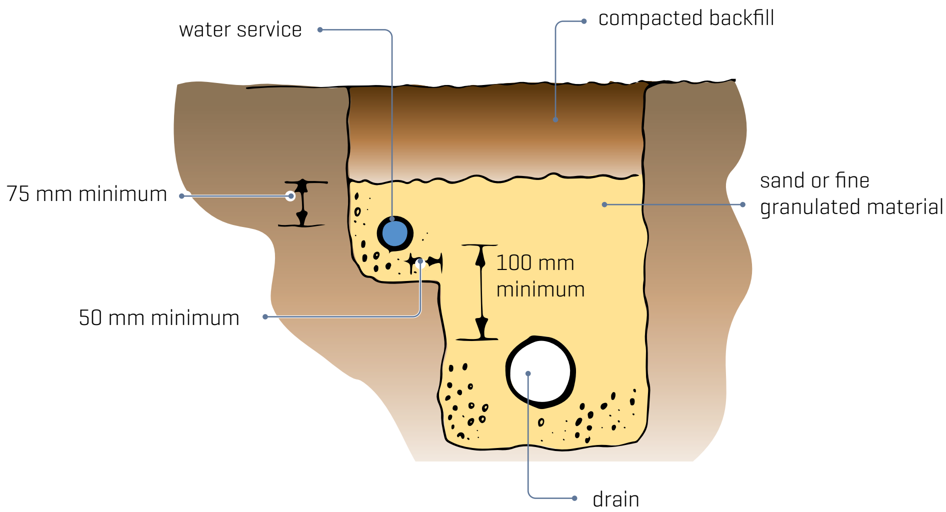


Figure 241. Method of laying water service pipe in the same trench as a drain.

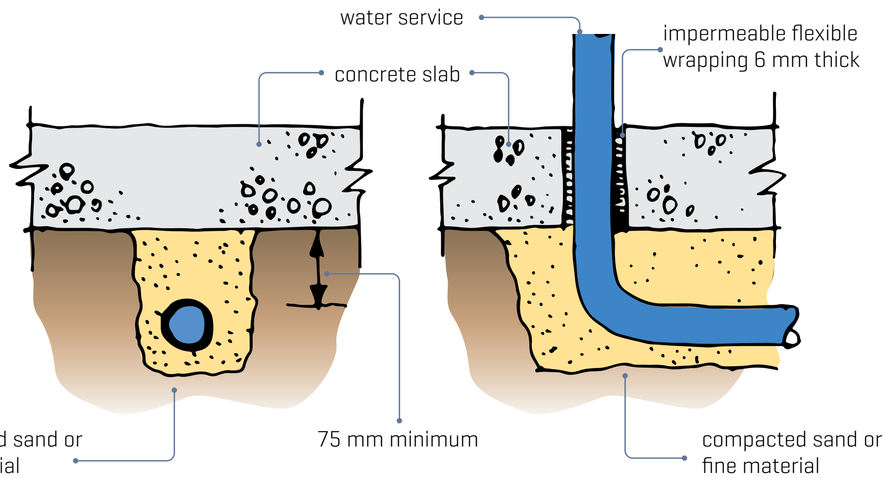


Figure 242. Water services under concrete slabs – pipes under slabs should be ducted or sleeved to allow for detection of leaks and for repair and replacement.

Table 41. Provision of isolating valves in domestic situations.

Location	AS/NZS 3500.1:2021	G12/AS1
At the boundary	Yes	Yes
Inlet to a storage tank (cold or hot)	Yes	Yes
Outlet to storage tank (over 50 litres)	Yes	*
Inlet to a flushing cistern	Yes	*
Each appliance	Yes	*
Each backflow prevention device	Yes	Yes
Each thermostatic mixing valve	Yes	*
Each pressure-limiting valve	Yes	*
At each branch serving a separate dwelling	Yes	Yes

Adapted from AS/NZS 3500.1:2021 clause 5.4.

*** BRANZ considers it good practice to provide isolating valves at these positions.**

9.12 NOISE IN WATER SUPPLIES

Water hammer (or pressure surge) occurs in high-pressure systems when there is a change in flow velocity. Sudden fluctuations in flow velocity set up shockwaves that cause pipework to vibrate and strike the structure making a hammering sound. Plastic piping is more flexible and may be less susceptible to water hammer than metal piping. Careful design, fixing and installation of all pipework will minimise such problems.

Fittings that can cause water pressure surges include:

- spring-closing valves
- quick-acting single-lever taps
- solenoid valves in washing machines and dishwashers
- pumps.

Water hammer can be reduced by:

- sizing the pipework so that water velocity is kept below 3 m/s
- reducing the pressure in the pipe – the maximum should be 500 kPa/50 m head
- using slower-acting valves and taps
- fixing pipework rigidly to prevent movement
- providing relief bends or flexible sections of pipe to absorb the shock
- fitting a proprietary water hammer arrester (Figures 243–244).

Turbulence-induced noise can be reduced by:

- forming large-radius bends
- using tapered joints
- making sure that there are no ridges, hollows or burred edges inside the pipes.

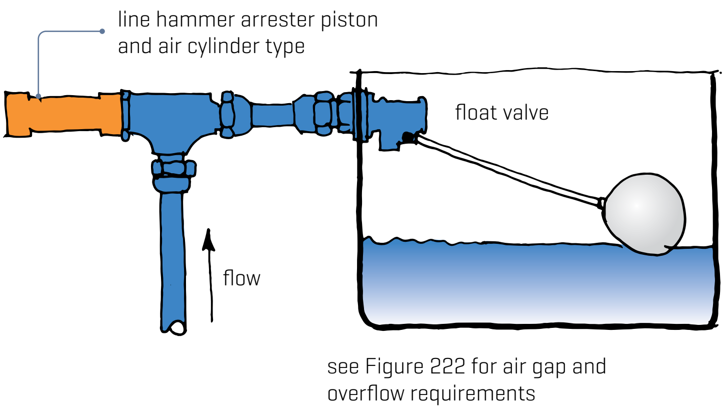


Figure 243. Proprietary water hammer arrester – piston and air cylinder.

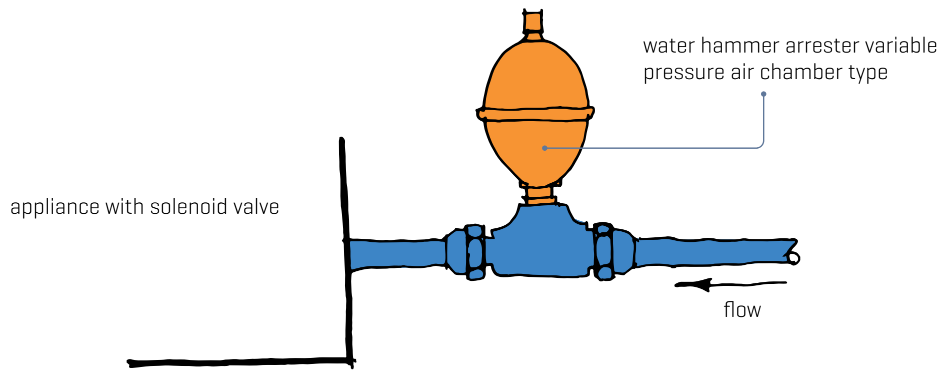


Figure 244. Proprietary water hammer arrester – variable pressure air chamber.

10

HOT WATER INSTALLATIONS

Safety and energy efficiency are taken into account when installing and operating hot water installations.

A hot water installation must:

- protect users from scalding caused by water being at too high a temperature for personal hygiene outlets
- prevent the growth of *Legionella* bacteria in the system
- be safe from explosion as this can occur in incorrectly installed water heaters
- provide potable hot water to sanitary fixtures and appliances used for personal hygiene, food preparation and utensil washing
- be efficient and avoid energy wastage.

10.1 WATER TEMPERATURE AND SAFETY FROM SCALDING

Children have more sensitive skins than adults and burn more quickly. People with disabilities or the elderly may have slow reaction times and may burn before they have realised it.

Skin burns more slowly as water temperatures decrease below 50°C (Figure 245).

The delivery temperature at the outlet of any sanitary fixture used for personal hygiene must not exceed:

- 45°C for early childhood education and care centres, schools, old people's homes, institutions for people with psychiatric or physical disabilities and hospitals
- 50°C for all other buildings.

To avoid the growth of *Legionella* bacteria in heating systems, the temperature at which water is stored in a water heater must be set at a temperature of not less than 60°C (Figure 246).

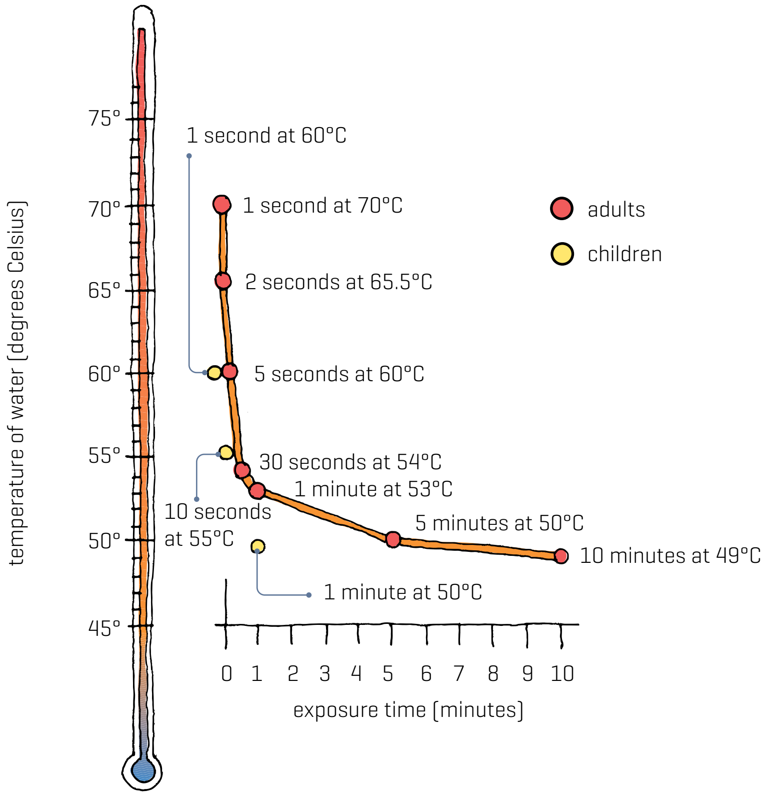


Figure 245. Time of exposure and water temperature at which full thickness skin scalds can occur.

Water temperatures significant to a domestic situation are indicated in Figure 247.

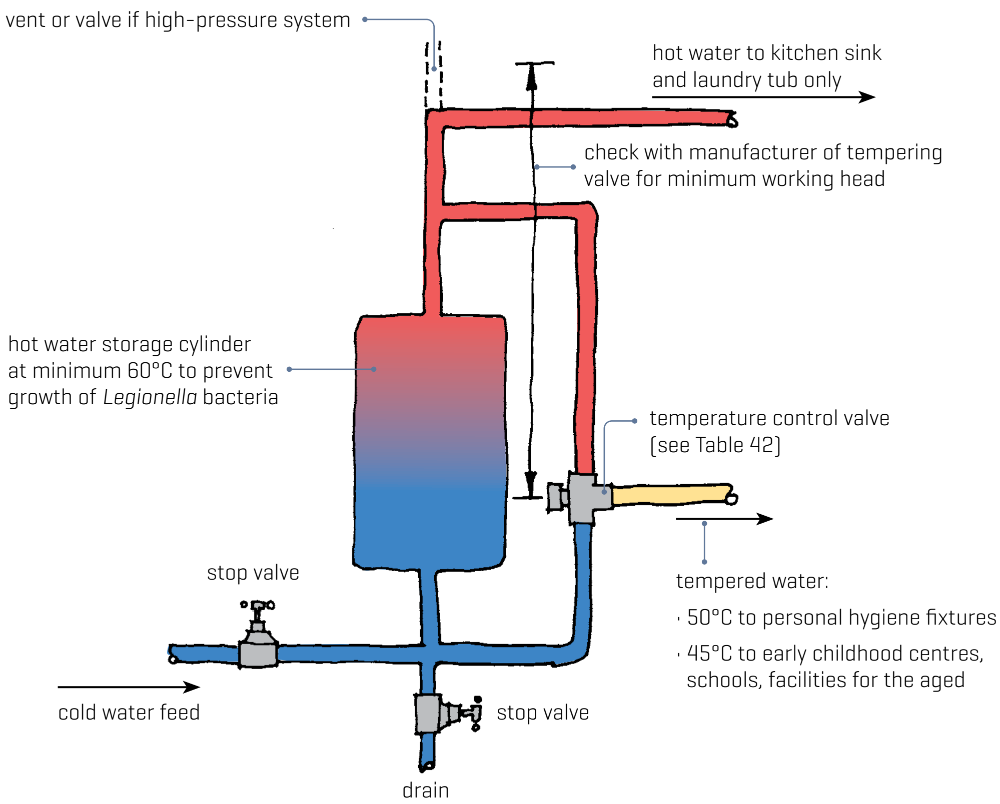


Figure 246. Water temperatures to prevent scalding and storage to prevent the growth of *Legionella* bacteria.

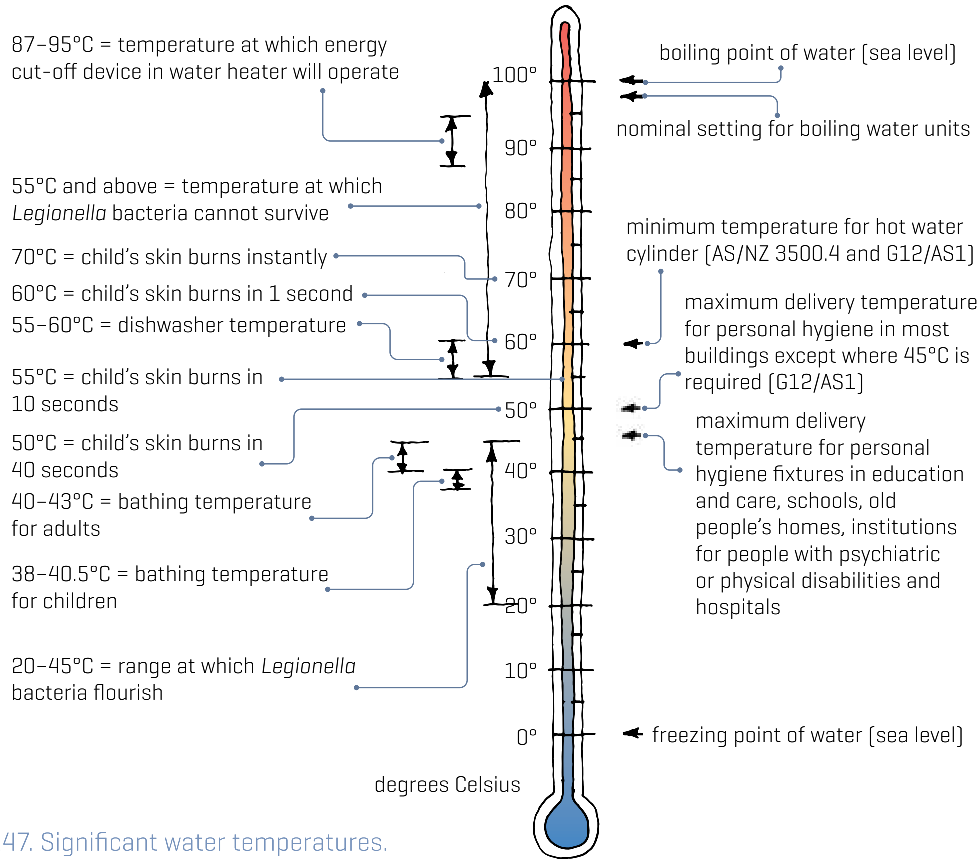


Figure 247. Significant water temperatures.

Requirements for the delivery temperature of hot water are given in:

- AS/NZS 3500.4:2021
- G12/AS1 clause 6.14.

10.1.1 Temperature control devices

Temperature control at the discharge point may be achieved by installing a temperature mixing device such as a thermostatic mixing valve or tempering valve between the hot water source and the fixture (Table 42).

Table 42. Temperature control devices.

	To achieve maximum delivery temperature		Applicable standard
	45°C	50°C	
Thermostatic mixing valve (Figure 248)	*	*	AS 4032.1 BS EN 1287 (high pressure) BE EN 1111 (low pressure)
Thermostatic mixer tap (Figure 249)	*	*	AS 4032.4
Tempering valve (Figure 250)		*	AS 4032.2 NZS 4617
Instantaneous temperature-limited water heater (Figures 273–274)		*	AS 3498

Thermostatic mixing valves and tempering valves must:

- have non-return valves fitted to the hot and cold water supply
- be maintained in accordance with AS 4032.3.

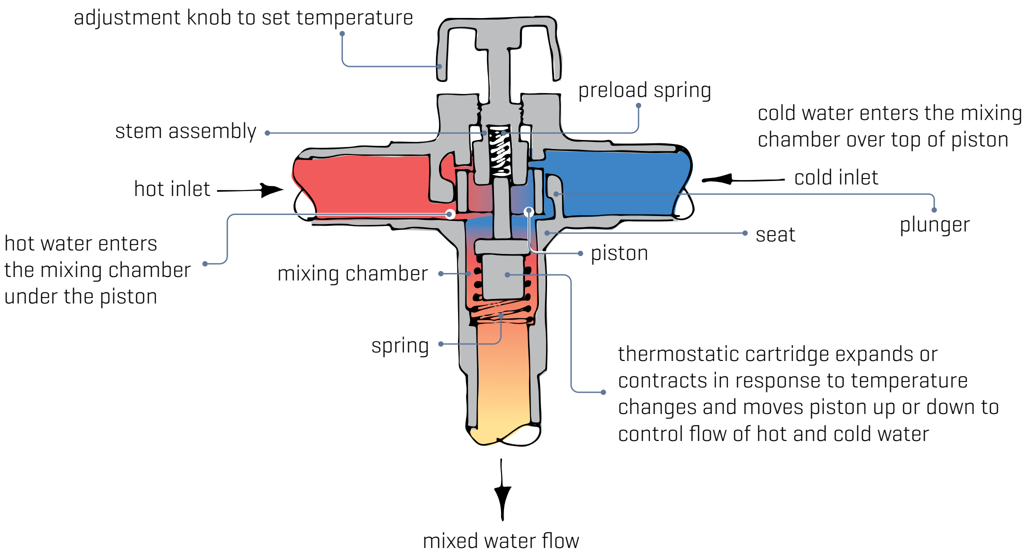


Figure 248. Typical thermostatic mixing valve.

10.2 WATER HEATERS

The choice of water heaters and their installation will be influenced by:

- availability of fuel – only gas and electricity are covered by this guide
- capital cost
- running cost
- available water pressure
- the chemical composition of the water.

Basic types of water heating installations include:

- storage heaters – at low pressure or mains pressure, electric or gas
- continuous flow water heaters – electric or gas
- boiling water units
- solar water heaters
- solid fuel heaters with a wetback
- heat pump water heaters.

