

# Plumbing and drainage, Part 2: Sanitary plumbing and drainage

This joint Australian/New Zealand Standard™ was prepared by joint Technical Committee WS-014, Plumbing and Drainage. It was approved on behalf of the Council of Standards Australia on DD Month 202X and by the New Zealand Standards Approval Board on DD Month 202X.

## Preface

This Standard was prepared by the joint Standards Australia/Standards New Zealand Committee WS-014, Plumbing and Drainage, to supersede AS/NZS 3500.2:2018.

The objective of this document is to provide installers with deemed to satisfy solutions for compliance with —

- (a) the National Construction Code (NCC) Volume Three, Plumbing Code of Australia (PCA); and
- (b) the New Zealand Building Code (NZBC), Clause G13 Foul Water.

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

DRAFTING NOTE This document is being released for a third round of Public Commenting. Comments are invited on [Clause 6.11.3](#) only. Comments on other clauses will not be considered for this revision but may be considered for later revisions of this document.

The major changes in this revision are as follows:

- (i) Conformance to individual product standards has been removed. All products used in plumbing and drainage systems in Australia need to comply with the PCA and, in New Zealand, the NZBC, see [Appendix A](#) for further information. Removal of specific product standard conformance requirements avoids inconsistencies and contradictions between this document and the PCA and NZBC.
- (ii) Definitions have been relocated to AS/NZS 3500.0 for consistency across the series.
- (iii) The range of materials that can be used for wet wells has been expanded to encompass prefabricated wells.
- (iv) Changes to the requirements for the marking of pipes in commercial buildings to assist in the better identification of pipework and avoid cross connections.
- (v) Changes to the connection requirements for drains at grade.
- (vi) The requirement for a commercial dishwashing machine drainage just to connect to a disconnecter gully with a 10 m discharge pipe has been removed. This allows the more effective arrangement of commercial kitchens.
- (vii) An appendix has been added providing guidance on the requirements of AS 2870 for flexible connections to be installed in plastics pipe drainage systems. It covers flexible connections, lagging and water ingress under the slab to accommodate a range of differential soil movement for Soil Classes M, M-D, H1, H1-D, H2, H2-D, E and E-D.
- (viii) Changes to the number of pressure attenuators required to allow more flexible installation options.

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

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

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

This document includes commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by “C” preceding the clause number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the document.

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## 1 Scope and general

### 1.1 Scope

This document specifies requirements for the design and installation of sanitary plumbing and drainage from fixtures to a sewer, common effluent system or an on-site wastewater management system, as appropriate. It applies to new installations as well as alterations, additions or repairs to existing installations.

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

NOTE 1 The pre-treatment of trade wastes is not specified in this document.

NOTE 2 All sanitary plumbing and sanitary drainage installations for relocatable dwellings on long-term sites should conform to this document.

### 1.2 Application

#### 1.2.1 Australia

This document shall be read in conjunction with the National Construction Code (NCC), Volume Three, the Plumbing Code of Australia (PCA).

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

#### 1.2.2 New Zealand

This document shall be read in conjunction with the New Zealand Building Code. This document may be used to demonstrate compliance with the New Zealand Building Code, Clause G13 Foul Water.

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

### 1.3 Normative references

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

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

AS 1345, *Identification of the contents of pipes, conduits and ducts*

AS 4809, *Copper pipe and fittings — Installation and commissioning*

AS/NZS 1546.1, *On-site domestic wastewater treatment units, Part 1: Septic tanks*

AS/NZS 1546.2, *On-site domestic wastewater treatment units, Part 2: Waterless composting toilets*

AS 1546.3, *On-site domestic wastewater treatment units, Part 3: Aerated wastewater treatment systems*

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

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

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

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

NZS 7643, *Code of practice for the installation of unplasticized PVC pipe systems*

ISO 7685, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes — Determination of initial specific ring stiffness*

ISO 9969, *Thermoplastics pipes — Determination of ring stiffness*

WMTS-518, *Rehabilitation of existing Non Pressure Pipelines by the use of Cured In Place Pipe (CIPP)*

## 1.4 Terms and definitions

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

## 1.5 Plastics abbreviations

The following plastics abbreviations are used in this document.

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

## 1.6 Measurement of pipe length

For the purposes of this document, the length of a branch drain or discharge pipe shall be measured along the centre-line from the weir of the trap to the point of connection to a stack, graded discharge pipe, drain or other drainage trap as shown in [Figure 1.6](#).

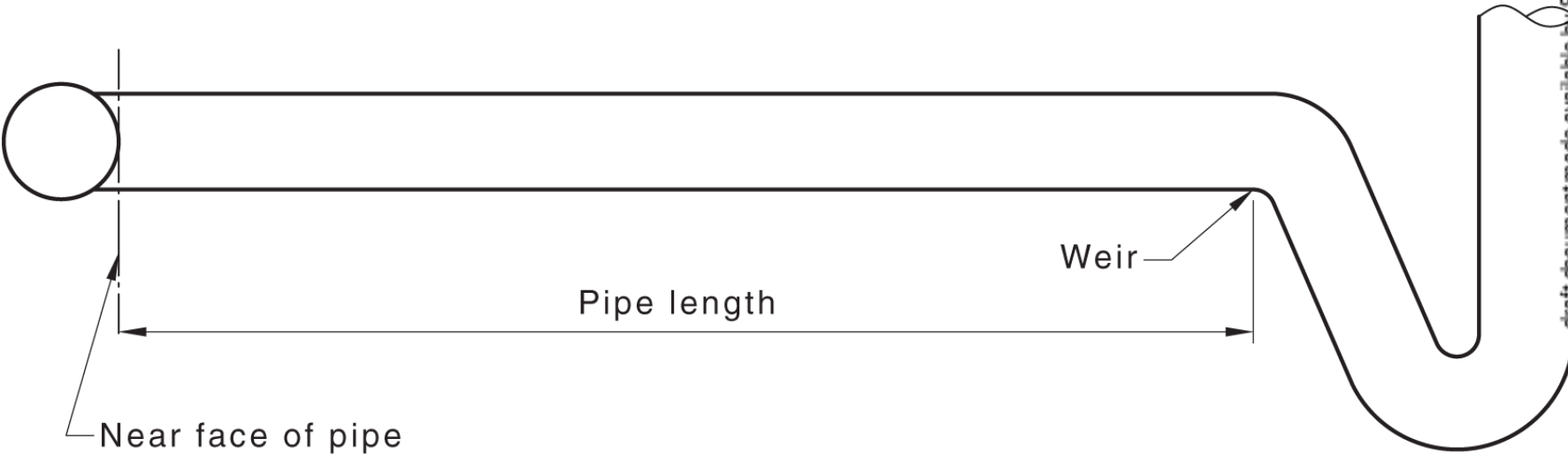


Figure 1.6 — Pipe length — Method of measurement

## 1.7 Pipe grades

In this document, pipe grades are expressed as a percentage of vertical to horizontal distances.

## 1.8 Equivalent pipe sizes

Nominal sizes of pipes and fittings specified in this document are applicable to all materials listed in [Appendix A](#), except for polyethylene (PE) and polypropylene (PP). Where the nominal size of a pipe or fitting is specified in this document, an equivalent pipe size, appropriate to polyethylene and polypropylene pipes and fittings, shall be selected from [Table 1.8](#).

Table 1.8 — Equivalent sizes for PE and PP pipes and fittings	
Nominal size DN	Equivalent OD for PE and PP
32	32
40	40
50	50
65	63
80	90
100	110
125	125
150	160
225	250
300	315

## 2 Materials and products

### 2.1 Scope of section

This section specifies requirements for materials and products to be used in sanitary plumbing and drainage systems.

### 2.2 General

Materials and products used in a sanitary plumbing and drainage systems shall be selected to ensure they are fit for their intended purpose.

NOTE 1 In New Zealand, the requirements for materials and products are contained in NZBC Clauses B2 Durability and G13 Foul Water.

NOTE 2 See [Appendix A](#) for information on selecting products that are fit for purpose.

NOTE 3 See [Section 16](#) for information on vacuum drainage systems.

### 2.3 Pipes and fittings — General limitations

The following limitations shall apply to the use of pipes and fittings for plumbing and sanitary drainage installations:

- (a) Bends in pipes shall be free from wrinkling and flattening.
- (b) Pipes and fittings shall be protected from excessive ambient heat.
- (c) When encased in concrete, all pipes and fittings shall be wrapped with an impermeable flexible sheath not less than 6 mm thick.

### 2.4 Metallic pipes and fittings

#### 2.4.1 Sanitary plumbing and drainage systems

Where metallic pipes and fittings are used in a sanitary plumbing and drainage system, they shall be of the following material types:

- (a) Cast iron fittings (grey cast iron).
- (b) Copper pipes and fittings.
- (c) Copper alloy pipes.
- (d) Copper and copper alloy fittings.
- (e) Ductile iron pipes and fittings.
- (f) Galvanized steel pipes and fittings.
- (g) Stainless steel (SS) pipes and fittings.

NOTE 1 See [Appendix A](#) for information on selecting products that are fit for purpose.

NOTE 2 See [Clause 2.4](#) for information on plastic pipes and fittings.

#### 2.4.2 Limitations

Metallic pipes and fittings shall conform to the following:

- (a) Galvanized steel pipes and fittings shall not be —
  - (i) used for the conveyance of discharge from soil fixtures;
  - (ii) cement-lined;
  - (iii) bent; or
  - (iv) installed in inaccessible locations.
- (b) Copper pipes and fittings shall not be used to convey —
  - (i) undiluted discharges from urinals, trade waste discharges that could have a deleterious effect on the copper (e.g. wastes from photographic equipment or cooling towers); or
  - (ii) the discharge from grease arrestors.
- (c) Copper and copper alloy pipes shall not be bent on site beyond an offset angle of 10°. Type D copper shall not be bent.

NOTE 1 Refer to AS 1432 for information on copper types.



- (d) Copper alloy bends and junctions used at the base of stacks greater than 9 m in height shall be cast or hot-pressed.
- (e) Above ground stainless steel pipes and fittings shall have a PREN rating not less than 16.
- (f) Below ground stainless steel pipes and fittings shall have a PREN rating of not less than 22.

NOTE 2 The pitting resistance equivalent number (PREN) may be calculated as follows:

$$PREN = \%Cr + (3.3 \times \% Mo) + (16 \times \%N).$$

NOTE 3 A PREN of 18 is approximately equivalent to Grade 304, and a PREN of 23 is approximately equivalent to Grade 316.

### 2.4.3 Fabricated metallic pipes and fittings

Fabricated metallic pipes and fittings shall conform to the following:

- (a) Copper alloy fittings other than junctions shall not be fabricated on site.
- (b) All fabricated copper bends and junctions at the base of stacks up to 9 m in height shall be formed of Type B or heavier gauge copper.

NOTE 1 Refer to AS 1432 for additional information on copper types.

NOTE 2 Bends and junctions fabricated from copper pipe manufactured in accordance with NZS 3501 are also suitable for use in New Zealand.

- (c) Stainless steel fittings and assemblies, including bending, shall not be fabricated on site.

## 2.5 Plastics pipes and fittings

### 2.5.1 Sanitary plumbing and drainage systems

Where plastics pipes and fittings are used in a sanitary plumbing and drainage system, they shall be of the following material types:

- (a) Acrylonitrile butylene styrene (ABS) pipe and fittings.
- (b) High density polyethylene (PE) pipe and fittings.
- (c) Polypropylene (PP) pipe and fittings.
- (d) Unplasticized polyvinyl chloride (PVC-U) pipes and fittings.

NOTE 1 See [Appendix A](#) for information on selecting products that are fit for purpose.

NOTE 2 See [Clause 2.3](#) for information on metallic pipes and fittings.

### 2.5.2 Limitations

Plastics pipes and fittings of materials other than PVC, black PE or black PP shall be protected from direct sunlight.

NOTE Examples of protection include sleeving with metal or plastics pipe or conduit or lagging.

## 2.6 Pipes and fittings — Other materials

### 2.6.1 Sanitary plumbing and drainage systems

Where other than metallic or plastics pipes and fittings are used in a sanitary plumbing and drainage system, they shall be of the following material types:

- (a) Fibre reinforced cement (FRC) pipes and fittings.
- (b) Glass-filament-reinforced thermosetting plastic (GRP) pipe.
- (c) High grade, low thermal expansion, borosilicate glass.
- (d) Vitrified clay pipes and fittings.

NOTE See [Appendix A](#) for information on selecting products that are fit for purpose.

### 2.6.2 Limitations

Pipes and fittings other than metallic or plastics shall conform to the following:

- (a) Fibre-reinforced concrete (FRC) pipes shall not be used in waste lines receiving trade waste discharges that could have a deleterious effect on the FRC (e.g. wastes from photographic equipment or cooling towers).
- (b) Glass-filament-reinforced thermosetting plastic (GRP) pipes shall have a minimum pipe stiffness of 5 000 N/m deflection per metre length when installed below ground.
- (c) Vitrified clay pipes and fittings shall not be used above ground except where installed as a riser connected to a fixture in accordance with [Clause 3.8.3](#) or as a drain under buildings in accordance with [Clause 4.3.2\(b\)](#).

### 2.6.3 Pipes and fittings for pressure applications

Pipes and fittings for pressure applications shall conform to the pressure requirements of Section 2 of AS/NZS 3500.1:2021.

## 2.7 Sheet materials

### 2.7.1 Copper

Copper sheet shall be alloy C12200.

NOTE Refer to AS 1566 for a list of copper alloys.

### 2.7.2 Stainless steel

Stainless steel sheet shall have a PREN rating not less than 16. It shall be not less than 1.2 mm thick.

NOTE 1 The pitting resistance equivalent number (PREN) may be calculated as follows:

$$PREN = \%Cr + (3.3 \times \% Mo) + (16 \times \%N).$$



NOTE 2 A PREN of 18 is approximately equivalent to Grade 304.

## 2.8 Joints

### 2.8.1 Flanged joints

Where flanged joints are used, they shall be of the following material types:

- (a) PVC-U.
- (b) Polyethylene.
- (c) Ductile iron, cast iron and grey cast iron.
- (d) Copper alloy and composite.
- (e) Steel.

NOTE The following Standards contain additional information:

- (a) AS 2129 — flanges for pipes, valves and fittings.
- (b) AS/NZS 4331.1 — steel flanges.
- (c) AS/NZS 4331.2 — cast iron flanges.
- (d) AS/NZS 4331.3 — copper and copper alloy composite flanges.
- (e) AS/NZS 4087 — flanges for waterworks purposes.
- (f) AS/NZS 1477 — PVC pipes and fittings for pressure applications.
- (g) AS/NZS 2280 — ductile iron pipes and fittings.
- (h) AS/NZS 2544 — grey iron pressure fittings.
- (i) AS/NZS 4129 — Polyethylene fittings.

Flanged joints shall be tested in accordance with [Section 15](#).

### 2.8.2 Elastomeric seals

Where an elastomeric seal gasket is provided in the line or in a fitting, it shall not be replaced with mastic or sealant compounds.

### 2.8.3 Silver brazing alloy

### 2.8.3.1 Copper and copper alloys

Silver brazing alloys for capillary jointing of copper and copper alloy pipes and fittings shall conform to the requirements for silver brazing alloys or copper phosphorus alloys and contain a minimum of 1.8 % silver and a maximum of 0.05 % cadmium.

### 2.8.3.2 Stainless steels

Silver brazing alloys for capillary jointing of stainless-steel pipes and fittings shall contain a minimum of 38 % silver and a maximum of 0.05 % cadmium.

#### 2.8.4 Filler rods for stainless steel joints

10. Joints in stainless steel pipework larger than DN 25 shall be made using filler rods of low carbon stainless steel not greater than 2 mm in diameter.

### 2.8.5 Solvent cement and priming fluid

Solvent cement and priming fluid shall be used for the solvent cement jointing of PVC and ABS pipes and fittings.

Solvent cement shall not be used without priming fluid.

NOTE The colour of the priming fluid should be different from the colour of the solvent cement and the pipe to which it is applied. Generally, the priming fluid is pink, and the solvent cement is generally —

- (a) for Type P PVC, green (Australia) or blue or gold (New Zealand);
- (b) for Type N PVC, blue (Australia) or clear (New Zealand);
- (c) for Type P ABS, grey; and
- (d) for Type G, clear.

## 2.9 Miscellaneous

### 2.9.1 Concrete mix

Pre-mixed concrete shall have a minimum characteristic compressive strength of 20 MPa.

Site-mixed concrete shall consist of cement, fine aggregate and coarse aggregate, all measured by volume. Site-mixed concrete shall have sufficient water added to make the mix workable. It shall have a minimum characteristic compressive strength of 20 MPa.

NOTE 1 Refer to AS 1379 for information on the specification and supply of concrete.

NOTE 2 The compressive strength of concrete is defined in —

- (a) AS 3600 in Australia; and
- (b) NZS 3109 and NZS 3124 in New Zealand.

NOTE 3 Refer to AS/NZS 4671 for information for steel reinforcing materials.

### 2.9.2 Cement mortar

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

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

NOTE Refer to AS 1478.1 for information on chemical admixtures for concrete, mortar and grout.

### 2.9.3 Water for concrete and mortar

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

## 2.9.4 Timber

Timber exposed to the weather shall be of durability Class 2 conforming with AS/NZS 2878 or be treated in accordance with AS 1604.1. In New Zealand, exposed timber shall be treated to H3 (CCA) in accordance with NZS 3640.

Timber in contact with the ground shall be durability Class 1 for Australia and H4 (CCA) for New Zealand.

### 2.9.4.1 Timber in Australia

In Australia, timber exposed to the weather shall be of durability Class 2 or treated with an appropriate preservative. Timber in contact with the ground shall be durability Class 1.

NOTE 1 Refer to AS/NZS 2878 for information on timber classification into strength groups.

NOTE 2 Refer to AS/NZS 1604 for information on preservative treatment of sawn and round timber.

### 2.9.4.2 Timber in New Zealand

In New Zealand, timber exposed to the weather shall be treated to H3 (CCA). Timber in contact with the ground shall be treated to H4 (CCA).

NOTE 1 Refer to NZS 3631 for information on timber grading rules.

NOTE 2 Refer to NZS 3640 for information on chemical preservation of round and sawn timber.

## 2.9.5 Epoxy resins

Epoxy resins shall be compatible with the materials being joined.

## 2.9.6 Pipe bedding

Pipe bedding materials shall conform to [Clause 5.4](#).

## 2.9.7 Backfill

Backfill material shall conform to [Clause 5.5](#).

## 2.9.8 External protective coatings

External coatings used for the protection of drains installed in corrosive areas shall —

- (a) be impervious to the passage of moisture;
- (b) be resistant to the external corrosive environment;
- (c) be resistant to abrasion by the surrounding fill; and
- (d) not contain any material that could cause corrosion to the underlying pipes or fittings.

NOTE Polyethylene sleeving used to protect underground drains may require additional protection if installed in rock or in stony ground.

## 2.9.9 Fibreglass-reinforced plastics tanks

Fibreglass-reinforced plastics tanks shall be manufactured in accordance with AS/NZS 1546.1.

# 3 Drainage design

## 3.1 Scope of section

This section specifies requirements for the design of sanitary drainage systems.

NOTE See [Section 16](#) for information on vacuum drainage.

## 3.2 Location of drains

Any drain located under or inside a building shall only serve fixtures within that building.

NOTE 1 Drains should be located external to the building wherever practicable.

NOTE 2 The sanitary drainage system should accommodate the range of differential soil movement in accordance with the soil movement classified on each individual site.

## 3.3 Size and length of drains

### 3.3.1 Fixture unit loading

The size of a drain shall be determined by the number of fixture units and type of fixtures discharging into it. The fixture unit loading for each pipe size and grade shall not exceed the maximum specified in [Table 3.3.1](#).

NOTE Fixture unit ratings are given in [Tables 6.3\(A\)](#) and [6.3\(B\)](#).

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Table 3.3.1 — Maximum fixture unit loading for vented drains							
Grade %	Nominal size of drain, DN						
	65 <sup>a</sup>	80	100	125	150	225	300
5.00	60	215	515	1 450	2 920	11 900	26 900
3.35	36	140	345	1 040	2 200	9 490	21 800
2.50	25	100	255	815	1 790	8 060	18 700
2.00	×	76	205	665	1 510	7 090	16 600
1.65	×	61	165	560	1 310	6 370	15 000
1.45	×	(50)	(140)	485	1 160	5 810	13 900
1.25	×	(42)	(120)	425	1 040	5 360	12 900
1.10	×	×	×	(380)	935	4 970	12 100
1.00	×	×	×	(340)	855	4 500	11 400
0.85	×	×	×	×	(725)	3 850	10 300
0.65	×	×	×	×	(595)	3 250	9 090
0.50	×	×	×	×	×	×	7 720
0.40	×	×	×	×	×	×	6 780

<sup>a</sup> DN 65 drains may be used as branch drains only, provided no soil fixtures (except urinals) are connected thereto.

NOTE 1 “x” indicates that the combination of nominal size and grade is not acceptable.

NOTE 2 Values in parentheses are the maximum fixture unit loadings for drains laid at reduced grades in accordance with [Clause 3.4.2](#).

NOTE 3 The regulatory authority may prescribe or approve the sizing and grading of any drain on the basis of observed peak flows for buildings of similar occupancy in lieu of the size determined as prescribed in this document.

NOTE 4 See [Table C.1](#) for conversion of percentage to ratio.

3.3.2 Main drain

The minimum size of a main drain shall be DN 100.

3.3.3 Branch drains

The minimum size of a branch drain shall be DN 65.

3.3.4 Limitations on vented DN 80 branch drains

Not more than two water closet pans shall be connected to a vented DN 80 branch drain. Any discharge pipe from a bath or laundry trough connected to a DN 80 vented branch drain shall be DN 40.

3.3.5 Use of eccentric taper fitting

Where any fixture with a P-trap of DN 40 or DN 50 is connected to a DN 65 branch drain, the eccentric taper fitting used to make the connection shall be fitted immediately downstream of the fixture trap, as shown in [Figure 3.3.5](#). The soffit of the fitting shall be in common alignment with the soffit of the pipe to which it is connected.

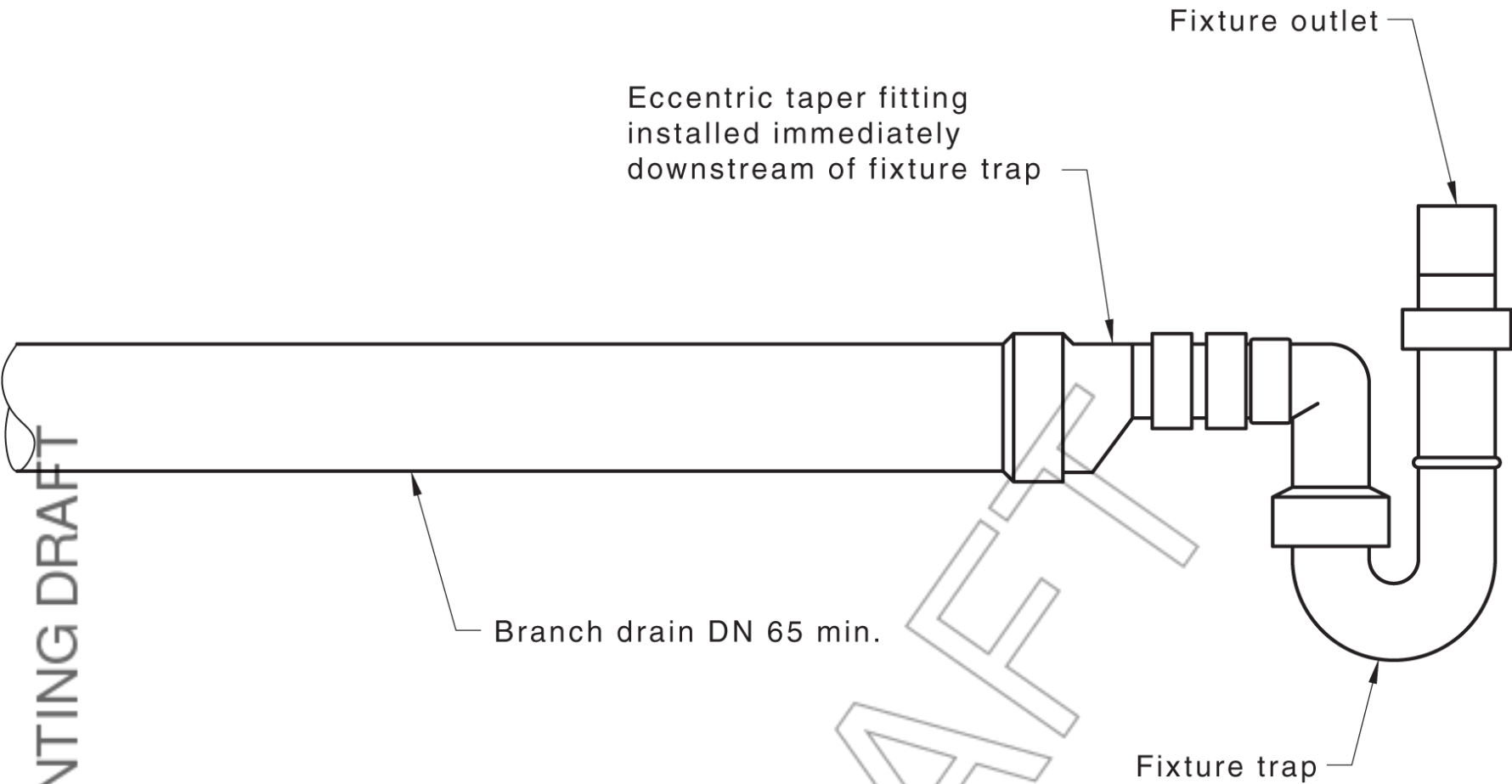


Figure 3.3.5 — Connection of fixture traps (DN 40 or DN 50) on grade to branch drains

3.3.6 Size change

A drain shall not diminish in size in the direction of flow.

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### 3.3.7 Downstream of boundary trap

Drains downstream of a boundary trap shall be not smaller than DN 100.

### 3.3.8 Oversizing of drains

A drain shall not be increased in size unless the fixture unit loading is in excess of the maximum allowable for that size drain at a particular grade, as specified in [Table 3.3.1](#).

### 3.3.9 Maximum length of fixture discharge pipes

The maximum length of fixture discharge pipe without venting shall be in accordance with [Appendix B](#).

## 3.4 Grades of drains

### 3.4.1 Minimum grade

The nominal minimum grade of vented and unvented drains shall be as given in [Table 3.4.1](#).

Table 3.4.1 — Minimum grade of drains	
Nominal size DN	Minimum grade %
65	2.50
80	1.65
100	1.65 <sup>a</sup>
125	1.25
150	1.00
225	0.65
300	0.40

<sup>a</sup> Except for drains from septic tanks, sewage treatment plants and unvented discharge pipes from tundishes, which may have a minimum grade of 1.00 %.

NOTE [Table C.1](#) provides a table for conversion of grades as a percentage to grades as a ratio.

### 3.4.2 Reduced grades

Where the minimum gradient required by [Clause 3.4.1](#) cannot be obtained, drains may be laid at the reduced grades given in [Table 3.4.2](#).

Where soil fixtures are connected, the fixture unit loading on the drain shall be not less than the appropriate value given in [Table 3.4.2](#). If this loading cannot be achieved, provision shall be made for flushing the drain.

Table 3.4.2 — Minimum fixture unit loadings for reduced grade drains				
Reduced grade %	Nominal size of drain, DN			
	80	100	125	150
1.45	9	10	—	—
1.25	10	18	—	—
1.10	x	x	27	—
1.00	x	x	38	—
0.85	x	x	x	75
0.65	x	x	x	160

NOTE 1 “x” indicates that the combination of nominal size and grade is not acceptable.

NOTE 2 “—” indicates that the grade is acceptable by [Table 3.4.1](#) for this size (i.e. not reduced grade).

NOTE 3 [Appendix C](#) provides a table for conversion of grades as a percentage to grades as a ratio.

### 3.4.3 Steep grades

Where it is necessary to install a drain on a grade between 20 % and vertical, anchor blocks shall be installed —

- (a) at the bend or junction at the top and bottom of the inclined drain; and
- (b) at intervals not exceeding 3 m.

### 3.4.4 Anchor blocks

Anchor blocks for drains up to DN 150 shall be of reinforced concrete having two reinforcing rods of not less than 9 mm diameter. The reinforcing rods shall be bent to a radius that is 100 mm greater than the outside diameter of the pipe, as shown in [Figure 3.4.4](#). Anchor blocks shall —

- (a) be not less than 150 mm in thickness;
- (b) extend across the full width and be firmly keyed into the sides of the trench;
- (c) extend above the top of the pipe to a minimum height of 150 mm;
- (d) extend below the base of the trench for a minimum depth of 150 mm; and

(e) not cover any flexible joint.

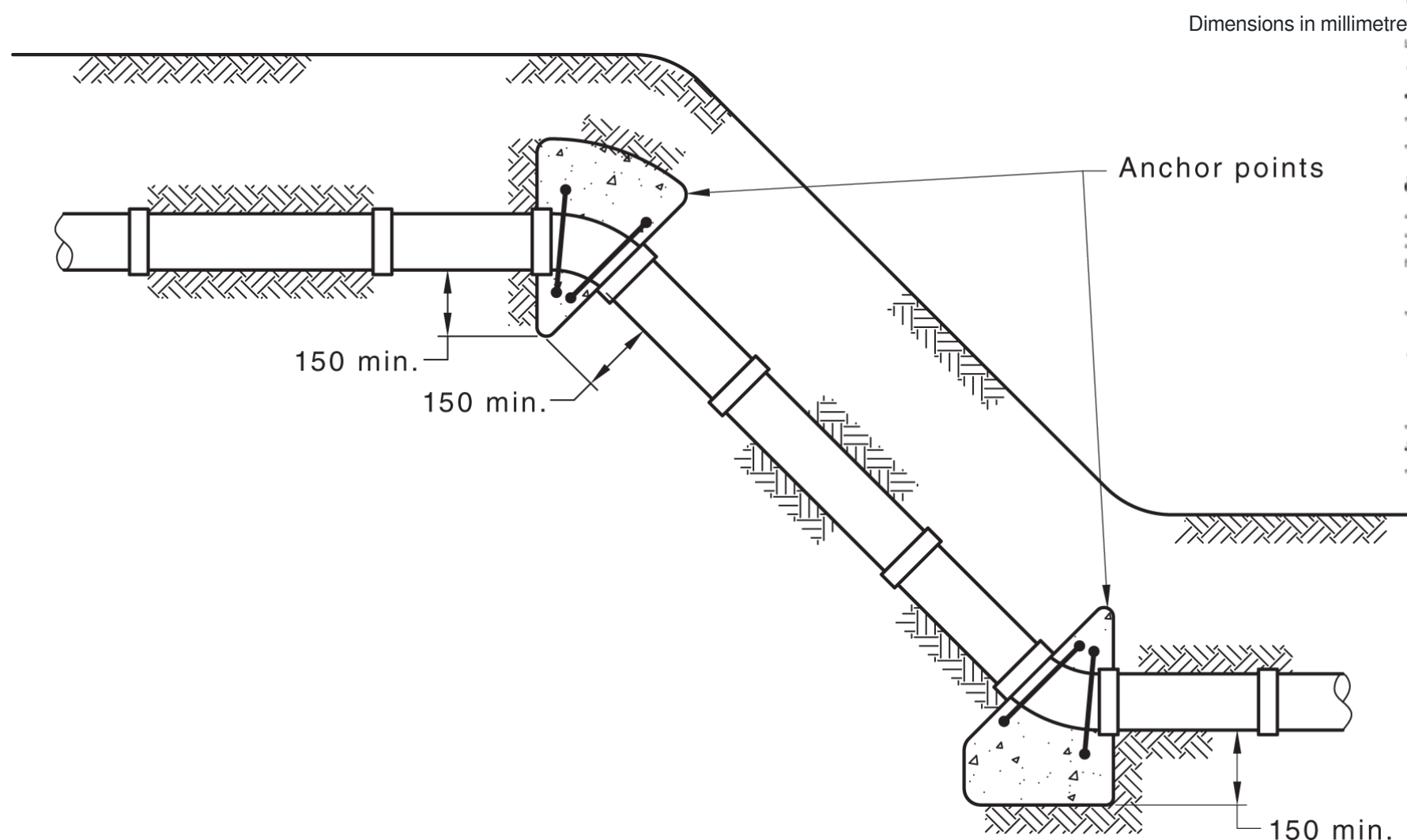


Figure 3.4.4 — Anchoring of drains

## 3.5 Laying of drains

### 3.5.1 General

Where a drain is to be located in an open cut trench that is in a road, easement, public place or the like, it shall be installed in accordance with the following:

- (a) Where the full depth at the point of connection is not required to drain the property, a jump-up shall be installed either at the point of connection or within the property boundary.
- (b) Where the presence of any obstacle prevents the drain from being laid at an even grade and with the required cover, the drain shall pass beneath the obstacle at an even grade with a jump-up only at the point of connection. Alternatively, a minimum clearance of 25 mm shall be provided between the obstacle and the drain, or an inclined section may be installed adjacent to the obstacle in the form of a graded jump-up with changes of direction not greater than 60°.
- (c) The minimum cover of the drain shall be as specified in [Table 3.7.2](#).

### 3.5.2 Easements and watercourses

Drains crossing an easement or watercourse shall be installed in accordance with the following:

- (a) The drain shall pass under or over any pipeline or closed conduit in the easement or under any open channel or watercourse.
- (b) In an easement, a minimum clearance of 100 mm shall be maintained between an open channel, pipeline or conduit and the drain.
- (c) No drain shall be laid through any such obstacle as outlined in Item (a).
- (d) Where the drain is to pass over any obstacle as set out in Item (a), the drain shall have the minimum depth of cover specified in [Clause 3.7.2](#).

## 3.6 Proximity to other services

### 3.6.1 General

Where electrical conduit, wire, cable or consumer gas pipes, drains and other services are in existence, pipes shall be installed in accordance with the requirements of [Clauses 3.6.2 to 3.6.8](#).

### 3.6.2 Above-ground services

Separation of at least 25 mm shall be maintained between any above-ground sanitary plumbing and drainage and any of the following services:

- (a) Electrical or telecommunications conduits.
- (b) Electrical or telecommunications wires or cables.
- (c) Consumer gas pipes.
- (d) Other sanitary plumbing and drainage.
- (e) Storm water drainage.
- (f) Above-ground water services.
- (g) Any other services.

Where a pipe is insulated, the measurement shall be from the outer edge of any insulation or wrapped material applied to the pipework.

### 3.6.3 Separation from underground electrical supply cables or consumer gas pipes

- The separation between any underground drain and an electrical supply cable shall be at least —
- (a) 100 mm, provided the electrical supply cable is indicated along its length with orange marker tape and is mechanically protected; or
  - (b) 600 mm, where the electrical supply cable is neither indicated nor protected.

- The separation between any underground drain and consumer gas pipes shall be at least —
- (i) 100 mm, provided the consumer gas pipe is indicated along its length with marker tape laid 150 mm above the installed pipe and is mechanically protected; or
  - (ii) 600 mm, where the consumer gas pipe is neither indicated nor mechanically protected.

NOTE 1 Mechanical protection may be provided by concrete slabs, continuous concrete pour, polymeric cover strips, or bricks designed for protecting electrical supply cables and may include a suitable conduit.

NOTE 2 See Clause 3.6.5 for separation from a communication cable.

NOTE 3 Refer to AS/NZS 2648.1 for information on non-detectable tape.

### 3.6.4 Separation from underground electrical earthing electrode

For an electrical supply not exceeding 1 000 V, the separation between any underground drainpipe and an electrical earthing electrode shall be at least 500 mm.

NOTE For an electrical supply exceeding 1 000 V, the relevant regulatory authorities should be contacted for a ruling.

### 3.6.5 Separation from underground communication cable

The separation between any underground drain and a communication cable shall be at least 100 mm.

### 3.6.6 Separation from other underground services

The separation between any underground drain and any other service other than electrical supply cables, consumer gas piping, communication service or water service shall be at least 100 mm or 300 mm from a stormwater drain exceeding DN 100.

NOTE See Figure 3.6.6 for a typical shared trench.

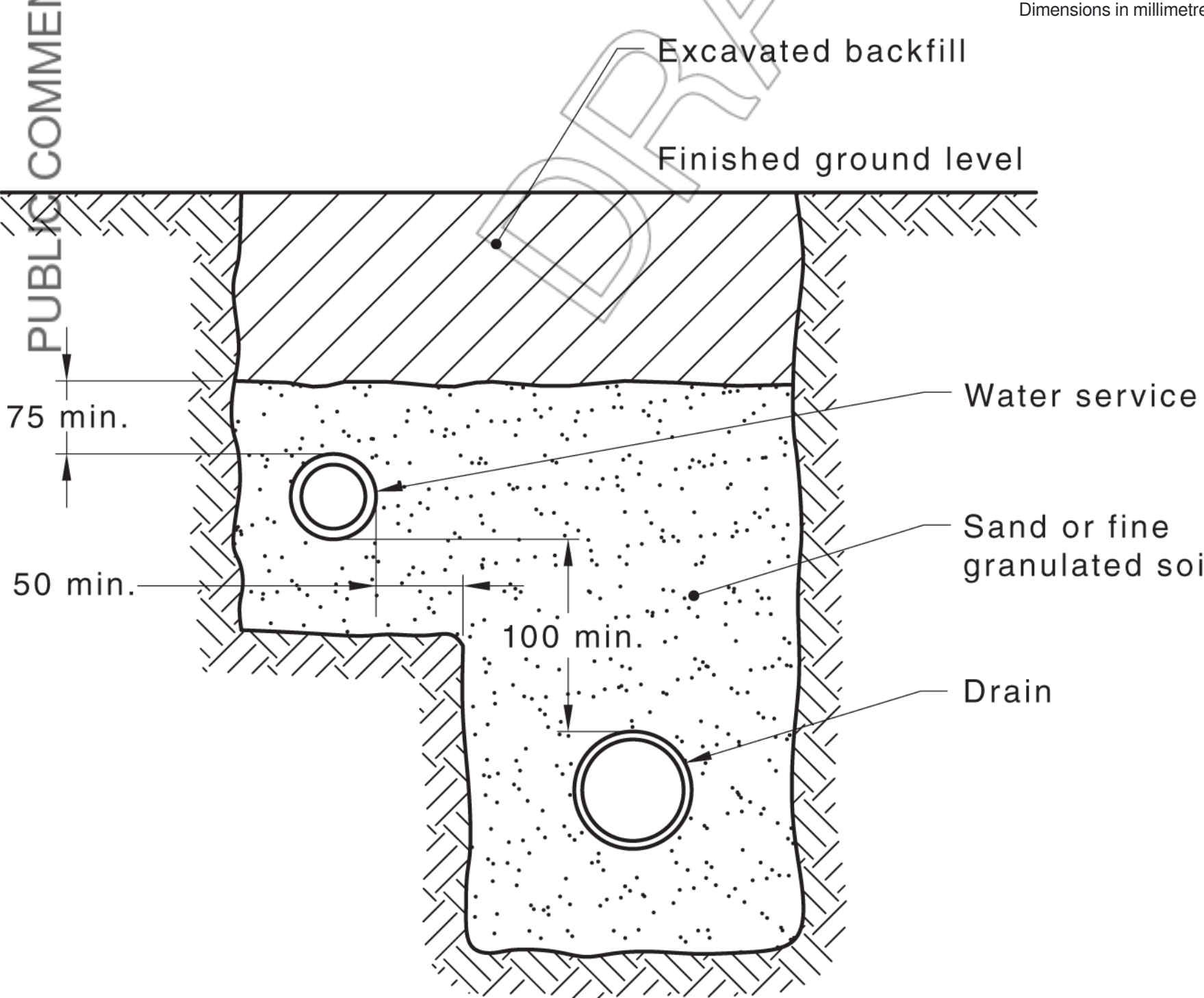


Figure 3.6.6 — Typical shared trench

### 3.6.7 Crossover of underground services

- Any underground drain crossing a service or any underground service crossing a drain shall —
- (a) cross at an angle of not less than 45°;
  - (b) have a vertical separation of not less than 100 mm; and
  - (c) be marked along its length for 1 m either side of the centre-line of the service with marker tape laid 150 mm above the installed service.



NOTE Refer to AS/NZS 2648.1 for information on non-detectable marking tape.

### 3.6.8 Clearance from underground obstructions

Drains shall be installed with sufficient clearance to any underground obstruction to protect the drain from physical damage and to permit repairs. The clearance shall be at least 100 mm.

NOTE See [Clause 3.8](#) for drains in proximity to footings and foundations.

## 3.7 Depth of cover for buried pipes

### 3.7.1 General

Drains shall be laid in a manner that provides protection against mechanical damage and deformation due to vehicular loadings.

### 3.7.2 Depth of cover

Drains shall be installed with a minimum depth of cover, measured from the top of the pipe socket or inspection opening to the finished surface level, as specified in [Table 3.7.2](#).

Table 3.7.2 — Minimum cover for buried pipes		
Location	Minimum depth of cover mm	
	Cast iron and ductile iron	Other materials
Subject to vehicular traffic	300	500
All other locations	Nil	300 <sup>a</sup>

<sup>a</sup> Except as provided in [Clauses 3.7.3](#) and [3.7.4](#).

### 3.7.3 Drains installed with less than minimum cover

Drains constructed of materials having less than the minimum cover specified in [Table 3.7.2](#) shall be covered by at least 50 mm of overlay and then paved with —

- (a) 100 mm minimum thickness of reinforced concrete, where subject to heavy vehicular loading;
- (b) 75 mm minimum thickness of brick or concrete paving, where subject to light vehicular traffic; or
- (c) 50 mm minimum thickness of brick or concrete paving, where not subject to vehicular traffic.

The paving shall extend the full width of the trench. If it does not extend the full width of the trench, the drain shall be protected from mechanical damage.

### 3.7.4 Drains under buildings

Drains below ground and under buildings may be laid with less than the minimum cover specified in [Table 3.7.2](#), provided —

- (a) 25 mm of overlay separates the drain from a reinforced concrete slab; or
- (b) the drain is adequately protected from mechanical damage and superimposed loads.

## 3.8 Building over drains

### 3.8.1 Alterations and additions to buildings

The footings for alterations or additions to buildings shall not be placed over or adjacent to existing drains until the clearances specified in [Clause 3.8.2](#) have been provided. Alternatively, such drains shall be relocated.

Any existing gully, inspection shaft, or boundary trap riser shall not remain under any such alterations or additions other than where specified in accordance with [Clauses 4.4.2.3](#), [4.6.5](#) and [4.6.6.5](#).

### 3.8.2 Installation near and under buildings

The following applies to drains in close proximity to footings or foundations:

- (a) Where a drain passes under a strip footing, its angle of intersection with the footing in the horizontal plane shall be not less than 45°. The minimum clearance between the top of the drain to the underside of the footing shall be 25 mm.
- (b) Drains laid through footings or walls, other than below-ground external walls, shall be installed with an annular space of not less than 25 mm filled with a liner of flexible material.
- (c) Pipes may be laid through below-ground external walls, provided —

(i) two flexible joints are provided externally within 800 mm of the external face of the wall, and such joints are not less than 600 mm apart; and

(ii) the penetration of the wall is made watertight.
- (d) Where a drain is installed parallel to a footing, the trench shall be located as follows:

(i) In Australia (for single dwellings), as shown in [Figure 3.8.2](#).

(ii) In New Zealand, in accordance with NZBC Acceptable Solution G13/AS2 for light timber framed and concrete masonry buildings.

NOTE For all other buildings or where the requirements of Item (d) cannot be achieved, an engineered design should be used.

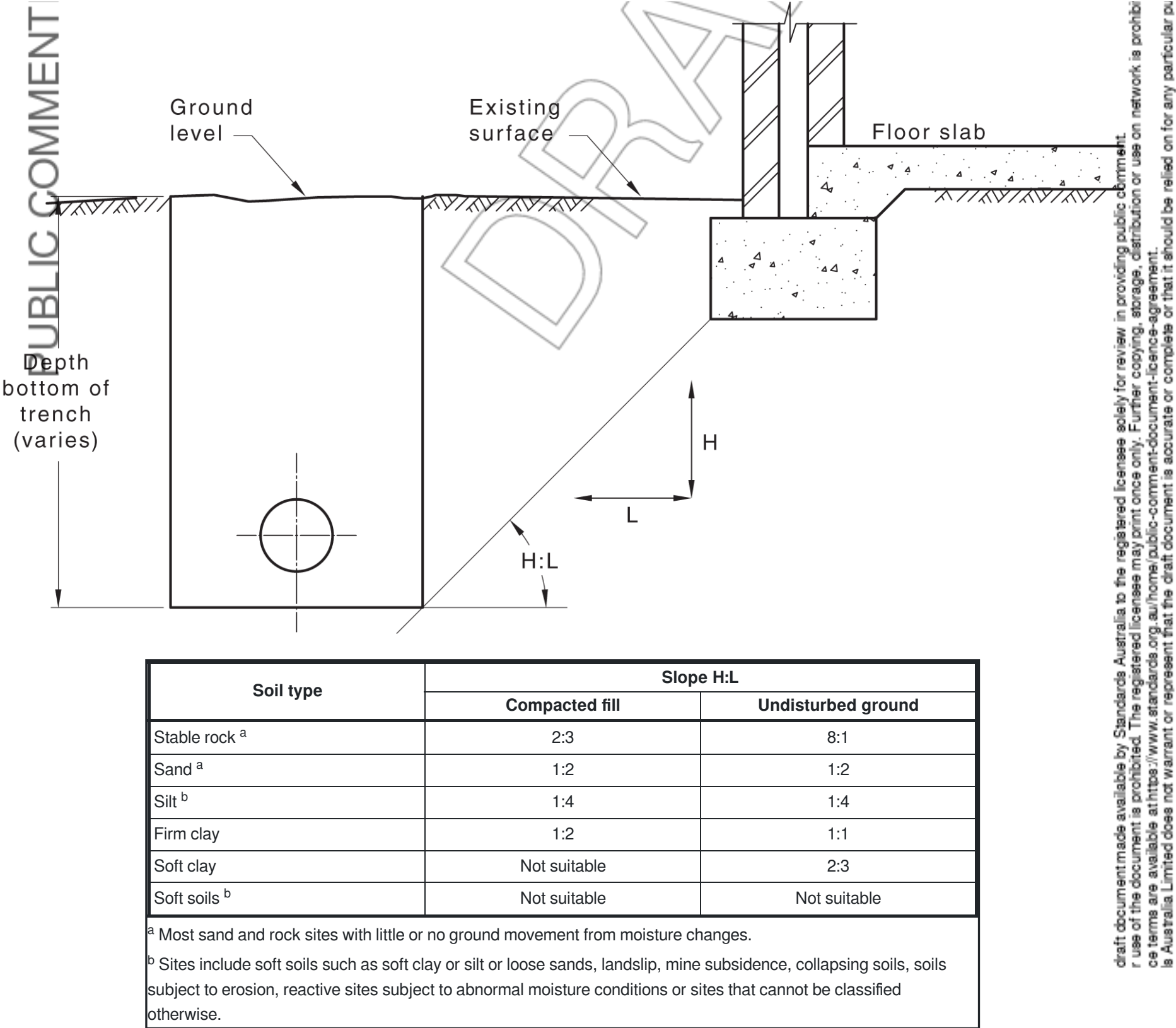


Figure 3.8.2 — Excavation near footings

### 3.8.3 Fixture connections to vitrified clay drains under buildings

Where a riser of vitrified clay material is installed for the purpose of connecting a fixture, it may be extended up to 1 m above ground surface, provided —

- (a) the spigot end of the riser is below ground;
- (b) only the socket of the exposed pipe extends above floor level; and
- (c) the exposed pipe is protected from damage.

## 3.9 Venting of drains

### 3.9.1 General

Vents in drains shall be provided —

- (a) at both ends of any drain that incorporates a boundary trap;
- (b) at the upstream end on any drain not incorporating a boundary trap;
- (c) at the upstream end of any branch drain to which a fixture trap or floor waste gully is connected, if the distance from the weir of the trap to the vented drain exceeds 10 m;
- (d) at the upstream end of a branch drain to which a gully is connected, or a sullage dump point located in a caravan park is connected, if the distance from the weir of the trap to the vented drain exceeds 10 m;
- (e) at the upstream end of any DN 100 branch drain to which three or more water closet pans are connected;
- (f) along the line of a DN 100 vented drain where 10 or more water closet pans are installed in a toilet block and are each individually connected in accordance with [Clause 3.9.3.4](#); and
- (g) in accordance with [Clause 3.9.3.1](#) for drains connected to vacuum sewerage systems.

NOTE See [Clause 6.10](#) for information on where air admittance valves are used.

### 3.9.2 Location

#### 3.9.2.1 Upstream vent

The upstream vent on any drain shall be connected —

- (a) to the drain downstream of any fixture or drainage trap connection, provided any unvented section of drain upstream of the vent branch connection conforms with [Clause 3.10.3](#); or
- (b) at the vent extension of a stack located at or near the upstream end of the drain, provided any unvented section of drain upstream of the stack branch connection conforms with [Clause 3.10.3](#).

3.9.2.2 Downstream vent

Where required by [Clause 3.9.1\(a\)](#), the downstream vent on any drain shall be connected within 10 m of the boundary trap riser, provided no other fixture is connected between the boundary trap riser and the vent connection.

3.9.2.3 Low level vent (ground vent)

Where a low-level vent is provided in accordance with [Clause 3.9.2.2](#), it shall be located so that —

- (a) the inlet of the vent is not less than 150 mm above ground level;
- (b) it terminates not less than 3 m from any opening into a building or 5 m from any air duct intake; and
- (c) it is not liable to be damaged or cause injury or obstruction.

3.9.3 Size of drainage vents

3.9.3.1 Minimum size

Drainage vents shall be sized in accordance with [Table 3.9.3.1](#) and —

- (a) the upstream vent on any main drain shall be not less than DN 50;
- (b) the upstream vent on any branch drain shall be not less than DN 40;
- (c) the section of drain acting as a vent shall be not less than DN 65, as shown in [Figure 3.9.3.1](#);
- (d) notwithstanding the number of fixture units discharging to the drain, the minimum size of any ground vent pipe shall be DN 50; and
- (e) if an air admittance valve is used to terminate an upstream vent, [Table 6.10.2\(A\)](#) shall apply.

NOTE 1 Branches connected into a positive pressure area, such as near boundary traps in multistorey buildings, may need additional venting.

NOTE 2 Where a branch vent has an AAV suitable for the fixture unit loading of that branch, the AAV can be taken into account to achieve a rating equal to or greater than the rating for the single vent.

Table 3.9.3.1 — Size and rating of vents			
Size of vent pipe DN	Fixture units discharging to drain		Vent rating
40	> 1	≤ 10	0.5
50	> 10	≤ 30	1
65	> 30	≤ 175	2
80	> 175	≤ 400	3
100	> 400	≤ 600	6

NOTE See [Clause 6.10](#) for the use of air admittance valves (AAV).

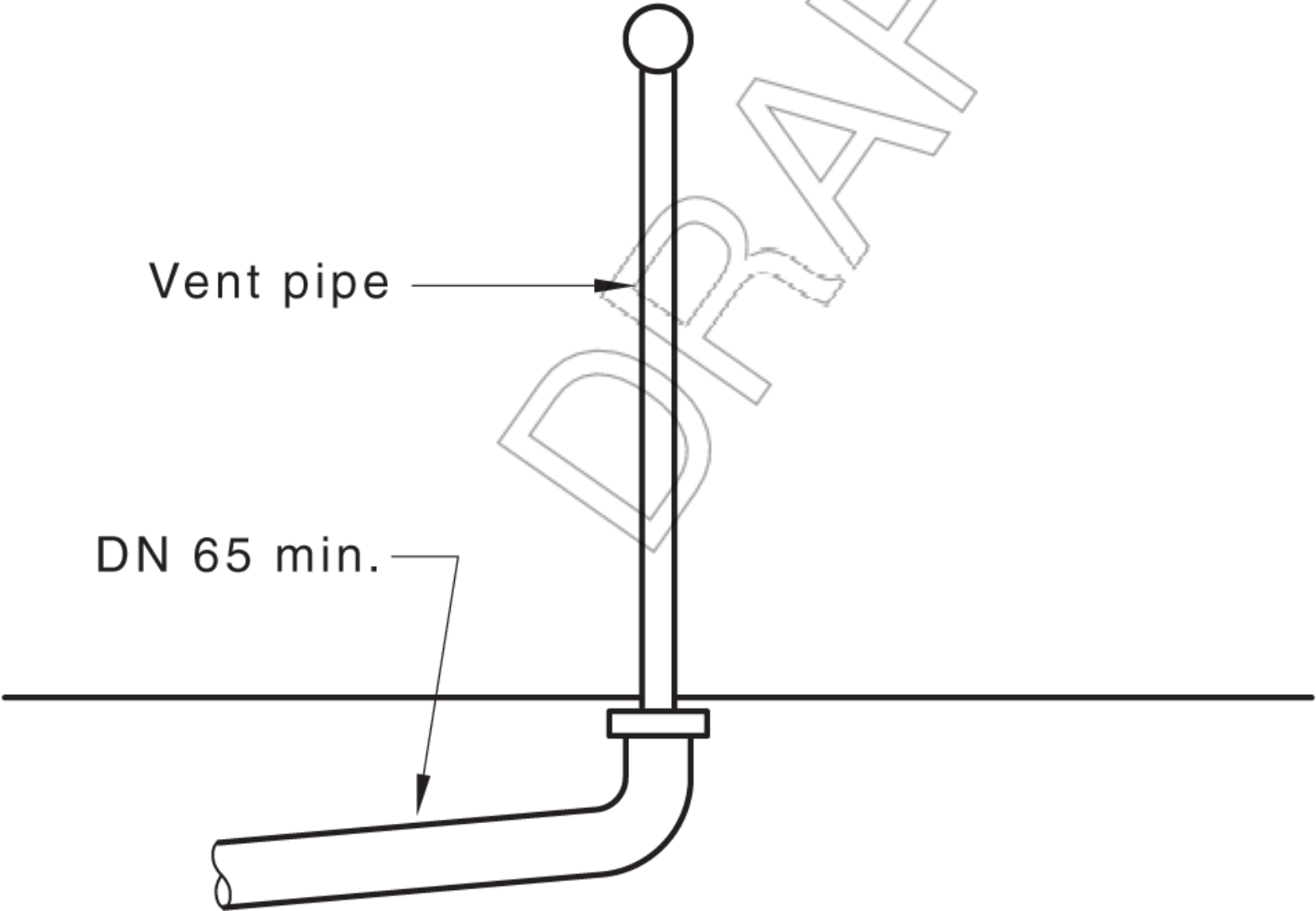


Figure 3.9.3.1 — Connection of vent to drain



### 3.9.3.2 Rating of vents

Where two or more vents are directly connected to a drain, these vents may take the place of the single vent required by [Table 3.9.3.1](#), provided the sum of the ratings is equal to or greater than the vent rating for the single vent as shown in [Figure 3.9.3.2](#).

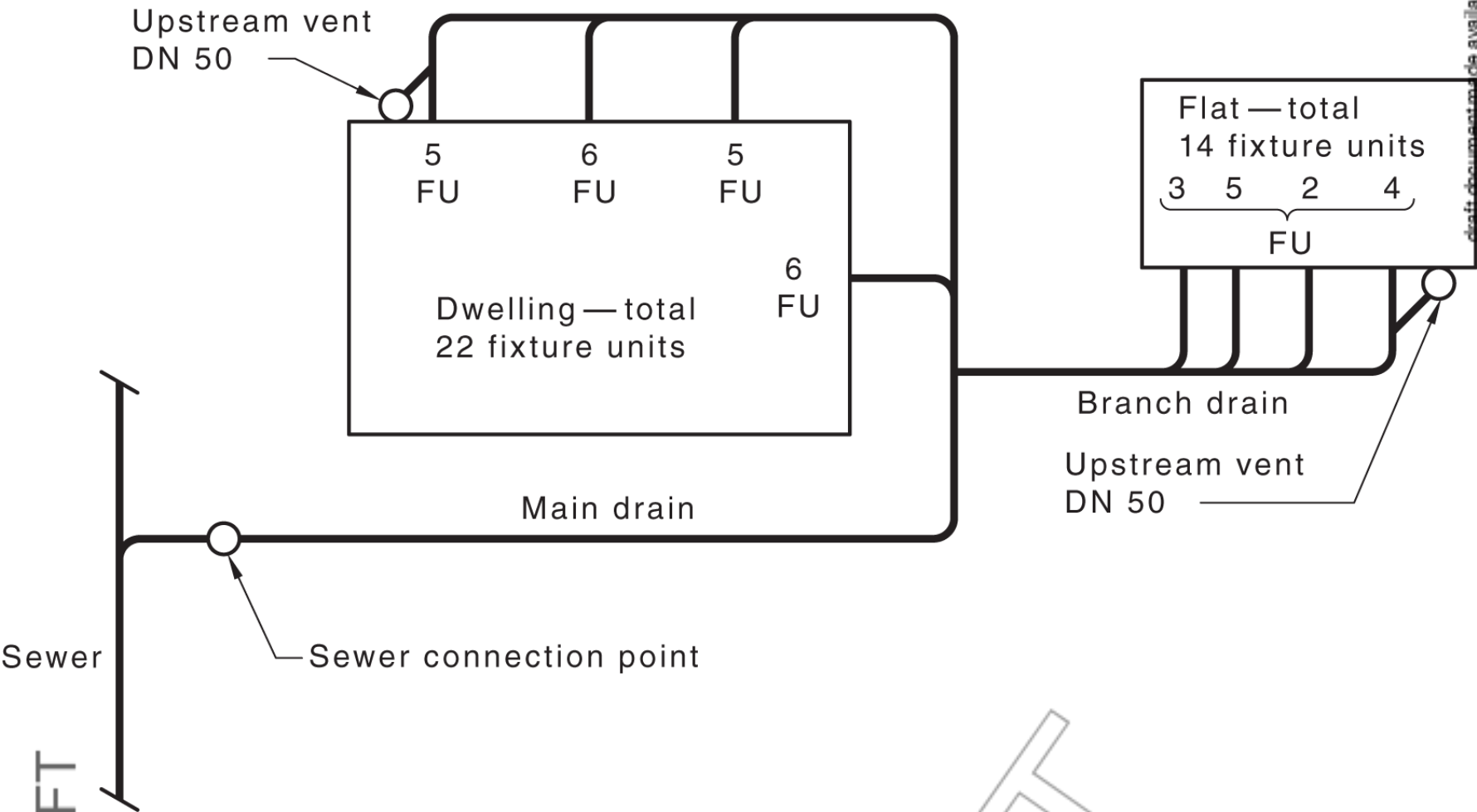


Figure 3.9.3.2 — Vent sizing

EXAMPLE

Total loading units discharging to drain = 36 FU.  
Required size of drainage vent = DN 65 — (Rating of 2), see [Table 3.9.3.1](#).  
The two other stack or drainage vents (assuming the branch drain is over 10 m) in combination may take the place of a single DN 65 or DN 50 vent.

### 3.9.3.3 Connection of vent to drain

Where the minimum size of DN 65 for a drain line exists, a minimum DN 50 vent pipe may be connected as shown in [Figure 3.9.3.1](#).

### 3.9.3.4 Water closet pans in toilet blocks

Water closet pans connected to a DN 100 drain in toilet blocks shall be vented in accordance with the following:

- (a) The vents shall be positioned to divide the water closet pans into approximately equal groups.
- (b) Where 10 or more water closet pans in any ground-floor toilet block are each separately connected to a vented drain and the spacing of respective branch drain connections to the vented drain are such that they are 2 m apart or less, one DN 50 vent, located between the last and second last pan, shall be provided for the first 10 pans. An additional DN 50 vent shall be provided for each additional 10 pans or part thereof.
- (c) Each vent shall branch from the vented drain, or from a water closet pan branch.

## 3.10 Unvented branch drains

### 3.10.1 General

The requirements of this clause shall apply to —

- (a) ground-floor connections to a vented drain installed on grade, located below or above the ground, see [Clause 10.10](#); or
- (b) connections to a disconnector or overflow relief gully.

### 3.10.2 Sizing

The size of an unvented branch drain shall be such that the sum of the fixture unit ratings, as given in [Table 6.3\(A\)](#), do not exceed the maximum loading specified in [Table 3.10.2](#).

**Table 3.10.2 — Size of unvented branch drains**

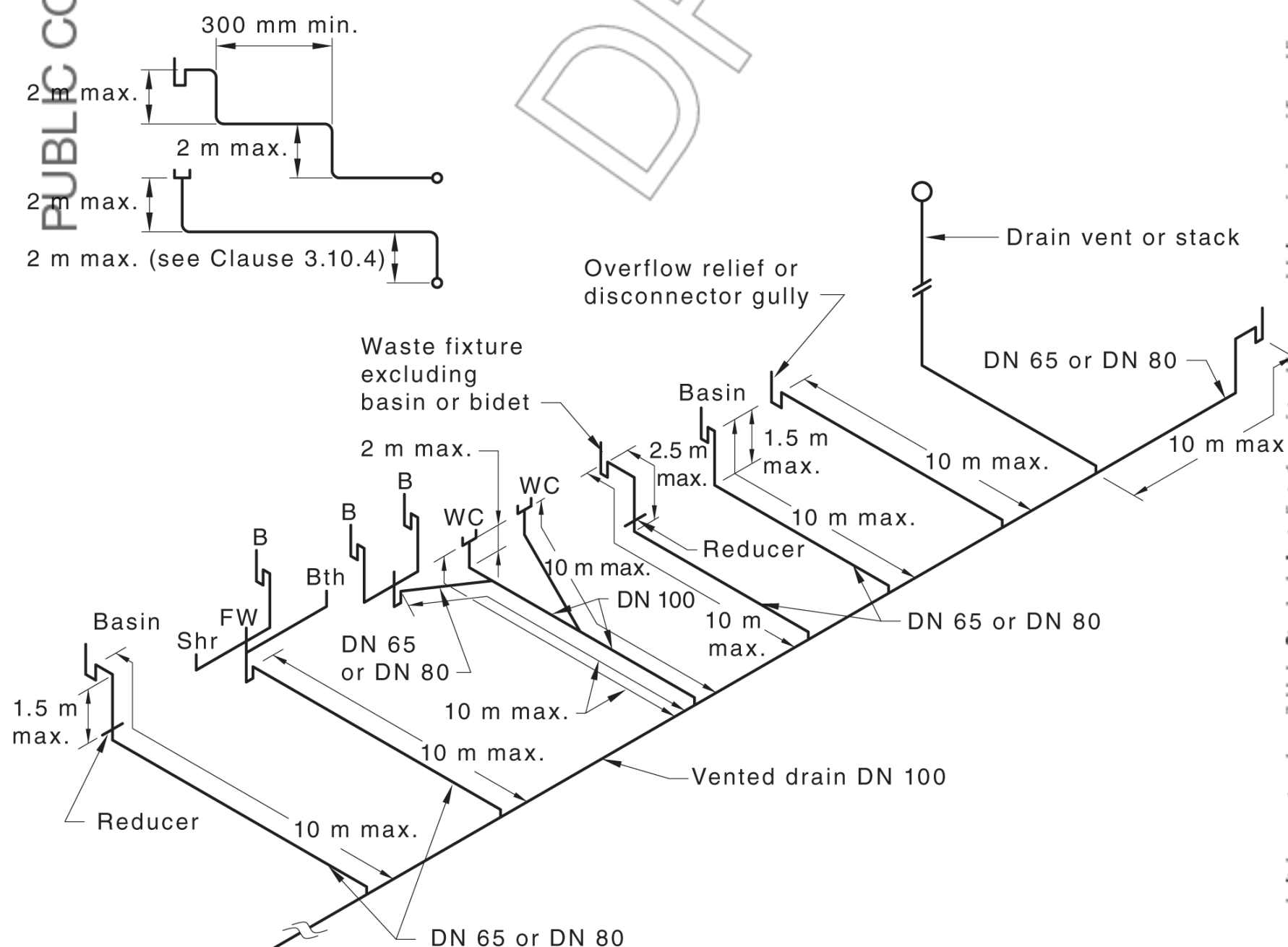
Size of pipe DN	Maximum fixture unit loading
65	5 fixture units (excluding a water closet pan or slop hopper); or 10 fixture units from one floor waste gully
80	12 fixture units (including not more than one water closet pan or slop hopper)
100	30 fixture units (including not more than one water closet pan or slop hopper)

### 3.10.3 Maximum length

The total length of an unvented branch drain, including the length of the fixture discharge pipe, shall be not greater than the following:

- (a) 10 m from the vented drain to the weir of the trap, provided the length of the discharge pipe does not include a vertical drop, between the crown of the trap and the invert of the branch drain, exceeds —
- (i) 2 m for water closet pans with DN 80 discharge pipes;
  - (ii) 1.5 m for basins and bidets fitted with “S” traps; and
  - (iii) 2.5 m for all other fixtures.
- (b) 10 m from the weir of a disconnector gully.
- (c) 10 m from a sullage dump point.

NOTE See [Figure 3.10.3](#) for a typical example of the above.



Key		
B	=	basin
Bth	=	bath
FW	=	floor waste
SHR	=	shower
WC	=	water closet

NOTE Total length of branch connections to fixtures to not exceed 10 m.

**Figure 3.10.3 — Typical connections of ground-floor fixtures to unvented branch drains**

### 3.10.4 Vertical sections

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Where the fixture discharge pipe is the same size as the unvented branch drain to which it connects, the drain to the trap shall have a maximum of two vertical jump-ups, each not exceeding 2 m in height, and separated by not less than 300 mm of graded pipe.

### 3.10.5 Connection of fixture discharge pipes

Where fixtures are connected to unvented branch drains, the requirements for the fixture discharge pipes shall be the same configuration as for the connection of fixtures to group vented branches and conform to the following:

- (a) [Clause 8.5.7.5.4](#) for connections of basins and bidets.
- (b) [Clause 8.5.7.5.5](#) for connection of all other fixtures.
- (c) [Clause 3.10.3](#) for maximum length of unvented drains.

### 3.1 Unvented drains discharging to gullies

### 3.11.1 General

A drain that receives the discharge from waste fixtures only may be connected to a gully.

The maximum fixture unit loading and size of unvented branch drain shall conform to [Table 3.10.2](#).

### 3.11.2 Length of unvented section

The combined length of an unvented drain and fixture discharge pipe shall not exceed 10 m. The fixture discharge pipe shall conform to [Clauses 3.10.3](#) and [3.10.5](#). If the combined length of the unvented drain and fixture discharge pipe exceeds 10 m, the branch line shall be vented in accordance with [Clause 3.9.2](#) or [Clause 6.9](#).

### 3.12 Inlet pipe to disconnector gully

Where the inlet pipe to a disconnector gully is DN 65 or larger, multiple branches may be connected to such inlet pipe, provided all fixture traps are within 10 m of the disconnector gully and within the fixture unit loading for pipe size and the disconnector gully.

### 3.13 Restriction on connections in proximity to a stack

Discharge pipes from fixtures shall only connect to a drain in proximity to a stack in accordance with [Clause 6.8](#) and [Figure 6.8.1](#).

### 3.14 Connection of basement fixtures

Fixtures installed in basements or other locations where surcharge could occur shall be connected to the sewerage system by means of a pumping installation conforming to [Section 12](#).

### 3.15 Connections in flood-prone areas

### 3.15.1 Inlet above flood level

In areas subject to known flooding, the inlet to a sanitary plumbing and drainage system shall be positioned at least 150 mm above the declared flood level.

### 3.15.2 Inlet below flood level

Where inlets to fixtures, fittings or appliances cannot be installed at a height of 150 mm above the declared flood level, they shall be connected as follows:

- (a) The discharge of the fittings, fixtures and appliances shall be raised by ejector or pump conforming with [Section 12](#) to a height required by the regulatory authority and discharged into the sewer as and where directed.
- (b) An automatic, float-controlled device or similar device shall be installed to ensure that the ejector or pump ceases to operate during periods of flooding.

### 3.16 Re-use of existing sanitary drains

### 3.16.1 Re-use where buildings are demolished or removed

When a building containing sanitary plumbing and drainage is demolished or removed from site and a new building constructed, the following requirements shall apply to the use of existing sanitary drains up to the point of connection:

- (a) Mortar-jointed vitrified clay, mortar-jointed concrete, asbestos cement and fibre-reinforced cement pipes shall not be re-used unless they have been renovated using a structural plastics liner in accordance with [Clause 3.16.3](#).
- (b) Drains constructed of other materials shall not be re-used unless they have been verified for conformance in accordance with the relevant clauses of this document and tested in accordance with [Section 15](#) and found to be satisfactory.

Drains that do not conform to the requirements listed above shall be replaced or repaired and retested.

### 3.16.2 Re-use in existing buildings

For an existing building, including alterations or additions that will involve additional fixtures being connected to the existing drain, if that section of the existing drain is found to be defective it shall be renovated in accordance with [Clause 3.16.3](#) or a new section of drain installed.

### 3.16.3 Renovation techniques

### 3.16.3.1 Cured in place pipe

The renovation of a drain by the cured in place pipe (CIPP) technique shall be in accordance with [Appendix F](#) with the exception of [Clause F.3\(g\)](#) which does not apply.

NOTE CIPP renovation is the lining of a drain with a flexible tube impregnated with a thermosetting resin. This produces a rigid pipe after the resin has cured.

### 3.16.3.2 Other renovation techniques

Other renovation techniques shall be as follows:

- (a) *Lining with discrete pipes* — Lining with short lengths of pipe that are jointed to form a continuous pipe one by one during insertion, the cross-section of the lining pipe remaining unchanged.



- (b) *Lining with continuous pipes* — Lining with a pipe made continuous prior to insertion, where the diameter of the lining pipe remains unchanged.
- (c) *Lining with close-fit pipes* — Lining with a continuous pipe for which the cross-section is reduced to facilitate installation and expanded after installation to provide a close fit to the existing pipe.
- (d) *Lining with spirally wound pipes* — Lining with a profile strip, spirally wound to form a continuous pipe after installation.

Appendix F shall apply to the above renovation techniques with the exception of [Clauses F.3\(c\)](#) and [F.3\(f\)](#) which do not apply.

NOTE Refer to ISO 11295, ISO 11296-1 and ISO 11296-2 for further information on renovation techniques for these pipes.