10.2.1 Storage water heaters

Storage water heaters hold hot water in a thermally insulated container until it is required. Hot water, which is less dense than cold water, rises to the top of the cylinder where it is drawn off and replaced by cold water entering the cylinder at the bottom.

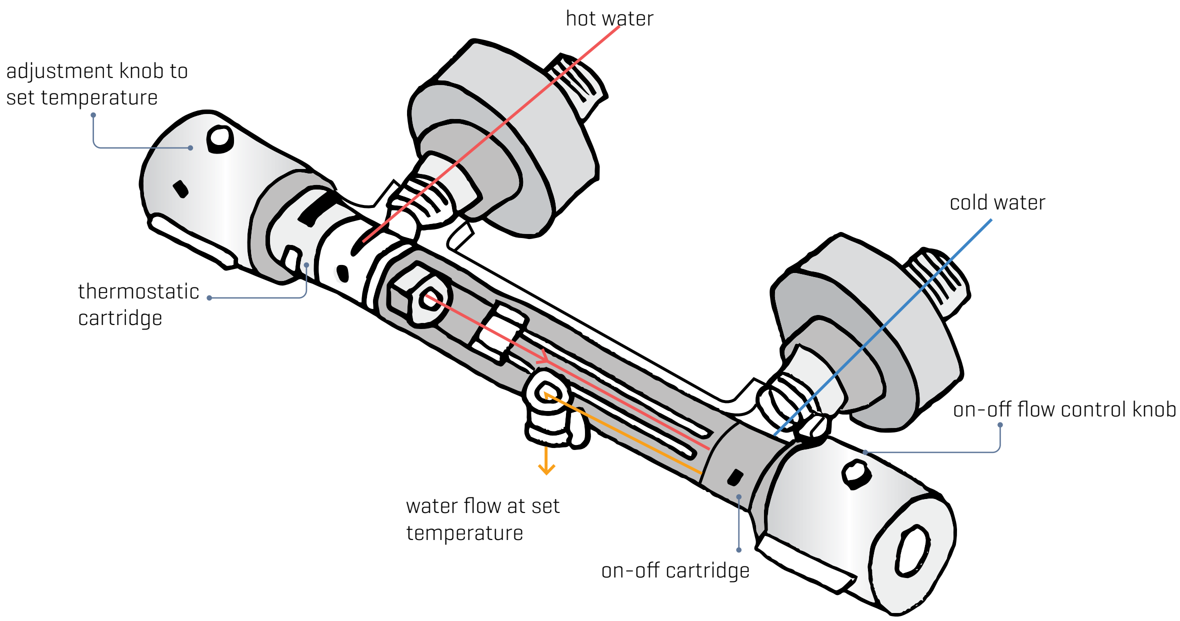


Figure 249. Typical thermostatic mixer tap.

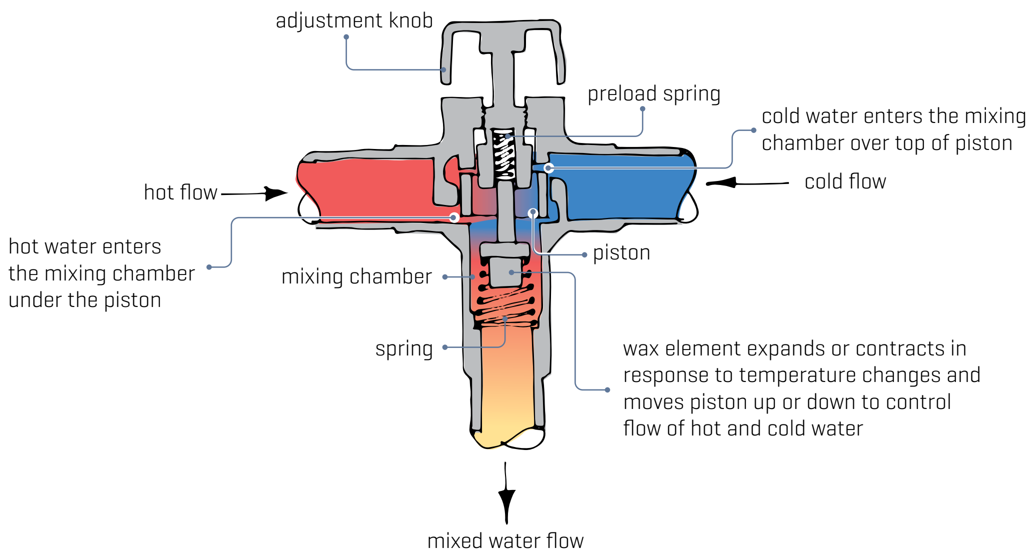


Figure 250. Typical tempering valve.

Cylinders must be large enough to meet the draw-off demand at peak periods and must have sufficient recovery capacity to be ready for the next peak draw-off (Figures 251–252).

The water pressure at which a storage water heater operates may be:

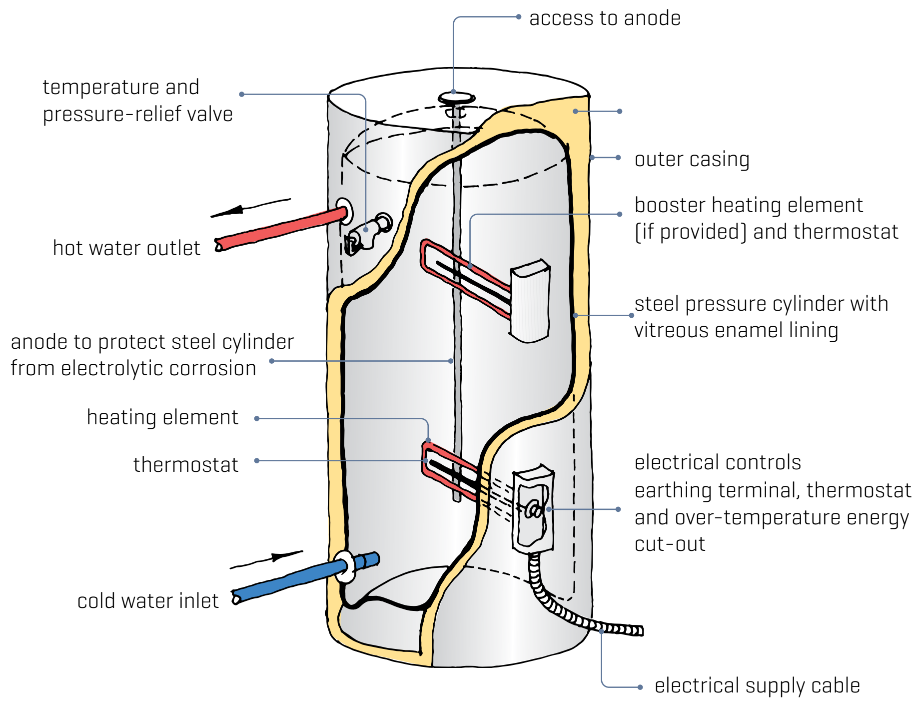
- low pressure – open-vented systems where the pressure is provided by a cold water storage header tank – 3–12 metre head (30–120 kPa), typically 2–3 metre head
- low-medium pressure – systems that rely on a pressure-reducing valve to reduce the pressure below the mains pressure – 3–12 metre head (30–120 kPa), typically 3–12 metre head
- mains pressure – with a working pressure equal to the incoming supply ranging from 120 kPa to 1400 kPa, typically 300–500 kPa.

Mains pressure water heaters are the predominant type used in new installations in New Zealand.

Table 43 gives an indication of some characteristics of some storage water heaters.

Table 43. Comparison of hot water storage systems at different pressures.

Feature	Mains pressure	12 metre head	7.5 metre head	3 metre head
Pressure	High	Low	Low	Very low
Flow of water	Very good	Good	Good	Low
Hot water pipe size	Small (15 mm) 18 mm to first branch	Medium (15–20 mm)	Medium (15–20 mm) large to maintain flow	
Shower operation	Very good	Good	Acceptable	May not be adequate
Compatibility with taps and mixers	Compatible	Usually compatible	Care needed in selection	Often not compatible
Suitable for tempering valve	Yes	Yes	Adequate	Marginal
Maintenance	Valves may need maintenance			Little required
Durability	8–20 years	15–30 years		20–40 years
Water usage	High	Moderate	Moderate	Low
Energy storage		20–25% more energy storage capacity at high temperature		



in New Zealand, the temperature and pressure-relief valve and the hot water outlet are usually in the top of the cylinder

Figure 251. Principles of electric mains pressure hot water storage heater.

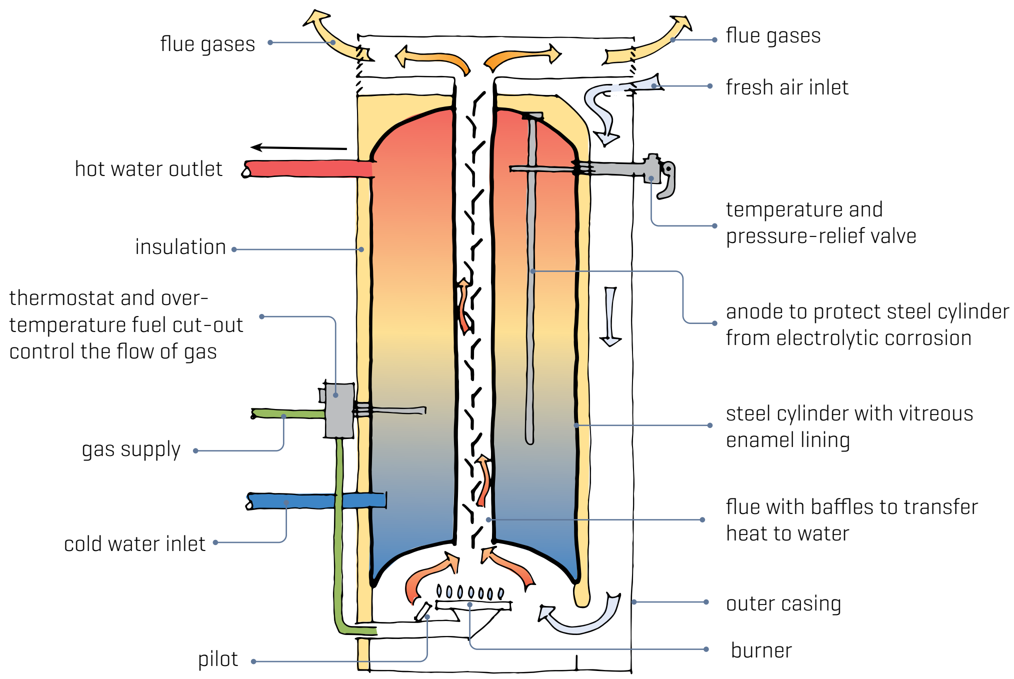


Figure 252. Principles of gas hot water storage heater.

10.2.1.1 Valves and controls for water storage heaters

Valves and control devices include:

- isolating valves – manually operated valves for isolating one section of the system from the rest (Figure 253)
- line strainers – filter particles of solid matter from the water to protect other valves downstream (Figure 254)
- non-return valves – prevent reversed flow within or from the system (Figure 255)
- pressure-reducing valves – automatically reduce the pressure to a preset level from mains pressure to low pressure (Figure 256)
- pressure-limiting valves – limit the pressure within preset limits – reduction of mains pressure (Figure 257)
- expansion control valves – release pressure in the cold water feed pipe caused by expansion of water in the heater during normal operation (Figure 258)
- expansion vessels – limit the pressure due to the expansion of the heating water without disharging water (Figure 259)
- energy control thermostats – control the input of heat energy to the water (Figure 251)
- temperature and pressure-relief valves – operate above a preset temperature and pressure (Figure 260)
- pressure-relief valves – release pressure in the storage cylinder if it rises to more than a preset limit
- energy cut-outs – cut gas/electricity supply to the heater if the thermostat fails (Figures 251–252).

Valves must be installed so they are readily accessible for operation, maintenance and repair.

Table 44 indicates which valves and devices must be fitted to various hot water heating systems. Valves and protection devices should be fitted as required by the manufacturer of all heaters or valves.

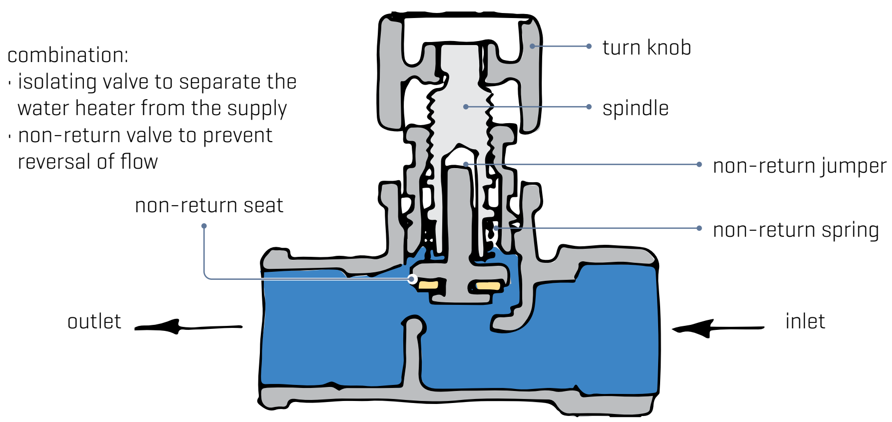


Figure 253. Combination isolating and non-return valve.

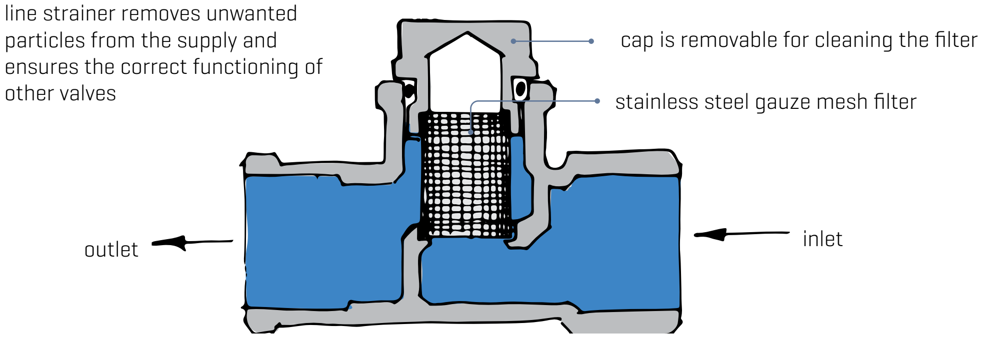


Figure 254. Line strainer.

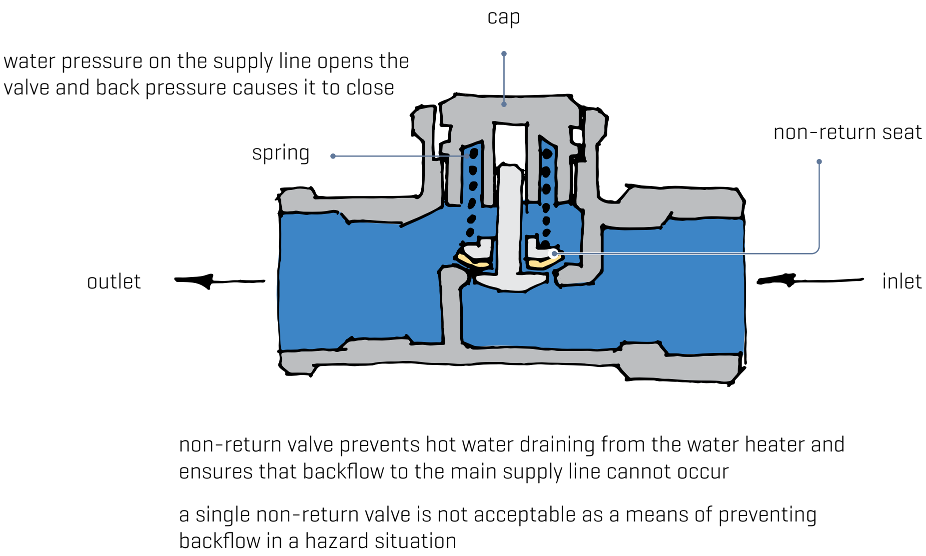


Figure 255. Non-return valve.

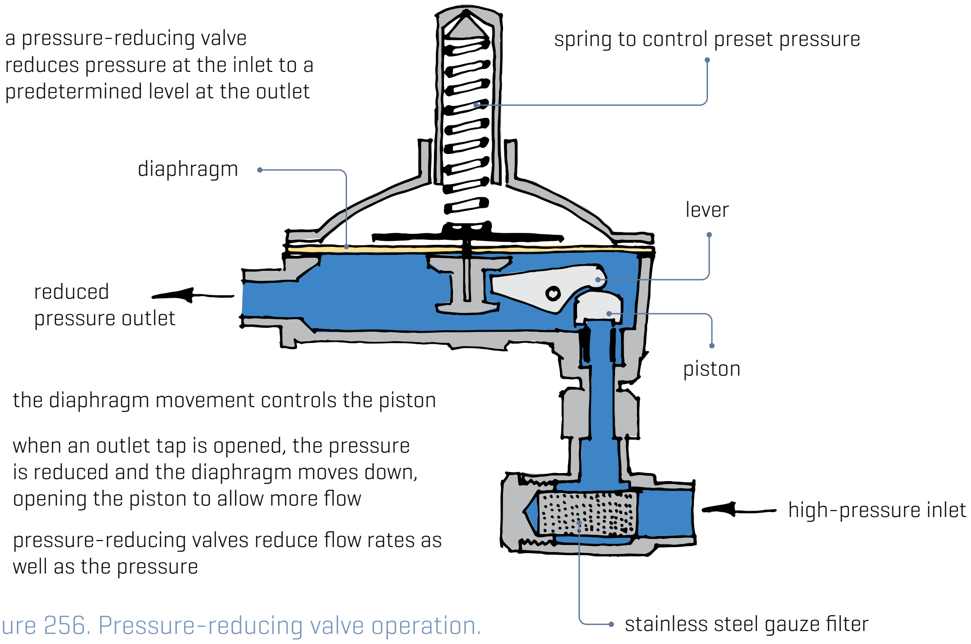


Figure 256. Pressure-reducing valve operation.