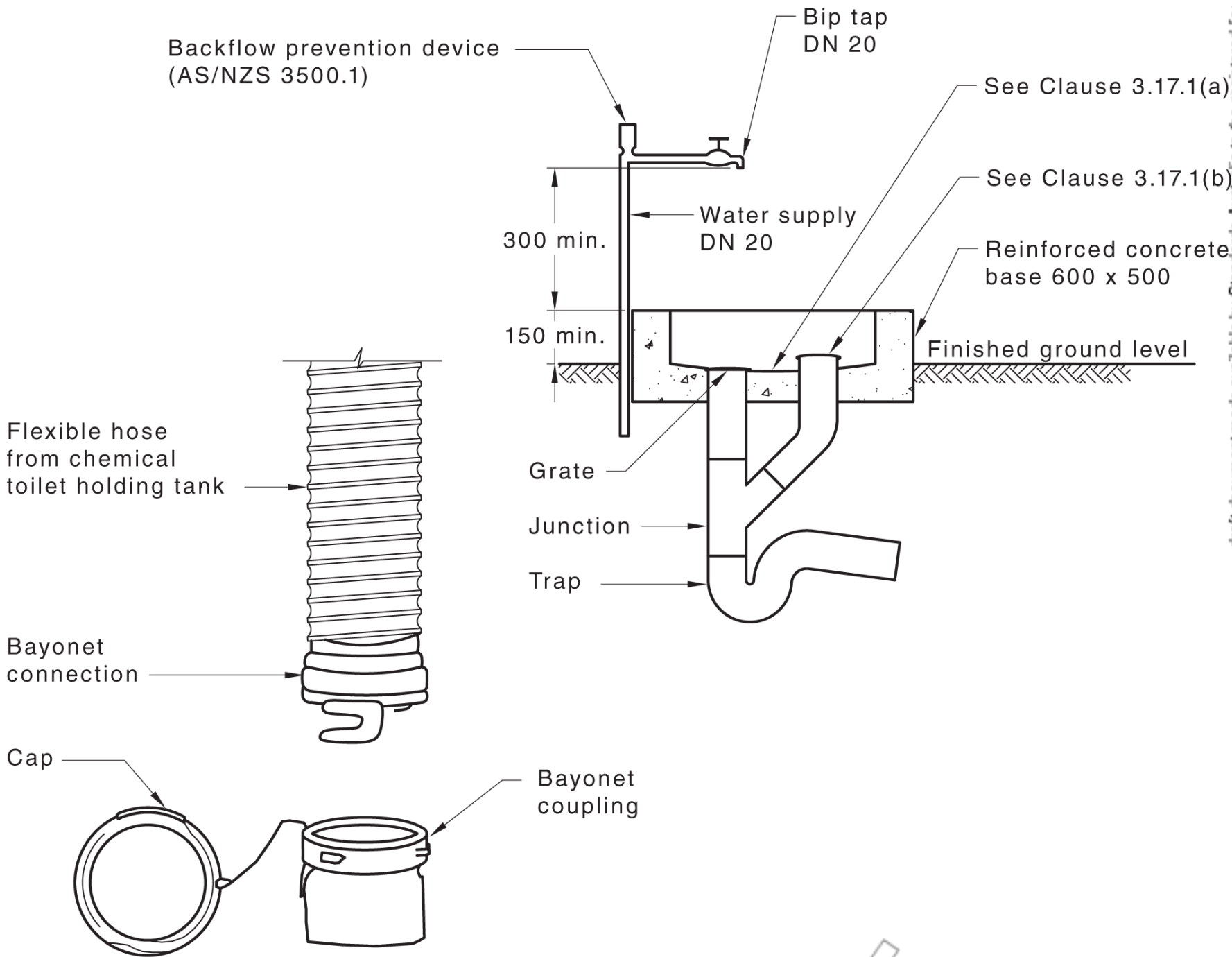
## 3.17 Dump points

### 3.17.1 Soil waste dump points

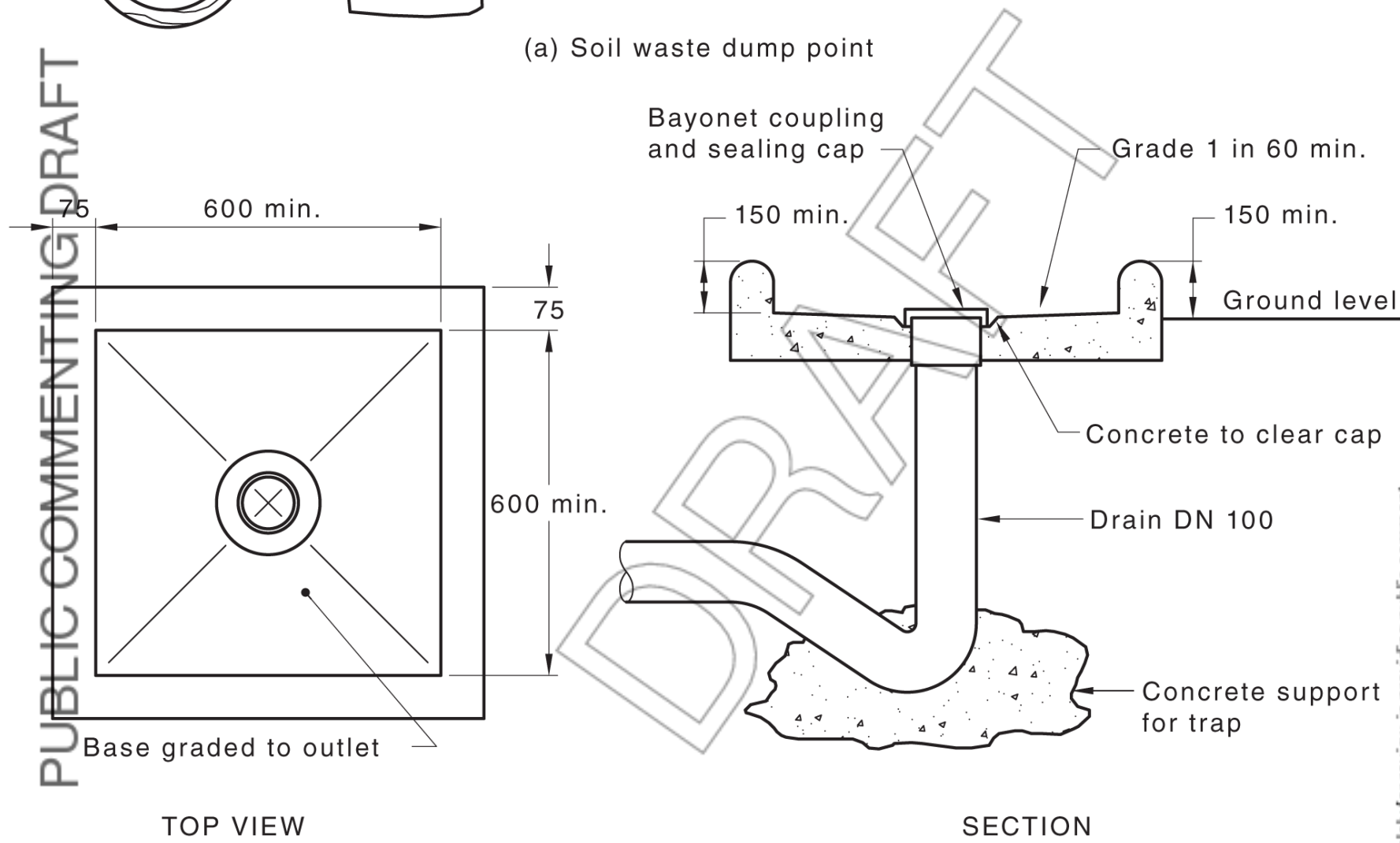
Dump points for discharging the contents of holding tank type toilets within caravans and relocatable dwellings shall be in accordance with [Figure 3.17.1](#) and the following:

- (a) The concrete base shall be graded to the outlet at a grade of not less than 1 in 60.
- (b) The outlet pipework shall be DN 80 or DN 100.
- (c) The bayonet connection shall include a sealing cap and hose coupling. The connection shall be at least 25 mm clear of any obstruction.

Dimensions in millimetres



(a) Soil waste dump point



(b) Alternative soil waste dump point

NOTE Bib tap and backflow prevention device to be provided.

Figure 3.17.1 — Soil dump points

### 3.17.2 Connection points for short-term sites

Where sullage connection points are provided to serve individual caravans or mobile home sites, they shall be constructed in accordance with [Figures 3.17.2\(A\) or 3.17.2\(B\)](#), as applicable.

Sullage points shall be positioned to obtain the shortest connection to the caravan. They shall be not more than 10 m from the vented drain.

Dimensions in millimetres





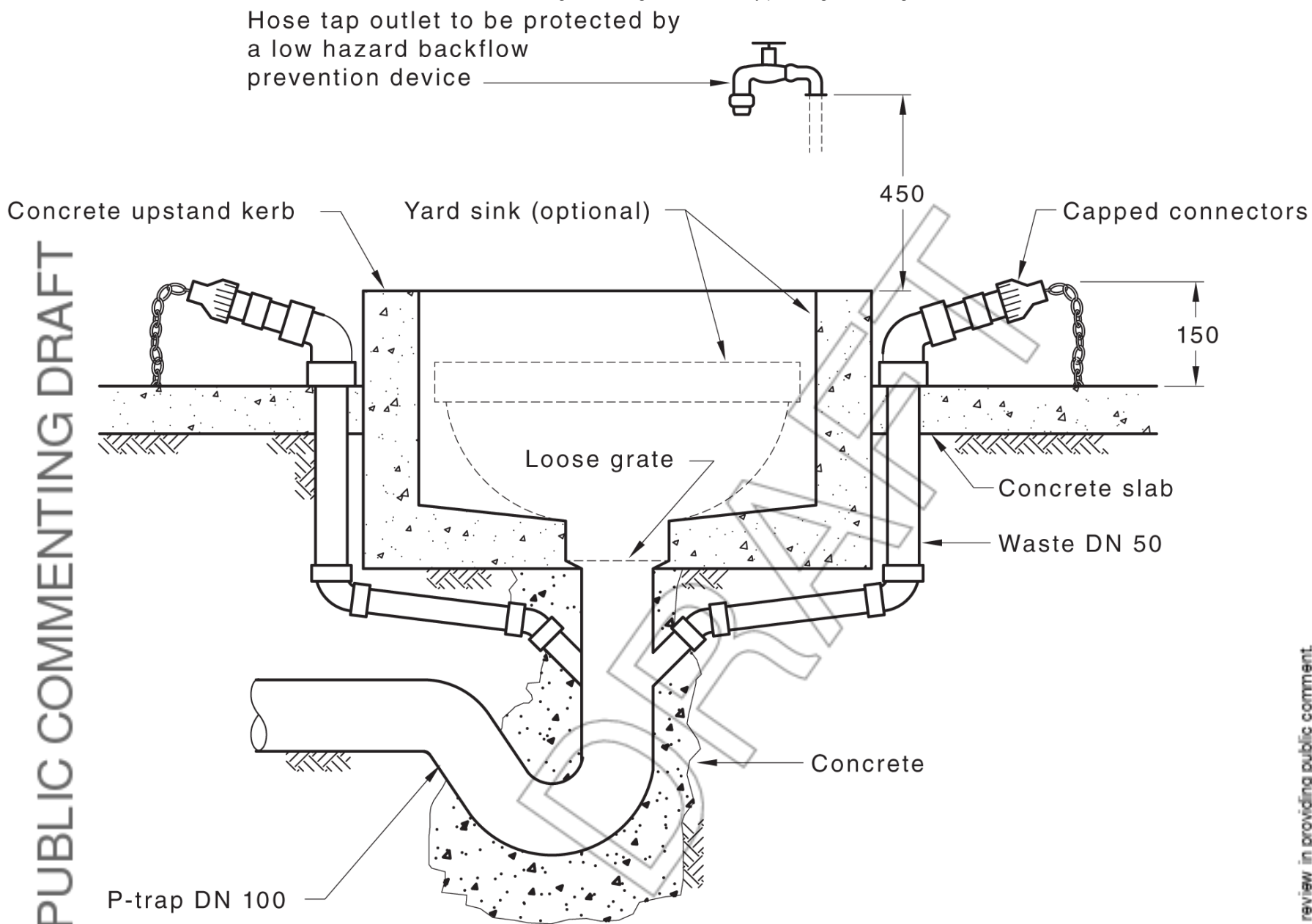


Figure 3.17.2(B) — Sullage dump point with multiple inlets

## 3.18 Drains connected to network utility operator vacuum sewerage systems

Drains connected to network utility operator vacuum sewerage systems shall be installed in accordance with the following:

- (a) An inspection shaft connected to the drain with a junction shall be placed as close as practicable to, and upstream of, the collection tank.
- (b) The junction inlet to the inspection shaft shall be against the grade of the drain so that any rodding of the line is in the direction away from the collection tank.
- (c) Where more than one drain is connected to a collection tank, the spill level of both overflow gullies of the drains shall be installed level with each other wherever practicable.
- (d) A DN 100 open vent pipe shall be provided at the upstream end of each drain connected to the collection tank. A DN 100 downstream vent shall be located within 10 m of the collection tank. No fixtures shall be connected between the collection tank and the downstream vent connection.

NOTE 1 In addition to the open vents, air admittance valves, installed in accordance with [Clause 6.10](#) may be used to provide additional venting of drains connected to a collection tank.

NOTE 2 Jump-ups should be avoided.

NOTE 3 Vacuum drainage systems are covered in [Section 16](#).

## 3.19 Common effluent drainage system

### 3.19.1 General

All sanitary plumbing and sanitary drainage in common effluent drainage systems shall conform to the relevant sections of this document.

### 3.19.2 Drainage connections

Drains connected to common effluent drainage systems shall be installed in accordance with the following:

- (a) Discharge from fixtures shall pass through a septic tank.

NOTE 1 Where this is impracticable due to location and available fall, discharge from waste fixtures may pass through a sullage tank.

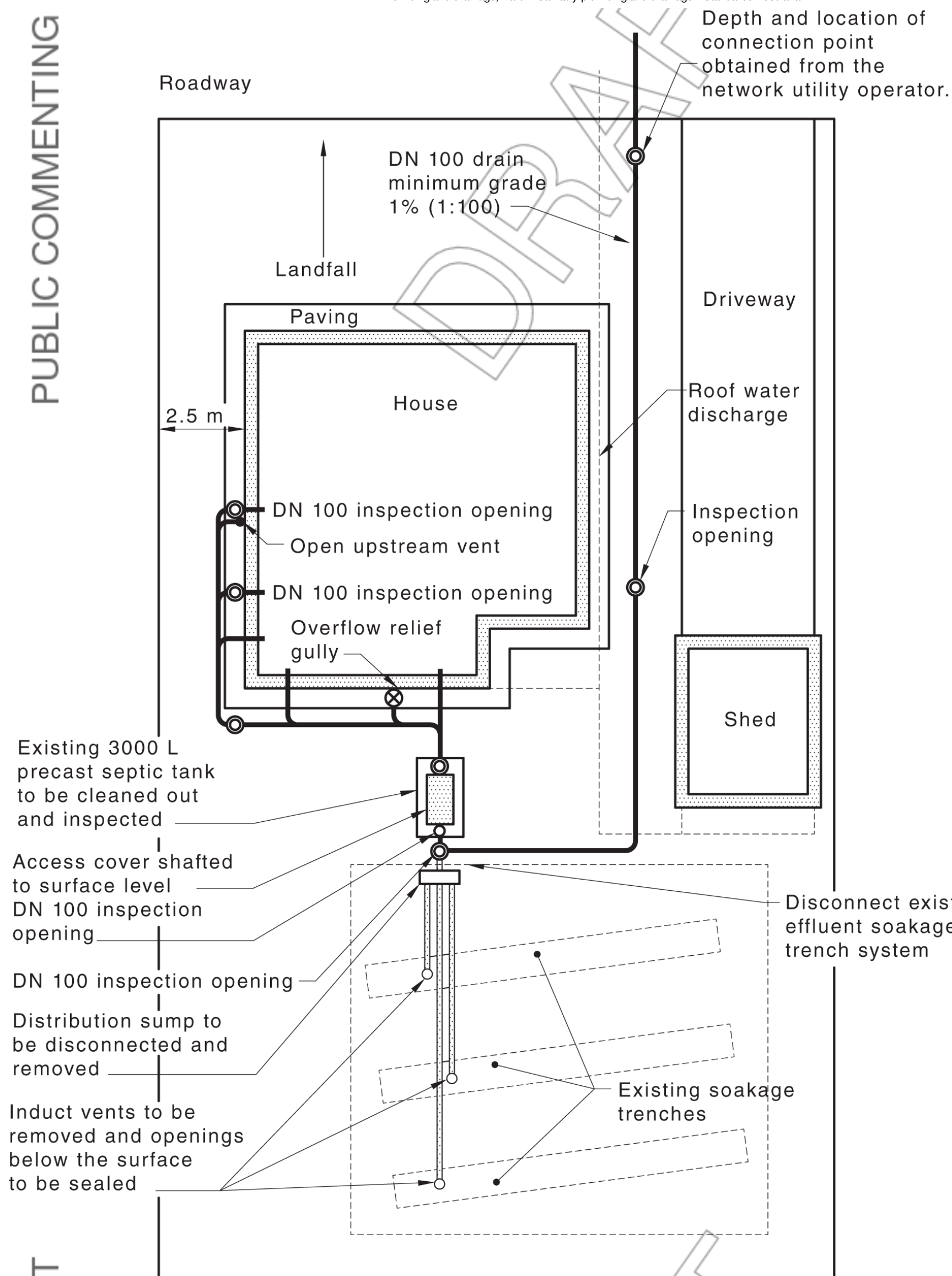
- (b) Drains from septic or sullage tanks to the common effluent drain shall be not less than DN 80 and not more than DN 100. They shall be laid at a grade of not less than 1 % (1 in 100).
- (c) Induct vents shall not be installed on septic tanks. Where induct vents are installed on an existing septic tank, they shall be removed before connecting the septic tank to a common effluent drainage system.
- (d) Inspection openings shall be provided in accordance with [Clause 4.7](#) and included on —
  - (i) the inlet to an on-site wastewater treatment unit; and
  - (ii) the outlet of the on-site wastewater treatment unit, within 2.5 m of the tank, where the connecting drain is greater than 10 m in length.
- (e) Existing and new drains shall be tested in accordance with [Section 15](#).
- (f) Soakage trenches, and stormwater, roof water and subsoil water drainage shall not be connected to a common effluent drainage system.

NOTE 2 Typical connections are shown in [Figures 3.19.2\(A\), 3.19.2\(B\), 3.19.2\(C\) and 3.19.2\(D\)](#).

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**Figure 3.19.2(A) — Typical site layout plan showing connection details for an all-waste septic tank system**

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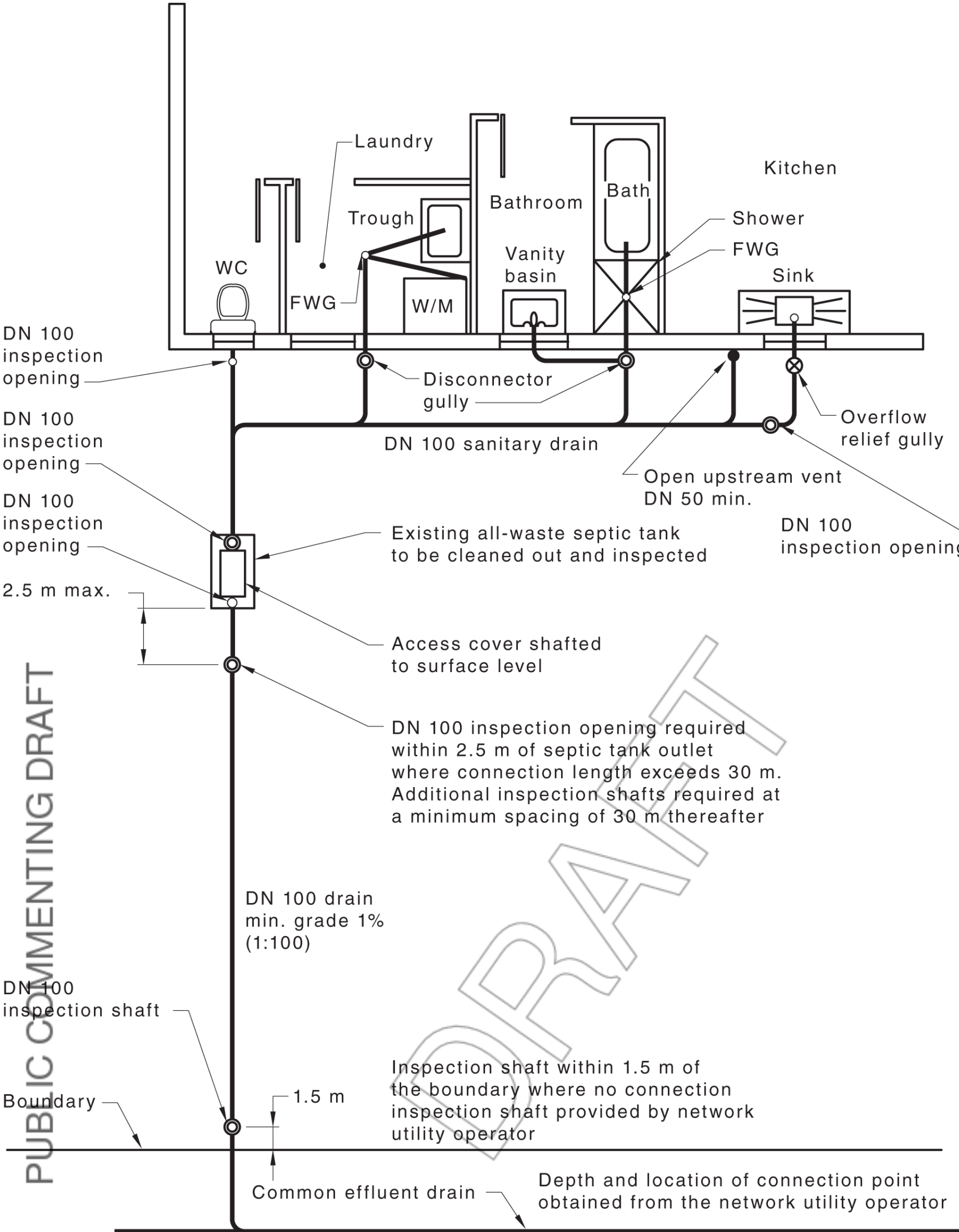


Figure 3.19.2(C) — Typical connection details for an all-waste septic tank system

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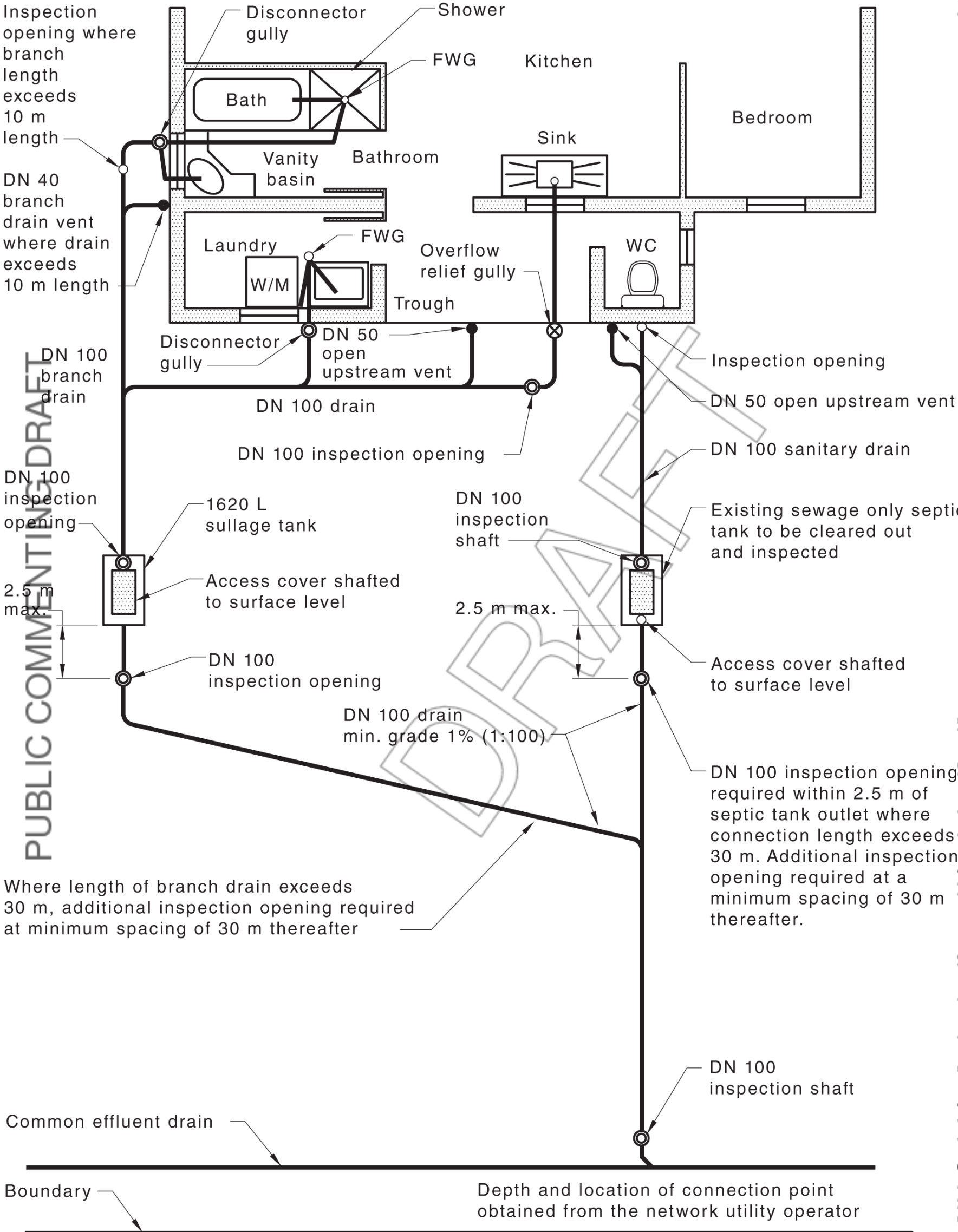


Figure 3.19.2(D) — Typical connection details for a septic tank and sullage tank system

3.19.3 Septic tanks

Where septic tanks are part of the effluent system, they shall be sized, constructed and installed in accordance with AS/NZS 1546.1. Septic tanks shall be inspected for soundness and hydrostatically tested before connection to the common effluent drain.

3.19.4 Sullage tanks

Sullage tanks shall be sized, constructed and installed in accordance with AS/NZS 1546.1. Sullage tanks shall be inspected for soundness and hydrostatically tested before connection to the common effluent drainage system.

NOTE 1 The satisfactory performance of common effluent drainage systems is dependent on regular cleaning out and desludging of each septic tank and sullage tank, which should be done once every five years, or sooner, if necessary.

NOTE 2 The connecting drain from the septic tank to the common effluent drain may require flushing from time to time.

3.20 On-site wastewater treatment units

On-site wastewater treatment units shall be installed in accordance with:

- (a) AS/NZS 1546.1 for septic tanks.
- (b) AS/NZS 1546.2 for waterless composting toilets.
- (c) AS 1546.3 for secondary treatment systems.

## 4 Drainage system

### 4.1 Scope of section

This section specifies requirements for components of sanitary drainage systems.

NOTE See [Section 16](#) for requirements for components of vacuum drainage system areas.

### 4.2 Point of connection

#### 4.2.1 General

Drains connected to the network utility operator’s sewer shall be not less than DN 100.

NOTE 1 When connecting fixtures that operate to a sewer by gravity, care should be taken to ensure that the flood level rim of the lowest fixture or trap is of adequate height above the soffit of the sewer so as to avoid the sewer discharging onto the property under normal operating conditions.

NOTE 2 Where the height of the lowest fixture or trap in Note 1 cannot be achieved, then consideration should be given to the lowest fixture or trap discharging to the sewer —

- (a) through a reflux valve in accordance with [Clause 4.5](#); or
- (b) by means of a sewage ejector or pump, conforming with [Section 12](#).

NOTE 3 Where a sanitary drain is to connect to a network utility operator’s sewer, information relating to any restrictions regarding soffit requirements and the point of connection should be obtained from the network utility operator prior to commencing any design.

NOTE 4 In Australia, some network utility operators manage combined stormwater and sewerage systems. In these cases, connection of surface water and roof water may be permitted to a sanitary plumbing and drainage system. Before any connection of surface water or roof water is made to a sanitary plumbing or drainage system, check with the relevant network utility operator.

Whenever drainage works are carried out, necessary measures should be taken to protect the network utility operator’s sewers from damage and to prevent the entry of —

- (a) extraneous water;
- (b) soil, sand or rock;
- (c) the contents of any septic tank; or
- (d) any other substance, the discharge of which would impede the operation of the sewer.

#### 4.2.2 Tidal or water-charged locations

Where a point of connection is provided in ground affected by tidal water or a high water table, the connection shall be made so as to prevent the ingress of water to the sewer.

## 4.3 Drains

### 4.3.1 Below ground

Drains below ground shall —

- (a) be laid to an even grade, be straight and have no lipped joints or internal projections;
- (b) have a minimum number of changes of grade and direction;
- (c) be sized in accordance with the fixture unit loading given in [Table 3.3.1](#);
- (d) be continuously supported under the barrel, other than for cast iron and ductile iron pipes and fittings;
- (e) be protected against damage;
- (f) be watertight;
- (g) have the interior of each pipe cleared of any foreign matter before it is laid and prior to commissioning; and
- (h) have a jump-up installed to connect drains at different elevations.

NOTE 1 The person or authority having rights over an easement may have specific requirements for drains laid in proximity of the easement or for drains laid within or passing through the easement.

NOTE 2 Refer to the NCC for protection against termite infestation under slab and penetrations of slab.

### 4.3.2 Above ground under buildings

Where drains are installed above ground under buildings, the following shall apply:

- (a) The drain shall be protected from mechanical damage.
- (b) Support and fixing shall conform to [Clause 10.2](#).
- (c) Provision for expansion shall be made appropriate to materials and their application.
- (d) The drain shall satisfy the requirements of [Clause 3.6](#) as appropriate.

### 4.3.3 Changes of direction

Changes of direction or gradient in drains shall be effected by the use of bends or junction fittings or at inspection chambers.

### 4.3.4 Maximum length of fixture discharge pipes

The maximum length of fixture discharge pipe without venting shall be in accordance with [Appendix B](#).



## 4.4 Inspection shafts and boundary traps

### 4.4.1 General

The main drain shall be provided with either an inspection shaft in non-boundary trap areas, or a boundary trap in boundary trap areas, located at or near the point of connection to the sewer.

NOTE 1 Inspection shafts and boundary traps located in an area that is subject to flooding should comply with the requirements of the relevant authority.

NOTE 2 Boundary trap or inspection shafts should not terminate within buildings in a habitable room as defined in the NCC.

### 4.4.2 Inspection shafts and boundary trap risers

#### 4.4.2.1 Installation

The following applies to inspection shafts and boundary trap risers:

- (a) They shall terminate at or near ground or surface level with a removable airtight inspection cap of the same diameter as the shaft or riser. For boundary trap risers, a low-level vent shall be installed in accordance with [Clause 3.9.2.3](#).
- (b) The cap shall be sealed into the shaft or riser.
- (c) Where the inspection shaft or boundary trap riser is subject to vehicular traffic, the cap may be installed below finished surface level. Access shall be provided in accordance with the following:
  - (i) A heavy-duty trafficable cover shall be installed at finished surface level above and independent of the cap.
  - (ii) The cover shall be supported so that no load can be transmitted onto the shaft.
  - (iii) The shaft shall be terminated immediately below the underside of the cover.
- (d) Risers shall be installed vertically with no offsets.

#### 4.4.2.2 Location

The inspection shaft or boundary trap riser shall be located —

- (a) wholly within the property served;
- (b) as close as practicable to the boundary;
- (c) clear of all authority easements;
- (d) as near as practicable to the point of connection;
- (e) in the open air, except as provided in [Clause 4.4.2.3](#);
- (f) in an accessible position; and
- (g) so that the inspection cap is not covered from view, except as allowed in [Clause 4.4.2.1\(c\)](#).

#### 4.4.2.3 Alternative locations

Where the requirements of [Clause 4.4.2.2](#) cannot be met, an inspection shaft and boundary trap riser may be sited at other locations as follows:

- (a) *Under cover* — An inspection cap may be installed under a roofed area, provided the cap is —
  - (i) located at finished surface level; and
  - (ii) readily accessible for inspection, rodding and plunging with not less than 1 m clear space vertically above the inspection cap.
- (b) *In a recess* — If all or part of a building is constructed up to the boundary of the property, and if this makes it impracticable to site the inspection cap in the open air or within a building under cover, the inspection cap may be installed within a recess constructed in the wall of the building, provided —
  - (i) the inspection cap is airtight;
  - (ii) the recess is constructed to provide a clear space of at least 1 m above the inspection cap;
  - (iii) at least 100 mm clear space is provided on each side and to the rear of the inspection cap; and
  - (iv) the recess has a removable panel.

### 4.4.3 Installation of inspection shafts

#### 4.4.3.1 General

Inspection shafts shall be provided at the lower downstream end of a drain in accordance with the following:

- (a) A junction shall be installed in the graded drain with the branch of the junction extended vertically upwards to the surface to form a shaft.
- (b) Where a jump-up is constructed within a property and is not more than 3 m from the point of connection, the jump-up shall be extended upwards to the surface level to form a shaft.
- (c) No branch drain or fixture discharge pipe shall be connected to an inspection shaft where the shaft is constructed from a square junction installed in a graded drain.
- (d) The jump-up shall be supported by placing a concrete footing not less than 100 mm thick under the bend with a width of not less than 100 mm beyond the sides of the shaft and extending up to the centre-line of the drain.

An inspection chamber with an open channel or maintenance shaft may take the place of an inspection shaft.

#### 4.4.3.2 Size

Inspection shafts shall be —

- (a) the same size as the drain for drains up to DN 150;
- (b) not smaller than DN 150 for drains larger than DN 150; or
- (c) the same size as the jump-up where an inspection shaft is constructed by extending a jump-up.

## 4.4.4 Installation of boundary traps

### 4.4.4.1 Outside buildings

Boundary traps located outside buildings shall be installed in accordance with the following:

- (a) Where the point of connection is provided in a vertical section of the sewer within the property, a boundary trap shall not be installed in the same trench as the sewer jump-up.
- (b) A downstream vent conforming with [Clause 3.9.2.2](#) shall be installed at the boundary trap riser.
- (c) Boundary traps of materials, other than cast iron, shall be directly supported on a solid foundation by placing a concrete pad under the trap. The concrete pad shall —
  - (i) be not less than 100 mm thick; and
  - (ii) extend upwards to the inlet socket of the trap.
- (d) The shaft shall be protected and supported during the installation and placement of backfilling.

### 4.4.4.2 Inside buildings

Boundary traps located inside buildings and installed above the ground or floor surface shall be —

- (a) protected against mechanical damage;
- (b) located as close as practicable to and within the boundary line; and
- (c) supported independently of the drain.

### 4.4.4.3 Size

The size of the boundary traps and risers shall be not smaller in size than the drain that discharges to it, or smaller than DN 100.

## 4.5 Reflux valves

### 4.5.1 Location

A reflux valve shall be located wholly within the property and be accessible.

NOTE This may be achieved by using either an access chamber or a riser shaft to the finished surface level.

### 4.5.2 Installation

A reflux valve shall be installed where —

- (a) the minimum height of the overflow relief gully and the lowest fixture specified in [Clause 4.6.6.6](#) cannot be achieved; or
- (b) a fixture is located in a basement and discharges to a sewage ejector or wet well and could be affected by a surcharge from a fixture at a higher level.

### 4.5.3 Surcharging sewer

Where a reflux valve is to be installed to protect against surcharges from the network utility operator, it shall be located in accordance with the following:

- (a) Where the drain has an inspection shaft, the reflux valve shall be installed adjacent to the shaft.
- (b) Where the drain has a boundary trap, the reflux valve shall be located immediately downstream from and adjacent to the outlet of the boundary trap.

### 4.5.4 Reflux valve chambers

Except where a reflux valve is installed in an accessible position within a building or can be fully serviced and maintained from finished surface level, all reflux valves shall be installed within an inspection chamber conforming with [Clause 4.8](#).

NOTE See [Clause 10.11.2](#) for information on reflux valves.

## 4.6 Gullies

### 4.6.1 General

Gullies shall be used for one or more of the following purposes:

- (a) As relief in the event of sewage surcharge (overflow relief gully).
- (b) To provide disconnection between waste discharges and the remainder of the sewerage installation (disconnecter gully).

### 4.6.2 Installation

Gullies shall —

- (a) be of the self-cleansing type;
- (b) have the top of the gully riser provided with a grating to relieve surcharge; and
- (c) where installed below ground —
  - (i) be supported on a concrete footing of a thickness not less than 100 mm, with a width not less than 100 mm beyond the sides of the trap and extending upwards to not less than 100 mm above the base of the gully; and
  - (ii) have the top of the gully riser protected from damage at finished surface level (e.g. by means of a concrete surround).

### 4.6.3 Maintenance of water seal

The water seal shall be permanently maintained in a gully (see Note 1) by —

- (a) the discharge from a waste fixture or floor waste gully in accordance with [Table 4.6.3](#);
- (b) the discharge from a waste stack of not more than five floors in height;

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- (c) water from a hose tap located a minimum of 450 mm above the grating where no waste pipe discharges into gully;
- (d) the discharge from temperature/pressure-relief valves and/or expansion control valves (see Note 2);
- (e) the discharge from a charge pipe in accordance with [Figure 4.6.8.1](#) and [Clause 4.6.8](#);
- (f) discharges from refrigeration condensate lines; or
- (g) waste fixtures or waste stacks connected into a gully riser, discharging below the level of the grating and above the surface level of the water seal.

NOTE 1 See [Figure 4.6.6.5](#) for examples of water seals permanently maintained in a gully.

NOTE 2 See [Clause 2.3\(b\)](#) for information on temperature limitations.

Table 4.6.3 — Connection of fixtures to disconnecter gullies	
Fixture	Maximum unvented length of waste pipe, m
Basin or bidet with DN 40 traps and waste pipes	3.5
All other waste fixtures and floor waste gullies with DN 50 or smaller waste pipes	6
Floor waste gullies and fixtures with DN 65 or larger waste pipes	10

NOTE 1 Bends to be kept to a minimum.

NOTE 2 For New Zealand, bidets do not discharge to disconnecter gullies.

### 4.6.4 Soil fixtures

Discharges from soil fixtures shall not connect, either directly or indirectly, to a disconnecter or overflow relief gully.

In Australia, some network utility operators manage combined stormwater and sewerage systems. In these cases, connection of surface water and roof water may be permitted to a sanitary plumbing and drainage system. Before any connection of surface water or roof water is made to a sanitary plumbing or drainage system, check with the relevant network utility operator.

### 4.6.5 Disconnecter gullies inside buildings

A disconnecter gully may be located within a building, provided —

- (a) the gully riser extends to the finished surface level and is sealed with a removable airtight cover;
- (b) a DN 50 vent pipe, branching from the riser pipe or a fitting, extends at a grade of not less than 1.25 % and terminates with a grating at an external wall of the building —
  - (i) above the overflow level of the lowest internal fixture connected to the sealed disconnecter gully;
  - (ii) at least 75 mm above the finished surface level; and
  - (iii) in areas likely to be inundated, in accordance with [Clause 4.6.6.8](#);
- (c) fixtures or appliances are not connected to the vent pipe; and
- (d) air admittance valves are not used to vent sealed disconnecter gullies.

Where it is not practicable to extend the vent to an external wall, the vent may terminate in the atmosphere external to a building in accordance with [Clause 6.9.4](#).

### 4.6.6 Overflow relief gullies

#### 4.6.6.1 General

At least one overflow relief gully shall be installed in the drain, except as provided in [Clause 4.6.6.2](#). Disconnecter gullies conforming with the requirements of [Clauses 4.6.6.3 to 4.6.6.7](#) may be used as overflow relief gullies.

NOTE See [Section 14](#) for multi-unit developments.

#### 4.6.6.2 Omission of overflow relief gully

An overflow relief gully may be omitted where —

- (a) the drain serves fixtures in a toilet block or an amenities building and is located in a park or reserve, provided the floor of the building is graded to fall towards an external doorway;
- (b) the site is entirely built on and it is not possible to locate the gully in any of the alternative locations specified in [Clause 4.6.6.5](#), and the fixtures on the ground floor discharge through a reflux valve to the sewer by gravitation;
- (c) the lowest fixtures connected are located on floor levels that are 3 m or more above ground surface level at the point of connection to the sewer; or
- (d) an alternative overflow relief point, equal to or the equivalent cross-section area of the drain served, is provided to the drainage systems.

#### 4.6.6.3 Size

The size of overflow relief gullies shall be determined from the size of the largest section of the main drain as given in [Table 4.6.6.3](#).



Table 4.6.6.3 — Size of overflow relief gullies	
Size of main drain DN	Size of gully outlet DN
100 and 150	100
> 150	150

4.6.6.4 Location

The overflow relief gully shall be located —

- (a) within the boundaries of the property;
- (b) external to the building;
- (c) so that the top of the gully is accessible and positioned where any discharge will be noticeable; and
- (d) with clear access for more than 2 m above the top of the gully grate, and not be enclosed.

4.6.6.5 Alternative locations

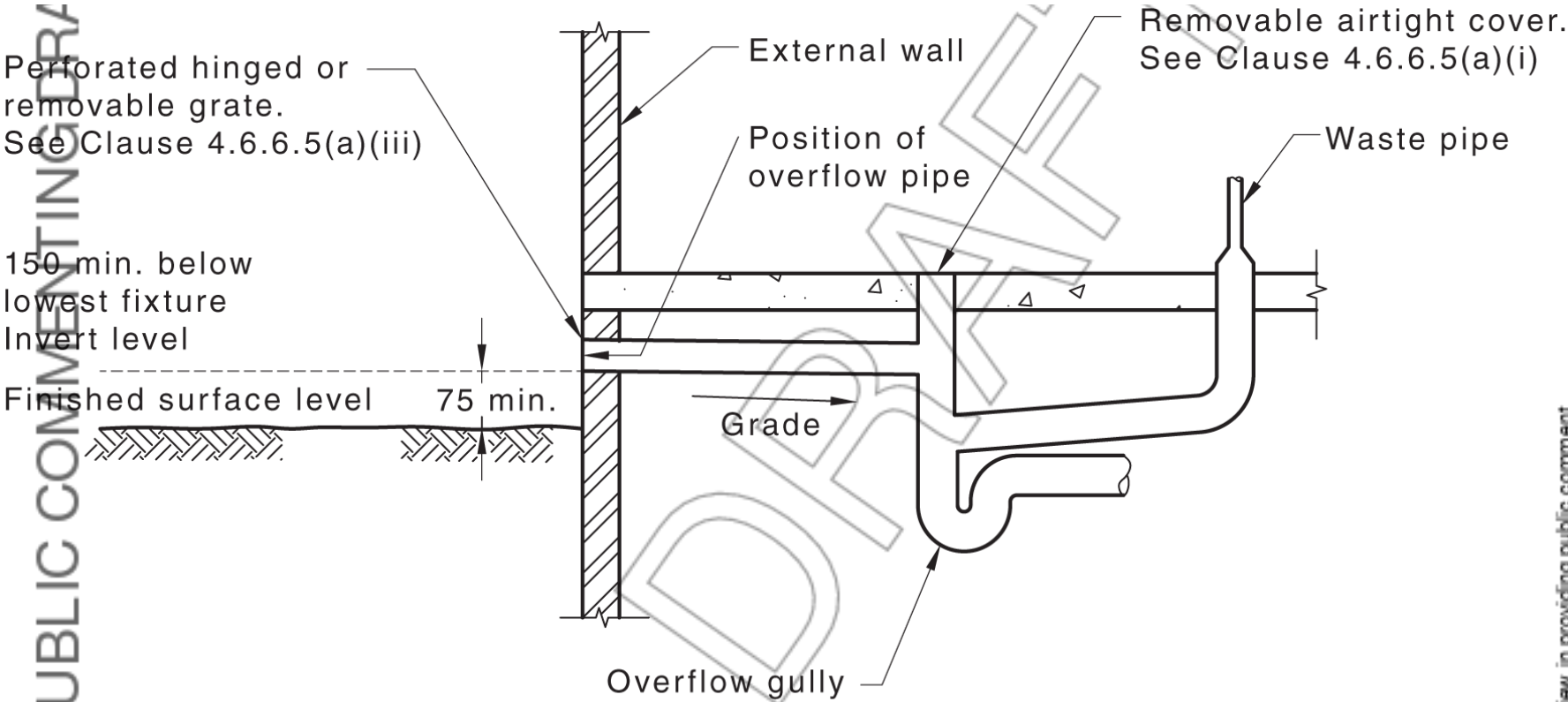
Where it is not possible to conform to [Clause 4.6.6.4](#), an overflow gully may be located as follows:

- (a) Within a building [see [Figure 4.6.6.5\(A\)](#)], provided —
  - (i) the gully riser extends to floor level and is sealed with a removable airtight cover;
  - (ii) an overflow pipe of the same size as the gully riser is installed at a grade of not less than 1.25 % and terminates in the open air at an external wall of the building in accordance with [Clauses 4.6.6.6](#) and [4.6.6.7](#), and areas affected by flooding conform to [Clause 4.6.6.8](#);
  - (iii) the overflow pipe is provided with a perforated removable or hinged cover that will not restrict discharge under surcharge conditions; and
  - (iv) fixtures or appliances are not connected to the overflow pipe.
- (b) Recessed within an external wall [see [Figure 4.6.6.5\(B\)](#)], provided —
  - (i) the recess is not less than 300 mm wide and 600 mm high, measured above the top of the gully riser;
  - (ii) the centre of the riser is not greater than 300 mm from the face of the building and the riser is fully accessible; and
  - (iii) the base of the recess is graded away from the building.

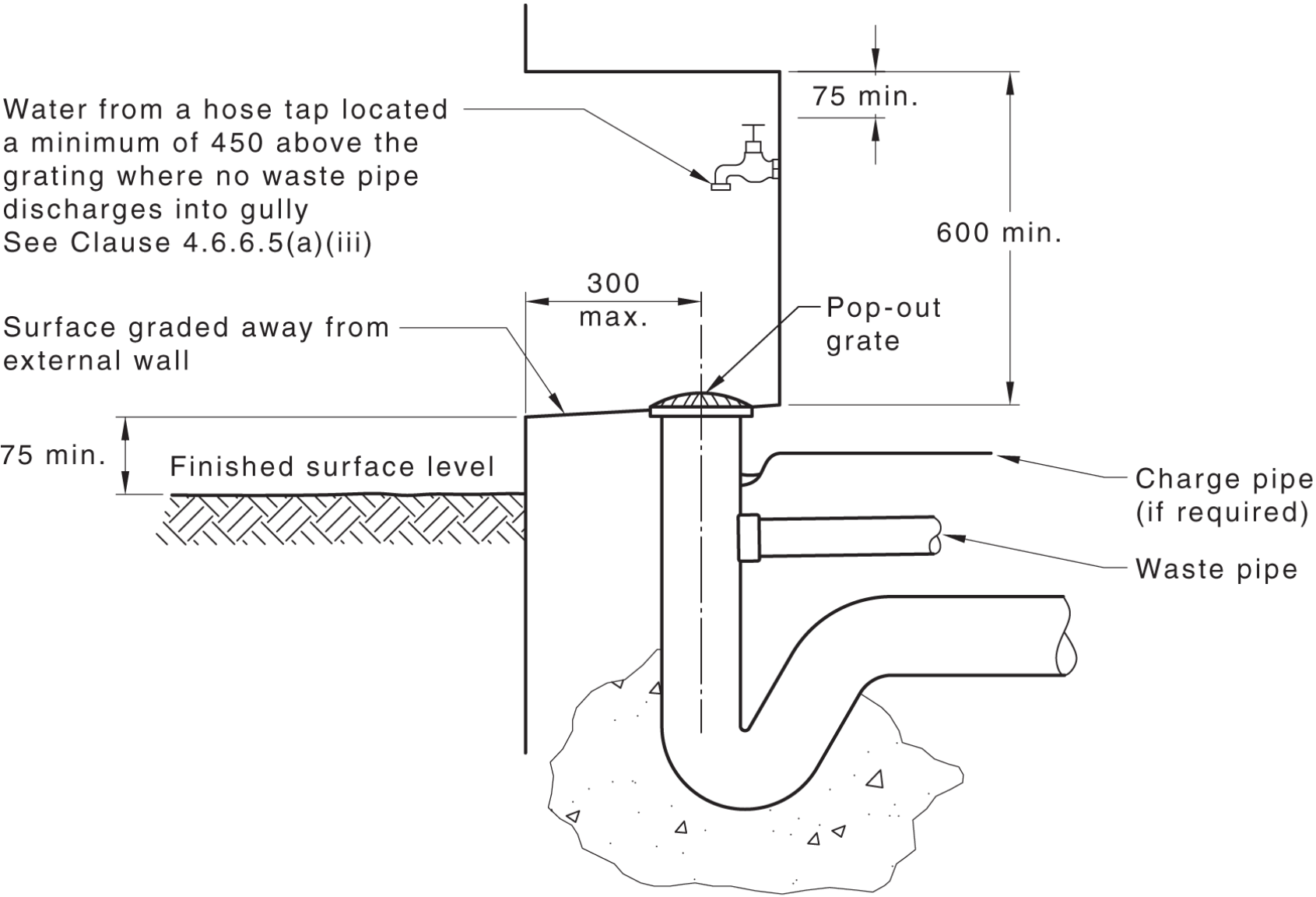
NOTE Additional gullies may be installed —

- (a) to receive the discharge from a domestic swimming pool;
- (b) on installations that serve multiple residential buildings and have separate yards provided for each occupancy;
- (c) where a lower building may be affected by surcharge from a higher building;
- (d) where a lower fixture in a building may be affected by surcharge from higher fixtures; or
- (e) where such gullies need not conform to the requirements of [Clause 4.6.6.6](#).

Dimensions in millimetres



(a) Typical details of overflow relief gully inside building



(b) Typical details of overflow relief gully positioned in recess

Figure 4.6.6.5 — Positioning of overflow relief gully

4.6.6.6 Height of overflow point below lowest fixture

A minimum height of 150 mm shall be maintained between the top of the overflow gully riser and the lowest fixture connected to the drain.

This height shall be measured vertically from the overflow level of the gully riser or from the invert level of the overflow pipe to the point given in Table 4.6.6.6.

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**Table 4.6.6.6 — Point of measurement on fixtures for height above overflow gully**

Fixture	Point of measurement
Soil fixture with an integral trap	Top surface level of the water seal
Floor waste gully or shower	Top surface level of the grate
Soil fixture located in an outbuilding or room, the flow of which is graded to an external doorway	Overflow rim of the fixture
Other fixtures (include greywater diversion devices)	Top surface level of the fixture outlet

#### 4.6.6.7 Height above surrounding ground

The minimum height between the top of the overflow gully riser, or the invert of the overflow pipe, and the finished surface level shall be 75 mm, except where the gully riser is located in a path or a paved area, where it shall be finished at a level so as to prevent the ponding and ingress of water.

#### 4.6.6.8 Height in flood-affected areas

The top of the gully riser in flood-affected areas shall be —

- (a) finished at a level not less than 150 mm above the declared flood level; or
- (b) sealed with a removable watertight cover with a vent of the same size as the gully, terminating at a level not less than the declared flood level and in accordance with [Clause 4.6.6.6](#).

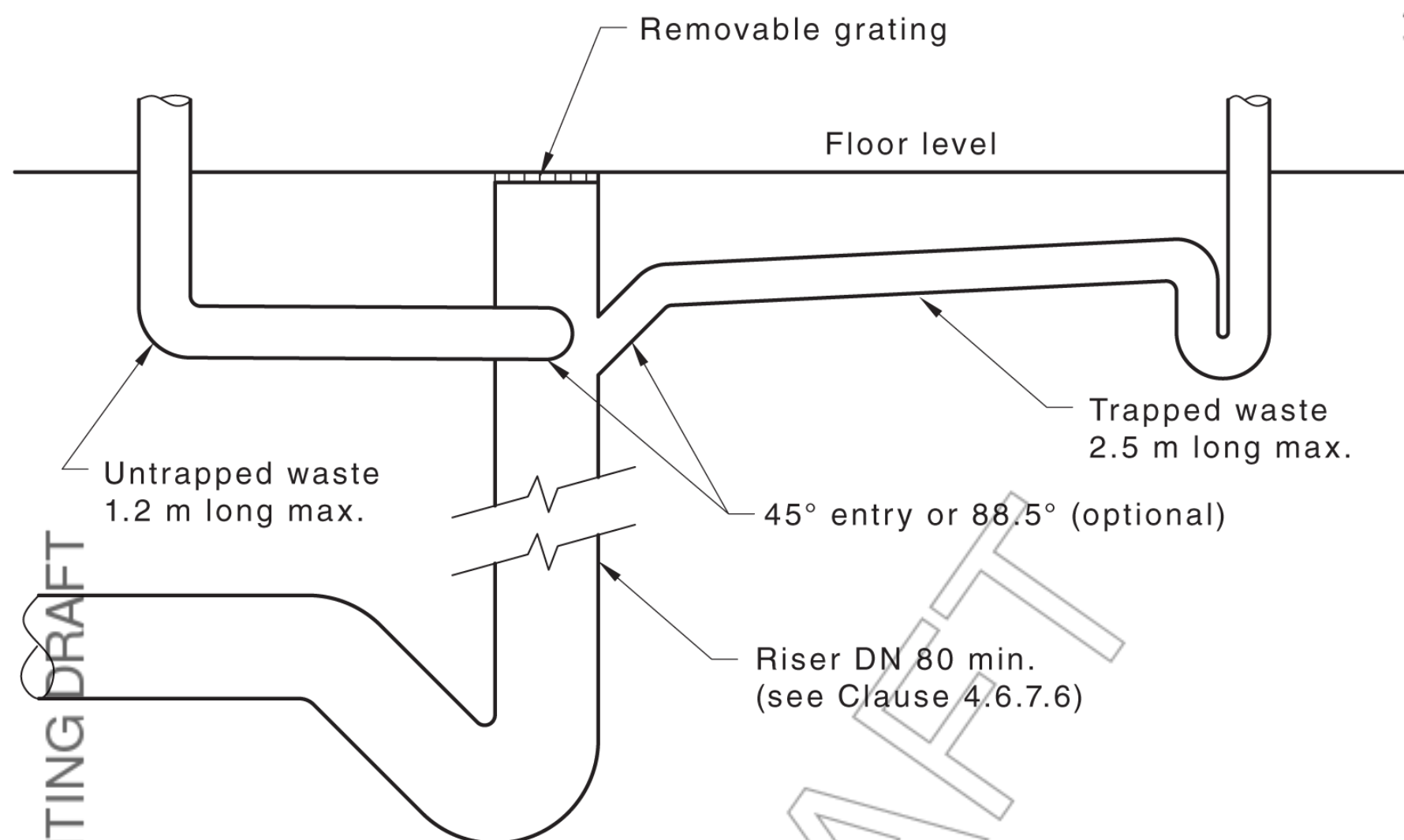
Where either of the above requirements cannot be achieved, no sanitary drain shall gravitate to the network utility operator's sewer.

#### 4.6.7 Floor waste gullies

#### 4.6.7.1 General

For the purpose of [Clause 4.6.7](#), a floor waste gully (FWG) shall be deemed to be a fixture trap.

NOTE See Figure 4.6.7.1 for a typical connection of waste pipe to a floor waste gully.



**Figure 4.6.7.1 — Typical connection of waste pipes to a floor waste gully**

#### 4.6.7.2 Discharge to floor waste gullies

Where an FWG is used, only fixtures listed in [Table 4.6.7.2](#) and fixture pairs in accordance with [Clause 6.5.4](#) shall be connected.

These fixtures except for tundishes shall be located within the same room as the floor waste gully.

Basins and drinking fountains that discharge to a floor waste gully shall have a trap installed immediately adjacent to the outlet of the fixture.

NOTE Where it is known that the discharge may cause a foaming problem, fixtures should not be connected so as to discharge through a floor waste gully.



Table 4.6.7.2 — Discharge to floor waste gullies			
Waste fixture	Maximum length of waste pipe m		
	Connected to riser of floor waste gully		Connected to submerged inlet floor waste gully <sup>a</sup>
	Fixture untrapped	Fixture trapped	Fixture trapped or untrapped
Bain-marie, sterilizer	1.2	2.5	Not allowed
Bar sink (commercial), glass-washing machine	1.2	2.5	Not allowed
Bar sink (domestic)	1.2	2.5	2.5
Basin, drinking fountain	Not permitted	2.5	2.5 (trapped only)
Bath, shower/bath	1.2	2.5	2.5
Bidet	1.2	2.5	Not applicable
Cleaners' sink	1.2	2.5	Not allowed
Clothes-washing machine	1.2	2.5	2.5
Laundry and ablution trough	1.2	2.5	2.5
Refrigerated cabinet	1.2	2.5	2.5
Shower	1.2	2.5	2.5
Tundish <sup>b</sup>	10.0	10.0	10.0

<sup>a</sup> See [Figure 4.6.7.2](#).

<sup>b</sup> See [Clause 4.6.7.8](#).

NOTE Floor waste gullies or similar traps directly connected to the drainage system and subjected to infrequent use shall be provided with an approved means of maintaining their water seals.

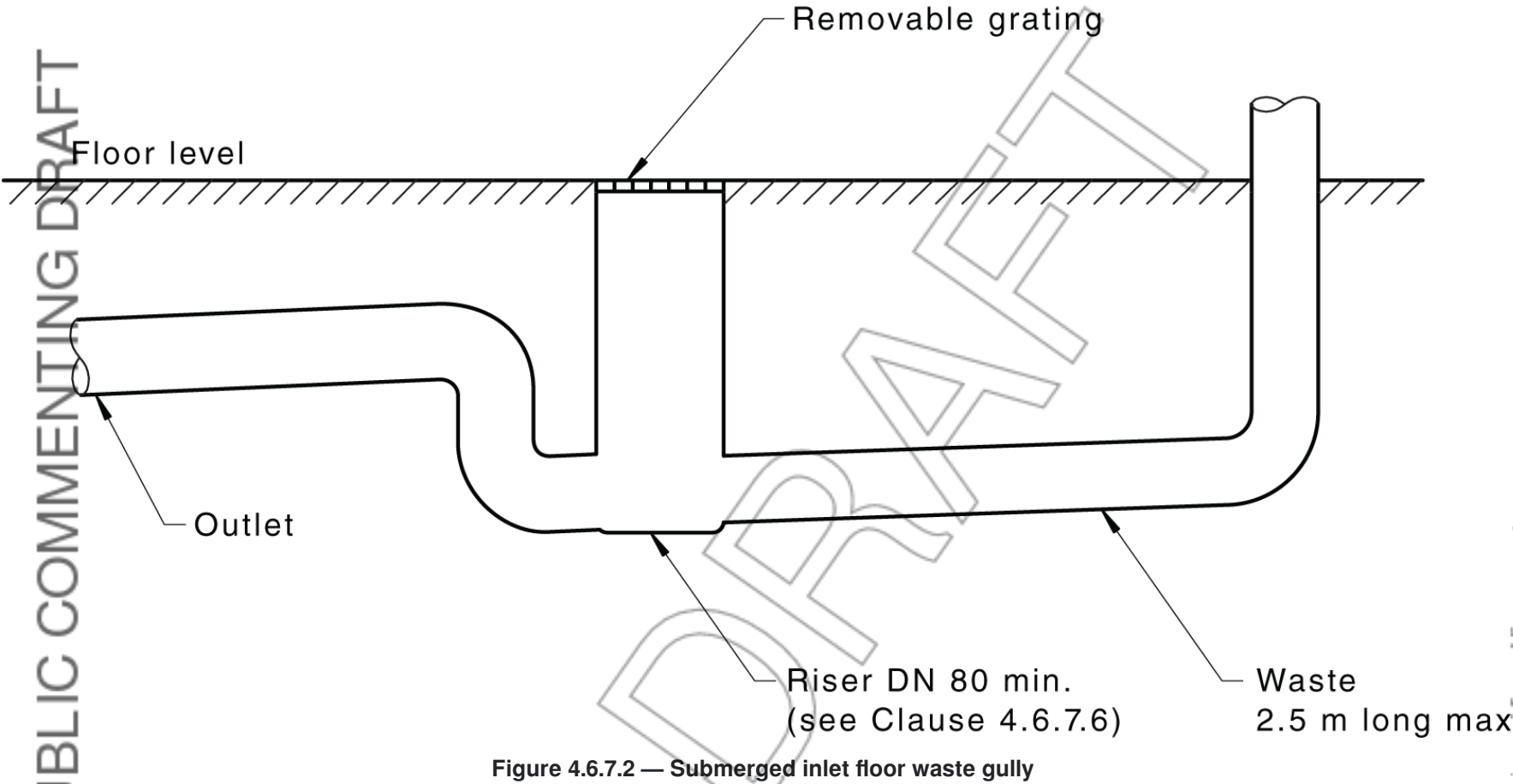


Figure 4.6.7.2 — Submerged inlet floor waste gully

4.6.7.3 Connection of fixtures

Each fixture or fixture pair that is connected to an FWG shall be connected by a separate waste pipe at a grade of not less than 2.5 % and with a length not exceeding that specified in [Table 4.6.7.2](#).

4.6.7.4 Waste pipes discharging to floor waste gullies

Waste pipes discharging to FWGs shall not be extended. Trap vents shall not be installed on fixture discharge pipes.

4.6.7.5 Refrigerated coolrooms and air-conditioning return air plenums

Floor waste gullies shall not be installed in any refrigerated coolroom, air-conditioning return air plenum, or similar structure.

4.6.7.6 Removable grate

Floor waste gullies shall be installed with an accessible removable grate and have a riser of not less than DN 80 to finished surface level. Where the sole function of the FWG is to dispose of water spillage and wash-down water, a minimum DN 50 riser may be used.

4.6.7.7 Height of gully riser

The height of the gully riser shall be measured from the top of the water seal to the floor surface level and conform to the following:

- (a) For floor waste gullies with connections to the gully riser —
- (i) the minimum height shall conform to [Table 4.6.7.7](#); and

(ii) the maximum height shall be 600 mm.

(b) For floor waste gullies with submerged inlets, the minimum height shall be 100 mm.

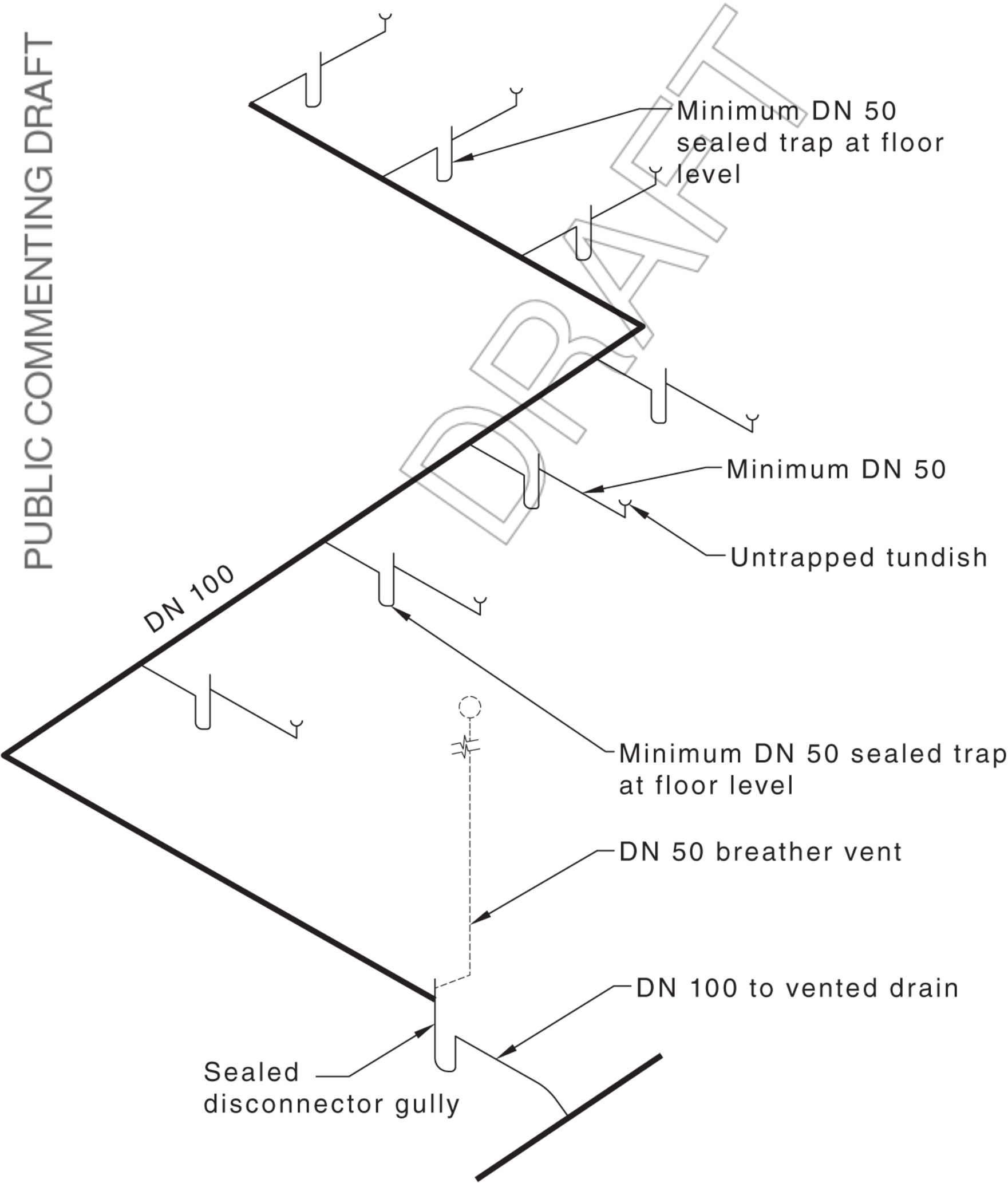
NOTE The maximum height maybe extended to 1 m when receiving the discharges from plant rooms located above ground floor level.

Table 4.6.7.7 — Minimum height of floor waste gully risers			
Waste fixtures connected to gully riser	Size of gully riser		Minimum height, mm (water seal to floor level)
	DN	88° entry	45° entry
All waste fixtures including maximum one bath	80	200	150
	100	150	100

4.6.7.8 Discharges from tundishes

In addition to the discharges specified in Table 4.6.7.2, tundishes receiving discharges from water heater drains, air-conditioning units, other condensate lines, and the like, may discharge to a floor waste gully. The maximum length of the unvented discharge pipe shall not exceed 10 m.

NOTE See Figure 4.6.7.8 for an example of a tundish drainage layout.



NOTE 1 Maximum unvented length 10 m.

NOTE 2 DN 50 open vent required if more than 10 m (not air admittance valve).

NOTE 3 Sealed disconnector gully inside building installed in accordance with Clause 4.6.5.

NOTE 4 DN 100 at minimum grade 1:100.

Figure 4.6.7.8 — Typical un-trapped tundish connection to sealed disconnecter gully via sealed floor waste gully

4.6.7.9 Size of gully trap outlet

The minimum size of floor waste gully outlets shall be as specified in Table 4.6.7.9. Where the sole function of the floor waste gully is to dispose of water spillage and wash-down water, a minimum DN 50 outlet may be used.

Table 4.6.7.9 — Floor waste gully outlet size	
Maximum number of fixture units discharging into gully trap	Minimum nominal size of outlet DN
3	50
10 (including the discharge from not more than one bath)	65
15	80

NOTE A shower outlet may be used as a floor waste gully.

4.6.7.10 Connection of waste pipes

Individual waste pipes shall connect —

- (a) to a floor waste gully riser at an angle between 45° and 88°, as close as practicable above the water seal; or
- (b) to a submerged inlet floor waste gully riser at an angle of 88°.

4.6.7.11 Size of waste pipes from fixtures

The size of waste pipes from fixtures connecting into floor waste gullies shall be as given in Table 6.3(A).

4.6.8 Charging floor waste gullies

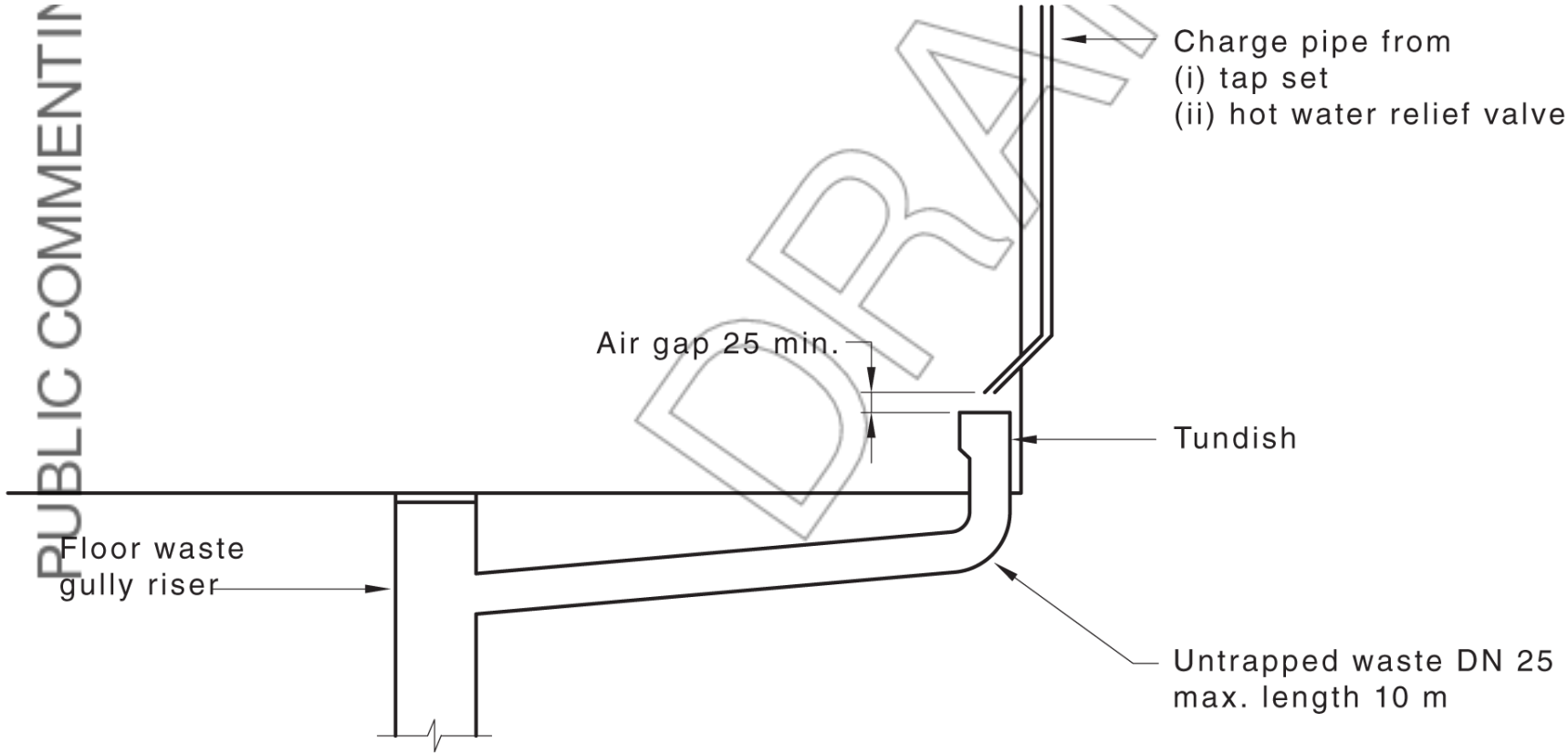
4.6.8.1 General

Where a floor waste gully is located in a position that cannot receive a waste discharge, the water seal shall be maintained by one of the following means:

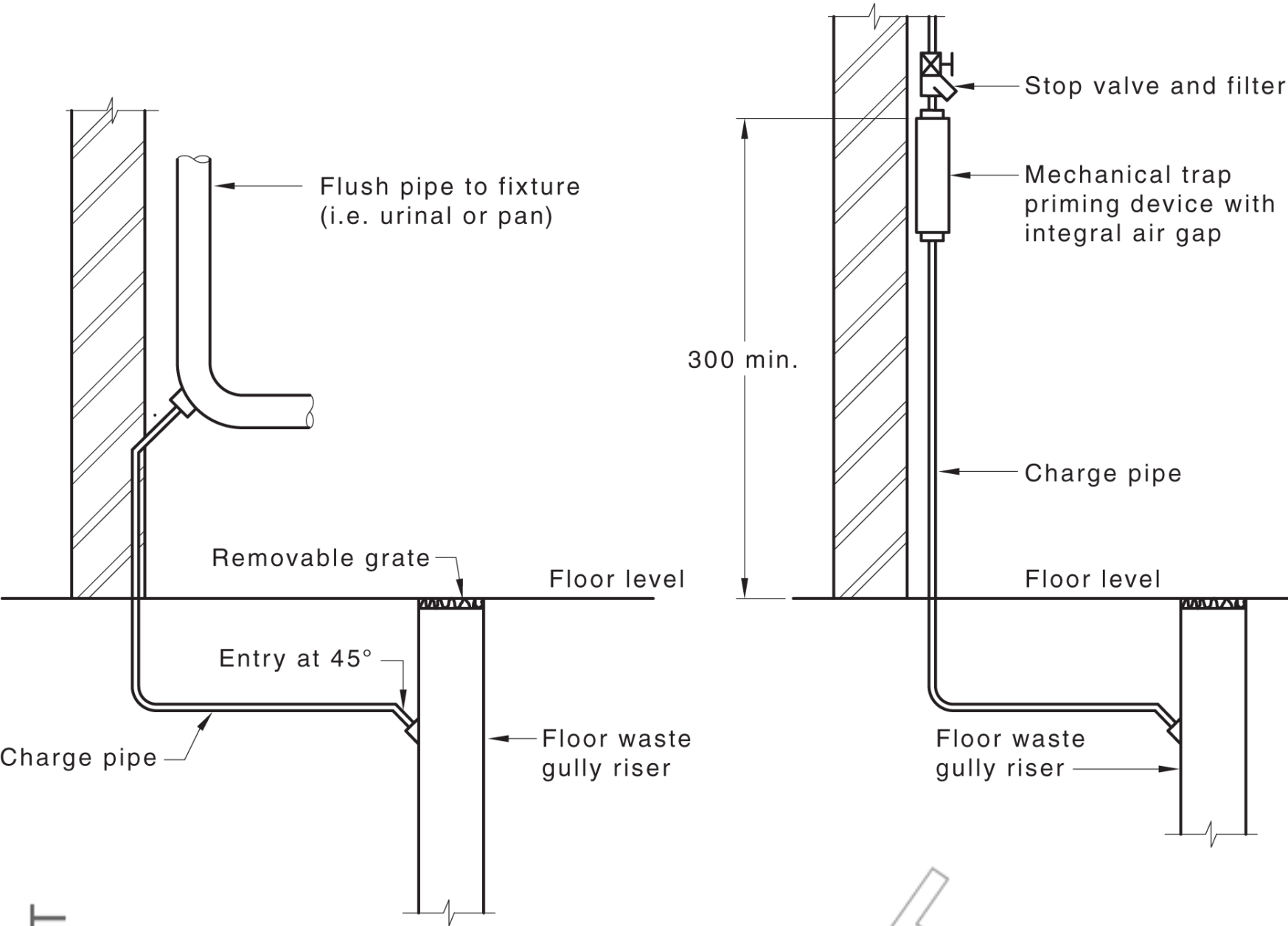
- (a) A charge pipe from a flushing device connected at the heel or the base of the flush pipe with a union. The charge pipe shall enter the floor waste gully at 45°, not less than 50 mm above the water seal. The charge pipe shall be silver brazed or joined by a union to the riser as shown in Figure 4.6.8.1(B).
- (b) A charge pipe from a tap set or a drain from a water heater relief valve, which shall drain over a tundish so that the air gap is maintained as shown in Figure 4.6.8.1(A).
- (c) A charge pipe extended from a mechanical or electronic trap priming device to the floor waste gully within the same room or compartment as shown in Figure 4.6.8.1(C).
- (d) Hose tap installed in the same room, if floor is graded to the floor waste gully.