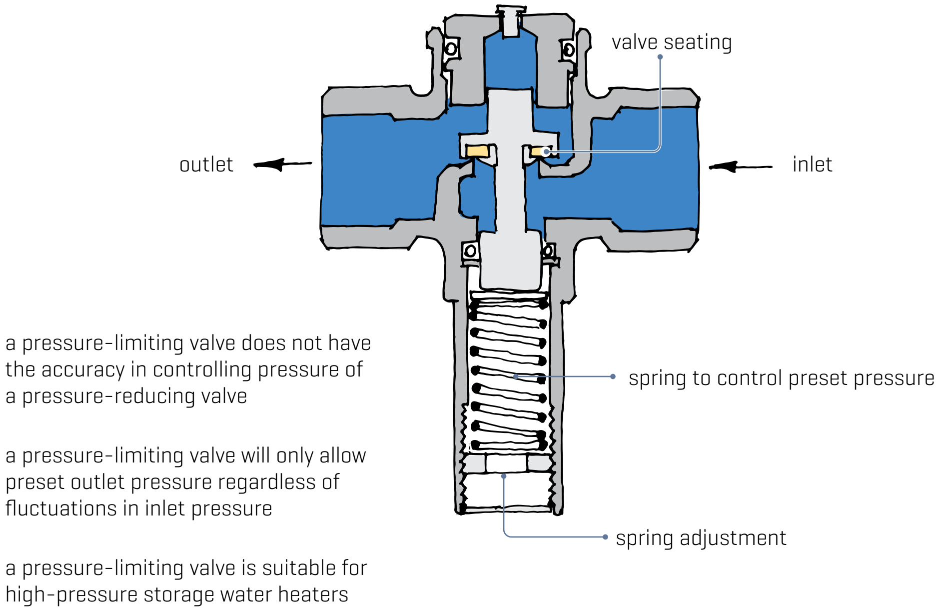


Figure 257. Pressure-limiting valve.

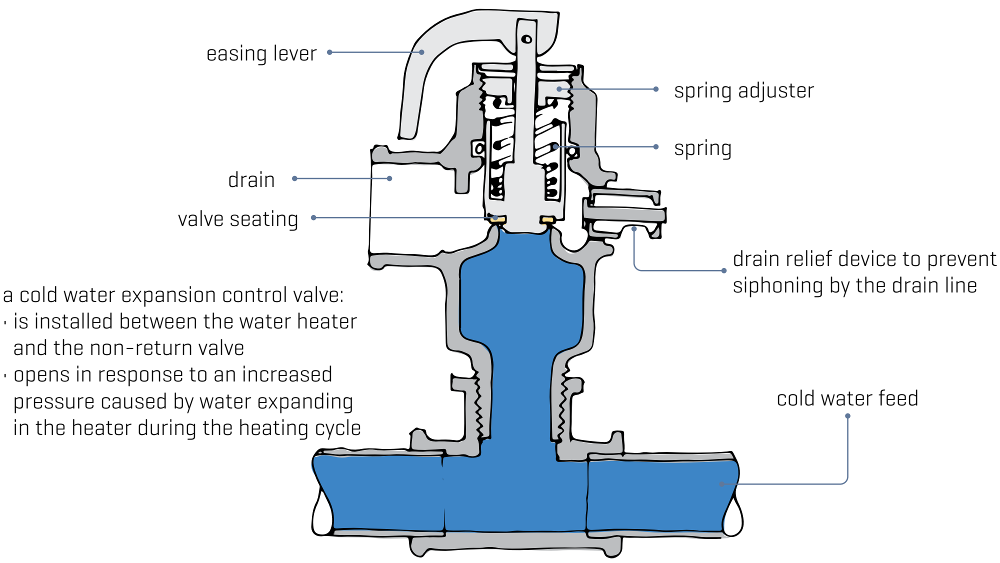


Figure 258. Cold water expansion control valve.

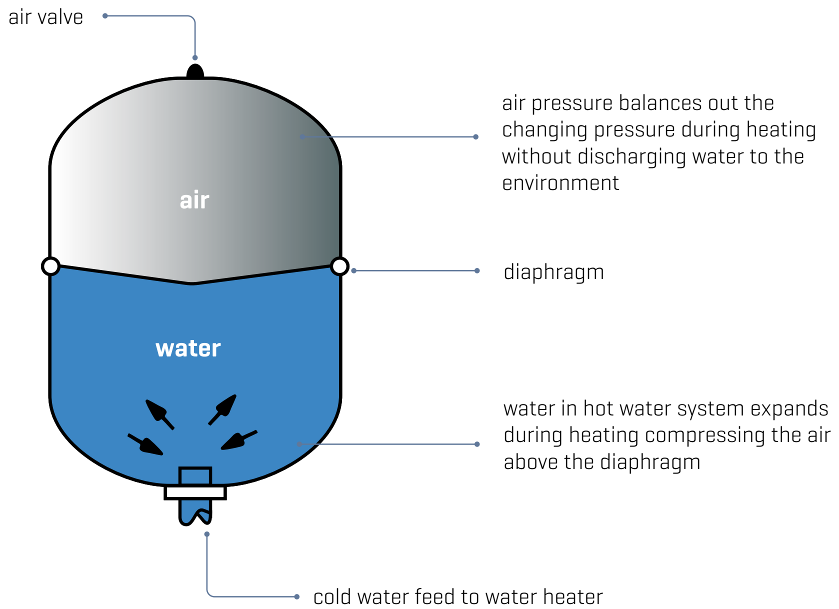


Figure 259. Typical expansion vessel operation.

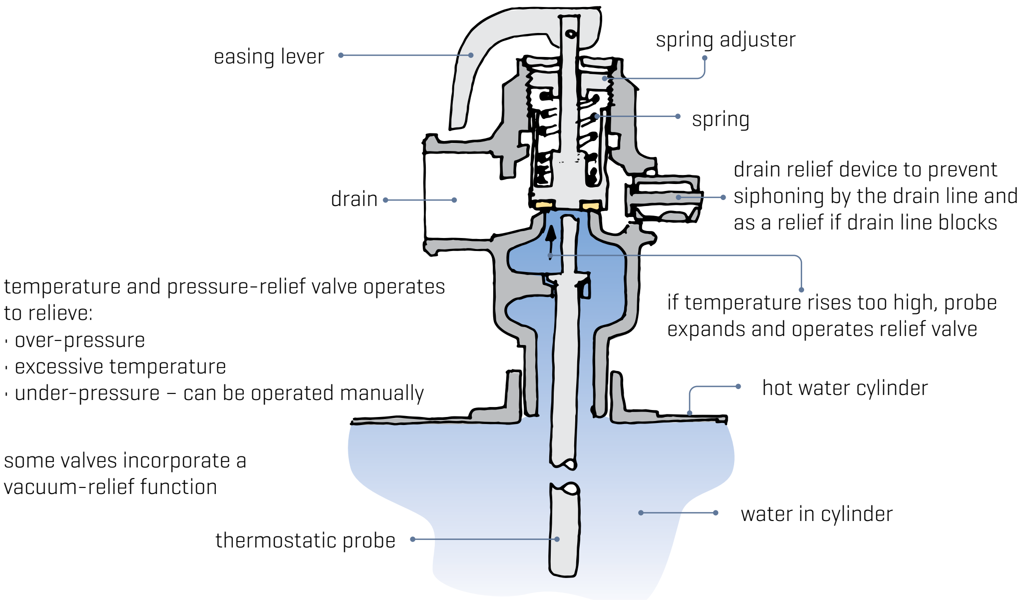


Figure 260. Temperature and pressure-relief valve.

Table 44. Valves and devices that must be fitted to water heating systems.

Valve or fitting	Type of water heater system					
	Continuous flow	Unvented		Vented		Push through
		Mains pressure	Reduced pressure	Low pressure	Reduced pressure	
Isolating valve	Yes Full flow	Yes	Yes	Yes	Yes	Yes
Line strainer	1	1	1	N/A	1	N/A
Non-return valve	N/A	Yes	Yes	Yes	Yes	Yes
Pressure-limiting valve	Yes	Yes	No	N/A	No	Yes
Pressure-reducing valve	No	No	Yes	Yes	Yes	No
Expansion control valve AS/NZS 3500.4:2021	1	1	1	N/A	N/A	N/A
Expansion control valve G12/AS1	N/A	Yes	Yes	N/A	N/A	N/A
Expansion vessel	2	Yes	No	N/A	N/A	N/A
Temperature control valve	2	2	2	2	2	2
Temperature and pressure-relief valve (TPR)	N/A	Yes	3	N/A	N/A	N/A
Pressure-relief valve (PRV)	N/A	3	3	N/A	N/A	4

Notes:

1. Where required by manufacturer or local authority.
2. Some form of temperature control for personal hygiene outlets is required on the system but it need not necessarily be associated with the heater.
3. Either a TPR or PRV must be fitted.
4. Required by G12/AS1.

10.2.1.2 Expansion vessels

G12/AS1 states that, when an expansion vessel is used on a mains pressure hot water system instead of an expansion control valve, it must be:

- manufactured to BS EN 13881 and be suitable for use with potable water
- sized to ensure that working pressure does not exceed the working pressure of the water heater and the expansion vessel itself
- precharged to a pressure matching the water supply pressure and the mains storage water heater installed to provide for easy access for replacement, servicing and maintenance
- supported or restrained to prevent damage to the connection to the pipework if the vessel is subject to external forces.

The minimum capacity of an expansion vessel shall be calculated from the formula:

$Ve = Vs \times \eta / AF$

where:

Ve = minimum capacity of expansion vessel (litre)
Vs = volume of hot water storage (litre)
ŋ = expansion factor (from G12/AS1 Table 7)
AF = (P2 – P1)/(P2 + 101)
P1 = water supply pressure (kPa, typically the setting of the pressure limiting or pressure reducing valve)
P2 = 0.85 x TPR valve setting (kPa).

The minimum expansion vessel capacities shown in Table 45 are based on a mains pressure storage water heater system with a 500 kPa water supply pressure and 850 kPa TPR valve setting.

Table 45. Minimum expansion vessel capacity.

Storage water heater volume (litres)	Storage water heater thermostat setting (°C)							
	60	65	70	75	80	85	90	95
135	8	9	11	12	14	15	17	19
180	11	13	15	17	19	21	23	25
250	16	18	20	23	26	29	32	35
300	19	21	24	28	31	34	39	42

Table 45 provides examples of minimum expansion vessel capacities for a mains pressure storage water heater system calculated using this method for a situation in which:

- P1 = 500 kPa (P1 = pressure limiting valve setting)
- P2 = 722.5 kPa (P2 = 0.85 x TPR valve setting).

Expansion vessels can also be sized using AS/NZS 3500.4:2021 Appendix P.

10.2.1.3 Energy efficiency of water heaters

New Zealand electric and gas storage water heaters in new installations must comply with NZS 4305:1996 *Energy efficiency – Domestic type hot water systems*. This standard specifies the requirements, testing methods to be used and maximum standing heat losses applicable to water storage heaters.

10.2.1.4 Hot water storage heater installation systems

Detailed information on requirements for hot water supply systems is given in:

- AS/NZS 3500.4:2021
- G12/AS1.

Typical hot water storage heater installation systems include:

- an open-vented system with supply from a header tank (Figure 261)
- an open-vented system with supply via a pressure-reducing valve (Figure 262)
- a low-pressure unvented system with supply via a pressure-reducing valve (Figure 263)
- a mains pressure unvented system (Figure 264).

Figure 265 shows the requirements for a relief valve drain to avoid blockage.

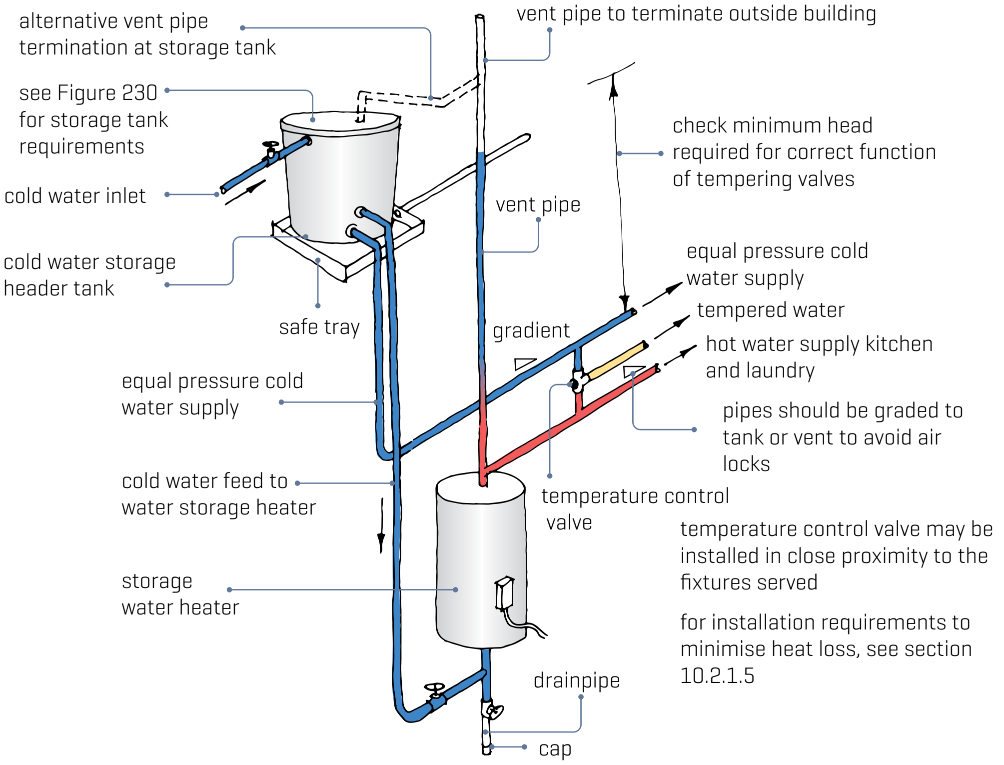


Figure 261. Open-vented storage water heater system with supply from header tank.

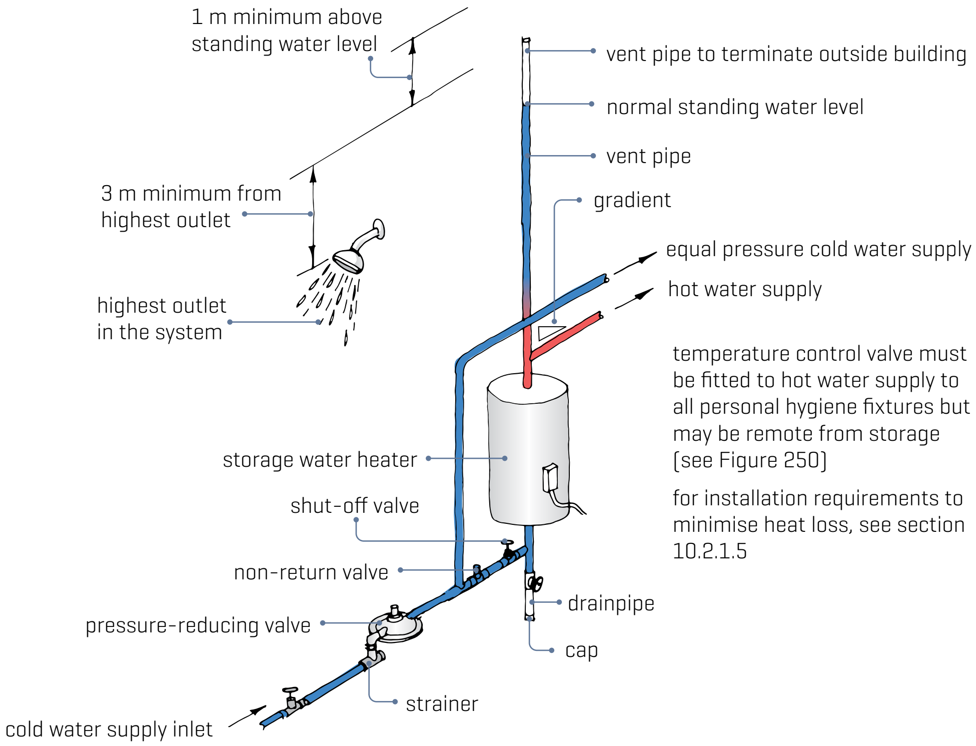


Figure 262. Open-vented storage water heater – pressure-reducing valve supply.

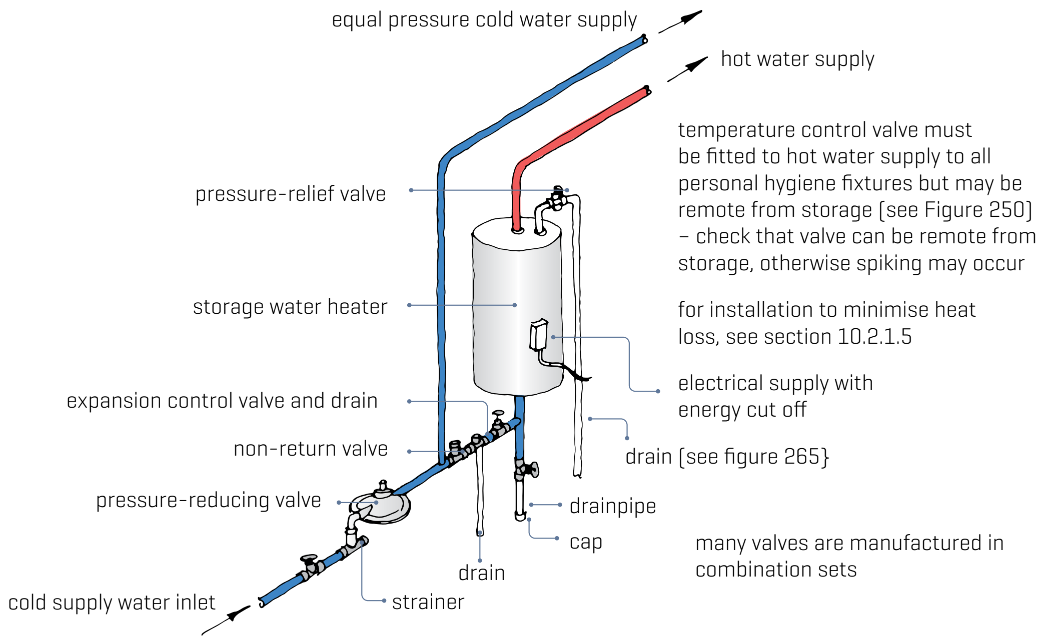


Figure 263. Low-pressure unvented storage water heater system, pressure-reducing valve supply.

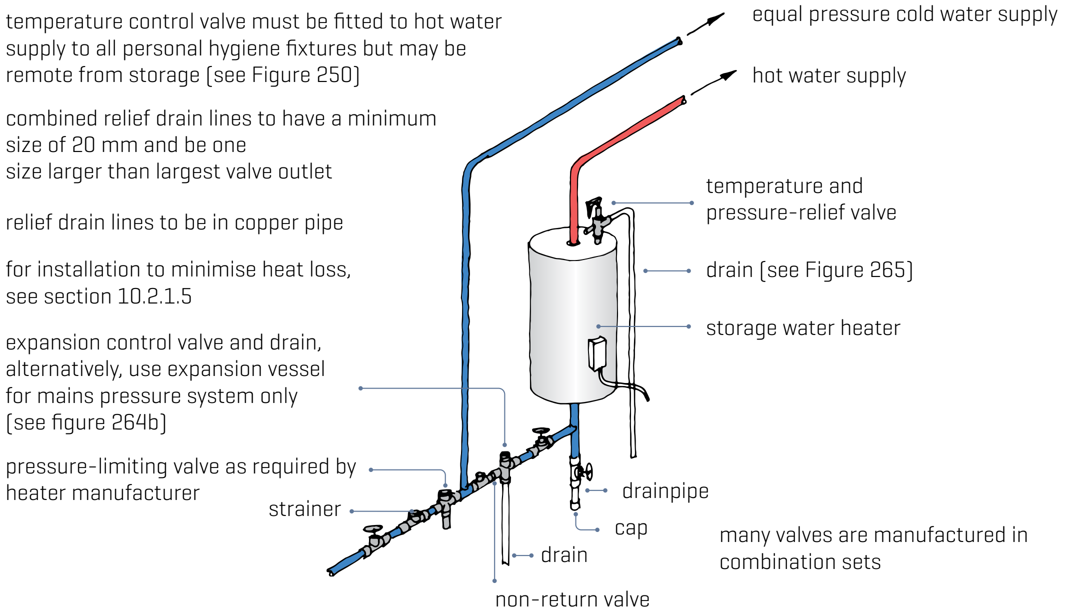


Figure 264. Mains pressure unvented storage water heater system.

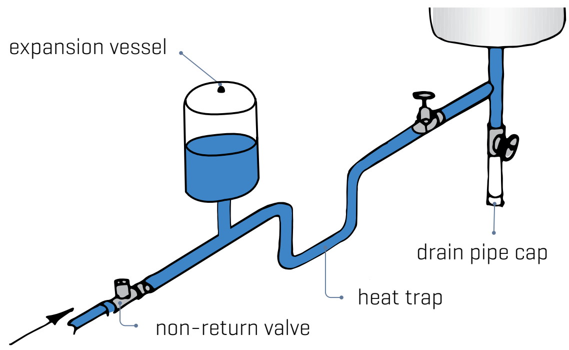


Figure 264b. Typical expansion vessel.

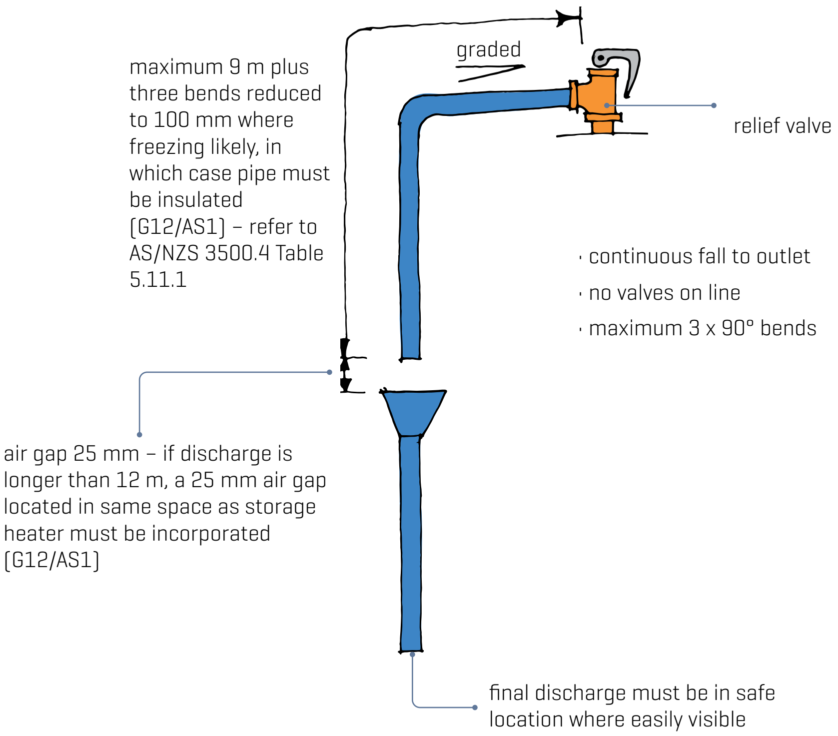


Figure 265. Drain from relief valve.

10.2.1.5 Installation of water heaters to minimise heat loss

To minimise heat loss from long pipe runs and from water standing in pipes between draw-offs, water heaters should be located as close as practical to the areas they service. In a household unit, the maximum run of pipe between the storage water heater and the kitchen sink should not exceed the lengths shown in Table 46.

Table 46. Guide to acceptable maximum pipe lengths between water heater and kitchen sink.

Pipe size (mm)	10	15	20
Length (m)	25	12	7

To minimise heat loss from water storage heaters, the following should be thermally insulated:

- Temperature and pressure-relief (TPR) valves in accordance with Figures 266–267.
- Vent pipes as shown in Figure 268.
- Hot water distribution pipes from the storage water heater in accordance with Figures 269–270.
- All pipes outside a building's thermal envelope.
- Hot water pipes under a concrete floor.

Pipe insulation should have an R-value (thermal resistance) of not less than 0.3 $m^2 °C/W$.

Requirements for energy efficiency are given in AS/NZS 3500.4:2021 section 8.

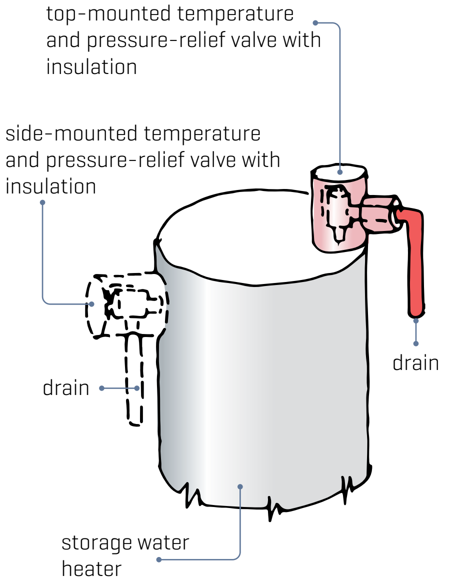


Figure 266. Insulation of temperature and pressure-relief (TPR) valve.

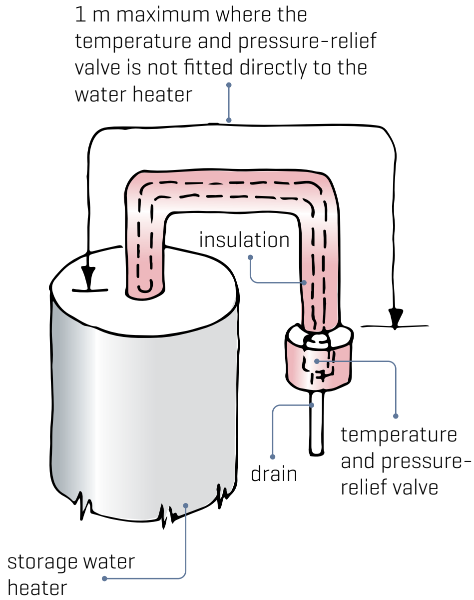


Figure 267. Insulation of temperature and pressure-relief (TPR) valve not fitted directly to the storage water heater.

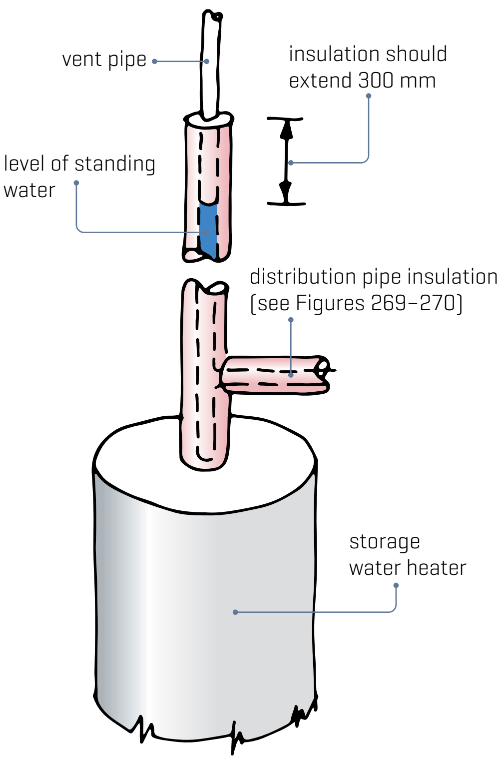


Figure 268. Insulation of vent pipes.

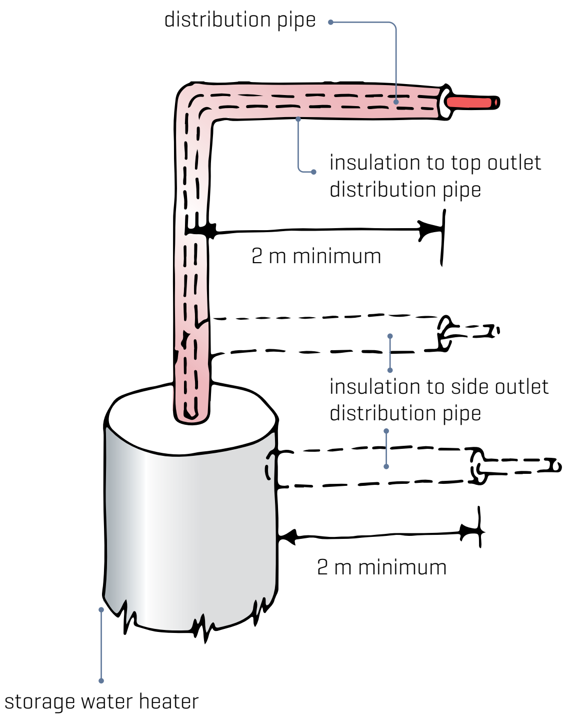


Figure 269. Insulation of hot water distribution pipes – alternatively, a heat trap may be installed (see Figure 270).

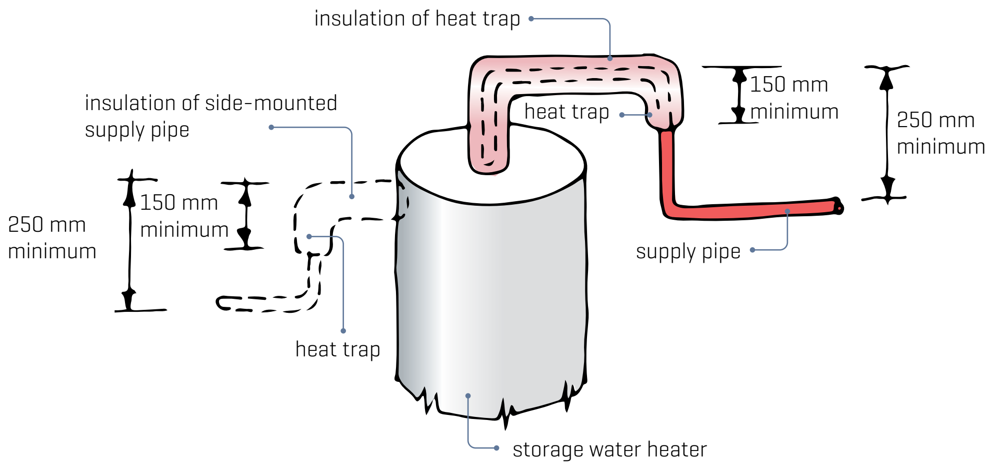


Figure 270. Insulation of hot water distribution pipes where a heat trap is formed.

10.2.1.6 Seismic restraint of storage water heaters

Building Code clause B1.3.2 requires building elements, including storage water heaters, to be secured to withstand earthquake forces. G12/AS1 Figure 14 specifies seismic restraint requirements for storage water heaters up to 360 litre capacity (Table 47).

Table 47. Strap requirements for seismic restraint of storage water heaters.

Storage water heater capacity	Number and location of straps
0–200 litres	Two straps are required: • One within the top 100 mm of the heater. • One within the bottom 100 mm of the heater. If the bottom strap cannot be installed in the bottom 100 mm because it clashes with the water heater inlet, outlet or controls, three straps are required: • One within the top 100 mm of the heater. • One within the bottom 25% of the heater. • One located centrally.
200–300 litres	Three straps are required: • One within the top 100 mm of the heater. • One within the bottom 100 mm of the heater. • One located centrally. If the bottom strap cannot be installed in the bottom 100 mm because it clashes with water heater inlet, outlet or controls, four straps are required: • One within the top 100 mm of the heater. • One within the bottom 25% of the heater. • Two evenly spaced between the top and bottom straps.
0–360 litres (located more than 12 m above finished ground level)	One extra strap is required up to a maximum of four straps.

10.2.2 Continuous flow water heaters

Continuous flow water heaters are compact units that have no storage capacity and only heat water when a tap is turned on and water flows through the heating device. They are often used to service a single outlet but are available in a range of sizes serving several outlets and can be fitted with remote electronic controls.

Electric continuous flow water heaters (Figures 271–272)

Advantages	Limitations
• Constant supply of hot water available – never runs out of hot water. • No heat losses from stored water. • Water can be delivered at a preselected temperature – no need to add cold water. • Heating units are compact and can be accommodated in small spaces.	• Heat input is fixed and the temperature can only be increased by lowering the delivery. • Heavy demand on power when draw-off occurs.

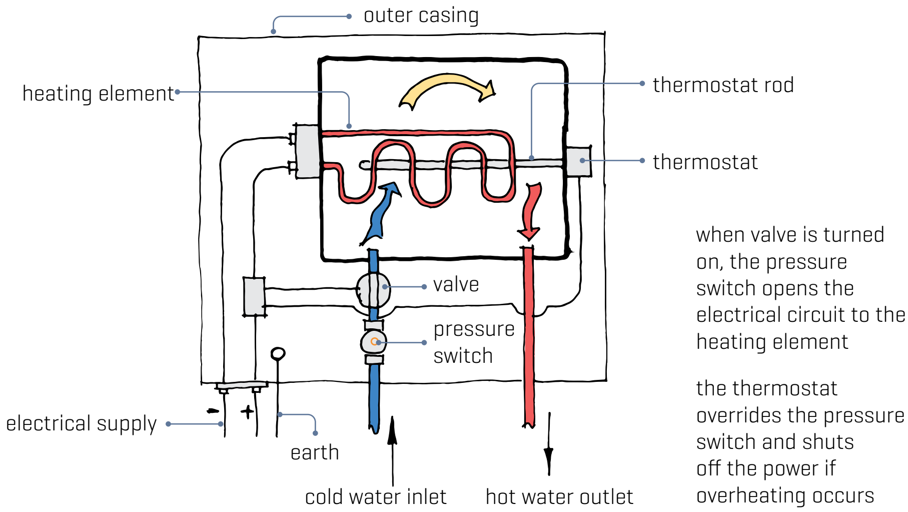


Figure 271. Principle of electric continuous flow hot water heating.

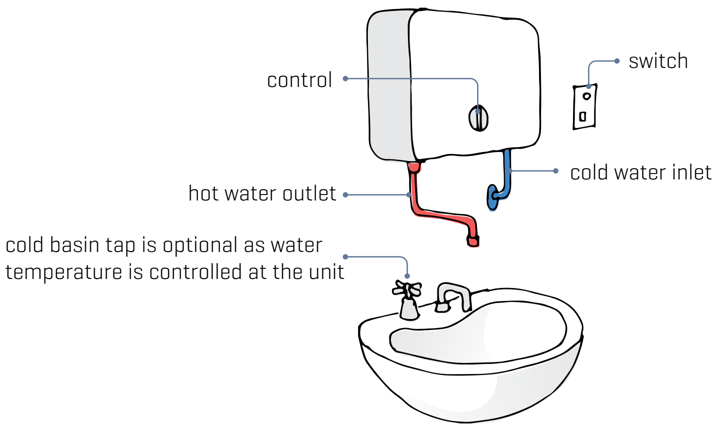


Figure 272. Single unit continuous flow electric water heater.

Gas continuous flow water heaters (Figures 273–275)

Advantages	Limitations
• Constant supply of hot water available – never runs out of hot water. • No heat losses from stored water. • Water can be delivered at a preselected temperature – no need to add cold water. • Models with output to suit several draw points are available. • External models save floor space and do not require special ventilation.	• Some models have a fixed heat input and the flow can only be increased by lowering the delivery temperature and the temperature can only be raised by reducing the flow. • Requires adequate ventilation if it is an indoor model. • Potential wastage of water if located far from outlets.

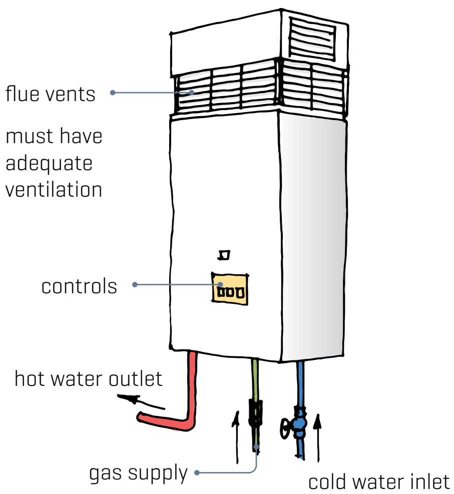


Figure 273. Continuous flow gas water heater.

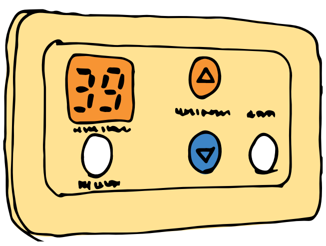


Figure 274. Continuous flow water heater remote electronic control panel.

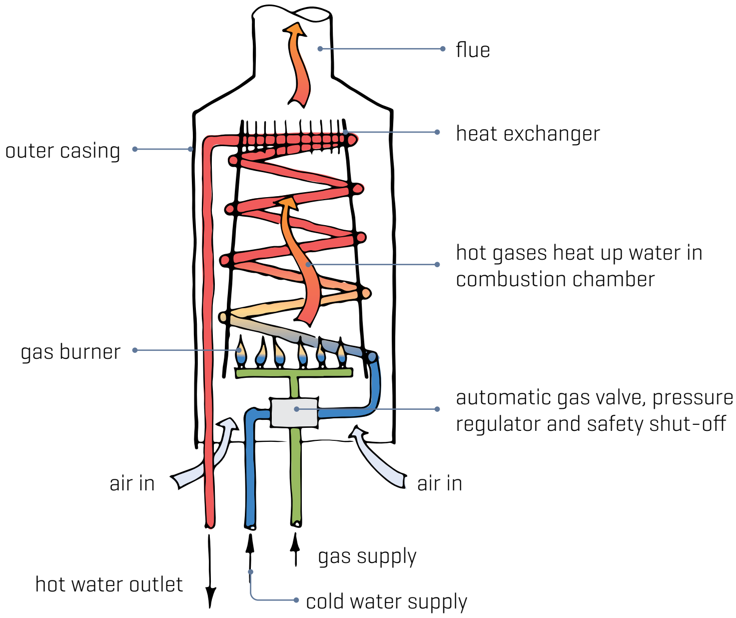


Figure 275. Principle of gas-burning continuous supply hot water heater.

10.2.3 Boiling water units

Figure 276 shows an electric unit for boiling water.