Dimensions in millimetres





(a) Connection of tundish



(b) Connection of charge pipe

(c) Trap primer arrangement

Figure 4.6.8.1 — Connections of charge pipes to floor waste gully

4.6.8.2 Installation of charge pipes

Charge pipes shall be in the size range of DN 6 to DN 15. Charge pipes from flushing devices, tap sets or water heater relief valve drains shall not exceed 10 m in length.

NOTE The connection of a charge pipe to a floor waste gully riser should not restrict the bore of the riser or impede access for maintenance of the gully.

4.7 Inspection openings

4.7.1 Location

Except where inspection chambers are provided, inspection openings (IOs) for maintenance purposes shall be provided —

- (a) outside of a building, not further than 2.5 m along each branch drain connecting one or more water closets or slop hoppers;
- (b) at intervals of not more than 30 m, with a minimum of one inspection opening on each main drain;
- (c) at the connection to the network utility operator’s sewer if not provided by the network utility operator;

- (d) on the downstream end of the drain where any drain passes under a building except where waste fixtures only are concerned;
- (e) where any new section of drain is connected to an existing drain;
- (f) immediately at or upstream of the upper bend of a jump-up;
- (g) at every change in horizontal direction of greater than 45° (New Zealand only); and
- (h) at every change in gradient greater than 45° (New Zealand only).

NOTE See Figure 4.7.1 for a typical provision of inspection openings.

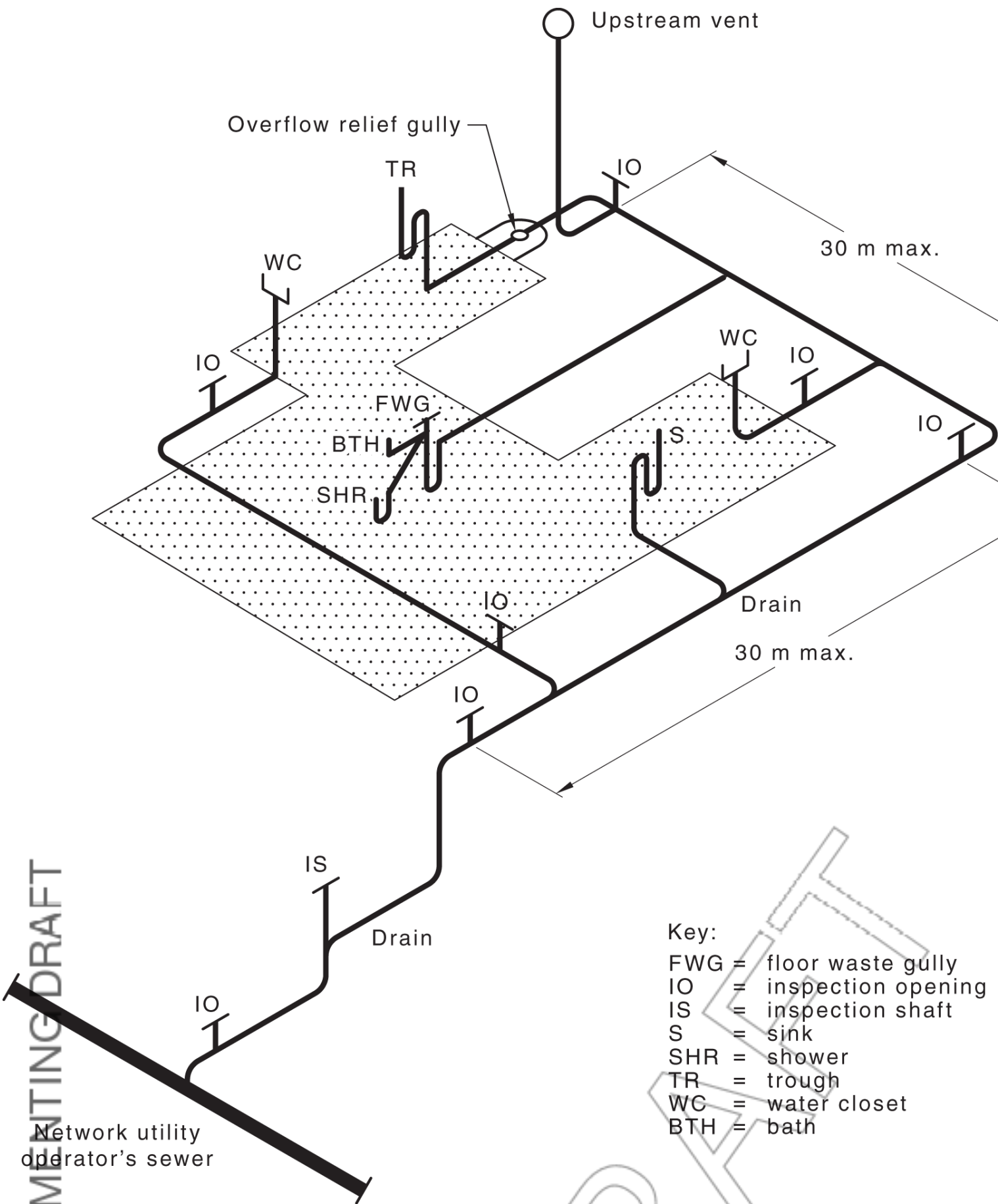


Figure 4.7.1 — Typical provision of inspection openings

### 4.7.2 Size

The size of inspection openings in drains shall be —

- (a) the same size as the drain for openings up to DN 150; or
- (b) not less than DN 150 for openings larger than DN 150.

### 4.7.3 Types

Inspection openings may be of the following forms:

- (a) Inspection branches or square junctions.
- (b) Inspection chambers in accordance with Clause 4.8.
- (c) Reflux valves.

### 4.7.4 Access to inspection openings

The following applies to inspection openings access:

- (a) At least one inspection opening shall be raised to finished surface level on each main drain.

- (b) Where raised to finished surface level, inspection openings shall be provided with airtight removable caps and protected by a cover and surrounded in such a manner that no traffic or structural loads are transmitted to the drain.

4.7.5 Sealing

Inspection openings and unused sockets shall be sealed with plugs or caps fitted with a gasket or sealing ring and securely held in position by a clip or strap or threaded connection.

When a plug or cap with a rubber ring or gasket is removed, a new rubber ring or gasket shall be fitted.

4.8 Inspection chambers

4.8.1 General

Inspection chambers shall be circular or rectangular in shape and either be —

- (a) prefabricated; or
- (b) constructed *in situ* from concrete at least 150 mm thick.

4.8.2 Size

The dimensions of inspection chambers shall conform to [Table 4.8.2](#).

Table 4.8.2 — Size of inspection chambers				
Depth of floor of chamber		Rectangular		Circular
		Width	Length	Diameter
Minimum internal measurements in Australia, mm				
600 > 900	< 600	450	600	600
	≤ 900	600	900	900
		750	1 200	1 050
Minimum internal measurements in New Zealand, mm				
100		< 1 000		450
> 100		< 1 000		600
All sizes		> 1 000		1 000

4.8.3 Construction

4.8.3.1 Conduits and channels

Conduits and channels in inspection chambers shall be constructed in accordance with the following:

- (a) The conduit in any inspection chamber located inside a building shall be either: (a) fully enclosed and incorporate an inspection opening; or (b) the inspection chamber shall be provided with an airtight cover.
- (b) The conduit in any external inspection chamber shall be either —
- (i) enclosed, as specified in Item (a); or
- (ii) an open channel of width and depth equal to the diameter of the drain.
- (c) The floor in any inspection chamber shall slope towards the channel, or towards the inspection opening, on a grade of approximately 8 %.
- (d) Formed junctions and bends in channels shall have a centre-line radius of not less than 300 mm.
- (e) A fall of at least 30 mm shall be provided in the invert of every channel that curves through 45° or more.

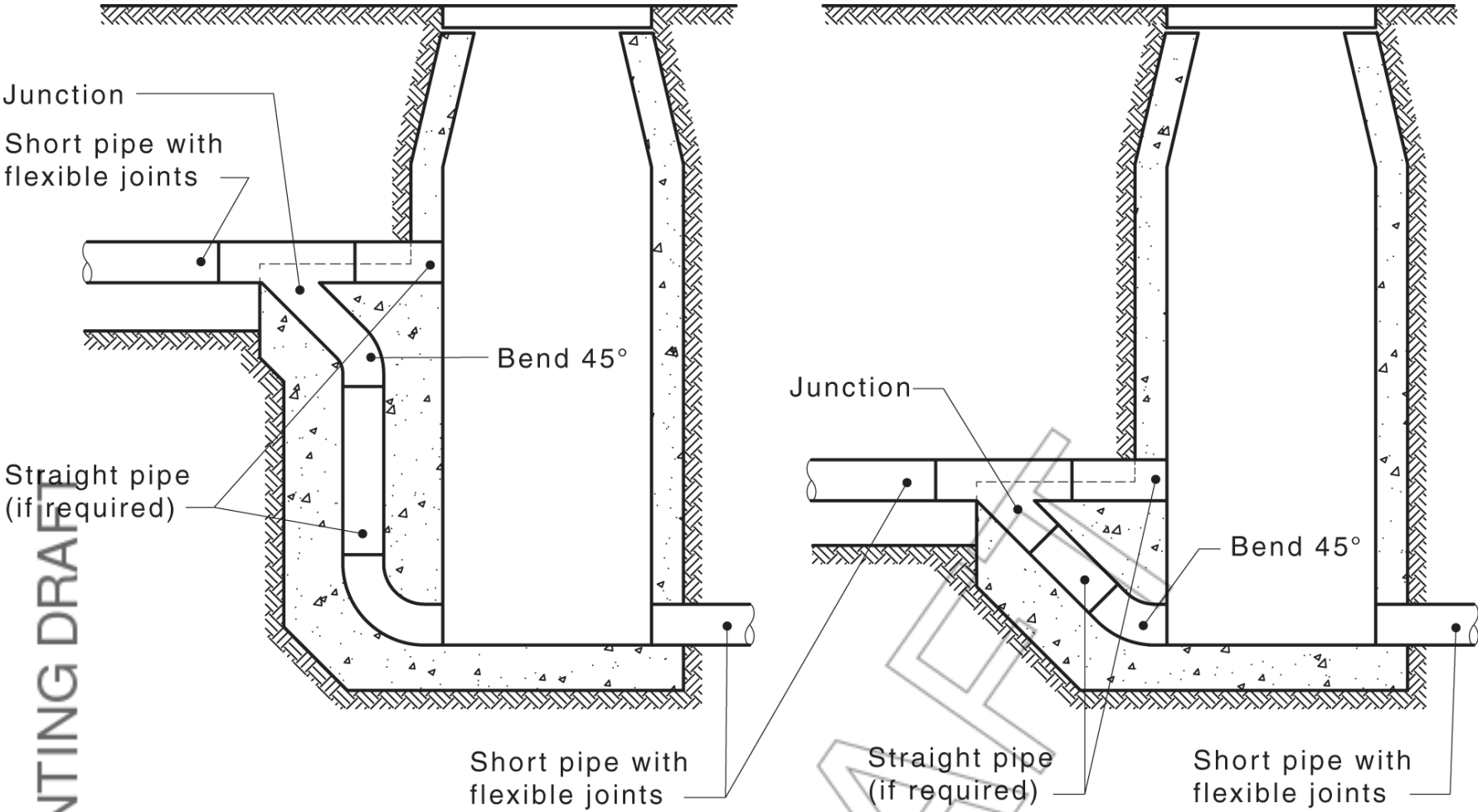
4.8.3.2 Jump-ups

Jump-ups at inspection chambers shall be as follows:

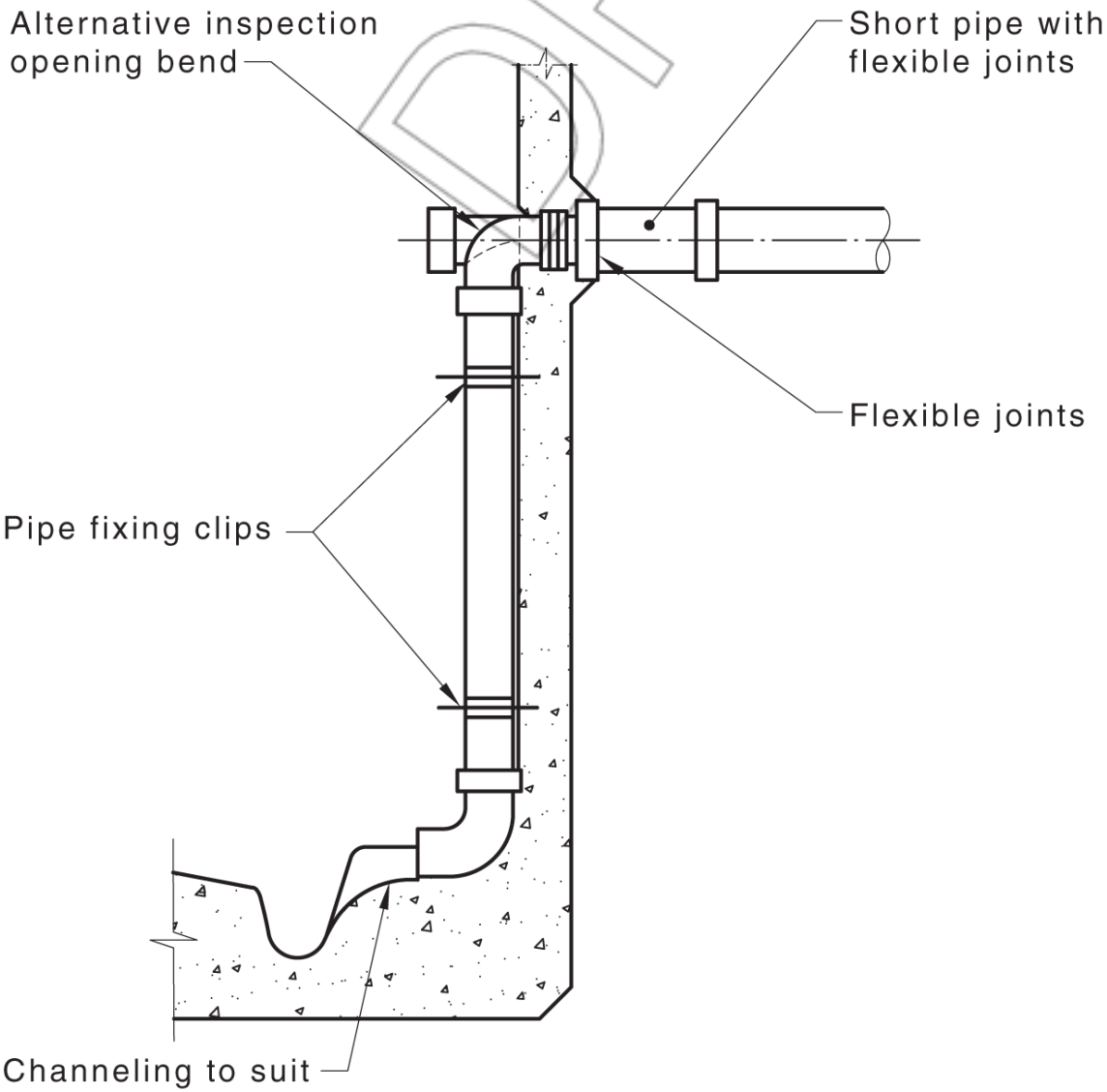
- (a) Where installed in an inspection chamber, the jump-up shall be clipped to the wall and terminate at each end with a 90° bend, the higher one of which shall incorporate an inspection opening or be a junction.
- (b) Where more than one jump-up is installed in any circular inspection chamber, the chamber shall be at least 1.2 m in diameter.

NOTE See [Figure 4.8.3.2](#) for typical jump-ups at inspection chambers.





(a) Jump-up outside the chamber



(b) Jump-up inside the chamber

Figure 4.8.3.2 — Typical jump-ups at inspection chambers

4.8.3.3 Ladders

Where the depth of an inspection chamber, well or sump exceeds 1.2 m, rung-type and individual-rung ladders shall be installed provided the individual-rung ladders are limited to inspection chambers with a maximum depth of 3.0 m and to structures without prefabricated walls.

- NOTE 1 Following manufacture, steel ladders should be hot-dip zinc galvanized.
- NOTE 2 Refer to AS 1657 for information on fixed platforms, walkways, stairways and ladders.
- NOTE 3 Refer to AS/NZS 4680 for information on hot dip galvanized (zinc) coatings on fabricated ferrous articles.

4.8.3.4 Cement rendering

The floor and cast *in situ* channels of all inspection chambers shall be rendered with a coat of cement mortar at least 10 mm thick and trowelled to a smooth finish.

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### 4.8.3.5 Top section

Inspection chambers may be constructed either full size to surface level or, at a height of not less than 1.5 m above the floor, may be tapered to an access opening, provided the access shaft is at least 600 mm in diameter and does not exceed 350 mm in length.

### 4.8.3.6 Access opening

A circular or rectangular access opening or access chamber at least 500 mm in size and fitted with a removable watertight cover shall be provided at surface level.

Where subject to vehicular traffic, the cover shall be adequate for the applied loading.

### 4.8.3.7 Construction joints

Where required, construction joints shall be provided in accordance with the following:

- (a) Not more than 24 h shall elapse between successive pours of concrete.
- (b) The keying surface shall be scabbled and cleaned.
- (c) A cement slurry or bonding agent shall be applied immediately prior to pouring concrete.

### 4.8.3.8 Inserts

Holes broken into, or formed in, walls of inspection chambers for insertion of pipes or fittings shall be made watertight by —

- (a) keying and preparing as for construction joints, caulking the annular space between the concrete and pipe, or fitting with a stiff 2:1 mix of sand-to-cement mortar; or
- (b) sealing with an epoxy-based or other type of sealant.

## 4.8.4 Differential settlement

Where differential settlement may occur and a drain passes through the wall of an inspection chamber over 1 m deep, two flexible joints shall be provided on the drain adjacent to the wall. The length of drain between the two flexible joints shall not exceed 600 mm, see [Figure 4.8.3.2](#).

## 4.9 Junctions in drains

### 4.9.1 Drains installed at grade

#### 4.9.1.1 General

The connection of any drain to a graded drain shall be by means of a junction with an upstream angle not greater than 45°. The connection shall conform to the following:

- (a) Double 45° junctions shall not be used.
- (b) Where unequal junctions are used, the invert of the branch drain shall be at least 10 mm higher than the soffit of the drain to which it connects, see [Figure 4.9.1 \(b\)](#).

NOTE See [Figure 4.9.1](#) for a typical arrangement of drains joined at grade.

#### 4.9.1.2 New installations

Where a junction is used to make the connection of a DN 100 branch drain to another DN 100 drain, the entry level of the branch drain shall be elevated at an incline of not less than 15° above the horizontal.

NOTE 1 See [Figure 4.9.1 \(a\)](#) for a typical example of a branch drain entering another drain.

NOTE 2 Positioning the junction a minimum of 15° above horizontal removes the probability of the partial backwash of a discharge into the branch causing stranding that can lead to blockages in the drain.

NOTE 3 Refer to AS/NZS 3500.0 for the definition of a branch drain.

#### 4.9.1.3 Other installations

The entry level of the branch drain may be on grade —

- (a) for repairs or extensions to existing installations;
- (b) where WC pans are not connected upstream; or
- (c) where the main and branch drains are not DN 100.

NOTE Where sufficient height is available in existing installations to avoid the potential for blockages, it is recommended the provisions of [Clause 4.9.1.2](#), be followed.

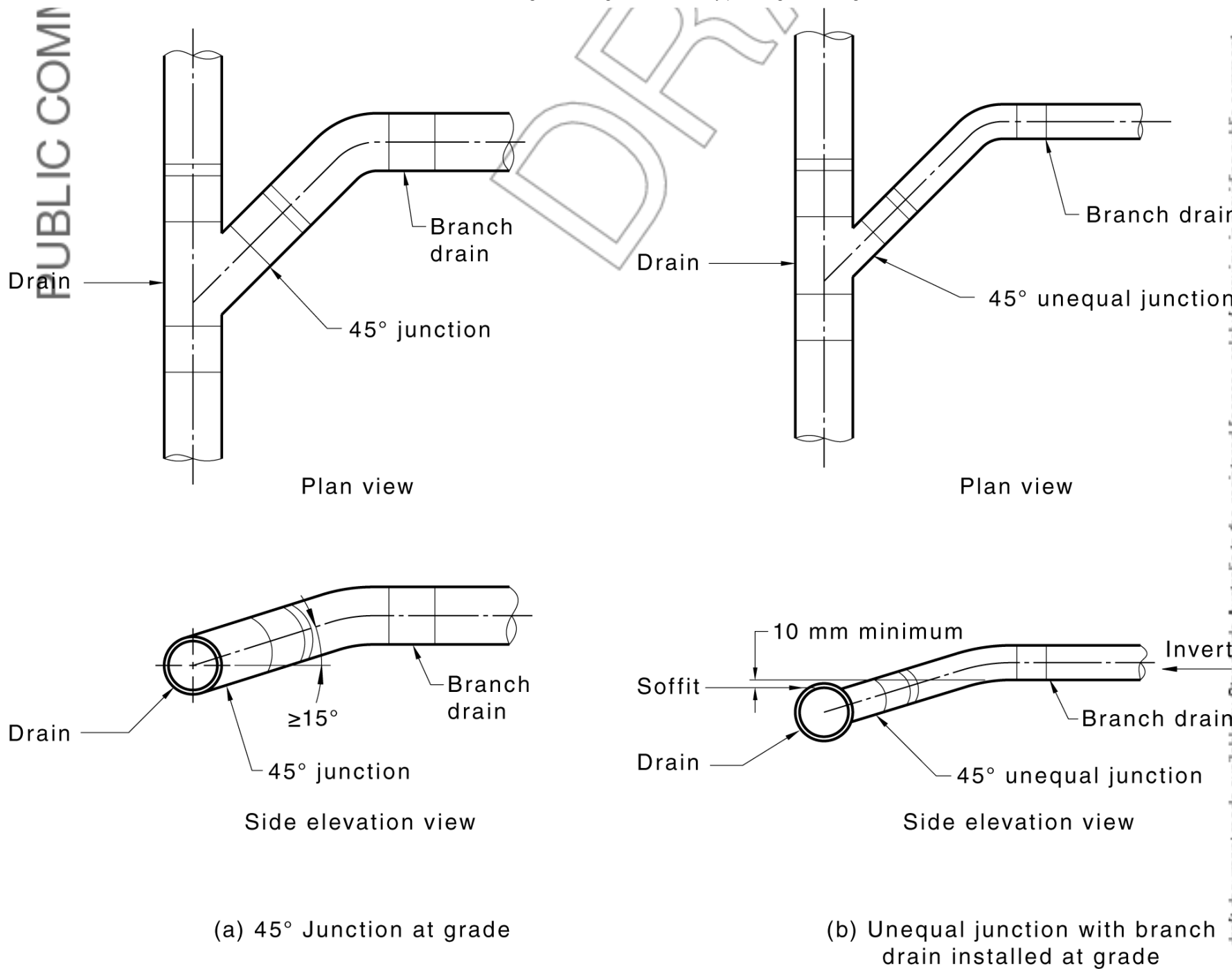


Figure 4.9.1 — Typical arrangement for a graded branch drain entering another drain

## 4.9.2 Junctions installed in vertical plane

Junctions installed in a vertical plane shall not be used for connection of stacks. Junctions installed in the vertical plane for the connection of a single discharge pipe or a drain shall have an upstream angle not greater than  $45^\circ$ , provided the following criteria are met, where applicable:

- (a) The vertical riser does not exceed 2 m in height, above the invert of the graded drain.
- (b) Where the length of the branch drain connected to the vertical riser exceeds 500 mm, the branch drain is independently supported.
- (c) Where a vertical riser is to be extended to finished surface level and/or the distance between the invert of the main drain and the invert of the branch drain exceeds 1 m, the junction is supported in accordance with [Clause 5.3](#).

## 4.9.3 Square junctions

Square junctions in drains shall be used only —

- (a) at the top of a jump-up at the point of connection;
- (b) at the connection of an inspection shaft to a graded drain;
- (c) at the connection of a drain to a boundary trap riser;
- (d) where a vent is connected to a boundary trap riser;
- (e) as the inlet riser of a gully or floor waste gully;
- (f) as an inspection opening; and
- (g) at the top of a jump-up in a drain, in lieu of a bend and inspection opening.

## 4.9.4 Junctions for stacks connected to below-ground drainage

A  $45^\circ$  junction installed on grade and a bend at the base of the stack, as specified in [Clause 6.8.3](#), shall be used for the connection of a stack to a below-ground drain.

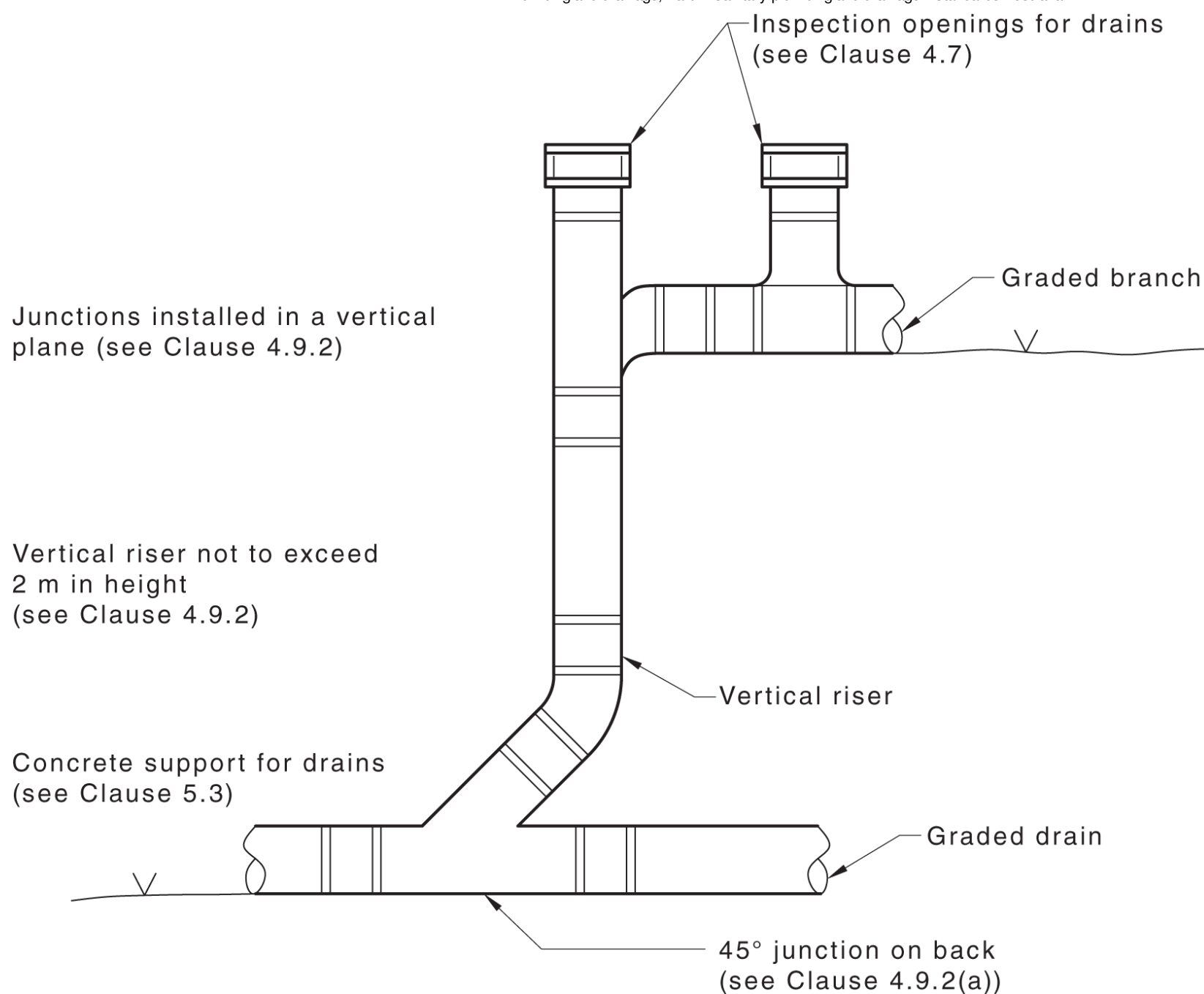
## 4.10 Jump-ups

Jump-ups in drains shall be constructed in accordance with the following:

- (a) The bend at the base of the vertical section of drain shall be supported in accordance with [Clause 5.3](#).
- (b) A bend,  $45^\circ$  junction, square junction or a sweep junction shall be used at the top of the vertical section of drain.
- (c) The vertical section shall be protected and supported during the installation and placement of backfilling.

Branch drains connected to jump-ups shall be independently supported where the unsupported length exceeds 500 mm.





**Figure 4.10 — Typical vertical jump-up from main drain to graded branches**

#### 4.11 Disconnection and sealing

#### 4.11.1 Disconnection from the sewer

Disused drains shall be disconnected in accordance with the following:

- (a) Disconnection shall be made at the point of connection to the network utility operator's sewer.
- (b) Extraneous water, soil, sand, rock or other substances shall not enter the sewer.
- (c) Where the point of connection is in water-charged ground, dewatering shall be carried out in accordance with [Clause 5.2.3](#).

#### 4.11.2 Sealing

Disused drains shall be disconnected as near as practicable to the drains remaining in service, which shall be made watertight using a cap or plug and sealed in a manner appropriate for the material remaining in use.

## 5 Excavation bedding support and backfilling

## 5.1 Scope of section

This section specifies requirements for excavation, bedding, support and backfilling of drains. It covers pipes up to DN 225, see [Clause 3.8](#).

NOTE 1 Excavation should be conducted in accordance with workplace health and safety legislation.

NOTE 2 See [Clause 3.8.2](#) where the bottom of the trench is adjacent to or below the footing and walls of any adjoining building or structure.

## 5.2 Excavation of trenches

### 5.2.1 Trench dimensions

Trenches shall be made with a minimum clearance of 100 mm on each side of the drain barrel, measured to the inside of the sheeting or side of trench.

### 5.2.2 Over-excavation

Where a trench has been excavated deeper than necessary, the excess depth shall be filled either with bedding material compacted to achieve a density as near to the original soil density as possible, or with concrete.

### 5.2.3 Water-charged ground

Excavation in water-charged ground shall be in accordance with the following:

- (a) The water level shall be lowered below the base of the proposed trench and maintained at that level during excavation, laying of the drain and backfilling of the trench.
- (b) Dewatering shall be carried out in accordance with the following:
  - (i) The removed water shall be discharged into a location where it will not cause a nuisance or damage to property or the environment.

(ii) The removed water shall not discharge, either directly or indirectly, into the sewer.

NOTE Pumps and spearheads or similar devices may be used.

### 5.3 Concrete support for drains

Concrete pads used to support drains shall be a minimum of 100 mm thick and be laid —

- (a) under gully traps and boundary traps of material other than cast iron;
- (b) under all inspection junctions where a riser is brought to the surface;
- (c) under all bends greater than DN 65 forming risers from the main drain;
- (d) not closer than 20 mm to flexible joints;
- (e) for square junctions, beneath the junction to a minimum thickness of 100 mm and continued up vertically to the centre of the junction fitting; and
- (f) for 45° junctions, beneath the junction to a minimum thickness of 100 mm and continued up vertically to the underside of the bend fitted to the junction fitting.

### 5.4 Bedding of drains

#### 5.4.1 General

The bed onto which drains are laid shall continuously support the installed drain accommodating the loads from the pipeline and surrounding ground. Bedding of drains shall conform to the following:

- (a) In stable soil, drains shall either be laid on a bedding material conforming with [Clause 5.4.2](#) or be directly supported on the undisturbed base of the trench, provided the base of the trench is free from any rocks or tree roots.
- (b) In clay, rock, shale, gravel or ground containing hard objects, drains shall be supported on a bedding material placed in the base of the trench.
- (c) Groundwater or surface water entering the trench shall not disturb the bedding materials.

#### 5.4.2 Bedding materials

Filling materials used for bedding of drains shall be one of the following:

- (a) Crushed rock, gravel screenings or similar recycled materials of nominal size between 7 mm and 10 mm.
- (b) Cement mortar containing 1 part of Portland cement to 4 parts of sand by volume, thoroughly mixed with clean water to a workable consistency.
- (c) Cement mortar bedding where the base of the trench is rock or shale. Where the grade is greater than 20 % (1 in 5), the cement mortar shall be —
  - (i) of a minimum depth of 50 mm, measured below the barrel of the pipe;
  - (ii) not less than 75 mm wide;
  - (iii) not closer than 20 mm to flexible joints; and
  - (iv) have pipes supported at not greater than 1 500 mm from the centres, prior to placing the mortar bedding.
- (d) Free-running sand capable of passing through a 2 mm mesh sieve, which does not contain clay, organic or any other deleterious materials.

NOTE 1 Cast iron and ductile iron pipes may be unsupported for up to 600 mm either side of each pipe joint.

NOTE 2 Refer to AS/NZS 2032 for installation of PVC-U pipe systems.

NOTE 3 Refer to AS/NZS 2033 for installation of polyethylene pipe systems.

#### 5.4.3 Pipe side support and overlay materials

Pipe side support and pipe overlay material shall not be inferior to the pipe bedding material.