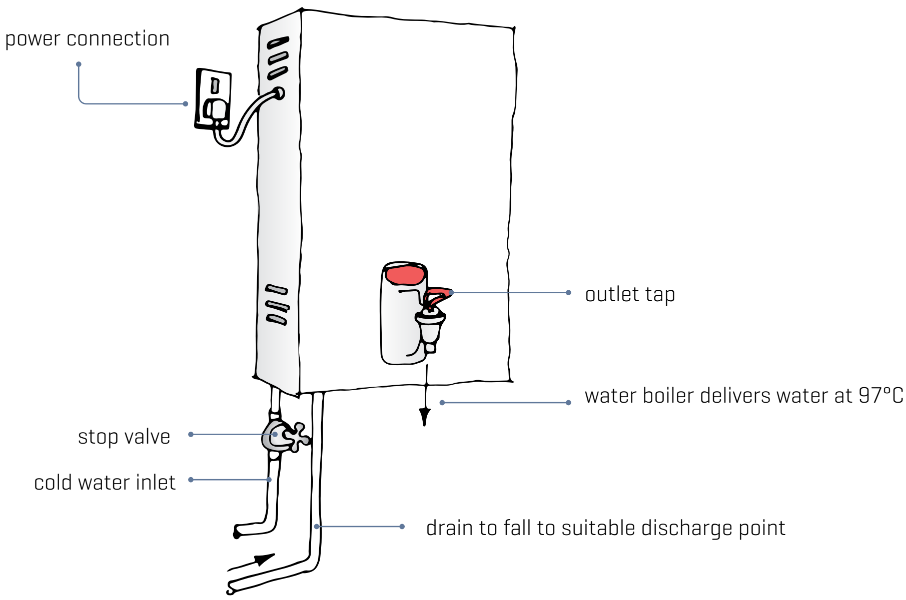


Figure 276. Wall-mounted electric water boiling unit.

10.2.4 Solar water heaters

This section on solar water heaters in based on G12/AS2 for hot water supply to sanitary fixtures and appliances in buildings. Hot and cold water pipework is to be designed and installed to comply with G12/AS1. Solar water heater system applications such as underfloor heating or swimming pool heating are not covered in this guide.

10.2.4.1 Structural limitations

Structural loads must be considered because of the weight of the solar water heaters and possibly the water storage tank being located on the roof.

Specific structural design should be undertaken when the solar water heater system does not comply with the structural requirement of the standards and limitations contained in G12/AS2.

10.2.4.2 Materials

Materials used in the design and installation of solar water heaters must comply with G12/AS2.

Solar water heaters must comply with AS/NZS 2712:2007 *Solar and heat pump water heaters – Design and construction.*

Water heater tanks that are part of a pumped solar water heating system where the tank is separately mounted from the collector must be insulated to the requirements of AS/NZS 4692.2:2005 *Electric water heaters – Minimum energy performance standard (MEPS) requirements and energy labelling*.

Where a solar water heater has a controller, it must meet the requirements specified in AS/NZS 2712:2007.

10.2.4.3 Solar water heater design

Collector size

To prevent overheating, solar water heaters must have minimum storage of 50 litres per square metre of collector area.

Operating and safety devices

Storage tanks in solar water heaters must have operating and safety devices that meet the requirements of G12/AS1.

Water from the installed system must not discharge onto the roof. Vent pipes and outlets from pressure-relief valves must be piped to a suitable drain point.

Legionella bacteria

To prevent the growth of *Legionella* bacteria, solar water heaters have one of these heating methods:

- Have a continuously energised heating element fitted within 55% of the bottom of the water tank (by volume) and a thermostat set to 60°C or higher.
- Be controlled so that the water above the element is heated to 60°C once a day and the element is in the bottom 20% of the water tank (by volume) and no more than 150 mm from the bottom of the tank.
- Be controlled so that all of the stored water is heated to 60°C or higher once a week for not less than 1 hour. The temperature must be measured by a probe in the bottom 20% of the water tank (by volume) and no more than 150 mm from the bottom of the water tank. For open loop systems, the stored water includes the water in the solar collector, and water must be circulated through the collector during the heating period.

Where the solar water heater stores potable water and is used as a preheater for an instantaneous water heater, it must have one of these heating methods:

- The hot water storage tank connected to the solar collector must be fitted with supplementary heating and a controller operating to meet the conditions outlined in G12/AS2.
- The instantaneous water heater must heat all water passing through it to not less than 70°C.

Where the solar water heater supplies inlet water to a storage water heater with an element in the bottom 20% of the water tank (by volume) and no more than 150 mm from the bottom of the tank with a thermostat set to no less than 60°C, no additional *Legionella* control is required.

Frost protection

To be protected from freezing, G12/AS2 section 3.6 requires that solar collectors must:

- have an automatic drain-down system (climate zones 1, 2 and 3)
- pass the level 1 test in AS/NZS 2712:2007 Appendix E (climate zones 1 and 2)
- pass the level 2 test in AS/NZS 2712:2007 Appendix E (climate zone 3).

Location of solar water heaters

Solar water heaters must be located away from the edge of a gable roof structure outside the high-pressure wind zone shown in Figure 277.

Solar orientation and inclination

For most-efficient operation, solar collectors should face geographic north and be inclined at the same angle to the horizontal as the angle of latitude of the location (Figure 278).

For relative performance, collectors should face within 45° of geographic north and be fitted at an angle of between 20° and 50° (Figure 279). Solar collectors can be installed within 90° of geographic north but will need extra collector area to achieve the same performance.

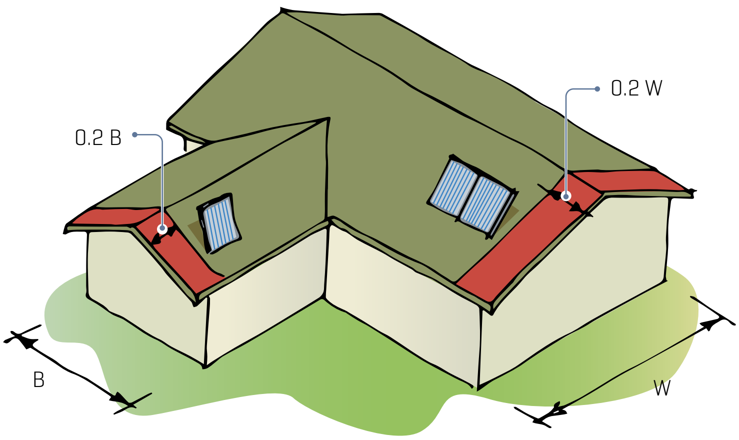


Figure 277. High-pressure wind zone (G12/AS2 Figure 2).

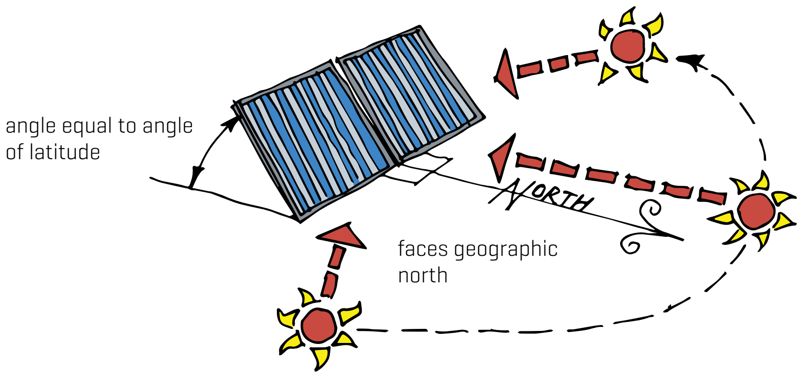


Figure 278. Solar orientation and inclination – most-efficient performance.

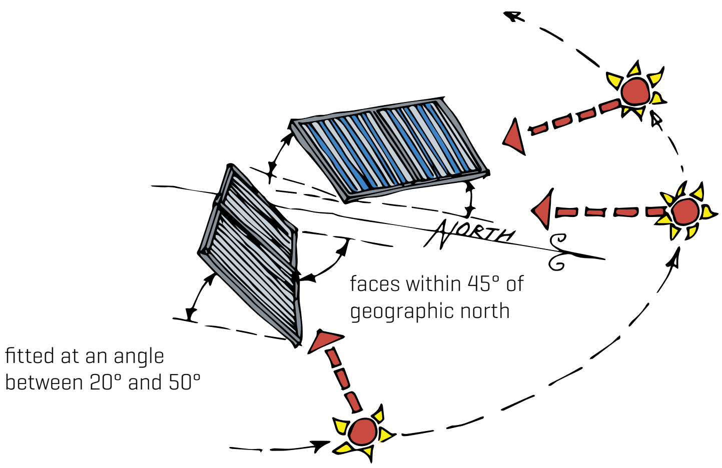


Figure 279. Solar orientation and inclination – relative performance.

10.2.4.4 Installation of solar water heaters

Solar water heaters must be installed to either AS/NZS 3500.4:2021 or G12/AS2.

Where water is heated by a wetback water heater and a solar collector, independent water pipe circuits must be installed for each heat source.

Weathertightness

Any penetrations made in the building cladding during the installation of a solar water heater must be flashed or sealed using purpose-made sealing washers or boots to prevent leaks.

Details for the correct installation of penetrations can be found in E2/AS1 and G12/AS1.

Structural support

Details for the structural installation of solar water heaters will be included in the specific design (if used) or G12/AS2.

10.2.4.5 Maintenance

Water storage tanks that form part of a solar water heater must have drainpipes that have an easily reached isolating valve and terminate with a cap or plug to empty the vessel for maintenance or terminate outside the building with a cap only.

10.2.5 Wetback water heaters

This section applies to wetback water heaters such as those commonly installed in solid fuel space heaters and connected by primary flow and return pipes to a storage vessel, such as a valve-vented electric storage water heater (Figure 280).

The primary flow and return pipes from the wetback to the storage water heater will transfer the heated water by thermosiphonage and must:

- be piped without any source of flow restriction or valves
- be sized in accordance with AS/NZS 3500.4:2021 Figure 7.2.1
- be insulated and, where exposed to the weather, the insulation waterproofed
- be continuously graded with an increasing gradient in the direction of water flow on the flow pipe of 1:20 (minimum) and an average of 1:7 and a decreasing gradient in the direction of the water flow on the return pipe
- be constructed of copper and not be in contact with dissimilar metals
- contain no elbows
- have connections with unions or similar couplings.

10.2.6 Heat pump water heaters

The principles of a heat pump water heater are shown in Figure 281. Ambient air is blown through the evaporator, and heat from the ambient air is transferred to the refrigerant. The refrigerant is compressed and becomes hot, and the hot refrigerant passes through the heat exchanger and transfers heat to the cold water to become hot water.

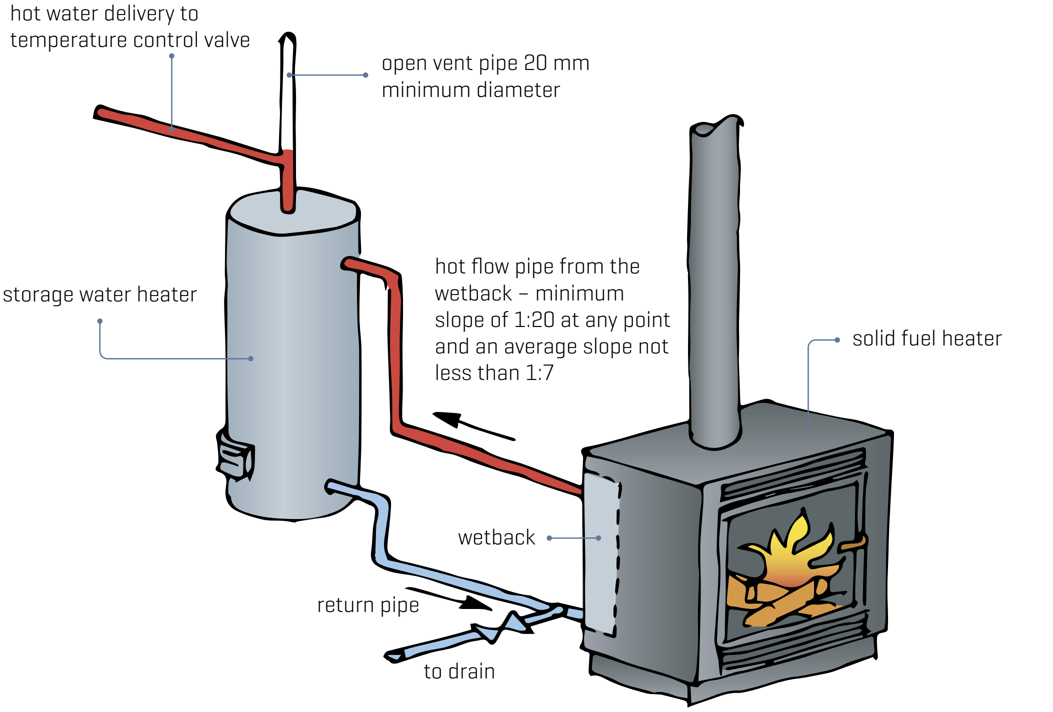


Figure 280. Wetback water heater.

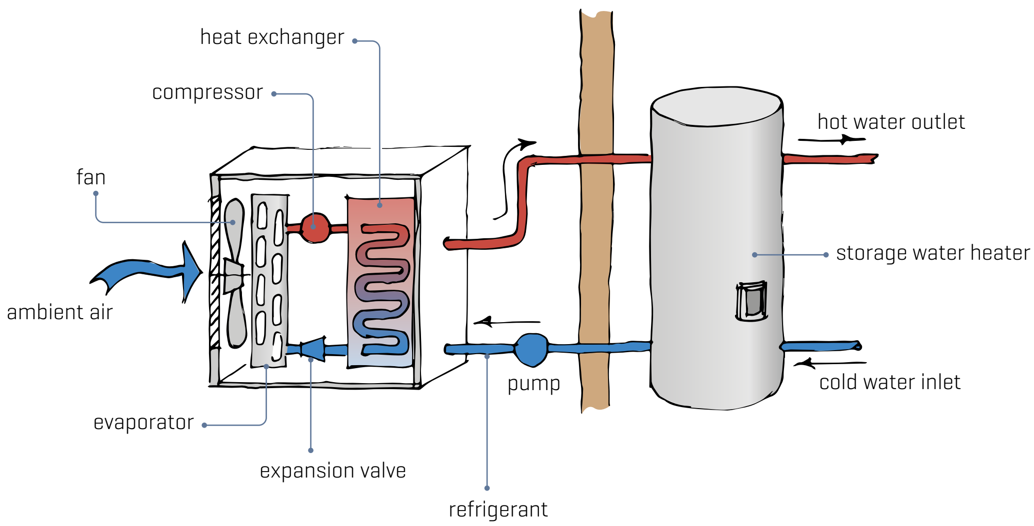


Figure 281. Heat pump water heater.

10.3 A TYPICAL DOMESTIC WATER INSTALLATION

A typical domestic water installation is shown in Figure 282. This incorporates a mains pressure hot water cylinder with a pressure-limiting valve. The location of the limiting valve ensures a balanced pressure to all fixtures but a higher pressure to hose taps for house washing.

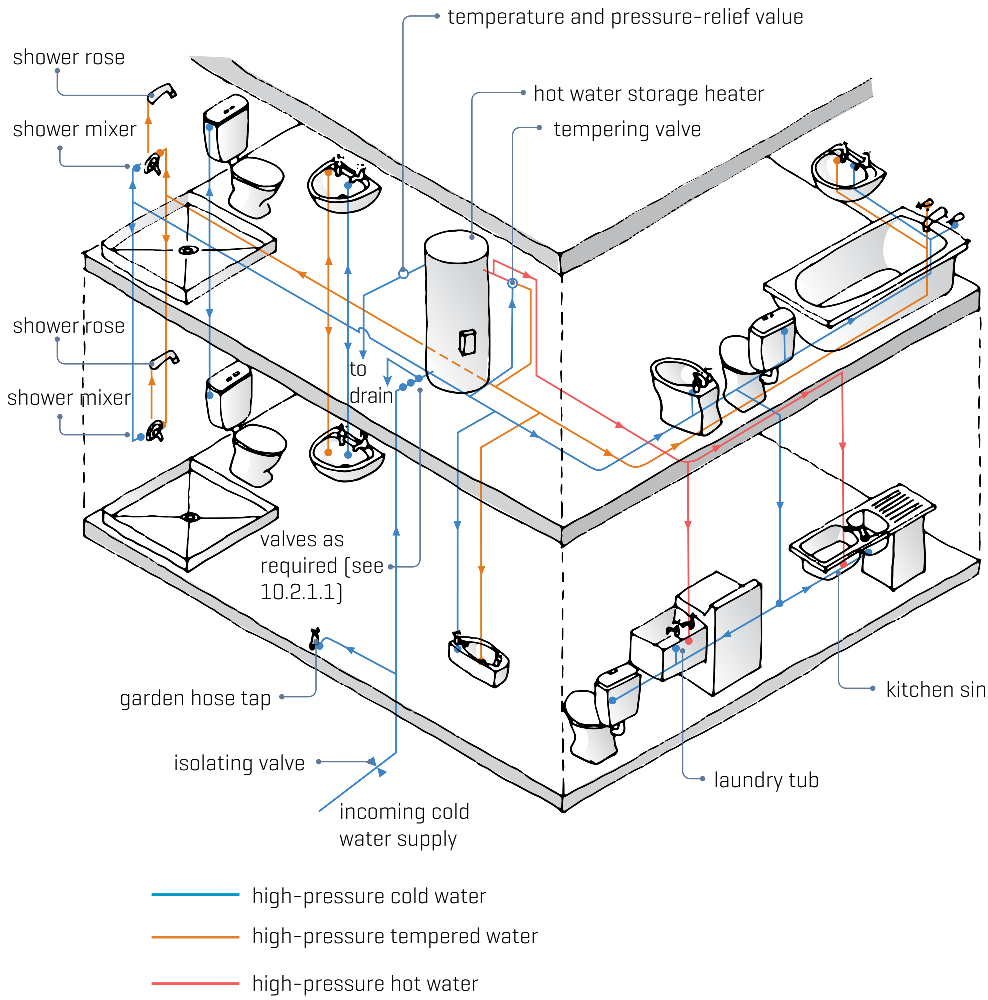


Figure 282. Guide to a typical domestic water installation – mains pressure.


EXIT
EXIT
EXIT
G10

11

MULTI-UNIT DEVELOPMENTS

The Building Code applies to buildings and building work as defined in the Building Act 2004. Therefore, work in association with buildings and not to the building itself such as the provision of plumbing and drainage network infrastructure may be designed and installed to standards and specifications to meet the requirements of the network utility operator (NUO) and the system owners.

The Building Code clauses that apply to multi-unit developments are:

- B2 *Durability* (because it applies to all Building Code clauses)
- E1 *Surface water*
- G12 *Water supplies*
- G13 *Foul water.*

Multi-unit apartment buildings combine the building work for each apartment and the reticulation of services to each apartment, with one connection to the NUO's systems for the whole apartment building. The maintenance and correct functioning of these services is undertaken by a body corporate.

Examples of areas for body corporate management are:

- building warrants of fitness for building features such as lifts, fire sprinklers and backflow preventers
- maintaining water pumps
- maintaining sewer pumps
- NUO water and sewer charges.

Traditionally, each building or house had its own services independently connected to NUO systems. In some cases, the development of subdivisions included these systems installed to council specifications, and ownership was taken over once the subdivision was complete.

The probable simultaneous flow rate to each unit is 0.48 L/s (AS/NZS 3500.1:2021 Appendix C).

AS/NZS 3500.1:2021 section 16 contains design information for water pipe sizing of multi-unit developments.

12 CLIMATE CHANGE

Over time, it is realistic to expect there will be changes to the performance criteria of the Building Code and supporting standards.

Some of these updates to the Building Code may result from predicted changes to the world's climate. Our current understanding of climate change in New Zealand suggests that it will likely affect the environmental conditions that buildings will have to handle in the future. Future changes to the Building Code could therefore include requirements addressing the impact of climate change on buildings.

The Building Code currently uses past data to inform requirements for factors such as earthquake loadings and locations, wind strength and wind zones. The Building Code also links to district plans under the Resource Management Act for data on flood levels.

In future, the Code may use performance criteria based on evolving and future-looking datasets and modelling, based on the likelihood of:

- increased rainfall intensity
- increased wind loading
- temperature change
- sea-level rise, coastal erosion and inundation.

APPENDIX

DOMESTIC SANITARY FIXTURES AND TAPS

This section gives the generic names and typical sizes of a range of domestic fixtures.

Wash-down WC pan

Water is flushed around the rim and falls into the bowl, forcing the contents through the trap and over the weir.

Flushing water required is 4.5 litres for a full flush and 3 litres for a half flush.

Materials

- vitreous china
- stainless steel (vandal-resistant)

Height

- nominal 400 mm to the rim
- junior patterns 350 mm to the rim
- models for disabled persons 460 to 480 mm to the seat

Pattern

- S trap
- P trap
- some models with side outlet – described as a left-hand or right-hand screw outlet

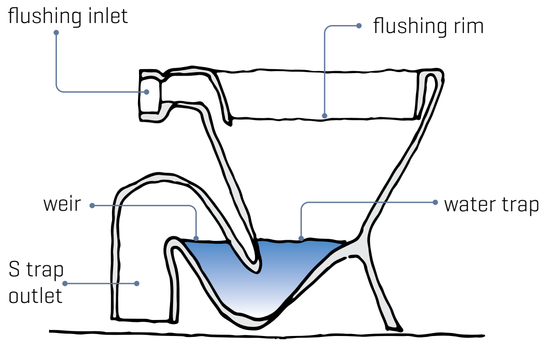


Figure 283. Wash-down WC pan S trap.

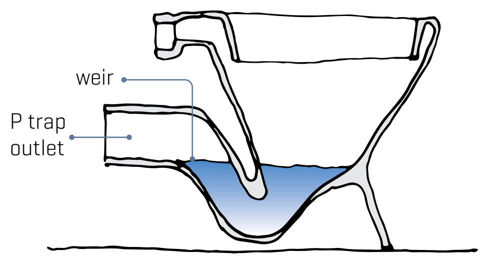


Figure 284. Wash-down WC pan P trap.

Low-level exposed cistern

Cistern fixed to the wall with exposed pipe for delivery of flushing water.

Materials

- vitreous china
- moulded plastic

Nominal sizes

- height – 400 to 450 mm
- width – 350 to 450 mm
- depth – 200 mm
- capacity – 4.5/3 litre dual flush

Integral flushing mechanism.

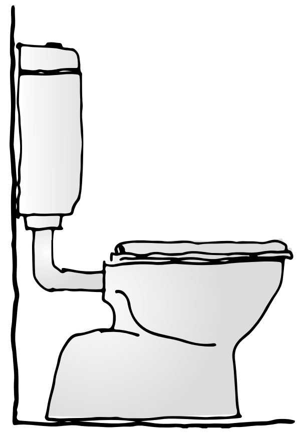


Figure 285. Low-level cistern and WC pan.

Close-coupled WC pan and cistern

The cistern is low and fixed directly over the top of the WC pan. In some models, a cistern and toilet seat are a single moulding.

Figure 286. Close-coupled toilet suite cistern and WC pan.

Wall-hung WC pan

Fixed to the wall with special brackets. The trap is concealed.

Pattern

- concealed cistern
- slim cistern fits in 160 to 200 mm wall space
- push-button flush device on wall

Integral flushing mechanism.

Flushing valve.

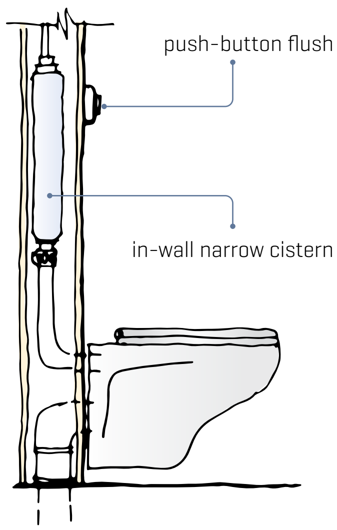


Figure 287. Wall-hung concealed trap WC pan.

Bidet

A personal washing device with a bowl and over-the-rim adjustable spray with hot and cold water.

Material

- vitreous china

Nominal sizes

- height – 400 mm
- length – 600 mm
- width – 350 mm

Pattern

- integral built-in concealed trap
- spray and mixer taps separate

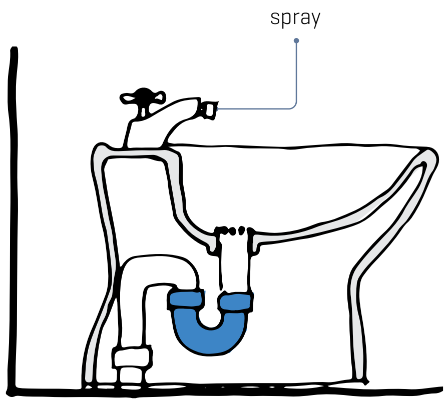


Figure 288. Bidet.

Wall-hung urinal

Single stall urinals mounted on special wall brackets.

Materials

- vitreous china
- stainless steel vandal-resistant models
- glass reinforced plastic

Nominal sizes

- height – 600 mm
- width – 450 mm
- depth – 400 mm

Pattern

- integral built-in trap
- available for high-pressure mains, flush valve or low-pressure tank flush
- may have manual, automatic or electronic flush control

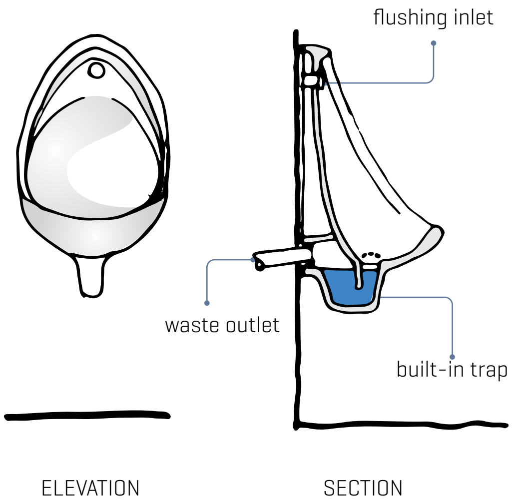


Figure 289. Wall-hung urinal.

Stall urinal

Available in 600 mm units each accommodating one person.

Material

- stainless steel

Nominal sizes

- height – 1100 mm
- width – multiples of 600 mm

Pattern

- low-pressure tank flush required
- step-up or step-on models

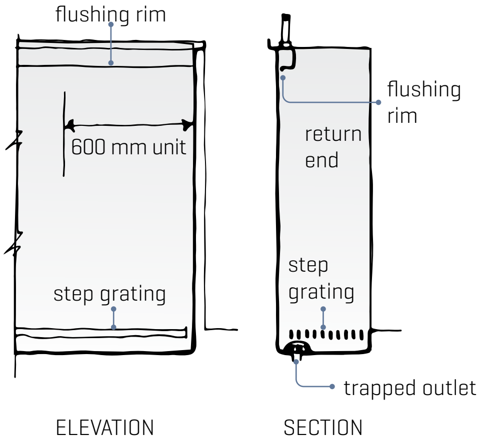


Figure 290. Stall type urinal.

Hand basins – wall mounted

Fixed to wall with special bracket support.

Nominal sizes

- width – 400, 450, 500, 550, 600 mm

Materials

- vitreous china
- stainless steel – vandal-resistant models

Pattern

- a range of designs
- most available in one, two or three taphole options

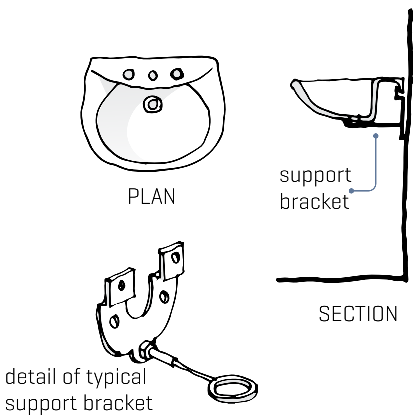


Figure 291. Wall-mounted hand basin.

Hand basins – semi-recessed

Partially let into vanity top and fixed with special bracket support.

Nominal sizes

- width – 400, 450, 500, 550, 600 mm

Material

- vitreous china

Pattern

- a range of designs
- most available in one, two or three taphole options

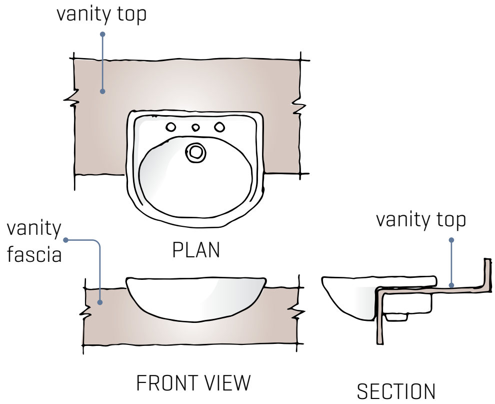


Figure 292. Semi-recessed basin.

Hand basins – fully recessed

Fully let into vanity top.

Nominal sizes

- width – 400, 450, 500, 550, 600 mm
- front to back – 400 to 500 mm
- bowl depth – 150 to 300 mm

Materials

- vitreous china
- pressed steel with vitreous enamel finish
- stainless steel
- plastic

Pattern

- a range of designs
- most available in one, two or three taphole options

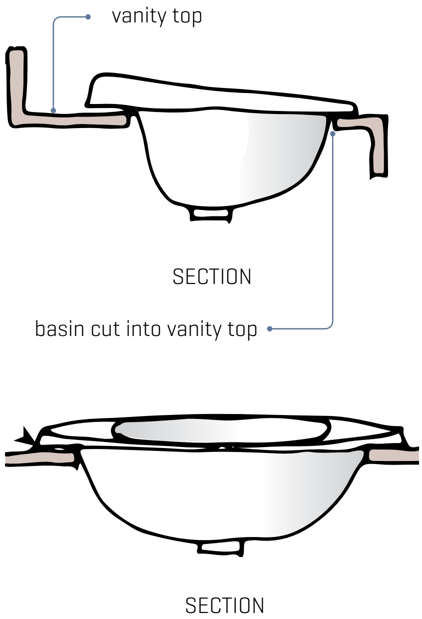


Figure 293. Fully recessed basin.

Corner basin

Space-saving unit.

Projection from corner – 400 mm.

Materials

- vitreous china
- pressed steel with vitreous enamel finish
- stainless steel

Pattern

- a range of designs
- most available in one, two or three taphole options

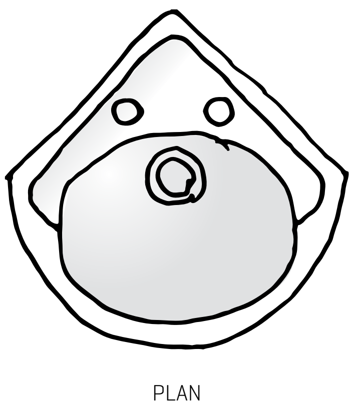


Figure 294. Corner basin.

Hand basins – compact

Suitable for hand washing in tight spaces.

Nominal sizes

- width – 500 to 550 mm
- front to back – 200 to 250 mm

Materials

- vitreous china
- moulded plastic

Pattern

- a range of designs
- available in one or two taphole options

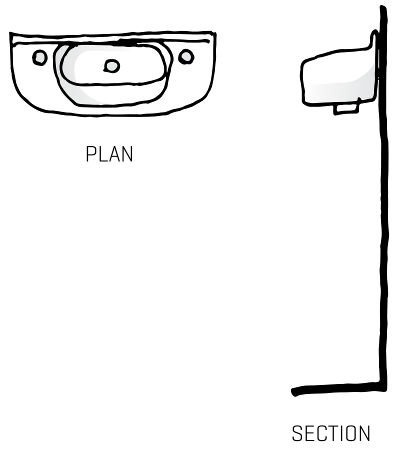


Figure 295. Compact hand basin.

Hand basins – shroud

A removable cover to the waste and trap is available for some wall-mounted models.

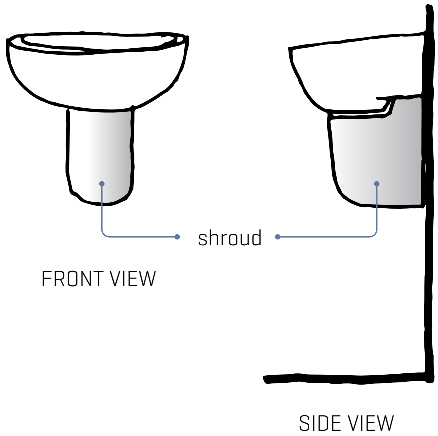


Figure 296. Shroud to hand basin.

Hand basins – pedestal

A cover to the trap and waste, which is full height from floor to underside of basin. Available for some models in vitreous china.

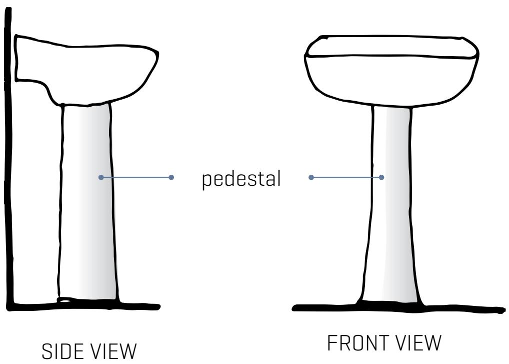


Figure 297. Pedestal to hand basin.

Baths

Nominal sizes

- length – 1500 to 1750 mm
- width – 750 to 850 mm
- height – 400 to 500 mm

Materials

- pressed steel with vitreous enamel finish
- plastic

Pattern

- extensive range of shapes and styles

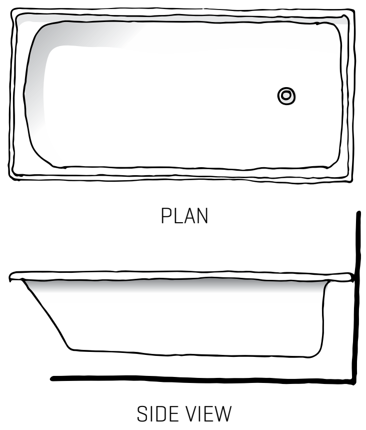


Figure 298. Bath.

Corner baths

Nominal sizes

- 1300 x 1300 mm
- 1400 x 1400 mm
- 1500 x 1500 mm

Material

- plastic

Pattern

- extensive range of shapes and styles

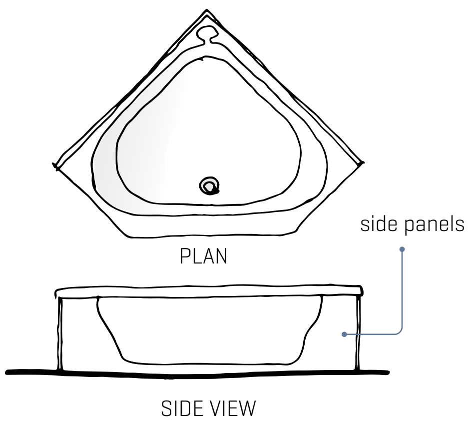


Figure 299. Corner bath.

Shower/bath (shub)

Combination of shower tray with sufficient depth for a shallow bath.

Nominal sizes

- 1200 x 800 mm

Material

- plastic

Pattern

- various

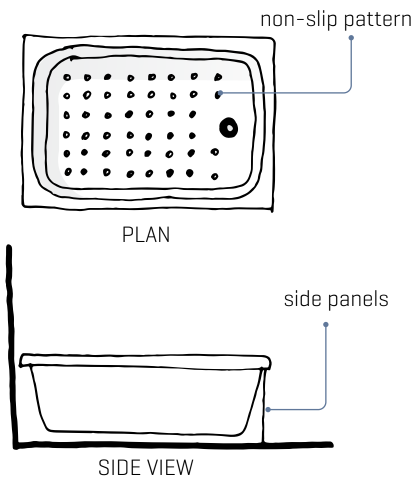


Figure 300. Shower/bath.

Spa baths

Bath fitted with pump and water jet. Extensive range of shapes and sizes.

Materials

- acrylic
- glass reinforced plastic
- pressed steel

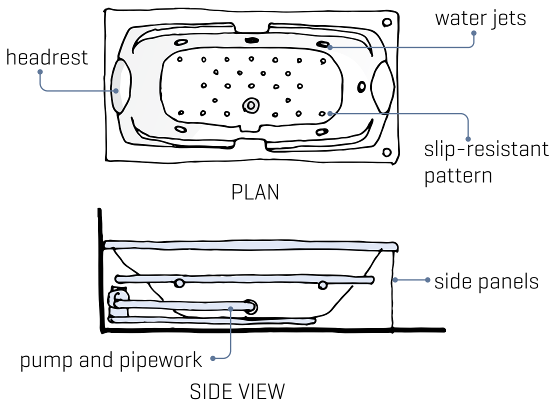


Figure 301. Spa bath.

Shower bases

Nominal sizes

- width – 750 to 1200 mm
- depth – 750 to 900 mm

Materials

- plastic
- stainless steel

Pattern

- some models are available with moulded walls, built-in seats and trays (plastic models have a slip-resistant pattern)

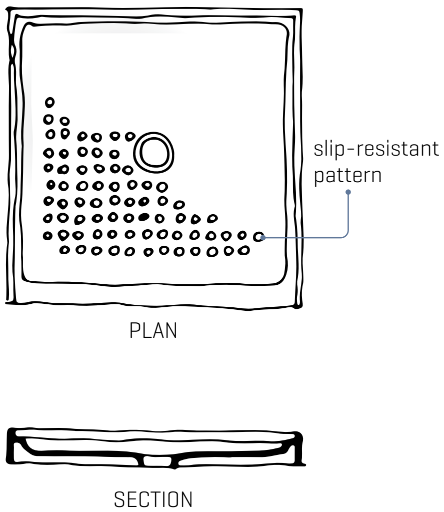


Figure 302. Shower base.