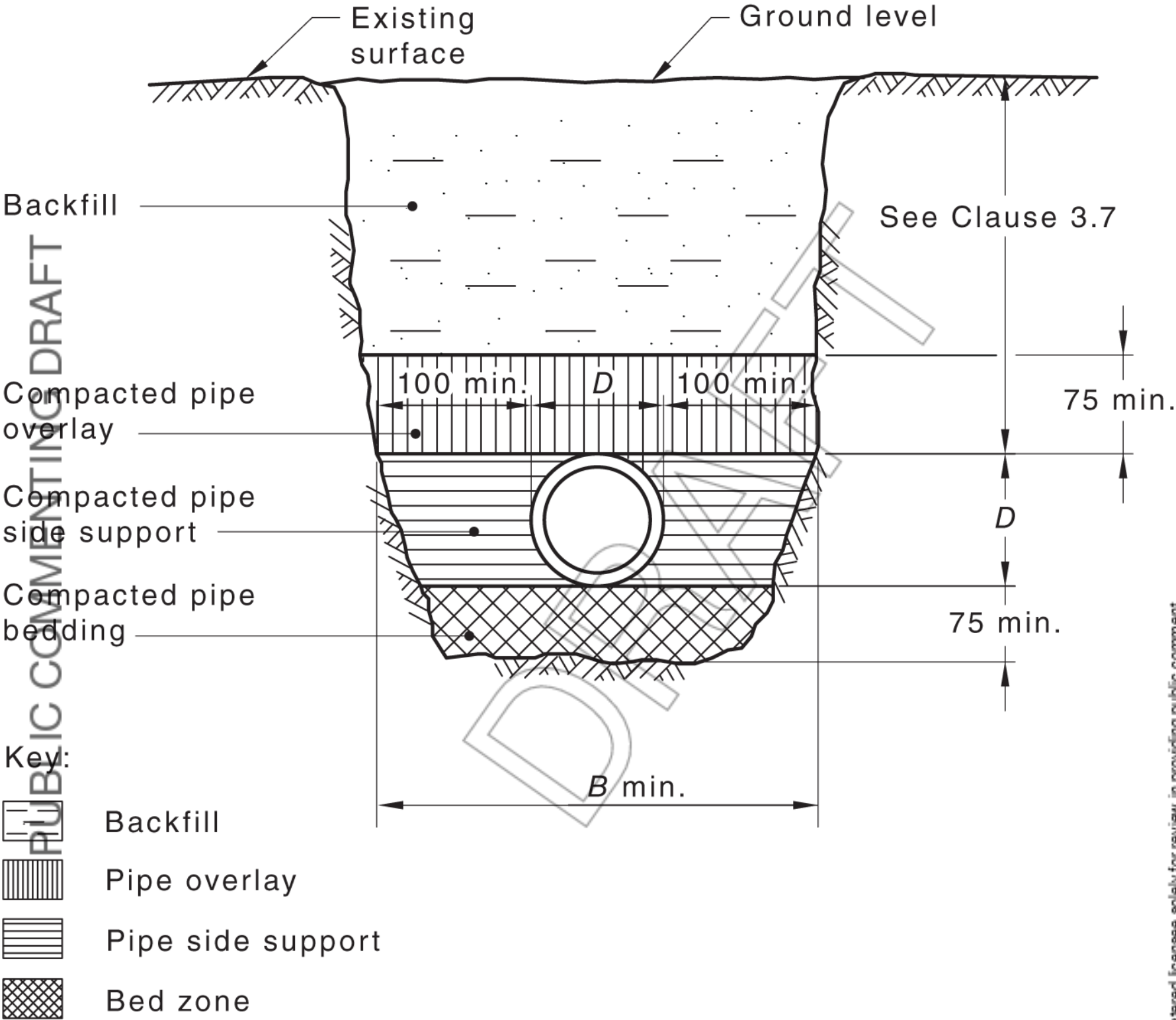
#### 5.4.4 Bedding and backfill

The sanitary drainage services shall be surrounded with not less than 75 mm of compacted sand, or fine-grained soil, with no hard-edged object to come in contact with or rest against any pipe or fitting.

NOTE See [Figure 5.4.4](#) for a typical example of bedding a drain.

Backfill shall be free from builder’s waste, bricks, concrete pieces, rocks or hard matter larger than 25 mm, and soil lumps larger than 75 mm.

Dimensions in millimetres



$B_{min.} = D + 200$

Figure 5.4.4 — Typical bedding of drains

5.4.5 Minimum cover

The minimum cover requirements for drain shall be in accordance with [Clause 3.7](#).

5.5 Installation of backfill materials

5.5.1 General

Backfill materials shall be compacted to restore the trench as near as practicable to the normal surrounding ground surface level and reduce the likelihood of subsidence.

NOTE See [Clause 3.7](#) for minimum cover.

5.5.2 Excavated material

Excavated material from the trench may be suitable for final backfill, provided it is free from rock, hard matter and organic material, and broken up so that it does not contain soil lumps larger than 75 mm.

NOTE Soil lumps larger than 75 mm may prevent adequate compaction.

5.6 Drains in other than stable ground

Where drains are to be laid in filled, unstable or water-charged ground, methods of support and bedding shall be designed to withstand and suit the ground conditions.

NOTE 1 See [Appendix G](#) for information on the installation of plastics pipe drainage systems in unstable soils within Australia.

NOTE 2 AS 2870 provides special design considerations for drains associated with residential slab or footing systems on moderately, highly or extremely reactive soils.

NOTE 3 [Clause 3.8.2](#) provides special design considerations for drains in close proximity to footings.

NOTE 4 For proclaimed mine subsidence or landslip districts, the appropriate authority should be referred to for advice on subsidence or landslip design parameters for proposed drainage systems.

NOTE 5 In Australia, acceptable evidence that a design may be deemed suitable is provided for in the Plumbing Code of Australia.

NOTE 6 In New Zealand, drains in other than stable ground should be specifically designed.

NOTE 7 In New Zealand, refer to NZS 4404 for information on the design of wastewater pipes in seismically active areas.

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# 6 General design requirements for sanitary plumbing systems

## 6.1 Scope of section

This section specifies requirements for all types of sanitary plumbing systems.

NOTE 1 The number of floor levels is specified in [Clause 9.2.5](#).

NOTE 2 See [Section 16](#) for information on vacuum drainage systems.

## 6.2 Renovation

When renovating a sanitary plumbing system by relining, the requirements of [Clause 3.16.3](#) shall apply.

## 6.3 Fixture unit ratings

Fixture unit ratings for all fixtures are given in [Table 6.3\(A\)](#). These ratings shall be used for the sizing of drains, stacks and graded discharge pipes.

Table 6.3(A) — Fixture unit ratings				
Fixture	Fixture abbreviations	Min. size of trap outlet and fixture discharge pipe DN		Fixture unit rating
			NZ (only)	
Autopsy table	AT	50		3
Bain-marie	BM	40		1
Basin	B	40	32	1
Bath (with or without shower) <sup>a</sup>	Bath	40		4
Bath (foot)	Bath (foot)	40		3
Bath (baby)	Bath (baby)	40		3
Bath (shower)	Bath (shr)	40		4
Bedpan sterilizer	BPS	50		4
Bedpan washer	BPW	80		6 (F. valve) 4 (Cist.)
Bedpan washer	BPW	100		6 (F. valve) 4 (Cist.)
Bedpan washer/sterilizer	BPWS	80		6 (F. valve) 4 (Cist.)
Bedpan washer/sterilizer	BPWS	100		6 (F. valve) 4 (Cist.)
Bidet, bidette	Bid	40	32	1
Circular wash fountain	CWF	50		4
Clothes-washing machine — domestic commercial	CWM	40		5
		50		See <a href="#">Table 6.3(B)</a>
Dental unit	DU	40		1
Dishwashing machine — domestic commercial	DWM	40		3
		50		See <a href="#">Table 6.3(B)</a>
Drinking fountain	DF	40	25	1
Floor waste gully — without fixture with fixture	FWG	50		0 as per fixture rating
Glass-washing machine		40		3
Potato peeler	PP	50		3
Sanitary napkin disposal unit	SNDU	40		3
Shower — Single multiple	Shr	40		2
		50		2 per shower head
Sink — single (with or without disposal unit) <sup>b</sup> double (with or without disposal unit) tea bar, domestic bar, commercial	S	50	40	3
	S	50	40	3
	T	50	40	1
	BS(D)	40		1
	BS(C)	50		3
Sink cleaner	CS	50	40	1
Sink laboratory <sup>b</sup>	LS	50		1
Sink (pot or utility)	PS	50		5
Slop hopper	SH	100		6 (F. valve) 4 (Cist.)

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Trough — ablation laundry (single or double)	Tr.(A) Tr.(L)	40 40		3 5
Urinal — wall-hung (including waterless) stall, or each 600 mm length of slab	Ur	40 50	32	1 1
Water closet pan	WC	80		6 (F. valve) 4 (Cist.)
Water closet pan	WC	100		6 (F. valve) 4 (Cist.)
Bathroom group in a single room (basin, bath, shower, water closet)				6
Combination pan room sink and flushing bowl	PRS	80		6 (F. valve) 4 (Cist.)
Combination pan room sink	PRS	100		6 (F. valve) 4 (Cist.)

<sup>a</sup> The maximum discharge from any fixture into the single-stack and single-stack modified system is 500 L. If the discharge is in excess of 500 L, the fixture unit loading may be determined in accordance with [Table 6.3\(B\)](#).

<sup>b</sup> To meet the requirements of the AS 1428 series, accessible design sinks on height-adjustable working surfaces in kitchens and laboratories may have DN 40 fixture discharge pipes.

NOTE 1 Where a dishwashing machine is connected to a sink trap, only the sink fixture unit rating is considered. Where a clothes-washing machine is connected to a trough trap, only the trough fixture unit rating is considered.

NOTE 2 Where waste fixtures are connected to a floor waste gully, the fixture unit rating of the floor waste gully is the sum of the fixture unit ratings of the fixtures connected.

Table 6.3(B) — Fixture unit ratings for continuous flows								
Flow, L/s	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Fixture unit equivalent rating	6	8	15	25	40	60	85	115

## 6.4 Venting for fixtures discharge pipes

Except for fixtures discharging to disconnector gullies (in which case [Table 4.6.3](#) applies), where the length of the fixture discharge pipe exceeds the length specified in [Appendix B](#), a trap vent or air admittance valve shall be provided.

NOTE See [Table 4.6.7.2](#) for discharge pipes connected to floor waste gullies.

## 6.5 Trapping of fixtures and appliances

### 6.5.1 General

Each sanitary fixture and appliance shall have a trap or self-sealing device. The trap or self-sealing device shall be in the same room as the fixture and/or appliance that it serves and be accessible.

### 6.5.2 Water seal

Under normal operating conditions, fixture traps shall retain a water seal of not less than 25 mm.

Traps that are installed in a pressurized chamber shall retain a water seal of not less than 70 mm when the maximum pressure within the chamber is applied.

### 6.5.3 Location of traps and self-sealing devices

Traps and self-sealing devices shall be connected as close as practicable to the outlet of the fixture or appliance being served. The maximum distance from the outlet of a fixture to the surface of the water seal of a trap shall be 600 mm for fixtures other than floor waste gullies and fixture pairs.

NOTE 1 See [Clause 4.6.7.7](#) for floor waste gullies.

NOTE 2 See [Clause 6.5.4](#) for fixture pairs.

### 6.5.4 Multiple outlets

#### 6.5.4.1 General

The following fixtures, or a combination thereof, may be connected in pairs to a single fixture trap, provided the fixtures have similar spill levels:

- (a) Basins.
- (b) Sinks (other than pot, laboratory or utility sinks).
- (c) Showers.
- (d) Laundry troughs.
- (e) Ablution troughs.

#### 6.5.4.2 Distance between outlets

Pairs of fixtures shall be connected so that the distance between their outlets does not exceed 1.2 m.

NOTE A typical connection of a fixture pair is shown in [Figure 6.5.4.2](#).

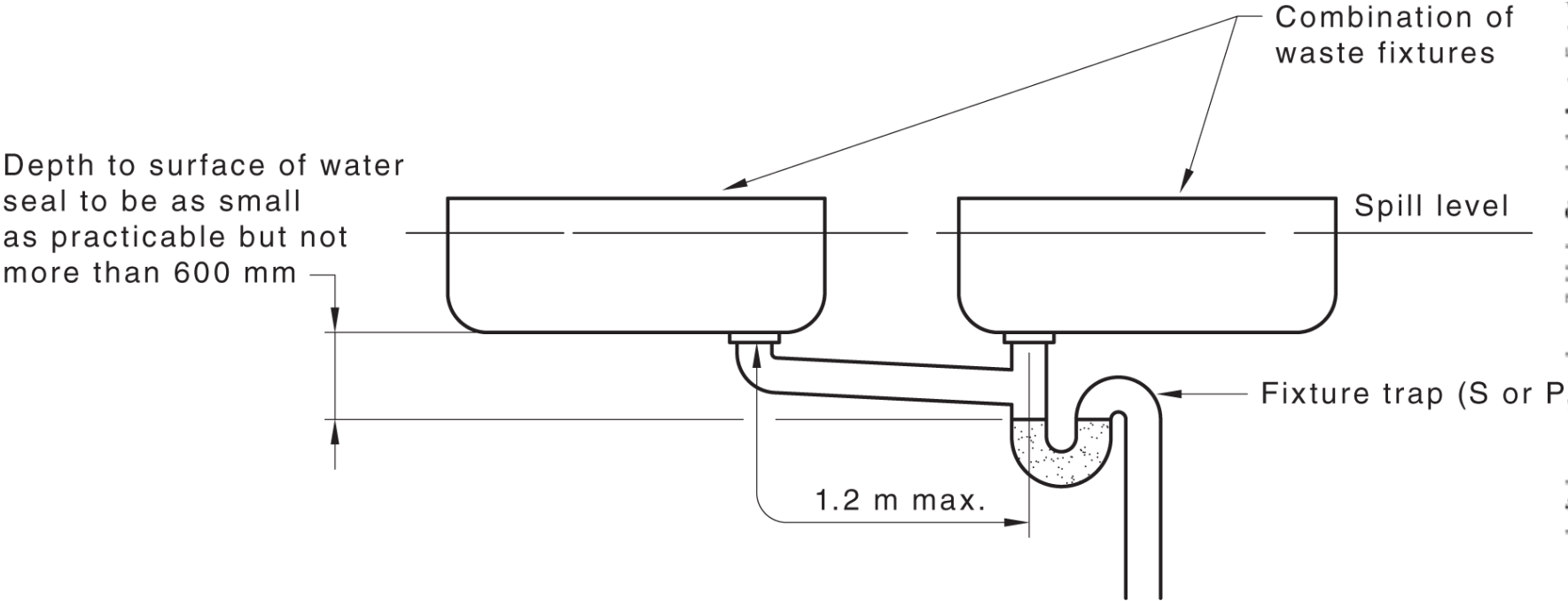


Figure 6.5.4.2 — Typical connection of a fixture pair

6.6 Graded discharge pipes

6.6.1 Minimum grades

The minimum grades of discharge pipes shall be in accordance with [Table 6.6.1](#).

Table 6.6.1 — Minimum grades of discharge pipes	
Size of graded section of pipe DN	Minimum grade %
40	2.50
50	2.50
65	2.50
80	1.65
100	1.65
125	1.25
150	1.00
225	0.65
300	0.40

NOTE: [Appendix C](#) provides a table for conversion of grades as a percentage to grades as a ratio.

6.6.2 Connection methods

6.6.2.1 General

Connection of graded pipes to each other or connection of fixture discharge pipes to graded pipes shall be in accordance with the following:

- (a) Graded discharge pipes of different sizes shall be connected so that the soffits of both pipes are in common alignment.
- (b) The invert level of a trap or floor waste gully weir shall be a minimum of 10 mm higher than the soffit of the graded discharge pipe to which it connects.

NOTE: See [Figure 6.6.2.1](#) for a typical connection.

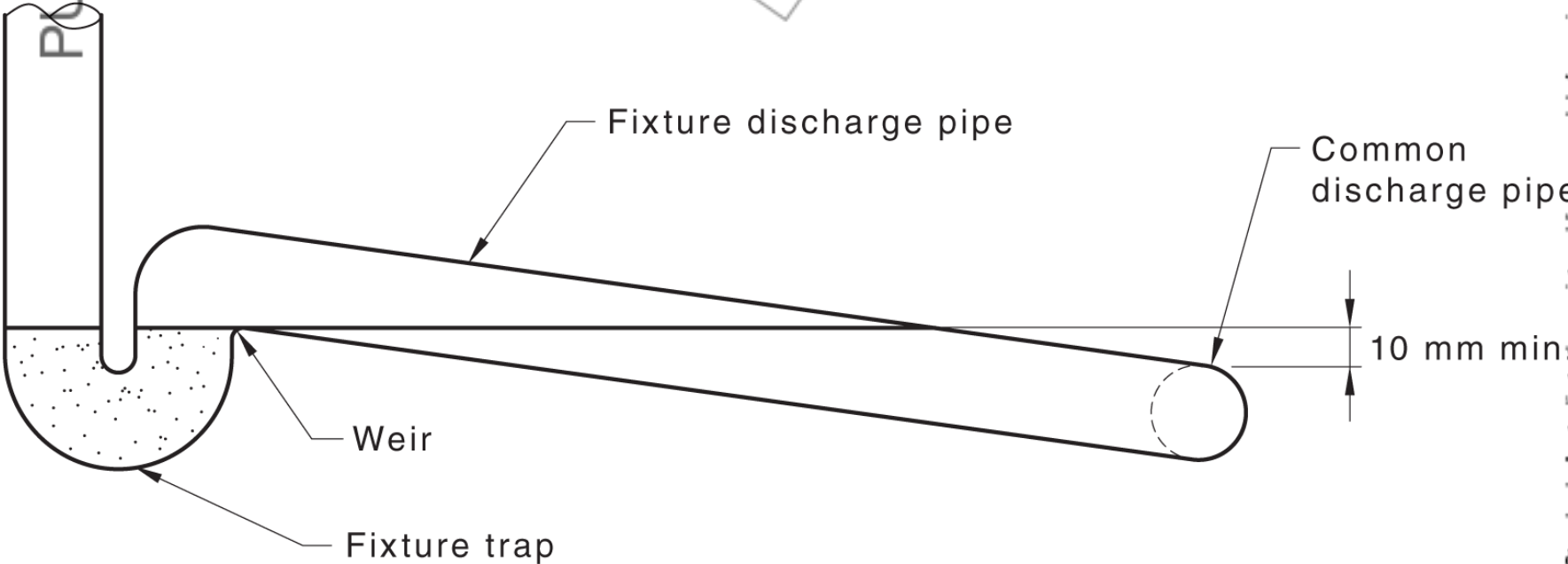


Figure 6.6.2.1 — Typical connection of fixture discharge pipe to a common discharge pipe

6.6.2.2 Opposed discharges

Opposed discharge pipes shall be connected to conform to [Clause 6.6.2.1](#) using —

- (a) two separate junction fittings; or
- (b) junction branches fabricated so that the opposed junction entries do not overlap.



### 6.6.2.3 Junctions in graded pipes

Junctions (whether equal or unequal) shall be 45°.

Double 45° junctions or double sweep junctions shall not be used to make connections on grade.

### 6.6.2.4 Junctions installed at grade

#### 6.6.2.4.1 General

Graded discharge pipes shall be joined to each other by means of a 45° junction. Where unequal junctions are used, the invert of the branch discharge pipe shall be at least 10 mm higher than the soffit of the discharge pipe to which it connects.

NOTE See [Figure 4.9.1](#) for a typical arrangement of junctions installed at grade.

#### 6.6.2.4.2 New installations

Where a junction is used to make the connection of a DN 100 branch pipe to another DN 100 pipe, the entry level of the branch pipe shall be elevated at an incline of not less than 15° above the horizontal. Where a fixture is connected to a graded discharge pipe, the installation shall also be in accordance with [Clause 6.6.2.1](#).

NOTE 1 See [Figure 4.9.1](#) (a) for a typical example.

NOTE 2 Positioning the junction a minimum of 15° above horizontal removes the probability of the partial backwash of a discharge into the branch causing stranding that can lead to blockages in the pipe.

NOTE 3 Refer to AS/NZS 3500.0 for the definition of a branch pipe.

#### 6.6.2.4.3 Other installations

The entry level of the branch pipe may be on grade —

- (a) for repairs or extensions to existing installations;
- (b) where WC pans are not connected upstream; or
- (c) where the main and branch pipes are not DN 100.

NOTE Where sufficient height is available in existing installations, to avoid the potential for blockages it is recommended the provisions of [Clause 6.6.2.4.1](#) be followed.

### 6.6.2.5 Junctions installed in a vertical plane

Forty-five degree junctions shall be installed in the vertical plane for the connection of a single discharge pipe and common discharge pipe.

### 6.6.2.6 Junctions for stacks connected to a graded pipe

Junctions installed on grade for the connection of a stack to a graded pipe shall be in accordance with [Clause 6.8.3](#).

## 6.7 Junctions in stacks

### 6.7.1 Types

The following types of junctions may be used to connect fixture, branch or common discharge pipes to a stack:

- (a) 45° junctions.
- (b) Sweep junctions.
- (c) Aerator junctions.
- (d) Ball junctions.
- (e) Square junctions.

No fixture shall be connected to the branch or common discharge pipe within 500 mm in length from the stack if the entry is at grade.

### 6.7.2 Restrictions for square and ball junctions

Where any fixture trap is connected to a ball junction, the weir of the fixture trap shall be at the same height or above the top of the branch junction fitting.

Where a square or ball junction is used and any discharge pipe is less than 500 mm in length from the stack, one of the following shall apply:

- (a) A self-sealing device shall be fitted to the fixture.
- (b) An S-trap shall be fitted to the fixture and a vertical dropper provided in the discharge pipe between the fixture and the stack junction.
- (c) A P-trap shall be fitted to the fixture, and the discharge pipe graded at not less than 6.65 % (1 in 15).

### 6.7.3 Opposed connections

#### 6.7.3.1 At the same level

Opposed connections at ball junctions or aerator junction fittings shall only be used where the opposing pipes are connected to equal numbers of the same type of fixtures.

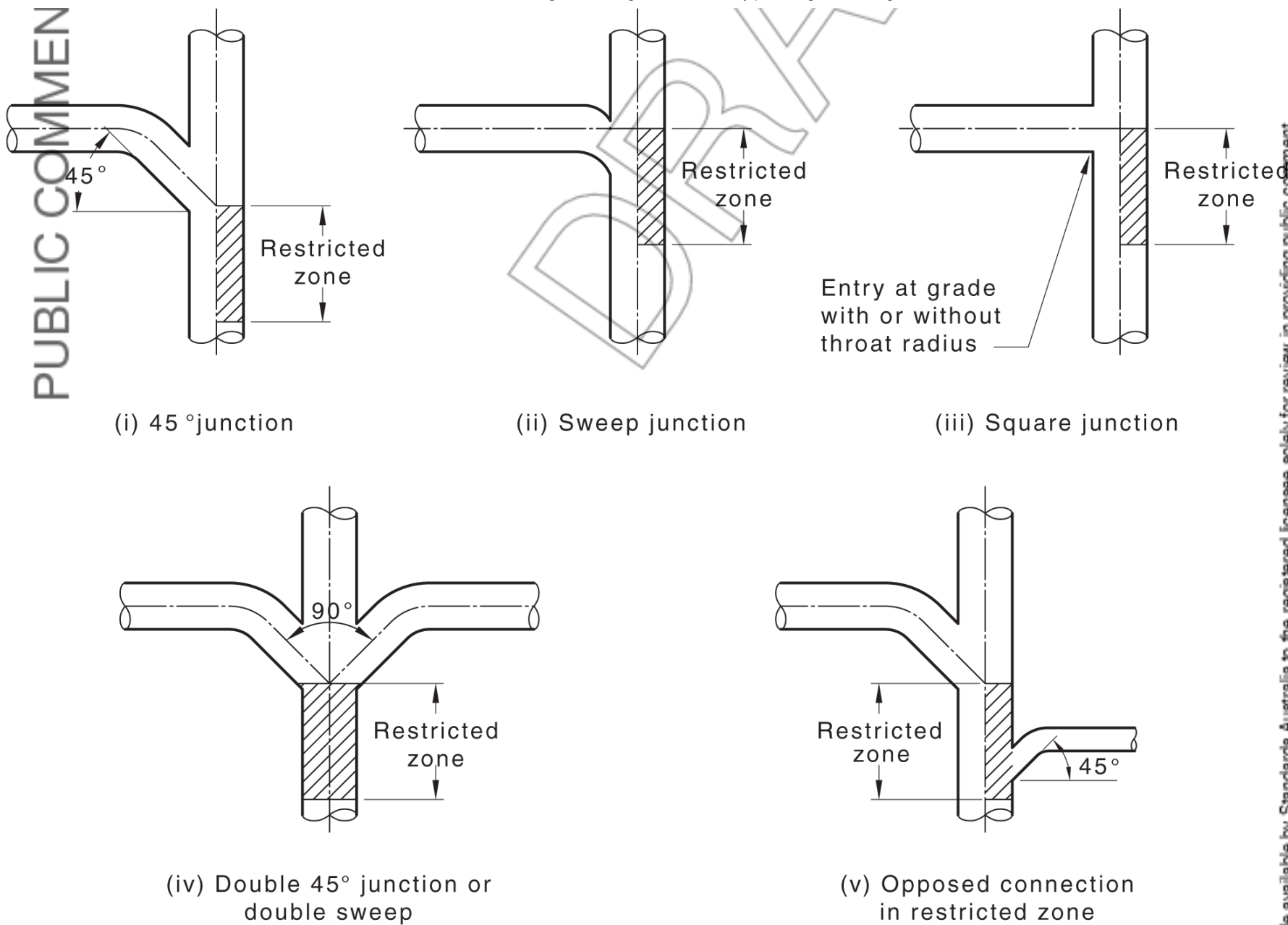
Opposed connections, other than at ball type junctions or aerator junction fittings, shall only be made using double 45° junctions or double sweep junctions.

#### 6.7.3.2 At different levels

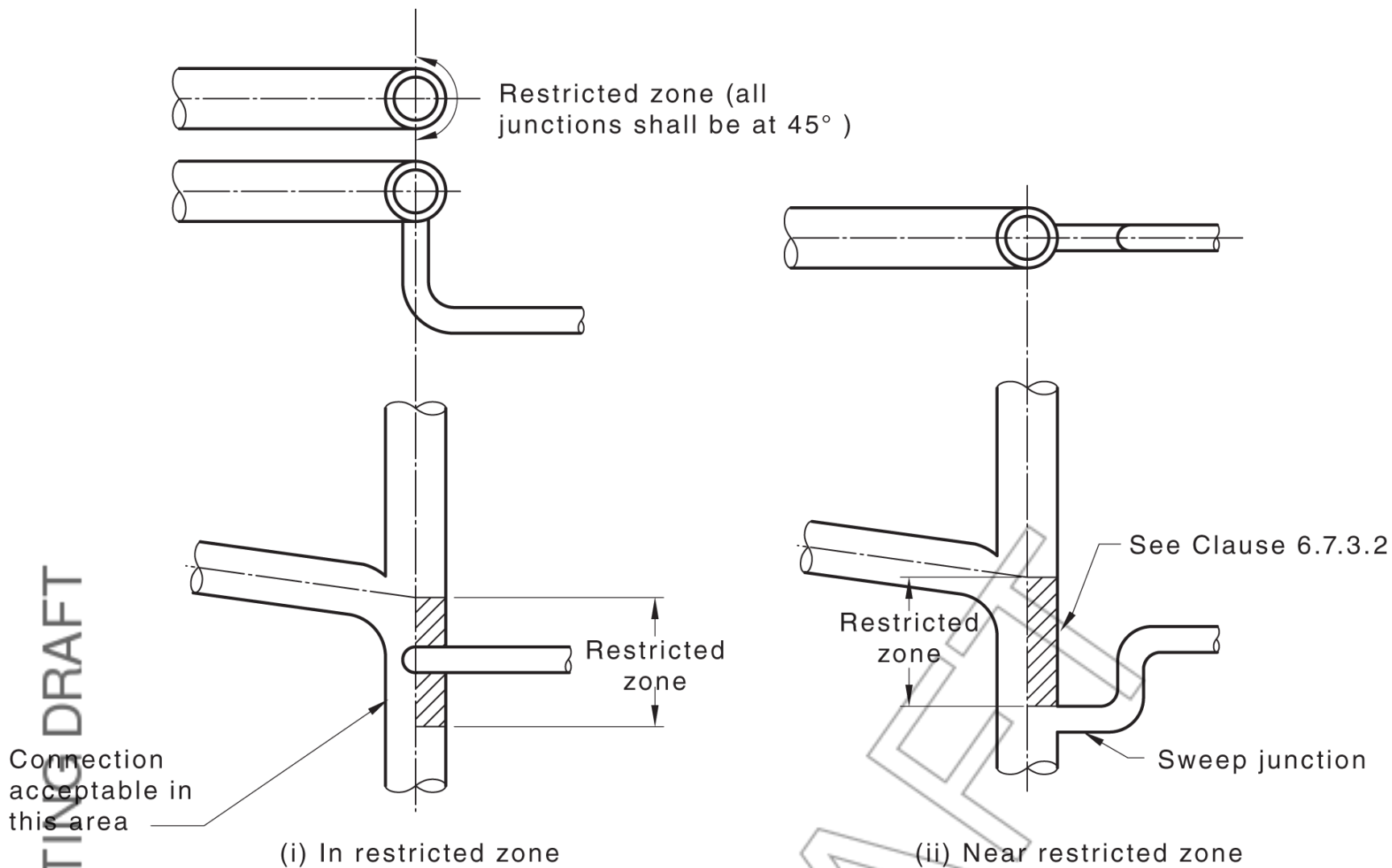
Graded fixture or common discharge pipes that are located at a lower level than any other opposed similar pipes shall not be connected to a stack within a restricted entry zone, as specified in [Table 6.7.3.2](#) and [Figure 6.7.3.2](#), unless the lower pipe enters the stack at an angle of 45°.

Table 6.7.3.2 — Restricted entry zone requirements				
Discharge pipe size DN		Stack size DN		Restricted entry zone vertical depth mm
40	≤ 65	> 40	≤ 80	90
40	≤ 65	100		110
40	≤ 65	125		210
40	≤ 65	150		250
80		≥ 80		200

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(a) Zone restrictions for stack connections



(b) Connections in or near restricted zones

Figure 6.7.3.2 — Connections to stacks

## 6.8 Connections near base of stacks

### 6.8.1 Connections to drains or graded pipes

Discharge pipes shall connect to a drain or a graded pipe in accordance with Figure 6.8.1 and the following:

- (a) For stacks of three floor levels or more —
  - (i) no connection shall be made closer than 2.5 m downstream or 1 m upstream of the base of the stack; and
  - (ii) no discharge pipe connecting a fixture upstream of a junction that connects a stack to a drain or graded pipe shall be closer than 1 m from the base of the stack.

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- (b) For stacks of two floor levels or less —
- (i) no connection shall be made closer than 500 mm downstream or upstream of the base of the stack; and

(ii) no discharge pipe connecting a fixture upstream of a junction that connects a stack to a drain or graded pipe shall be within 500 mm of the base of the stack.

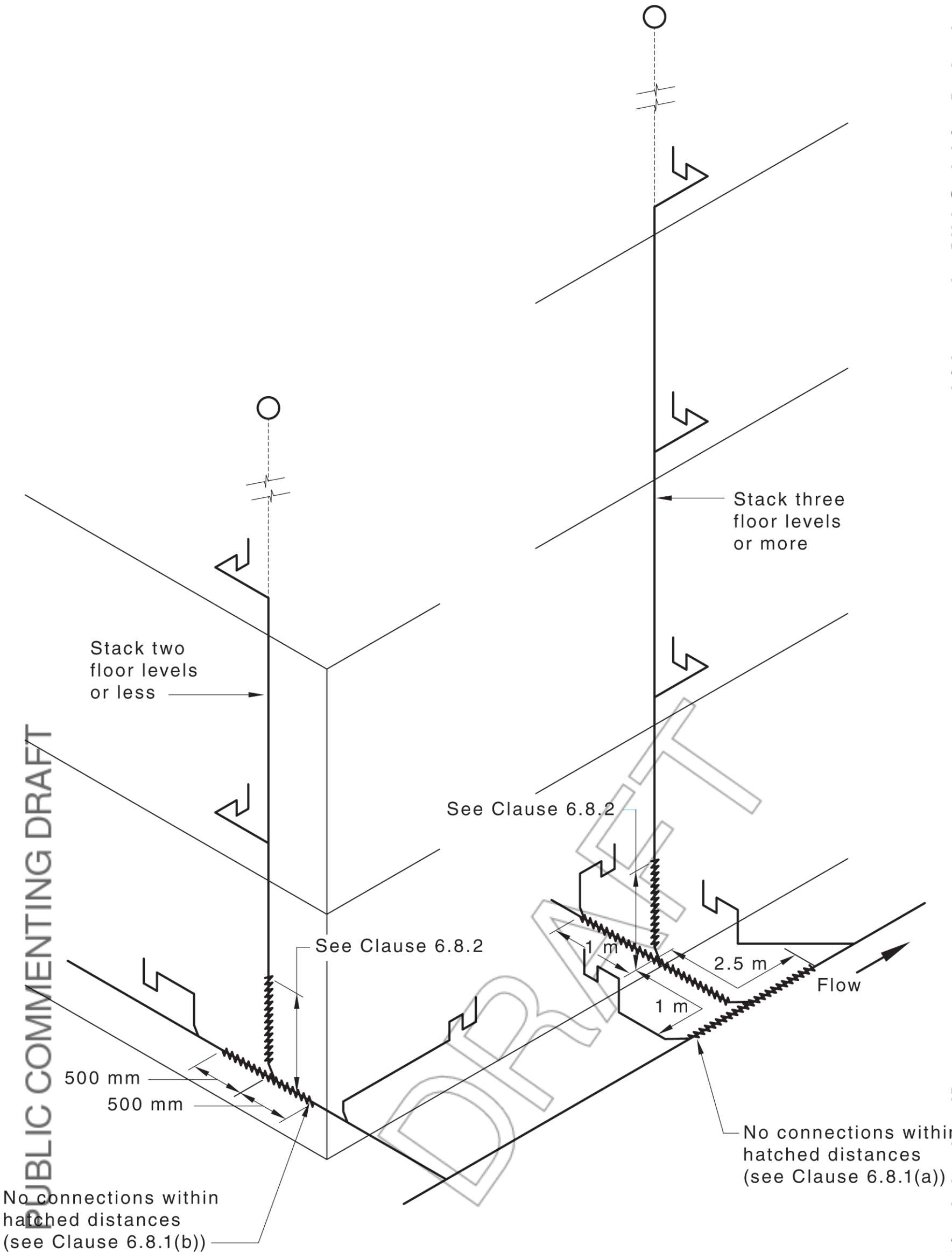


Figure 6.8.1 — Connections at or near base of stack

6.8.2 Connections above base of stack

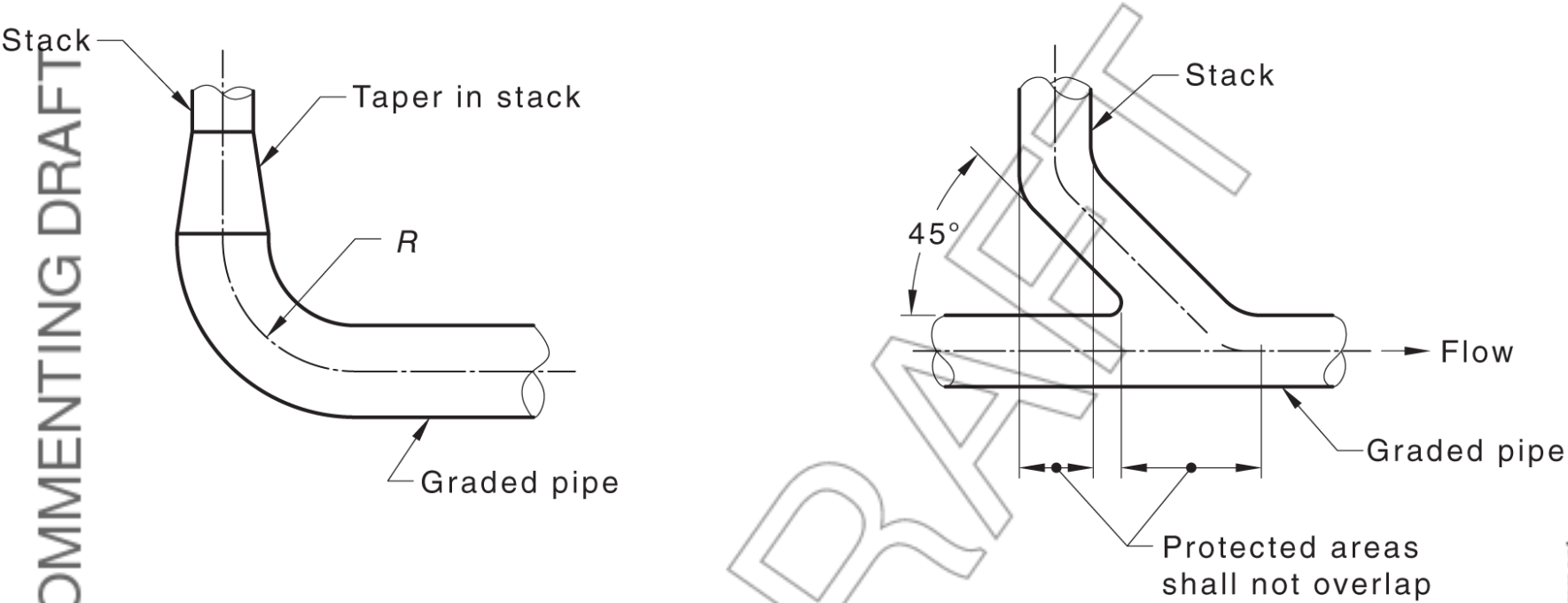
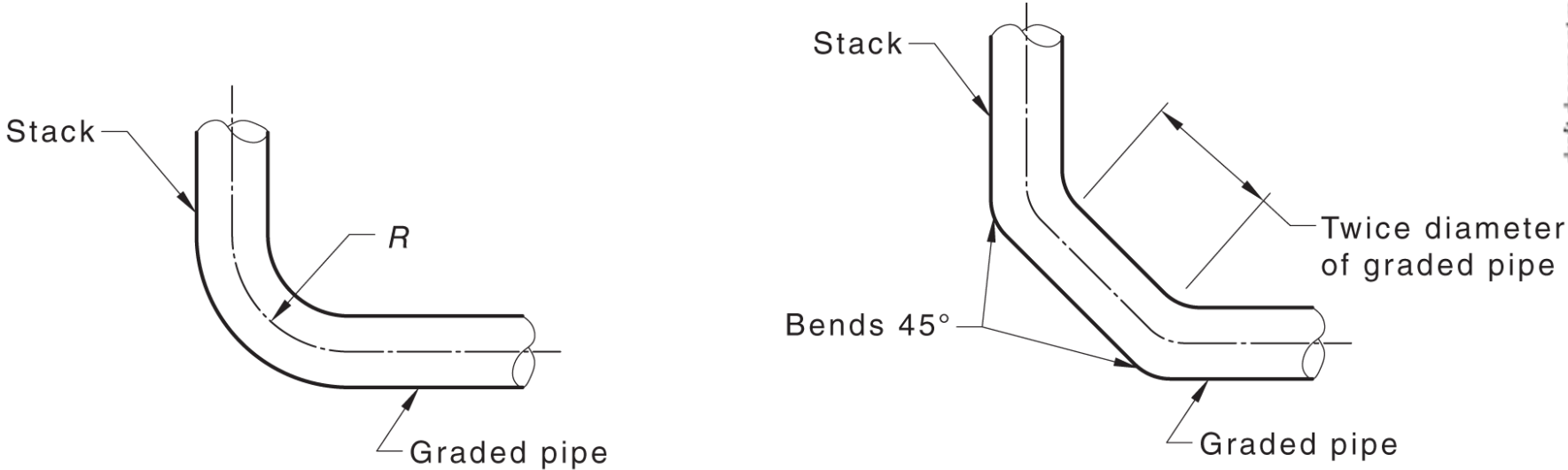
Branches shall not connect to a stack, as shown in [Figure 6.8.1](#), within the following distances, measured vertically from the base of the stack to the invert of the branch:

- (a) 600 mm for stacks that extend not more than five floor levels above the base of the stack.
- (b) 1 m for stacks that extend more than five floor levels above the base of the stack.
- (c) 2.5 m for all stacks in areas where foaming is likely to occur.