Corner shower base

Nominal sizes

- 900 x 900 mm
- 1000 x 1000 mm

Material

- plastic

Pattern

- some models are available with moulded walls, built-in seats and trays (plastic models have a slip-resistant pattern)

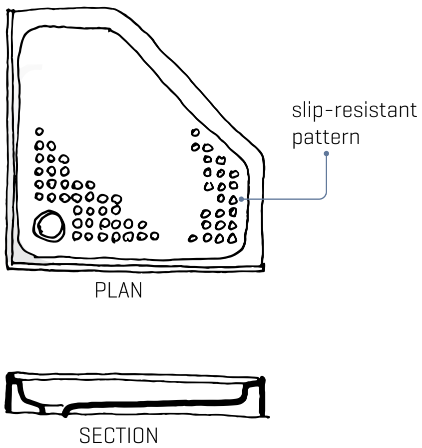


Figure 303. Corner shower base.

Kitchen sinks

Nominal sizes

- width – 500 mm, some models 400 mm
- length – 800 to 1200 mm (some models can be made as required)

Materials

- plastic (hard resins)
- stainless steel

Patterns

- extensive range – single, single + half, double bowl
- double drainer
- integral with bench top (resin, stainless steel) or underslung or top mounted

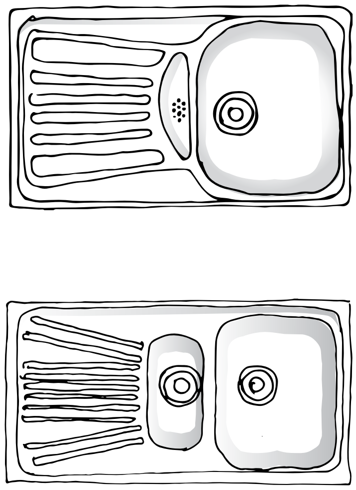


Figure 304. Kitchen sinks – single bowl and drainer and 1/2 bowl and drainer.

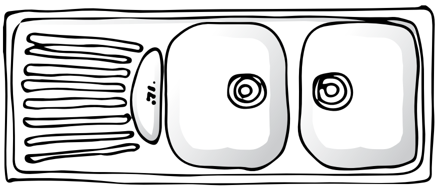


Figure 305. Kitchen sink – double bowl and drainer.

Cleaner's sink

Nominal size

- width – 550 mm
- depth – 450 mm

Material

- stainless steel

Pattern

- available with stainless steel splash-back and removable bucket grid

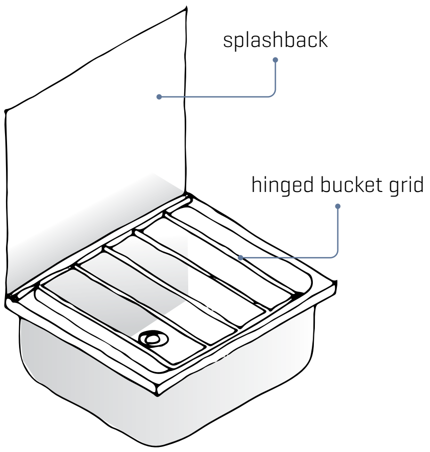


Figure 306. Cleaner's sink.

Bed pan sluice sink

Used in hospitals, rest homes etc. for flushing bed pans and urine bottles before sterilising.

Nominal size

- 600 x 600 x 400 mm deep bowl

Material

- stainless steel

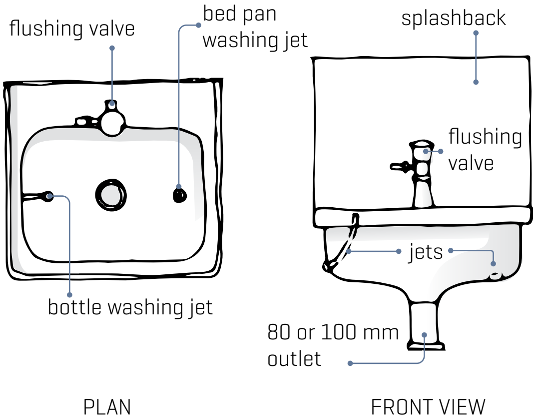


Figure 307. Bed pan sluice sink.

Drinking fountains

Nominal dimensions

- 300 x 300 mm or circular

Material

- stainless steel

Patterns

- free-standing or shrouded and floor mounted against the wall
- a range of tap functions

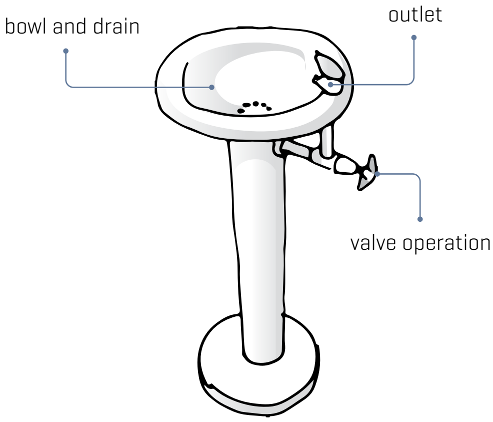


Figure 308. Free-standing drinking fountain.

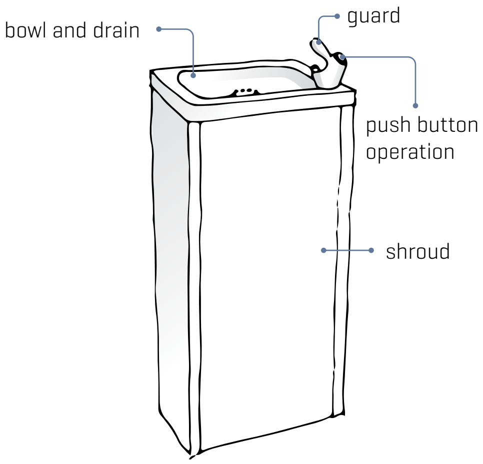


Figure 309. Drinking fountain with shrouded base.

Taps

Available in an extensive range of patterns and finishes.

Basin tap

Used for separate hot and cold supply.

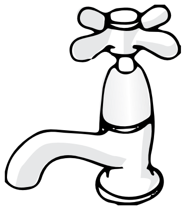


Figure 310. Basin tap.

Basin faucet

Mixes hot and cold water and delivers it via a single spout.

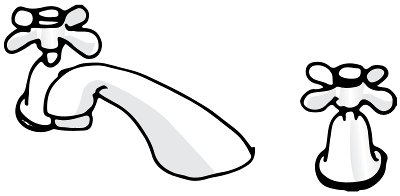


Figure 311. Basin faucet.

Basin mixer

Mixes hot and cold water with single lever operation and delivers it via a single spout.

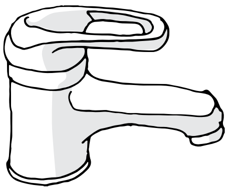


Figure 312 Basin mixer.

Bath tap

Mixes hot and cold water and delivers it via a single spout. Used for separate hot and cold supply.

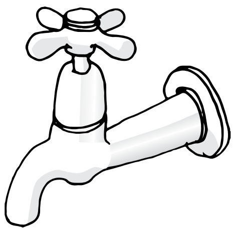


Figure 313. Bath tap.

Bath faucet – wall-mounted

Mixes hot and cold water and delivers it via a single spout.

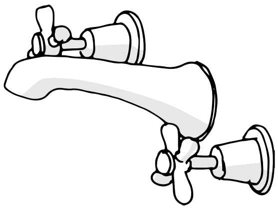


Figure 314. Bath faucet – wall-mounted.

Bath faucet – bath-mounted

Mixes hot and cold water and delivers it via a single spout.

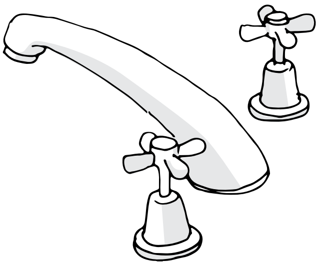


Figure 315. Bath faucet – bath-mounted.

Sink mixer – bench-mounted – two tap

Single hole. Mixes hot and cold water and delivers it via a single spout.

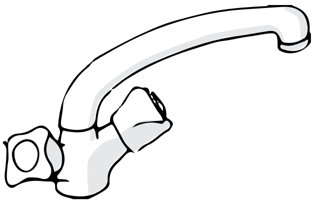


Figure 316. Sink mixer – bench-mounted – two tap.

Sink mixer – bench-mounted

Mixes hot and cold water with single lever operation and delivers it via a single spout.

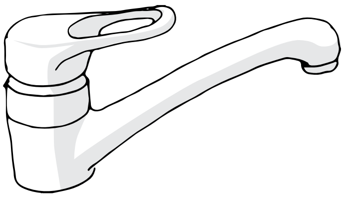


Figure 317. Sink mixer – bench-mounted.

Shower stop

Controls supply of hot or cold water to the shower rose.

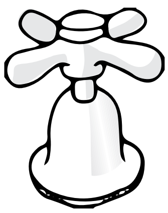


Figure 318. Shower stop.

Shower mixer

Single control lever mixes the water that is delivered to the rose.

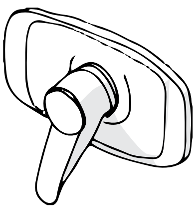


Figure 319. Shower mixer.

Shower rose
Wall-mounted spray outlet.

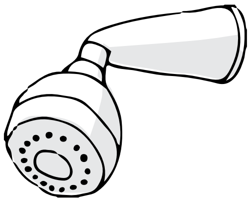


Figure 320. Shower rose.

Shower slide
Wall-mounted slide allowing adjustment of spray height and hand-held spray.

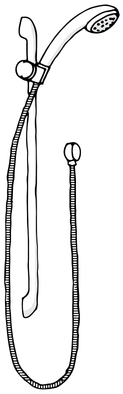


Figure 321. Shower slide.

Washing machine tap
Allows hose connections.

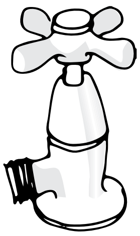


Figure 322. Washing machine tap.

Hose tap
External tap with screwed thread for attachment of a flexible hose pipe.

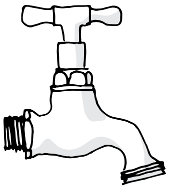


Figure 323. Hose tap.

Stop valve
Stops the flow in a pipe line.

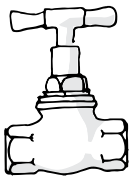


Figure 324. Stop valve.

GLOSSARY

GLOSSARY OF TERMS

This glossary of terms has been adapted from AS/NZS 3500.0:2021 *Plumbing and drainage – Glossary of terms.*

TERM	DEFINITION
45° junction	A junction where the branch pipe enters the main pipe at an upstream angle of 45°.
access chamber	A below-ground structure with a sealed cover constructed in the line of a sanitary drain to allow access for maintenance of the drain.
access pipe	A pipe provided with an opening and a removable cover for inspection and maintenance.
access point	A place where access may be made to a drain for inspection, cleaning or maintenance. It may be an inspection point, rodding point, inspection chamber or access chamber.
accessible	Capable of being reached for the purposes of inspection, maintenance, repair or replacement but may first require removal of an access panel, cover, door or similar obstruction.
air admittance valve	A valve installed on a sanitary plumbing system that is designed to open during periods of negative pressure and permit air to enter, thus maintaining the water level in the trap seal.
air gap	Free atmosphere between the outlet of a discharge pipe and the overflow level of the receptacle into which it discharges (for sanitary plumbing system); the lowest opening of a water service pipe or fixed outlet supplying water to a fixture and its highest possible water level (for water supply system).
anchor blocks	Concrete foundations placed on a pipeline to prevent pipe movement.
appliance	A piece of equipment such as a washing machine or dishwasher.
automatic flush tank	A flushing tank arranged to discharge its contents at regular intervals.

back siphonage	Backflow that occurs when the water supply pressure falls below atmospheric pressure.
backflow	Flow in a direction contrary to normal direction of flow or unintended reverse flow of water from a potentially polluted source into a potable water supply.
backflow prevention device	A device to prevent the reverse flow of water from a potentially polluted source into a potable water supply system.
backpressure	The difference between the pressure within any water service and a higher pressure within any vessel or pipework to which it is connected.
ball valve	A valve having a ball that can be turned to control the flow of water.
basin	A fixture holding water for washing purposes.
bath	A fixture containing water for bathing.
bedding	Material placed beneath a pipe to provide support.
bend	A length of pipe or a manufactured fitting used to make a change in direction in pipework.
bib tap	A screw-down pattern or ceramic disc draw-off tap with horizontal inlet and free water outlet.
bidet	A sanitary fixture pan with a spray device that can be applied to the body.
bidet tap	A tap that discharges over the rim of a bidet and provides an air gap.
boiling water unit	An apparatus for providing a continuous supply of boiling water.
boundary trap	A trap used to aerially disconnect the house drain from the sewer.
boundary trap riser	A vertical shaft that extends the inlet leg of a boundary trap to ground surface level to provide access to the drain for inspection, cleaning and maintenance purposes.
branch drain	A section of a drain that is intended to receive fixture discharge pipes that has a lower fixture unit loading than the main drain at its point of connection.
branch pipe	A common discharge pipe to which plumbing fixture traps at any one floor level are connected.
branch vent	A graded vent at any one floor level interconnecting two or more individual trap vents or group vents.
chamber	A compartment or enclosed space for air or water usage.
channel	An open graded passage for the conveyance of liquids.
charge pipe	A small diameter pipe for maintaining the water seal in a floor waste gully.
check valve	A valve to prevent reverse flow from the downstream section of a pipe to the section of pipe upstream of the valve – also called non-return valve.

cistern	A tank in which water is stored, the water normally entering through a float control valve set at a predetermined level and incorporating an air gap.
cleaner's sink	A sink near floor level for filling and emptying cleaning buckets. It is usually provided with a protective strip on the top front edge to prevent damage by the buckets and a grate on which to rest the buckets.
cleaning eye	A small access opening in a pipe for cleaning out obstructions and fitted with a removable and resealing cap or plug.
close-coupled WC	A WC pan directly coupled to the flushing cistern.
combination relief valve	A valve that combines the features of temperature and pressure-relief valves.
combined pipe	Any pipe that receives the discharge from both soil and waste fixtures and conveys those discharges to the sewage system.
combined stack	Any stack that carries discharges from both soil and waste fixtures.
combined tap	Water taps coupled together with a common outlet nozzle that may be either fixed or swivelling so as to discharge hot, cold or mixed water.
common discharge pipe	A graded pipe to which more than one fixture discharge pipe is connected.
common vent	A vent for venting the traps of not more than two fixtures.
compaction	The process of consolidating soil or other materials by mechanical or other means.
concrete surround	Concrete encasing of a pipe or fitting; the concrete margin around a gully or similar device.
connection	The short section of pipe connector that connects the supply pipe to a fixture; the servicing of a property with water supply or sanitary drainage or effluent disposal.
continuous flow water heater	A flow switch-controlled unvented water heater in which the heat energy is applied only while water flows to an outlet and does not incorporate any significant storage volume.
corbel water closet pan	A WC pan projecting from a wall in order to support the fixture clear of the floor.
cross-connection	Any connection between a potable water supply system and any fixture or storage tank through which it may be possible for non-potable water or contaminants to enter the potable water system.
cross-vent	A vent interconnecting a stack and its relief vent.
crown	The highest point on the external surface of a pipe or culvert at any cross-section.
crown of trap	The topmost point of the outlet leg of a trap.

depth of water seal	The vertical distance measured between the dip and the crown weir of a trap.
developed length	Total length along the centreline of a pipe and fittings, including all bends.
dip of trap	The lowest position of the barrier within any trap, which enables a water seal to be formed.
direct system	A hot water supply system in which the water supplied to the draw-off points is heated by a primary source of heat such as solid fuel, gas, electricity or oil.
discharge pipe	A pipe for carrying sewage and wastewater from any fixture, appliance or floor waste gully to a stack or drain.
discharge stack	A main vertical discharge pipe having two or more branch discharge pipe connections and vented to the atmosphere at one end via a discharge stack vent.
disconnector gully	A gully for use with a riser pipe and inlet fitting to provide disconnection by means of a water seal between waste discharges and the remainder of the sewage system.
domestic fixture appliance	A fixture or appliance designed for use in residential situations.
double bowl sink	A unit consisting of two sink bowls, which may incorporate a drainer.
double Y junction	A junction where two opposed discharges enter a main pipe at upstream angles of 45°.
downstream vent	A drainage vent located on or connected to a drain discharging to a boundary trap.
drain (sanitary)	A line of pipes above or below ground level within the property boundary, including all fittings and equipment generally external to a building, intended to convey sewage under gravity.
drain tap	A tap fitted to drain off the contents of a water system, pipe or tank.
draw-off tap	A tap for the purpose of drawing off water.
drench (safety) shower	A shower rose with a large output arranged to automatically give the user a rapid drenching in an emergency.
drinking fountain	A fixture providing a jet of potable water from which the user can drink.
drop junction	A vertical section of sanitary drain joining two drains at different levels – also called jump-up.
dropper	Vertical or near vertical water supply or sanitary plumbing pipework.
duct	An enclosed area to accommodate pipework.
elbow	A pipe fitting for providing a sharp change of direction in a pipeline.
elbow-action tap	A tap with a lever handle that can be operated by the elbow.

electronic tap	A tap activated by a sensor beam and solenoid valve (the temperature of the water is normally preset).
entry at grade junction	A junction between a graded branch pipe and a stack.
expansion control valve	A pressure-activated valve that opens in response to an increase in pressure caused by the expansion of water during the normal heating cycle of a water heater and designed to be installed on the cold water supply to the water heater.
expansion joint	A joint that permits longitudinal relative movement of the jointed parts caused by expansion and contraction due to temperature change.
fall	The difference in level between two points in the direction of flow.
fill	(Ordinary fill) earth removed from the excavation or imported used to refill a trench or form an embankment; (selected fill) specified material chosen for a particular application.
fire hose reel	A length of firefighting hose connected to a valved water supply and wound on a reel.
fitting	An item placed in a pipeline for jointing, connecting or changing the direction or internal diameter of the pipeline.
fixture	A receptacle (such as a basin or WC), the use of which results in a discharge into the sanitary plumbing or sanitary drainage installation.
fixture discharge pipe	The discharge pipe from a single fixture trap or a floor waste gully.
fixture discharge unit	A unit based on the rate of discharge that expresses the hydraulic load imposed by that fixture on the sanitary plumbing installation.
fixture outlet	An opening in a fixture, appliance or vessel serving to discharge the contents.
fixture pair	Two adjacent waste fixtures of the same type that have their outlets connected to the same fixture trap.
fixture trap	A trap connected directly beneath the outlet of a fixture.
flexible joint	A joint that permits deflection of the jointed pipes or fittings and includes elastomeric joint seals or seals housed in an integrally manufactured socket or a separately manufactured sleeve.
float	A buoyant device (often spherical) used to activate a mechanism by its response to a rise or fall of the surface of a fluid.
float valve	A valve for controlling the flow of a liquid into a cistern or other vessel that is operated by the movement of a float.
flood level rim	The lowest part of the top edge of any fixture from which water will spill when full.
floor level	When determining the height of a stack in floor levels, a floor level represents the vertical distance between two adjacent floor structures.