6.8.3 Connection of stacks to graded pipes or drains above ground

Connection of stacks to graded pipes or drains above the ground shall be made by —

- (a) a 45° junction installed on grade in accordance with [Clause 6.6.2.4](#) and a bend at the base of the stack in accordance with [Clause 6.8.4](#); or
- (b) a 45° junction installed in the vertical plane with an extended branch so that the vertical projection of the stack, on the graded pipe or drain above the ground, is wholly outside the junction area, as shown in [Figure 6.8.3\(b\)](#).



(a) Large radius stack bend (b) Alternatives to large radius stack bend

Figure 6.8.3 — Connection of discharge stacks to graded discharge pipes

6.8.4 Bends at the base of stacks

Bends at the base of stacks shall be not smaller in size than the graded pipe or drain to which they connect. They shall —

- (a) have a centre-line radius not less than that stated in [Table 6.8.4](#);
- (b) consist of two 45° bends separated by a straight pipe of length not less than twice the bore of the pipe; or
- (c) consist of an 88° bend where a stack extends through no more than two floor levels.

Where a stack is smaller than the graded pipe, a taper fitting shall be installed in the vertical stack, as shown in [Figure 6.8.3](#).

Table 6.8.4 — Minimum radius for bends at the base of stacks	
Pipe size DN	Radius (R) mm
≤ 100	225
> 100	300

6.9 Vents

6.9.1 General

This clause applies to the ventilation of the sanitary plumbing and sanitary drainage system using vent pipes.

NOTE See [Clause 6.10](#) for information on venting with air admittance valves.

6.9.2 Minimum grade

Vents shall be installed at a minimum grade of 1.25 % (1:80) so that any condensation or other liquids that form in or enter the vent will drain to the sanitary plumbing and sanitary drainage system.

6.9.3 Interconnections

Vents shall only be interconnected above the flood level rim of the highest fixture or floor waste gully served by the vent.

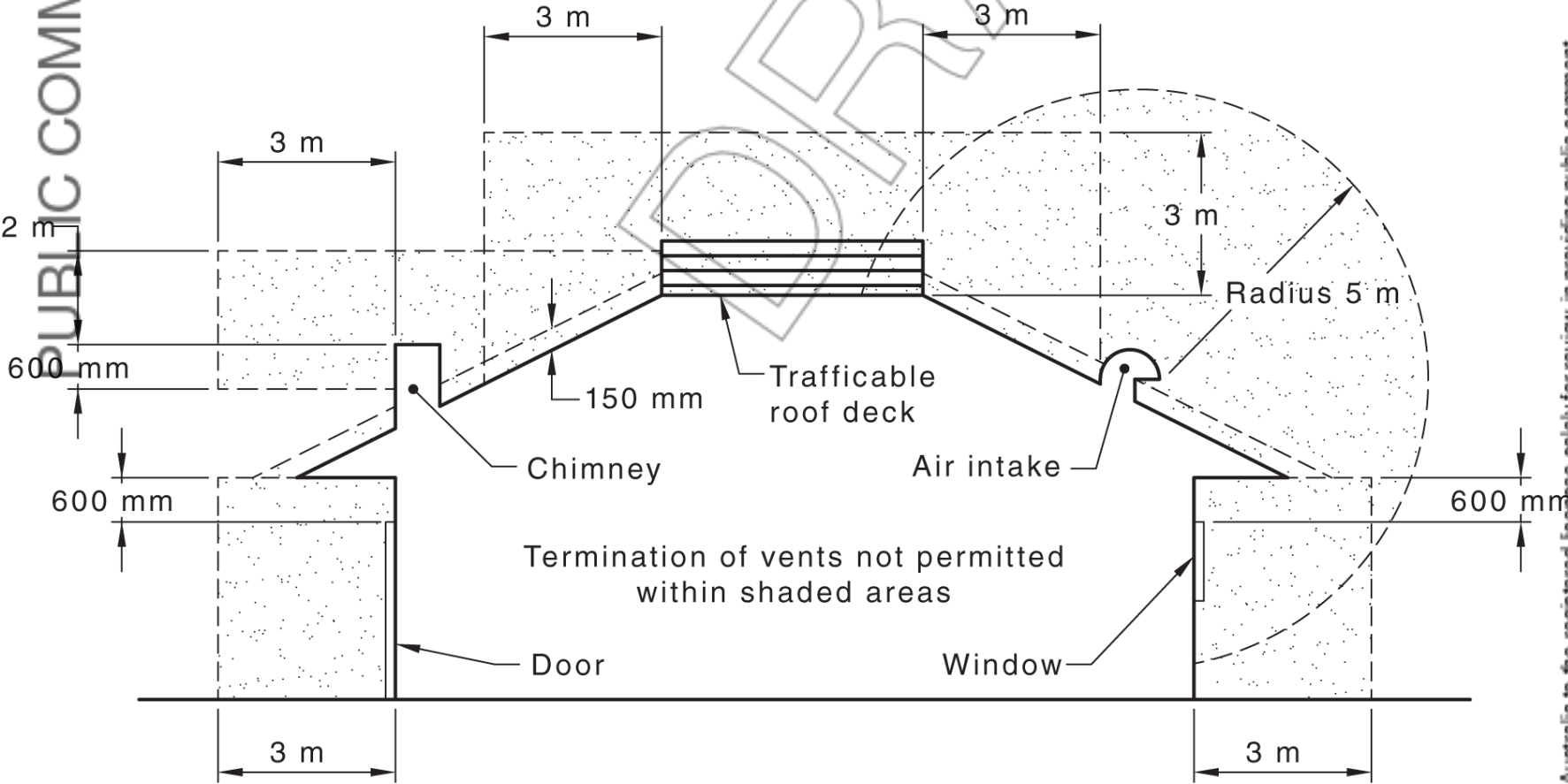
The following vent pipes shall be vented to the open air outside the building independently and not be interconnected to any other system vent:

- (a) Vent pipes connected to waste fixtures discharging into disconnector gullies.
- (b) Chamber or steam relief vents from bedpan sanitizers and washers.
- (c) Vent pipes from arrestor chambers.
- (d) Vent pipes from gullies located within buildings.

6.9.4 Termination

Vents shall terminate as shown in Figure 6.9.4 in the open air outside the building and in a location not less than —

- (a) 600 mm above any opening into any building that is within a horizontal distance of 3 m from the vent;
- (b) 150 mm above its point of penetration through any roof covering;
- (c) 3 m above any trafficable roof deck that is within a horizontal distance of 3 m from the vent;
- (d) 2 m above or 600 mm below any chimney or similar opening within a horizontal distance of 3 m from the vent;
- (e) 5 m in any direction from any air duct intake; or
- (f) 600 mm above any eaves, coping or parapet that is within a horizontal distance of 600 mm from the vent.



NOTE Trafficable decks exclude access workways and work platforms.

Figure 6.9.4 — Termination of vents

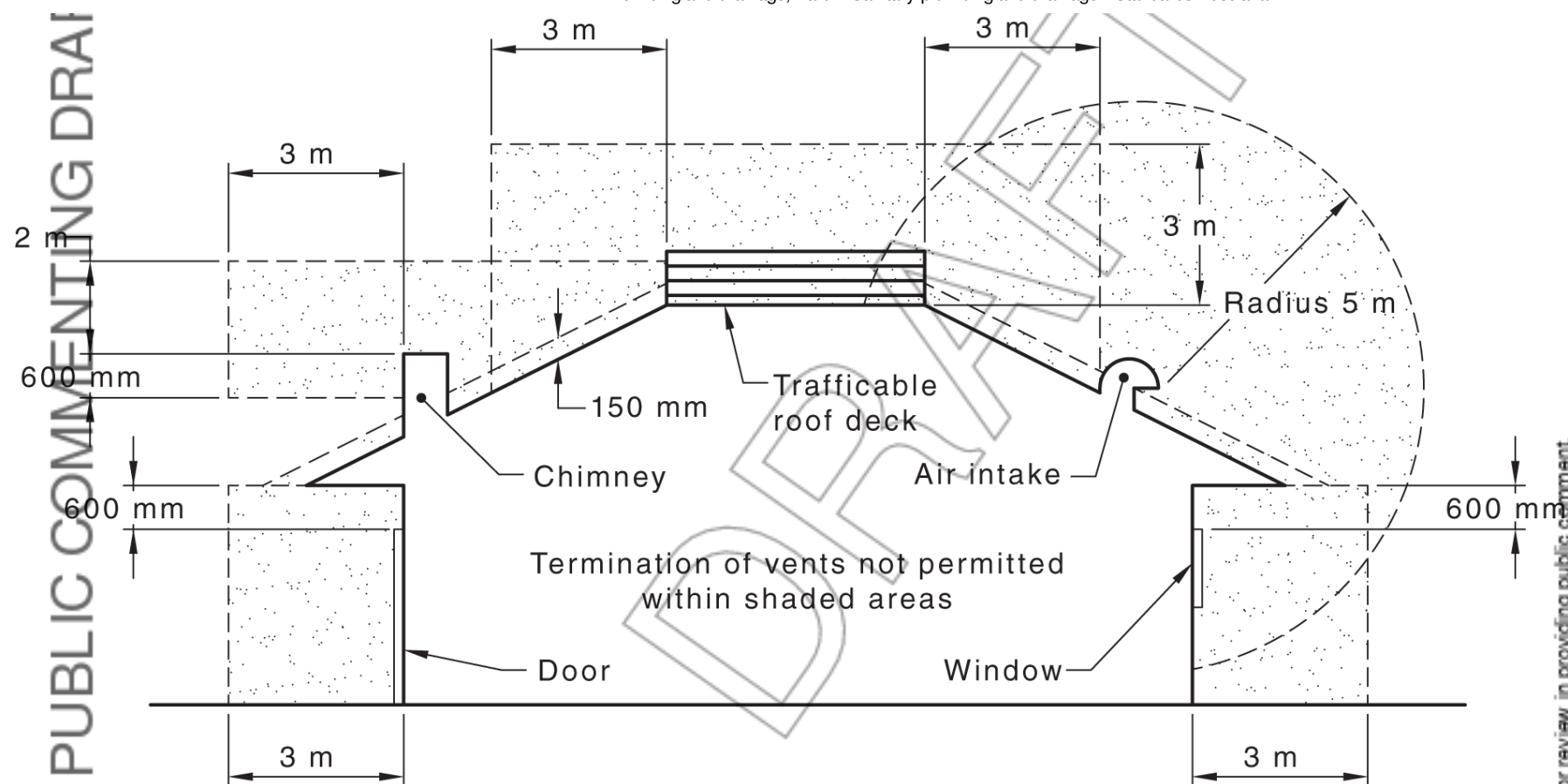
6.9.5 Connection to graded pipes

Where a vent is connected to a graded section of a discharge pipe, it shall be connected downstream of a fixture or trap and conform to the requirements of Clause 8.5.1.1.

NOTE See Figure 6.9.5 for a typical connection of a vent to graded pipes.

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**Figure 6.9.5 — Vent connected to graded pipes**

## 6.10 Air admittance valves

### 6.10.1 General

Air admittance valves (AAVs) may be used in sanitary plumbing systems for trap vents, group vents and stack vents and to ventilate branch drains. They shall not be used for the upstream venting of a main drain, a boundary trap ground vent, or to vent a grease interceptor device. AAVs shall be resistant to the chemicals present in the waste.

NOTE 1 Branches connected into a positive pressure area, such as near boundary traps in multistorey buildings, may need additional venting.

NOTE 2 AAVs specifically designed for laboratory chemical and grease waste pipe systems may be used for these wastes.

### 6.10.2 Requirements for use

The following requirements for air admittance valves apply:

- (a) AAVs shall be used only on systems that have at least one open upstream vent off the main drain. The upstream vent shall be sized in accordance with [Table 3.9.3.1](#) and be not less than DN 50.
- (b) Where the sanitary drains from three or more buildings on an allotment discharge to the sewerage system, the sanitary drainage system of each building shall have at least one open upstream vent connected to its sanitary drain, see [Tables 6.10.2\(A\) and \(B\)](#).
- (c) AAVs shall have a determined airflow capacity not less than that specified in [Table 6.10.2\(A\)](#) when used as a trap vent, group vent or branch drain upstream vent, and [Table 6.10.2\(B\)](#) when used as a stack vent.
- (d) An air admittance valve shall not be used as a stack vent where the stack extends through 10 or more floor levels.
- (e) Where an AAV is used to terminate a single stack system vent, it shall be sized in accordance with [Table 6.10.2\(B\)](#). Multiple AAVs may be used to achieve the required fixture unit loading, see [Figure 6.10.4](#).
- (f) Air admittance valves that form an integral part of a fixture trap shall only be used as a trap vent.
- (g) Where a sanitary plumbing system has a relief vent and the stack is vented by an AAV, the relief vent shall extend separately to atmosphere as an open vent.
- (h) AAVs fitted to the connecting branches and stacks shall have a combined air flow rating greater than the requirement of the total stack fixture unit loading.

Table 6.10.2(A) — Minimum determined airflow capacity of air admittance valves when used as a trap vent, group vent or branch drain vent

Fixture unit loading of discharge pipe	Minimum airflow capacity of AAV L/s
6	1.9
9	2.3
10	2.4
12	2.7
18	3.3
24	3.8
30	4.2
36	4.6
42	5.0
48	5.3
54	5.7
60	6.0

NOTE Further values may be interpolated or extrapolated using Equation 6.10.2(A) on which this table is based:

For discharge pipes —

$$Q = 2\sqrt{\frac{FU}{6.75}}$$

6.10.2(A)

where

- Q = determined airflow capacity of the valve, in litres per second
- FU = fixture unit loading

Table 6.10.2(B) — Minimum determined airflow capacity of air admittance valves venting discharge stacks

Fixture unit loading of discharge stack	Minimum determined airflow capacity of AAV L/s
1	3
2	4
4	6
6	7
10	9
12	10
15	11
20	13
25	15
30	16
40	18
60	23
80	26
100	29
200	41
300	51
400	58
500	65
600	72
1 000	92

NOTE Further values may be interpolated or extrapolated using Equation 6.10.2(B), on which this table is based:

For discharge stacks —

$$Q = 8\sqrt{\frac{(FU)}{6.75}}$$

6.10.2(B)

where

- Q = determined airflow capacity of the valve, in litres per second

FU = fixture unit loading

### 6.10.3 Location

Air admittance valves shall be —

- (a) accessible for service, repair or replacement;
- (b) located to allow a replacement air flow as specified by the flow rate of the valve;
- (c) provided with ventilation openings when located in a wall or roof space to allow a replacement airflow as specified by the flow rate of the valve; and
- (d) not installed where air is contaminated with solvents.

#### 6.10.4 Installation

Air admittance valves shall be —

- (a) connected to a graded fixture or combined fixture/discharge pipe conforming with [Clause 8.5.1.1](#) (see Note 1 below).

Traps with integral air admittance valves need not conform to the limitation to be at least 75 mm downstream of the trap as specified in [Clause 8.5.1.1](#) nor with the requirement to have 100 mm air cushion as detailed in [Figure 6.10.4](#);

- (b) installed upright within 5° of the vertical as shown in [Figure 6.10.4](#);
- (c) installed in areas where the ambient air temperature does not vary below 0 °C or above 60 °C unless the AAV is designed to perform outside these temperatures;
- (d) installed not more than 1 000 mm below the flood level of the fixture to which it is connected or, when installed on a branch, not more than 1 000 mm below the flood level of the lowest fixture connected to that branch;
- (e) protected from insect entry;
- (f) protected from ultraviolet rays if installed outdoors; and
- (g) protected from mechanical damage.

NOTE 1 In addition to the open vents, air admittance valves, installed in accordance with [Clause 6.10](#), may be used to provide additional venting of drains connected to a vacuum sewerage system collection bank.

NOTE 2 Additional UV protection is not required where the UV protection is provided by the inherent properties of the materials of the valve body.

Dimensions in millimetres

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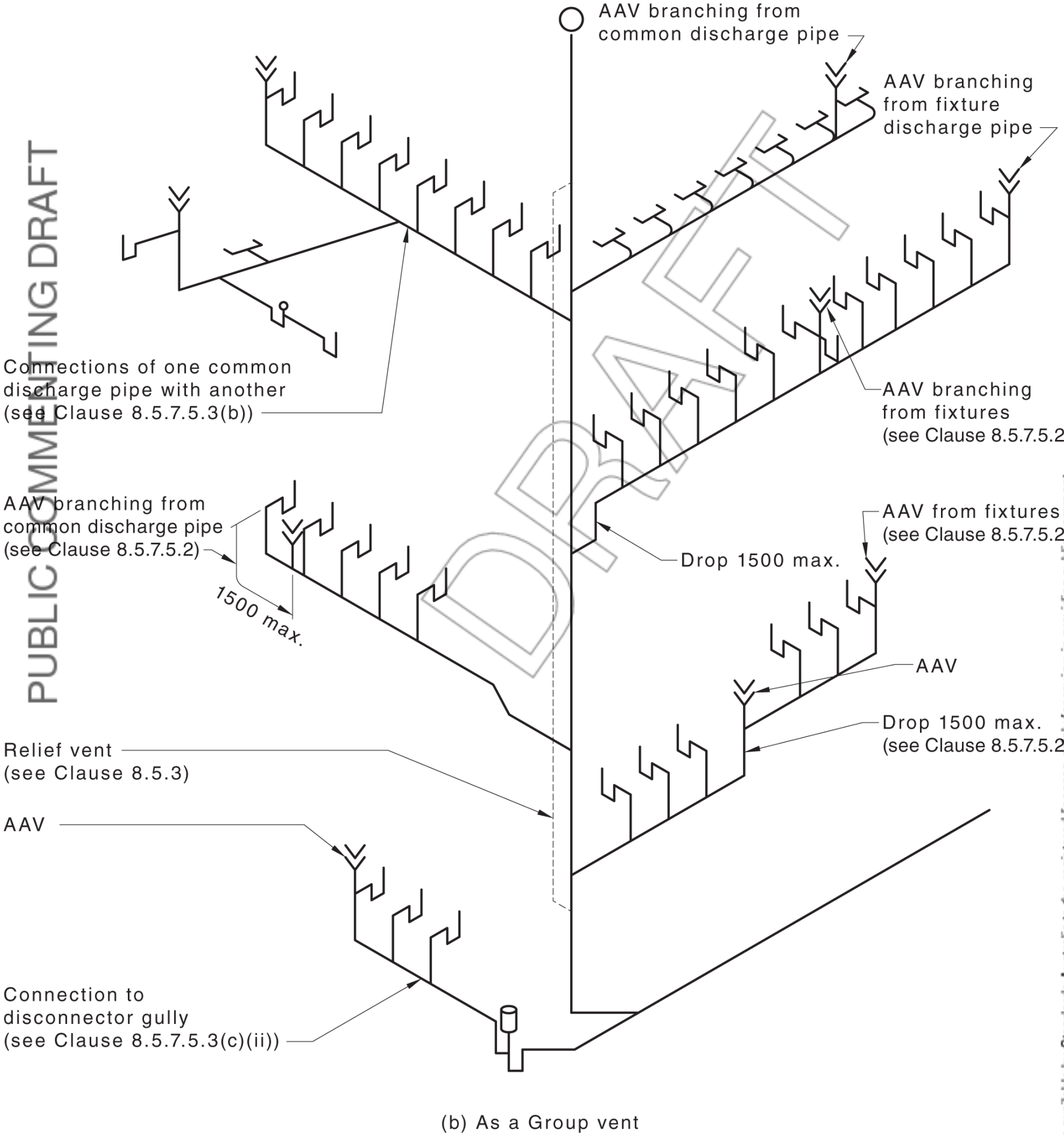
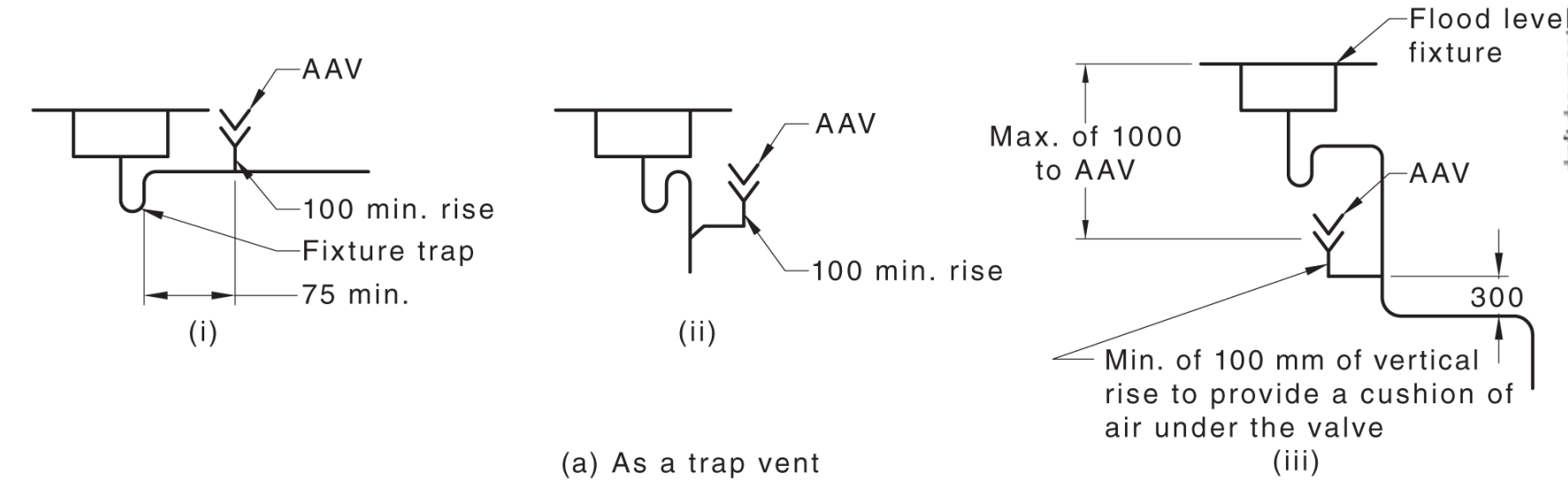


Figure 6.10.4 — Fully vented modified system using air admittance valves

## 6.11 Pressure attenuators

### 6.11.1 General

Pressure attenuators may be used in sanitary plumbing systems as an alternative to relief venting.

Attenuators shall not be used on stacks subject to continuous flows which may impede the operation of the attenuator.

- NOTE 1 Examples of continuous flows include draining of cooling towers and swimming pool backwash.
- NOTE 2 Attenuators are used to counter the tendency for the loss of trap water seals resulting from positive pressure pulses in discharge stacks. Positive pressure pulses or transients arise from disruptions to airflow produced at changes in direction or restriction to the airflow path.
- NOTE 3 The size of the pressure attenuator is independent of stack size and fixture unit loading.
- NOTE 4 The use of pressure attenuators is not limited by building height.

6.11.2 Installation of pressure attenuators

Pressure attenuators shall be —

- (a) connected to stacks by means of 45° or sweep junctions;
- (b) positioned above the point of connection in either a vertical or horizontal orientation;
- (c) adequately supported with allowance for thermal movement; and
- (d) installed as close as possible to the stack with minimum changes of direction. The maximum distance of pipework from the stack to the attenuator shall not exceed two meters.

Connections to the stack, other than those immediately above the base of the stack or offset, shall be above the branch discharge pipes at that floor level.

NOTE See Figure 6.11.2 for a typical connection of stack to pressure attenuators.

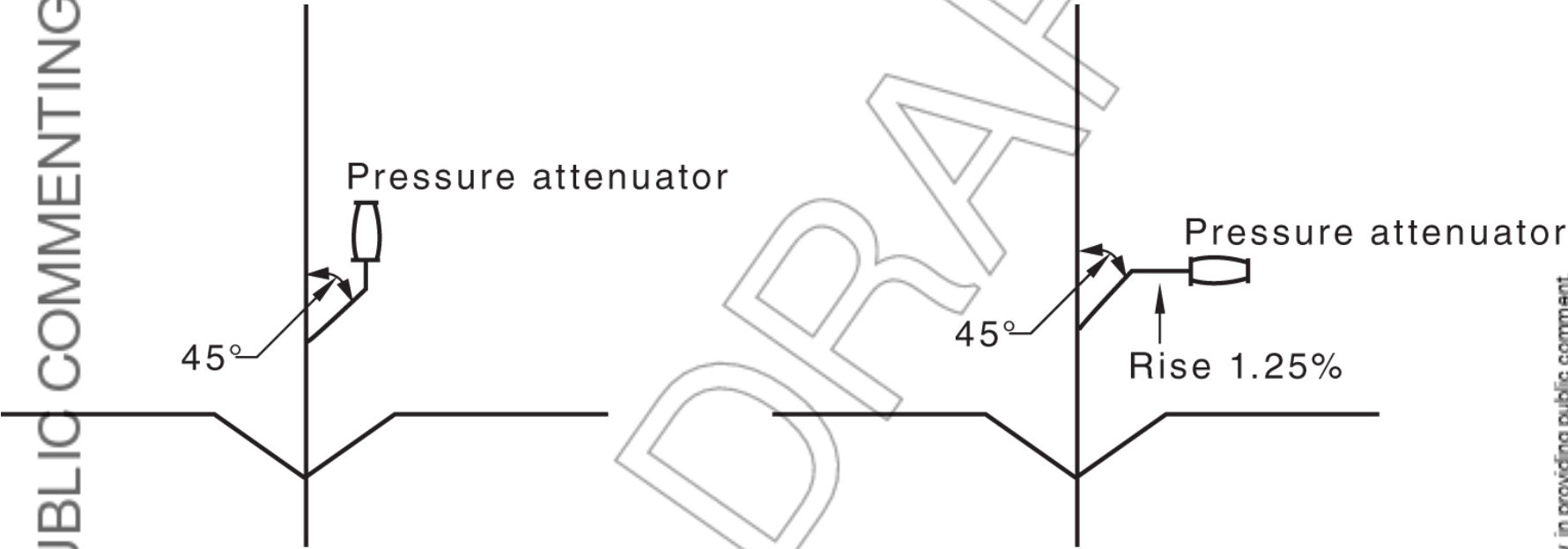


Figure 6.11.2 — Typical connection of pressure attenuators to stacks

6.11.3 Location of pressure attenuators

DRAFTING NOTE List Item (a) has been modified in response to concerns raised about its removal during the current revision cycle. It is proposed to reinstate “accessible and” as per the current publication.  
Comments on other clauses will not be considered for this revision but may be considered for later revisions of this document.

The following apply to the installation of pressure attenuators:

- (a) Pressure attenuators shall be accessible and installed in accordance with Table 6.11.3.
- (b) Attenuators at the base of the stack shall be installed above the no-connection zone and below the first branch in accordance with Clause 6.11.3(c).
- (c) The junction on the stack for the attenuator shall be no more than 3 m below the flood level of the lowest fixture on the branch directly above.
- (d) A stack, three or more floors above the base or a graded offset, shall be treated as a new stack and attenuators installed in accordance with Table 6.11.3.
- (e) Attenuators are only required where a vertical stack rises through 3 or more floors.

NOTE 1 See Clauses 8.6.2.3, 8.6.2.4, 8.6.2.5 and Figure 8.6.2.3 for restricted connection zones.  
NOTE 2 Graded stack offsets are to be read as a stack base.  
NOTE 3 See Figure 6.11.3 for examples of typical pressure attenuator installations.

Table 6.11.3 — Location of pressure attenuators	
Number of floor levels served by the stack above base or offset	Location of pressure attenuators
3–10	One unit at the base of the stack
11–15	One unit at the base of the stack, plus one at mid-level of the stack
16–25	One unit at the base of the stack, plus one unit 5 floors up, then one unit halfway between the remaining floors above 5
26–50	Two units in series at the base of the stack, then one unit every 5 floors to the 25th floor, then one every 10th floor thereafter

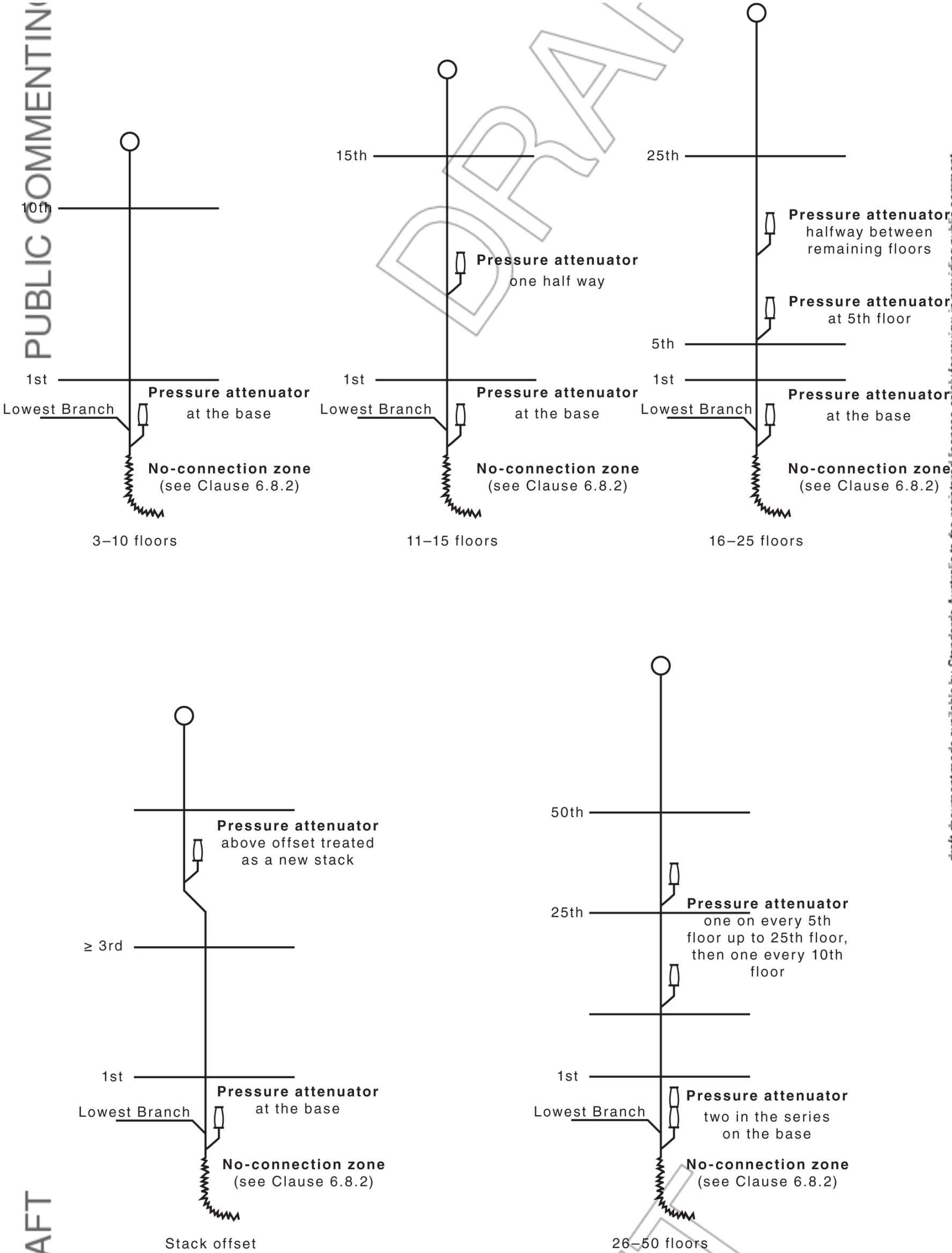


Figure 6.11.3 — Examples of typical pressure attenuator installations

## 7 Greywater plumbing and drainage systems

### 7.1 Scope of section

This section specifies requirements for the installation of greywater sanitary plumbing and drainage from the respective plumbing fixtures to greywater treatment or diversion devices and overflow therefrom where directed to the drainage system.

Greywater systems may include one of the following:

- (a) Direct diversion devices:
  - (i) Diversion valve installed in the sanitary plumbing system.
  - (ii) In-ground diversion vessels.
- (b) Treatment systems.

### 7.2 General

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Greywater plumbing and drainage systems shall be designed in such a manner so that —

- (a)

sewage surcharge cannot enter in ground greywater diversion vessels or greywater treatment systems; and
- (b)

rainwater, stormwater and surface water cannot enter a network utility operator’s sewerage system or an on-site wastewater disposal system such as a septic tank or common effluent system.

Where greywater use is being considered, a number of authorities should be consulted. These authorities include the following:

- (a)

The network utility operators responsible for drinking water supply or sewerage or both.
- (b)

The environmental protection authority.
- (c)

The respective health authority.
- (d)

Local councils.

Storage of untreated greywater for longer than 24 h is not recommended and may not be permitted under health requirements.

### 7.3 Material and products

All pipes and fittings from a sanitary fixture to a greywater diversion vessel shall conform to [Section 2](#).