floor waste	A grated inlet within a graded floor intended to drain the floor.
floor waste gully	A disconnector gully for installation inside a building for use with a floor grating or waste outlet fitting on a riser pipe and with provision, where required, for connection of wastepipes for fixtures.
flush pipe	A pipe connecting a cistern or flush valve to the inlet of a WC pan or urinal.
flush pipe connector	A jointing device used to make a watertight seal between the flush pipe and the inlet of a sanitary fixture.
flush valve	A manually operated hydraulic device that discharges a predetermined quantity of water to fixtures for flushing purposes.
flushing cistern	A cistern that is capable of discharging a measured quantity of water either automatically at intervals regulated by the rate at which water is fed to the cistern or by manual operation of the flushing mechanism.
flushing tank	A tank from which water from a fixture is discharged to flush a system of drains.
food waste disposal unit	An electrically operated device for reducing kitchen food waste into fragments small enough to be flushed into the drainage system.
foulwater	Any contaminated or non-potable water.
fully vented modified system	A system of sanitary plumbing differing from a fully vented system in that the traps of any group of two or more fixtures or floor waste gullies discharging to the same branch pipe are vented in common by one or more group vents.
fully vented system	A system of sanitary plumbing with provision for the separate ventilation of every fixture trap connected (other than fixtures discharging to a floor waste gully) and of the trap of every floor waste gully.
gate valve	A valve the water flows straight through and in which the flow is closed with a sliding gate.
grade	The inclination expressed as the ratio or percentage of unit rise to horizontal distance – also called gradient.
graded offset	A stack offset that changes direction at an angle less than 45° from the horizontal.
graded pipe	A pipe installed on a gradient less than 45° from the horizontal.
gradient	The inclination expressed as the ratio or percentage of unit rise to horizontal distance – also called grade.
grating	A plate having holes or slots to prevent ingress of large solids.
gravity main	A main through which water, sewage or stormwater flows under the influence of gravity.
ground level	The surface of the earth at a site.

group vent	A vent connected to a branch to which unvented fixture discharge pipes are connected.
gully	An assembly used in a wastewater system that provides a water seal to prevent odours and gases from escaping into a building or into the atmosphere.
gully trap	A trap used external to the building to receive the discharge of wastewater before discharging to the drain and to maintain a water seal between the drain and the waste lines.
head	The total energy possessed by a unit weight of water due to its elevation, pressure and velocity. It is expressed as a height in metres of fluid.
header vent	A vent interconnecting the tops of two or more relief vents or stack vents.
heat exchanger	An apparatus for use in transferring heat from a heat source to water and contained within a coil or storage cylinder.
heat trap	An arrangement of water piping constructed to counteract the heat loss due to convection of the hot water.
height of stack (in floor levels)	The number of floor levels through which the stack passes, counted from the base of the stack up to but not including the floor level on which the highest fixture is connected. Where the distance between the base of the stack and the lowest floor exceeds 2.4 m, this interval shall be counted as an additional floor level.
horizontal branch	That part of a soil pipe or wastepipe extending laterally from a soil stack or waste stack with or without vertical sections or branches that receives the discharge from one or more wastepipes or soil pipes and conducts it to the soil stack or waste stack.
hose connection vacuum breaker	A device fitted to a hose tap to prevent backflow (caused by back siphonage) in a water reticulation system.
hose tap	A tap with an external screw thread on the outlet for attaching the coupling of a flexible hose.
hot water reticulation	Other than the actual water heater, all parts of an installation providing a supply of hot water at the specified outlets.
hot water system	All parts of an installation, including the water heater, necessary to provide a supply of hot water at specified outlets.
indirect system	A hot water supply system in which the water supplied to the draw-off points is heated by means of a heat exchanger.
induced siphonage	The loss of water from a trap by siphonage caused by a reduction in pressure at the outlet of the trap.
inspection cap	A removable airtight cap fitted over a boundary trap riser or inspection shaft.
inspection chamber	A chamber constructed in a drainage system to facilitate inspecting, testing or the clearance of obstructions.

inspection junction	A junction entering the main pipe at grade and fitted with an airtight removable cap.
inspection opening	An access opening in a pipe or pipe fitting arranged to facilitate inspection, testing or the clearing of obstructions and fitted with a threaded cap or plug or an access cover.
inspection opening bend	A sanitary drainage bend that incorporates an inspection opening.
inspection shaft	A shaft constructed in the line of a sanitary drain for the purpose of inspection and future access for locating and clearing the drain.
integral trap	A trap incorporated as part of a manufactured fixture.
internal diameter	The diameter of waterway through a pipe, tube, tap valve or other fitting.
invert level	The level of the lowest point of the internal surface of a pipe or channel at any cross-section.
isolating valve	Any valve for the purpose of isolating part of a water system from the remainder.
joint	A junction between two or more pipes.
jump-up	A vertical section of sanitary drain joining two drains at different levels – also called drop junction.
junction	A sanitary fitting used to connect a branch pipe to a main pipe.
lagged pipe	A pipe surrounded with thermal insulation.
laundry tub	A fixture having one or more receptacles for temporarily retaining liquid during washing operations.
lever-handled tap	A quick-action tap operated by a lever handle attached to the spindle.
loading unit	A weighted factor applied to a fixture or appliance used for estimating simultaneous water usage rates taking into account the flow rate, length of time in use and frequency of use.
low-pressure water heater	A water heater designed to work under a pressure not exceeding 12 m head and not having a free water surface, i.e. not a zero-pressure water heater.
main	The main pipeline of a system.
main drain	The main pipe of a drainage system to which branches are connected that is normally located in the ground and conveys the discharge from all fixtures to the sewer.
mains-pressure water heater	An unvented water heater designed for direct connection to the water supply system and fitted with a pressure-relief valve.
maximum working pressure	The maximum pressure that can be sustained with a factor of safety by the type and class of pipe or fitting for its estimated useful life under the anticipated working conditions.
meter	An apparatus for measuring or recording flow of water.

meter assembly	An apparatus consisting of water meter, stop valve, strainer, additional valves (if fitted) and unions required to connect these components together and to the water supply pipework.
mixing tap	A tap into which hot and cold water entering through separate pipes is mixed in a chamber and then delivered through a common outlet, the temperature of the mixed water being controlled by the operation of a control handle.
mixing valve	A valve in which separate supplies of hot water and cold water are mixed together to give a desired temperature.
network utility operator	An authority that undertakes the piped distribution of potable water supply or is the operator of a sewage system.
nominal discharge capacity	The discharge capacity of a pipe fitting or fixture.
nominal size (DN)	Designation of size common to components in a piping system, loosely related to manufacturing dimensions.
non-potable water	Any water other than potable water.
non-return valve	A valve to prevent reverse flow from the downstream section of a pipe to the section of pipe upstream of the valve – also called check valve.
offset	The pipe and fittings used to provide continuity between pipes whose axes are parallel but not in line.
open air	A location outside the extremities of a building and where air circulation is unhindered by any other nearby object.
outfall	That part of the disposal system receiving sewage (foul) water from the drainage system.
outlet	An opening or passage for water or waste exits.
outlet connection	A connection made at the outlet of an appliance, fixture or fitting.
overflow	Flow from an overfilled vessel, sanitary appliance or chamber; that part of a sanitary fixture through which overflow is intended to take place; the level of the rim of a fixture or the invert level of an overflow pipe.
overflow level	The level at which liquid in a vessel will first start to overflow either through the overflow pipe, if any, or over the top edge.
overflow pipe	A pipe connected to a vessel, sanitary appliance, drain or chamber to discharge excess liquid.
overflow relief gully	A self-cleansing trap provided with a suitable loosely fitted grating located above ground surface level for the relief of any possible surcharge and to provide a measure of protection against overflow from a drain.
P trap	A trap constructed with the inlet leg vertical and the outlet leg horizontal.

pan connector	A fitting for connecting a WC pan or soil fixture to a soil pipe.
pedestal water closet pan	A floor-mounted WC pan.
pillar tap	A screw-down pattern draw-off tap with vertical inlet and free water outlet.
pipe	A single length of tube usually of circular cross-section used for the conveyance of fluids.
plumbing system	Fixtures, fittings, pipes, materials or appliances other than the sanitary drain used for the collection and conveyance of any wastes or wastewater from any premises and including all vents, flushing and water services connected therewith.
point of connection (sewer)	The point provided for the connection of a property sanitary drain to the authority's sewer.
potable water	Water suitable for human consumption.
precast chamber	A preconstructed component to provide for access, inspection or the clearance of obstructions in a drain.
pressure test	A test in which a pipe or system is pressurised to determine its watertightness.
pressure-limiting valve	A valve that limits the outlet pressure to the set pressure within specified limits at inlet pressures above the set pressure.
pressure-reducing valve	A valve that automatically reduces the pressure to below a predetermined value on the downstream side of the valve.
pressure-relief valve	A spring-loaded valve for automatically controlling the build-up of excessive pressure in pipework or fittings by means of a discharge to the atmosphere.
pump	A mechanical device used for raising fluids from a lower to a higher level or for circulating fluid in a pipework system.
reduced-pressure water heater	A displacement water heater designed to operate at a pressure below the normal water main inlet pressure and to be installed with a pressure-control device fitted on the inlet.
reducer	A pipe fitting for connecting pipes of different sizes together (sometimes referred to as a taper or reducing fitting).
reducing piece	A tapered length of spigot and socket pipe in which the spigot fits the larger pipe and the socket the smaller pipe, which may be concentric or offset.
reflux valve	A valve that prevents the reversal of flow by means of a flap or other mechanism.
regulatory authority	The authority empowered by statute to exercise jurisdiction over the installation of water, plumbing, sewerage or stormwater works.
relief valve	A valve that will open to release excess pressure from a system.

relief vent	A vent installed in a stack below the lowest fixture.
residential building	A building that contains one or more occupancy units.
reticulation main	A network of pipes to which service pipes of individual properties are connected.
rodding	A system of rods that are progressively joined to clear sewers and stormwater drains.
rodding point	A removable ground-level cap through which access may be had for cleaning and inspecting the sewage (foul) water drainage system.
S trap	A trap in which the outlet leg is parallel to the inlet leg.
safe tray	A watertight tray fitted under a water heater or feed tank to catch condensation, spillage or leakage and provided with a wastepipe to direct any discharge to a safe location.
safety valve	A pressure-relief valve fitted on or close to a boiler or unfired pressure vessel.
sanitary appliance	An appliance such as a dishwasher or clothes washing machine intended to be used for sanitation and is not a sanitary fixture.
sanitary drainage system	An assembly of pipes and fittings used to collect and convey the discharge from the sanitary plumbing system to the sewer (usually located below ground level).
sanitary fixture	Any fixture intended to be used for sanitation.
sanitary plumbing system	A system of pipes, fittings, fixtures and appliances used to collect and convey sewage to the sanitary drainage system.
sanitation	The activities of washing and/or excretion carried out in a manner or condition such that adverse effects on health is minimised.
set pressure	The nominal inlet pressure at which a pressure or vacuum relief valve is set to first open in service; the nominal outlet pressure a pressure-reducing valve is set to maintain.
set temperature	The nominal temperature at which a temperature-relief valve is set to first open in service.
sewage	Wastewater including all faecal matter, urine and household and commercial wastewater that contains human waste.
sewage system	A system that includes all sewer and sewage works vested in the local authority.
sewer	A conduit for the carriage of sewage vested in the local sewage authority.
sewer pipe	A non-pressure pipe for the conveyance of sewage.
sewerage	The system of pipes and treatment works to collect and safely dispose of sewage effluent.

shower	A sanitary fixture for washing the body.
shower base	A floor tray usually of stainless steel, ceramic tiles or plastic for use as the base of a shower compartment with a waste outlet.
shower bath (shub)	A bath combined with a shower outlet.
shower enclosure	A compartment for showering purposes, consisting of walls, base and a waste outlet.
shower head (rose)	A fitting used for showering purposes from which water issues as a spray.
single stack modified system	A system of sanitary plumbing differing from a single stack system in that additional venting is provided by means of a relief vent connected with the stack at intervals by cross-vents.
single stack system	A system of sanitary plumbing in which the stack and discharge pipes also serve as vent pipes.
sink	A fixture for holding water for cleansing purposes.
sink drainer	An area adjacent to the sink bowl for draining purposes.
siphon	A pipe system, typically in the shape of an inverted U with unequal legs, for conveying liquid over the edge of a vessel and delivering it at a lower level using atmospheric pressure.
siphonage	The action of a siphon.
siphonic WC pan	A WC pan in which the contents are removed by siphonic action induced by the flushing water.
slab urinal	A single-stall urinal fixed on the wall.
sleeve	A pipe built into the structure of a building to allow another pipe to pass through, giving protection and allowing for relative movement.
slop hopper	A soil fixture other than a WC pan or urinal used for the discharge of soil wastes and provided with a flushing apparatus, tap and grating.
soffit	The highest point of the internal surface of a pipe or culvert at any cross-section.
soil fixture	A WC pan, urinal, slop hopper or bed pan washer.
soil pipe	A pipe that conveys the discharges from one or more soil fixtures and may also carry discharges from waste fixtures.
soil stack	A stack that carries the discharges from one or more soil fixtures and may also carry waste discharges.
soil, waste and vent pipe	A non-pressure pipe for the conveyance of soil or pipe waste discharge or for the conveyance of gases from a drainage system.
solar water heater	An appliance to heat water using solar energy.

spa bath	A bath with the facility for injecting air and jets of turbulent water into water contained in the bath.
spill level (or flood level)	The maximum height to which water will rise while overflowing the rim level when water is flowing into the fixture.
spray outlet	A fitting attached to the outlet of a tap or mixing valve that causes water passing through it to break up into a spray.
square junction	A junction where the branch pipe enters the main pipe at 90°.
stack	Any vertical pipe including offsets extending through more than one floor level.
stack vent	The extension of a discharge stack above the highest connected discharge pipe.
steep offset	A stack offset that changes direction at an angle of 45° or more from the horizontal.
stop tap	A screw-down pattern tap with horizontal inlet and outlet connections permitting flow in one direction only.
stop valve	A valve that can be operated to stop the flow in a pipeline.
storage water heater	A water heater that incorporates a thermally insulated container in which the water is heated and stored for subsequent use.
strainer	A device for separating solid matter above a nominated size from liquid to prevent such matter from entering a pump, valve, meter or pipework.
surcharge (sanitary)	Overflow from a sewer or combined sewer caused by overloading or chokage.
sweep junction	A short length of pipe with a socketed branch at approximately 45° and a socket set at 90° to the pipe centreline.
swept junction	A long radius bend entering a main pipe at 45°; a 45° junction fitted with a 45° bend.
tank	A fixed container for storing liquids.
tap	A valve with an outlet used as a draw-off or delivery point.
temperature and pressure-relief (TPR) valve	A spring-loaded automatic valve limiting the pressure and temperature by means of discharge and designed for installation on the hot side of a storage water heater.
temperature control valve	A valve that mixes hot and cold water to deliver hot water at temperatures that reduce the likelihood of scalding and include tempering valves, thermostatic mixing valves and thermostatic mixer taps.
temperature-relief valve	A temperature-actuated valve that automatically discharges fluid at a specified set temperature. It is fitted to a water heater to prevent the temperature in the container exceeding a predetermined level in the event that energy input controls fail to function.

tempering valve	A mixing valve that is temperature actuated and used to temper a hot water supply with cold water to provide hot water at a lower temperature at one or more outlet fixtures.
terminal vent	A vent that allows air to exit from a drain.
territorial authority	A city council or district council.
test pressure	The pressure applied internally to pipes and fittings when being tested for strength and watertightness.
thermostatic mixer tap	A tap that contains a thermostatic mixing valve.
thermostatic mixing valve	A mixing valve in which the temperature from the mixed water outlet is automatically controlled by a thermostatic element/sensor to a preselected temperature that is suitable for direct contact with the skin.
throat radius junction	A short radius bend entering a main pipe at 45° with a throat radius of half the diameter of the branch pipe.
toxic	Any substance that would normally have detrimental health effects if consumed.
trap	Any fitting designed to retain a water seal for the purpose of preventing the passage of gases.
trap vent	A vent pipe venting an individual trap to the open air or to a main or branch vent pipe to prevent loss of water seal in the trap.
untrapped floor drain	A grated outlet to a pipe discharging to an outside location.
upstream vent	A vent installed adjacent to the upper end of a drain.
urinal	A sanitary plumbing fixture for receiving and flushing away urine.
vacuum-relief valve	A pressure-actuated valve that automatically opens to relieve vacuum conditions.
valve	A device for controlling the flow of a fluid, having an aperture that can be wholly or partially closed by the movement of a disc, piston or ball.
valve-vented (unvented) storage heater	A storage water heater in which the required venting to the atmosphere is controlled by a valve.
vent	A pipe provided to limit the pressure fluctuations within the discharge pipe system or to encourage the passage of gases.
vent pipe	An open-ended pipe connected at any high point in a hot water system or from any vessel containing hot water and arranged so that the open end discharges into the air space of the cold water feed tank or to the outside atmosphere.
vented water heater	A water heater in which provision is made for a vent permanently open to the atmosphere.

venting	Removal of foul gases from a sanitary installation to the atmosphere by means of a vent pipe; allowing air to enter or escape from a soil pipe or wastepipe to prevent the breaking of the water seal in the trap.
wall-hung urinal	A urinal consisting of a flat impervious slab fixed on a wall incorporating an integral channel.
wall-hung water closet pan	A sanitary fixture hung or cantilevered from a wall.
wash-down water closet	A WC pan from which the contents are removed by a flush of water discharged into the pan from the flushing rim.
waste	The discharge from a waste fixture or appliance.
waste outlet	An outlet pipe with or without overflow ports with a top flange and grating.
waste stack	A stack that only carries discharges from waste fixtures.
wastepipe	A pipe that only conveys the discharge from waste fixtures.
wastewater	The spent or used water of a community or industry that contains dissolved and suspended matter.
wastewater fixture	Any fixture other than a soil fixture.
water closet (WC) pan	A receptacle in the form of a bowl incorporating a water seal used in conjunction with a flushing device for the disposal of human waste.
water hammer	Pressure surges in a closed pipe system as the result of a sudden change in velocity of the liquid such as by a valve closure or pump start or stoppage.
water heater	An appliance, usually self-contained, providing hot water within a building by circulating it through a pipe network and usually lagged or insulated.
water main	A conduit or pipeline vested in the water authority or controlled and maintained by a network utility operator and constructed to convey potable water supplied by that authority.
water service	That part of the cold water supply pipework from the water main up to and including the outlet valves at fixtures and appliances.
water storage tank	A container for storing water.
water trap	A fitting designed to prevent foul air escaping from the plumbing system or sewage (foul) water drainage system and entering a building.
WC cistern	A flushing cistern installed in conjunction with a WC pan incorporating a mechanism, normally a float-control valve, to control the water level.
weir of trap	The lowest point of the outlet leg of a trap.
Y junction	A junction where the branch pipe enters the main pipe at an upstream angle of 45°.