### 7.4 Installation requirements

Sanitary plumbing and drainage piping from a sanitary fixture to a greywater system shall conform to the following:

- (a)

In an area serviced by a network utility operator’s wastewater system, a permanent connection to the wastewater system shall be maintained to enable the greywater to be redirected into the sanitary drain.
- (b)

Greywater to be returned to the network utility operator’s wastewater system shall be conveyed via a disconnecter gully.
- (c)

All access openings to any vessel shall be securely sealed and vermin-proofed.
- (d)

Greywater sanitary plumbing and drainage piping shall be installed directly to a treatment/diversion vessel and independently of other systems.
- (e)

Drainage from below-ground greywater diversion devices that gravitate to the sewer shall be protected from sewage surcharge by the installation of a reflux valve.
- (f)

All pipework greater than DN 80 connected to a diversion device or treatment system shall be clearly marked “GREYWATER” at intervals not exceeding 1 m in accordance with AS 1345.

NOTE A direct diversion device installed above the level of the overflow relief gully does not require protection from sewage surcharge.

## 8 Fully vented systems and fully vented modified systems — Design and installation

### 8.1 Scope of section

This section specifies design requirements and methods of installation for fully vented systems and fully vented modified systems of sanitary plumbing.

### 8.2 System types

#### 8.2.1 General

Systems installed in buildings shall comprise either a fully vented system ([Clause 8.2.2](#)) or a fully vented modified system ([Clause 8.2.3](#)), or a combination of both systems.

#### 8.2.2 Fully vented system

A fully vented system shall comprise a system of sanitary plumbing with provision for the individual venting of every fixture trap by means of a trap vent or air admittance valve (except for any traps that discharge to a floor waste gully) and in which a relief vent is installed and is in accordance with the maximum fixture unit loadings in [Tables 8.2.2\(A\)](#) and [8.2.2\(B\)](#).

Table 8.2.2(A) — Maximum fixture unit loadings for graded discharge pipes								
Grade %	Nominal size of pipe DN							
	40	50	65	80	100	125	150	225
5.00	6	15	51	65	376	953	1 959	7 098
3.35	5	10	29	39	248	686	1 445	5 583
2.50	4	8	21	27	182	509	1 148	4 513
2.00	×	×	×	20	142	410	953	3 739
1.65	×	×	×	16	115	342	813	3 258
1.25	×	×	×	×	×	254	627	2 656
1.00	×	×	×	×	×	×	509	2 272

NOTE 1

[Appendix C](#) provides a table for conversion of grades as a percentage to grades as a ratio.

NOTE 2

The symbol “×” indicates that the combination of pipe size and grade is not acceptable.

Table 8.2.2(B) — Maximum loadings on stacks in fixture units		
Size of stack DN	Maximum loading per floor level	Maximum loading per stack
(a) Four or more floor levels		
40	4	16
50	9	36
65	14	56
80	20	80
100	125	500
125	250	1 000
150	600	2 400
225	1 750	7 000
(b) Three or fewer floor levels		
40	2	6
50	5	15
65	6	18
80	13	40
100	65	195
125	150	450
150	250	750
225	950	2 850

### 8.2.3 Fully vented modified system

A fully vented modified system shall comprise a system of sanitary plumbing differing from the fully vented system in that each branch or discharge pipe connected to the stack is vented and some individual fixture trap vents or air admittance valves are omitted, and in which groups of two or more fixtures that discharge to the same graded pipe or branch are vented by means of one or more group vents or air admittance valves.

## 8.3 Size of discharge pipes

### 8.3.1 General

Discharge pipes shall be not less than the size of the fixture traps to which they are connected except for water closet pans and slop hoppers, which may be connected to DN 80 discharge pipes.

### 8.3.2 Fixture unit loading

The size of any discharge pipe shall be determined from [Table 8.2.2\(A\)](#), taking into account —

- (a) the sum of the fixture units that it carries, see [Tables 6.3\(A\)](#) and [6.3\(B\)](#); and
- (b) the proposed pipe grade.

### 8.3.3 Minimum size

The minimum size of any discharge pipe shall be DN 40.

### 8.3.4 Limitation on DN 80 pipes

Not more than two water closet pans shall be connected to a DN 80 discharge pipe.

### 8.3.5 Oversizing

Graded discharge pipes shall not be oversized for the sole purpose of acquiring a grade less than the minimum grades specified in [Table 6.6.1](#).

## 8.4 Size of stacks

Stacks shall be sized in accordance with the following:

- (a) The sum of the fixture unit ratings of all fixtures connected to any stack shall constitute the loading on the stack.
- (b) Depending on the number of floor levels, the total loading on any stack shall not exceed the maximum given in [Table 8.2.2\(A\)](#).
- (c) The total load increment from fixtures from any one floor level —
  - (i) for stacks of four floor levels or more, shall not exceed 25 % of the maximum stack capacity as specified in [Table 8.2.2\(B\)](#); and
  - (ii) for stacks of three floor levels or less, shall not exceed 33 % of the maximum stack capacity as given in [Table 8.2.2\(B\)](#).
- (d) Such limitations as to the maximum fixture unit loading discharging into any stack within any one floor level, as specified in Item (c), shall also apply to connections to any section of a stack with a vertical length of 2.4 m into which one or more graded pipes, branches or stacks are connected as shown in [Figure 8.4](#).
- (e) Where the fixture unit loading at any one floor level exceeds the loading given in [Table 8.2.2\(B\)](#), the stack shall be increased in size.
- (f) Where a DN 80 stack is installed as a fully vented modified system, the maximum number of water closet pans and slop hoppers connected to any graded pipe or branch shall not exceed two.
- (g) Where any stack is offset, the offset section shall be sized —
  - (i) as a straight stack, if the offset is 45° to the horizontal or greater; or

(ii) as a graded pipe, if the offset is less than 45° to the horizontal, and the stack shall continue undiminished in size to above the highest connection.

Any reduction in stack size, as given in Table 8.5.3.5, shall only be made above the highest connection.

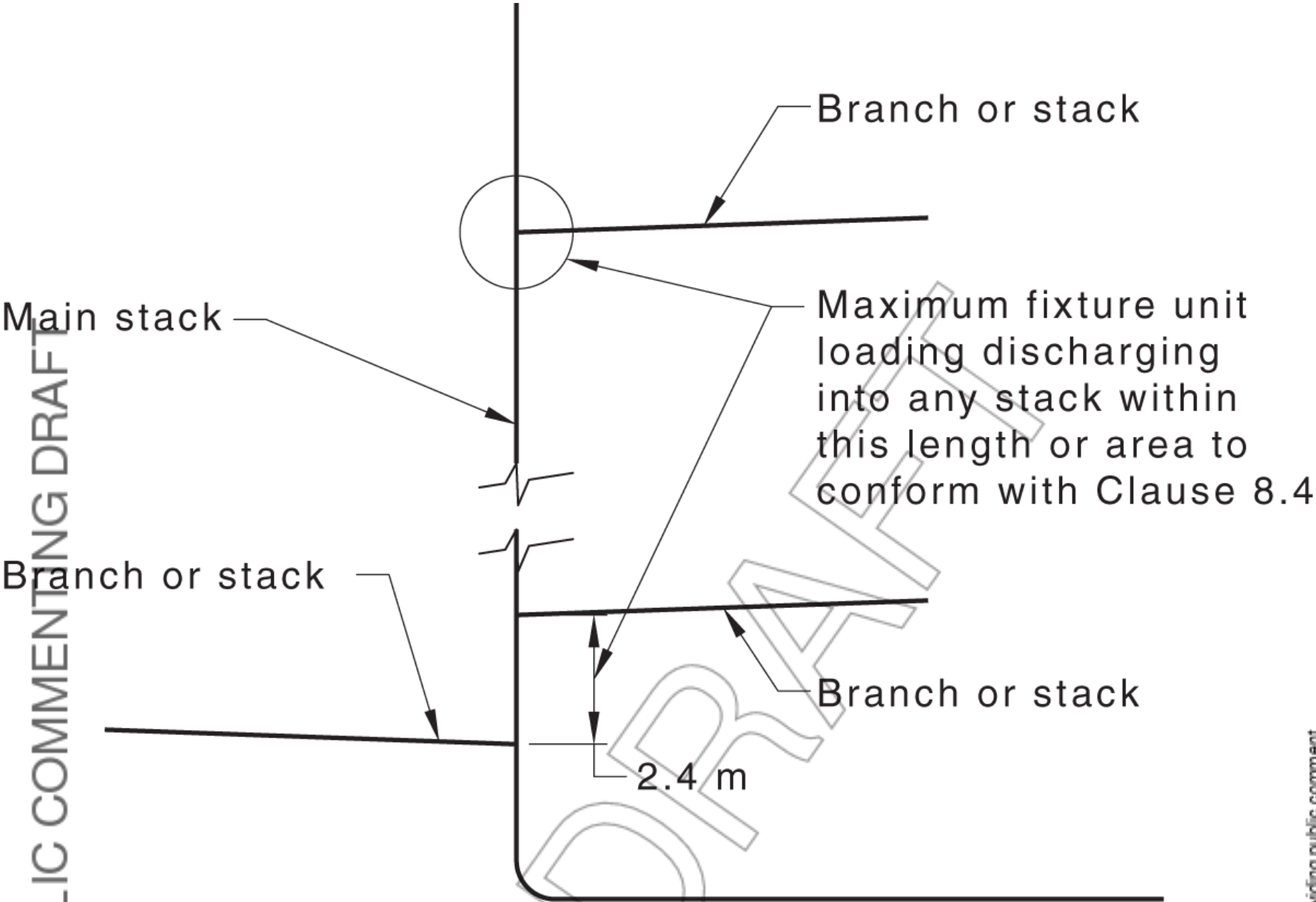


Figure 8.4 — Limitations applying to branch connections to stacks

8.5 Venting

8.5.1 Trap vents

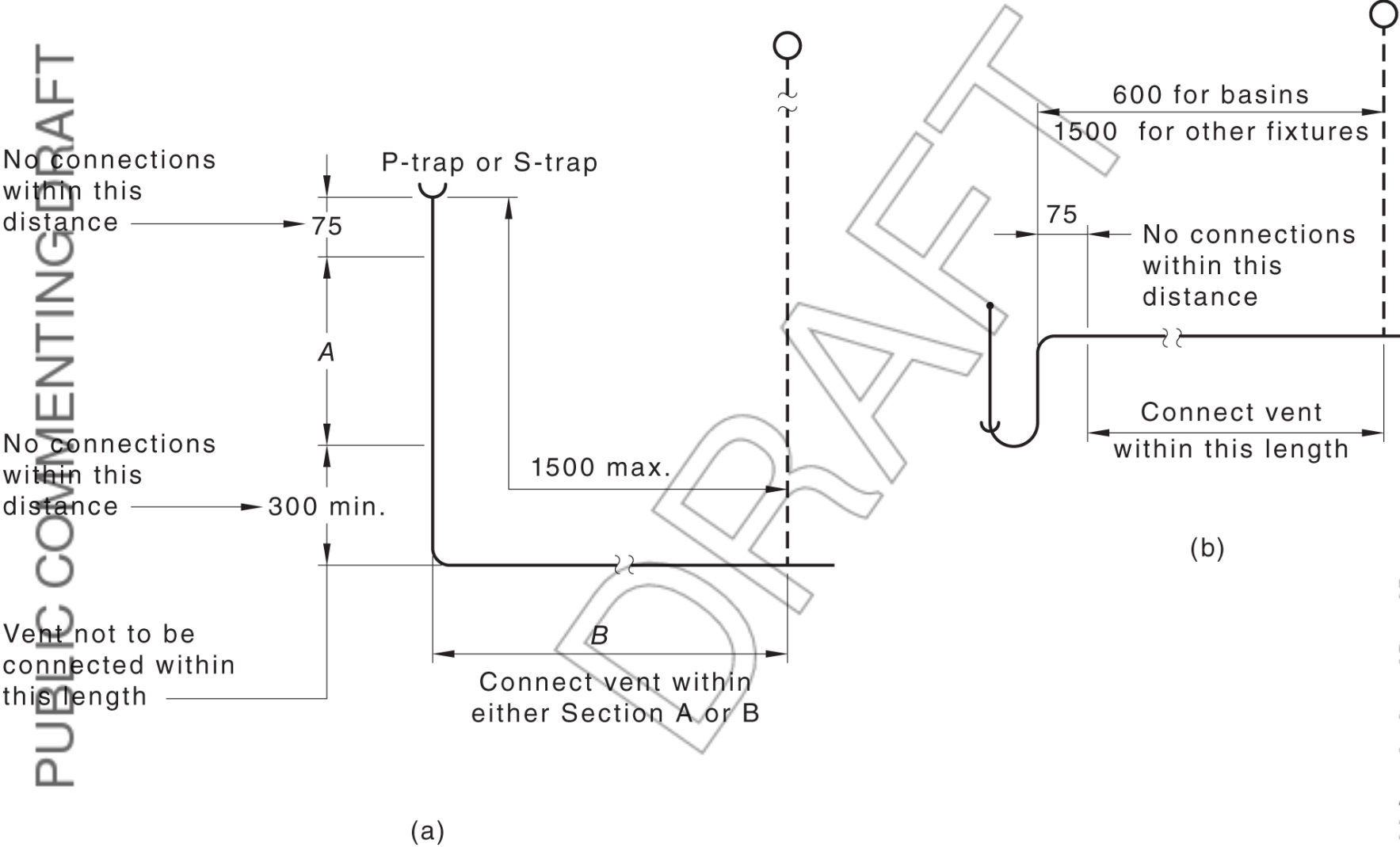
8.5.1.1 Connection for fixtures

Trap vents shall be connected to fixture discharge pipes in accordance with the following:

- (a) For basins and bidets, the vent shall be connected not closer than 75 mm and not further than 600 mm from the crown of the fixture trap, provided no change of direction occurs between the trap and the vent connection, as shown in Figure 8.5.1.1.
- (b) For fixtures other than basins and bidets, the vent shall be connected between 75 mm and 1 500 mm from the crown weir of the fixture trap, provided, where the S-trap is fitted or a bend is fitted downstream of the P-trap, the vent connection on the vertical discharge pipe is at least 300 mm from any bend at the base of the vertical section.

Dimensions in millimetres





8.5.1.2 Topmost fixture connected to the stack

Where the topmost discharge pipe connection to the stack exceeds 6 m for combination pan rooms sinks (DN 100), slop hoppers (DN 100), water closet pans and 2.5 m for all other fixtures, a trap vent shall be connected in accordance with [Clause 8.5.1.1](#).

8.5.1.3 Size

The minimum size of trap vents shall be as specified in [Table 8.5.1.3](#).

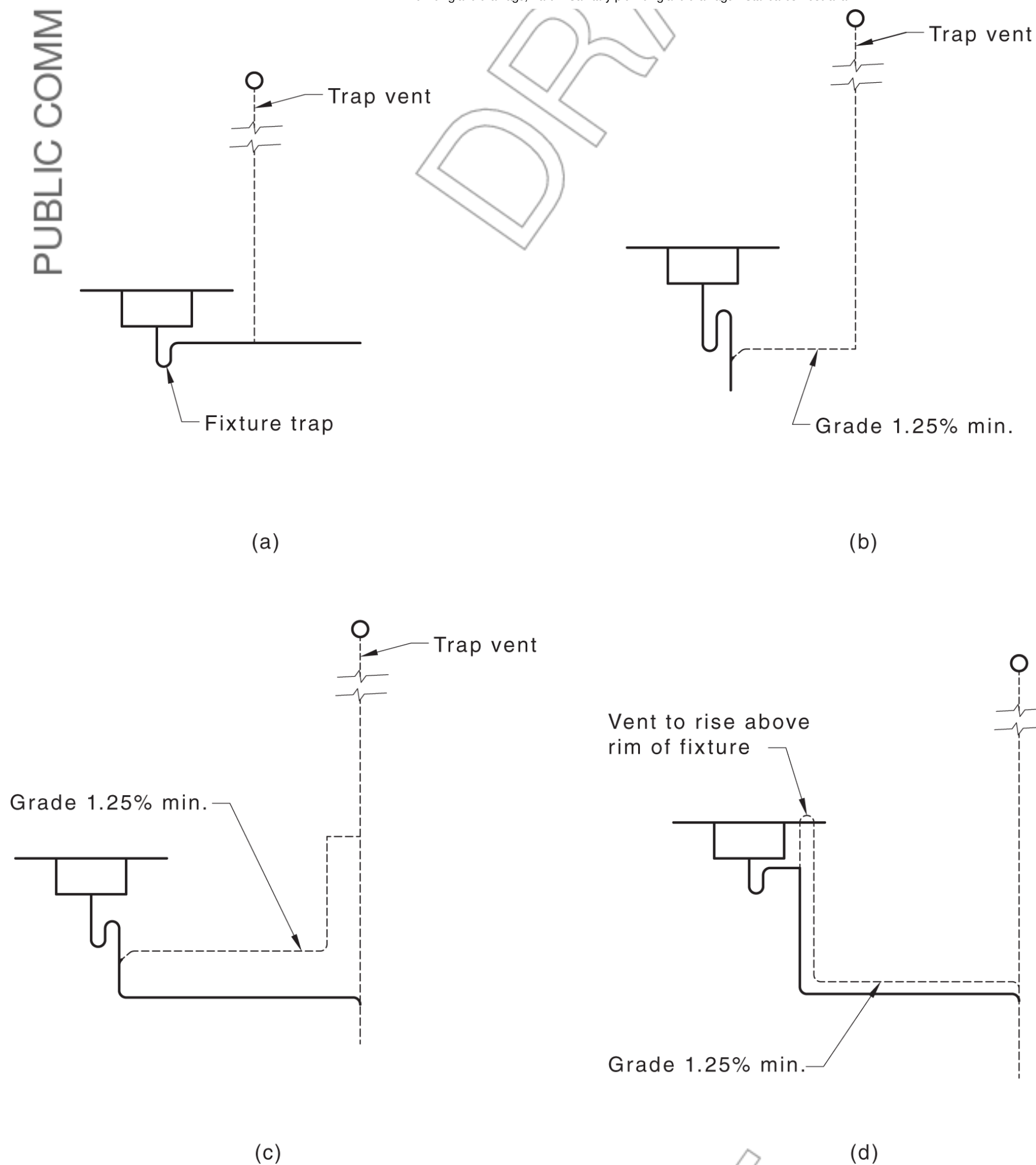
Table 8.5.1.3 — Minimum size of trap vents	
Size of fixture trap DN	Size of trap vent DN
40	32
≥ 50 ≤ 100	40

8.5.1.4 Installation

Every trap vent shall be extended upwards to a point above the flood level rim of the fixture in accordance with one of the following:

- (a) As a vertical vent to open air.
- (b) On an ascending grade of at least 1.25 %, as a vertical vent to the open air.
- (c) On an ascending grade of at least 1.25 % to a connection with a vertical or branch vent.
- (d) Looped downwards, either vertically or on a descending grade of at least 1.25 % to a connection at lower level with a vertical or branch vent.

NOTE See [Figure 8.5.1.4](#) for typical installations of trap vents.



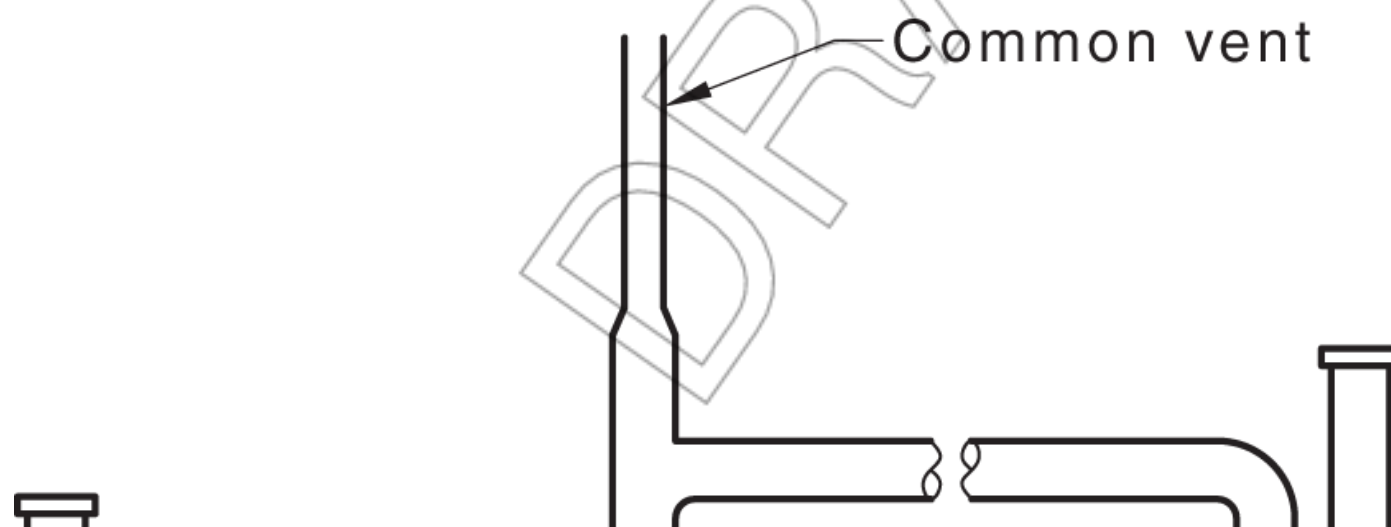
**Figure 8.5.1.4 — Typical installation of trap vents**

#### 8.5.1.5 Common vent for fixtures

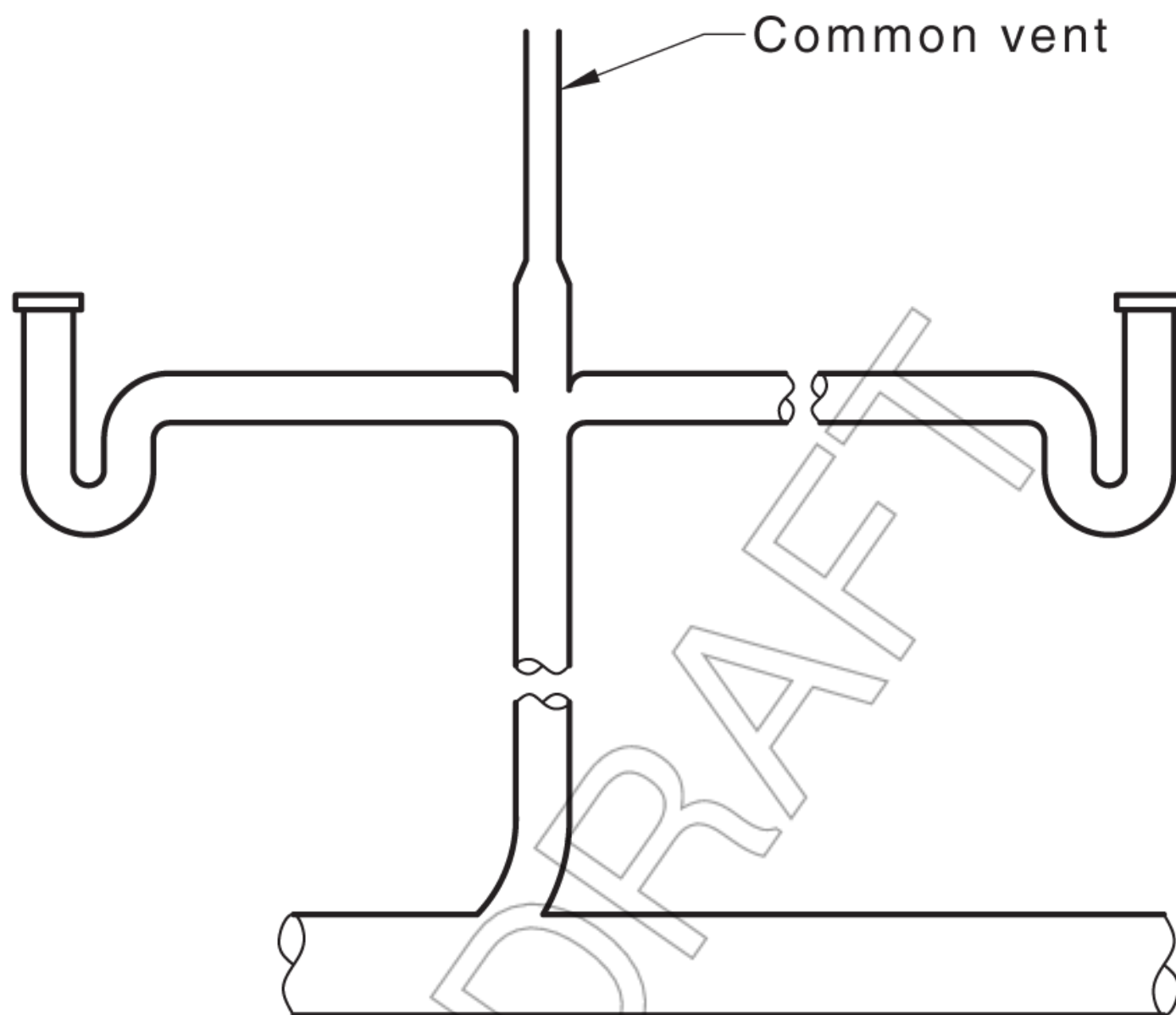
A single vent pipe may be used to ventilate the traps of any two fixtures connected in common to a vertical discharge pipe, provided —

- (a) P-traps are used;
- (b) where the discharge pipes from both fixtures are connected at the same level, either a Y-junction with a 90° included angle or a junction with opposed sweep entries is used;
- (c) the vent pipe is sized for the larger trap; and
- (d) the distance from the weir of either trap to the vent connections conforms with [Clause 8.5.1.1](#).

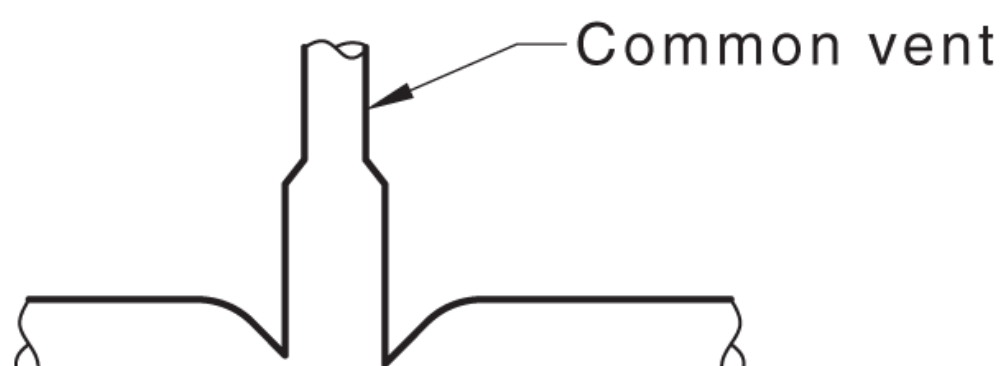
NOTE See [Figure 8.5.1.5](#) for examples of common vents for fixtures.



(a)



(b)



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**Figure 8.5.1.5 — Common vent for fixtures**

### 8.5.2.1 Size

The size of any branch vent shall be in accordance with [Table 8.5.2.1](#).

#### 8.5.2.2 Arrangement

Branch vents shall be used to interconnect two or more trap vents or group of vents.

The point of connection between any branch vent and any other vent shall be above the flood level rim of the highest fixture connected to the common graded pipe or branch served by the branch vent.

Branch vents may interconnect with relief vents or stack vents or extend separately upwards to the open air.

### 8.5.2.3 Size changes

Where the branch discharge pipe varies in size along its length, the corresponding sections of a branch vent shall be sized separately in accordance with [Table 8.5.2.1](#). Any enlargement in size in the branch vent shall occur prior to the junction with the trap vent or group vent as shown in [Figure 8.5.2.3](#).

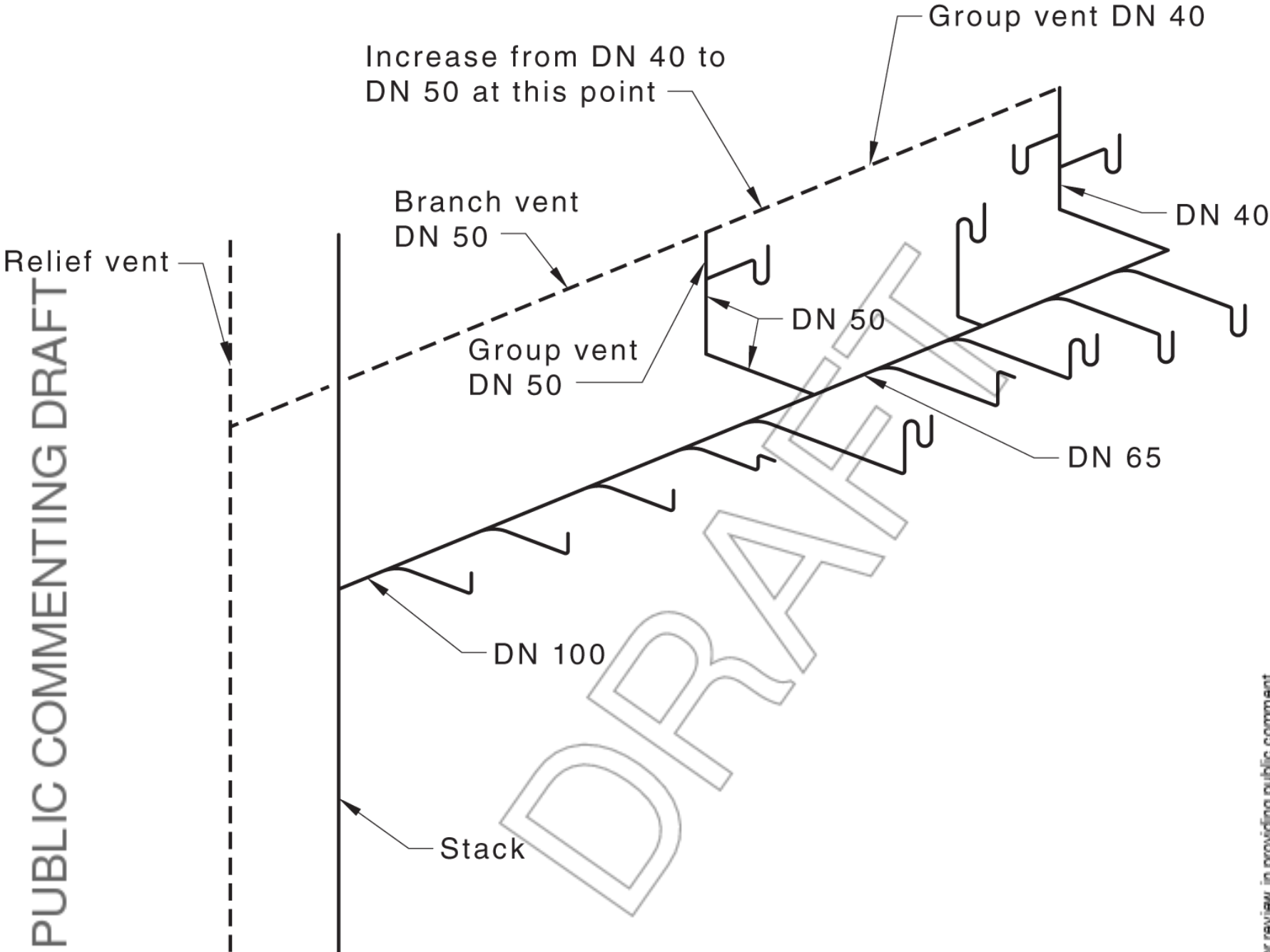


Figure 8.5.2.3 — Sizing of branch vents

8.5.3 Relief vents

8.5.3.1 General

If one or more floors separate the floor levels of the highest and lowest branch pipe connected to the stack, a relief vent shall be installed in accordance with [Clauses 8.5.3.2 to 8.5.3.5](#). Alternatively, pressure attenuators may be installed as specified in [Clause 6.11](#).

NOTE See [Figure 8.5.3.1](#) for a typical relief vent installation.

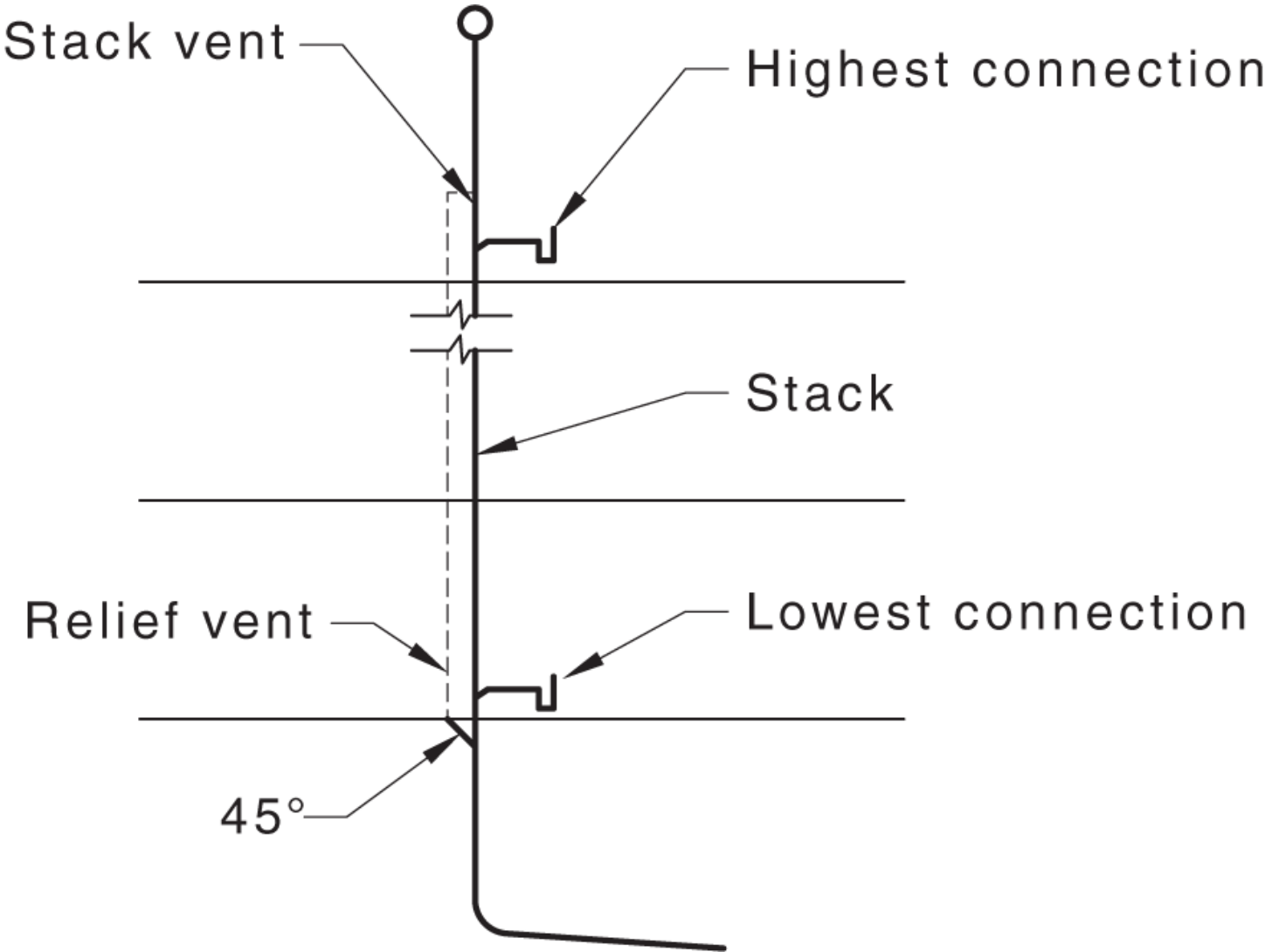


Figure 8.5.3.1 — Typical relief vent installation

8.5.3.2 At offsets in stacks

Where any stack is offset at less than 45° to the horizontal, a relief vent shall be provided —

- (a) on the stack below the offset if, disregarding the offset, one or more floors separate the floor levels of the highest and lowest branch pipe connected to the stack; and
- (b) on the stack above the offset, if one or more floors separate the floor levels of the highest and lowest branch pipe connected to the section of the stack above the offset.

NOTE See [Figure 8.5.3.2](#) for typical relief vent installations at stack offsets.

The lower relief vent may interconnect with the upper relief vent above the flood level rim of the lowest fixture served by the upper relief vent.

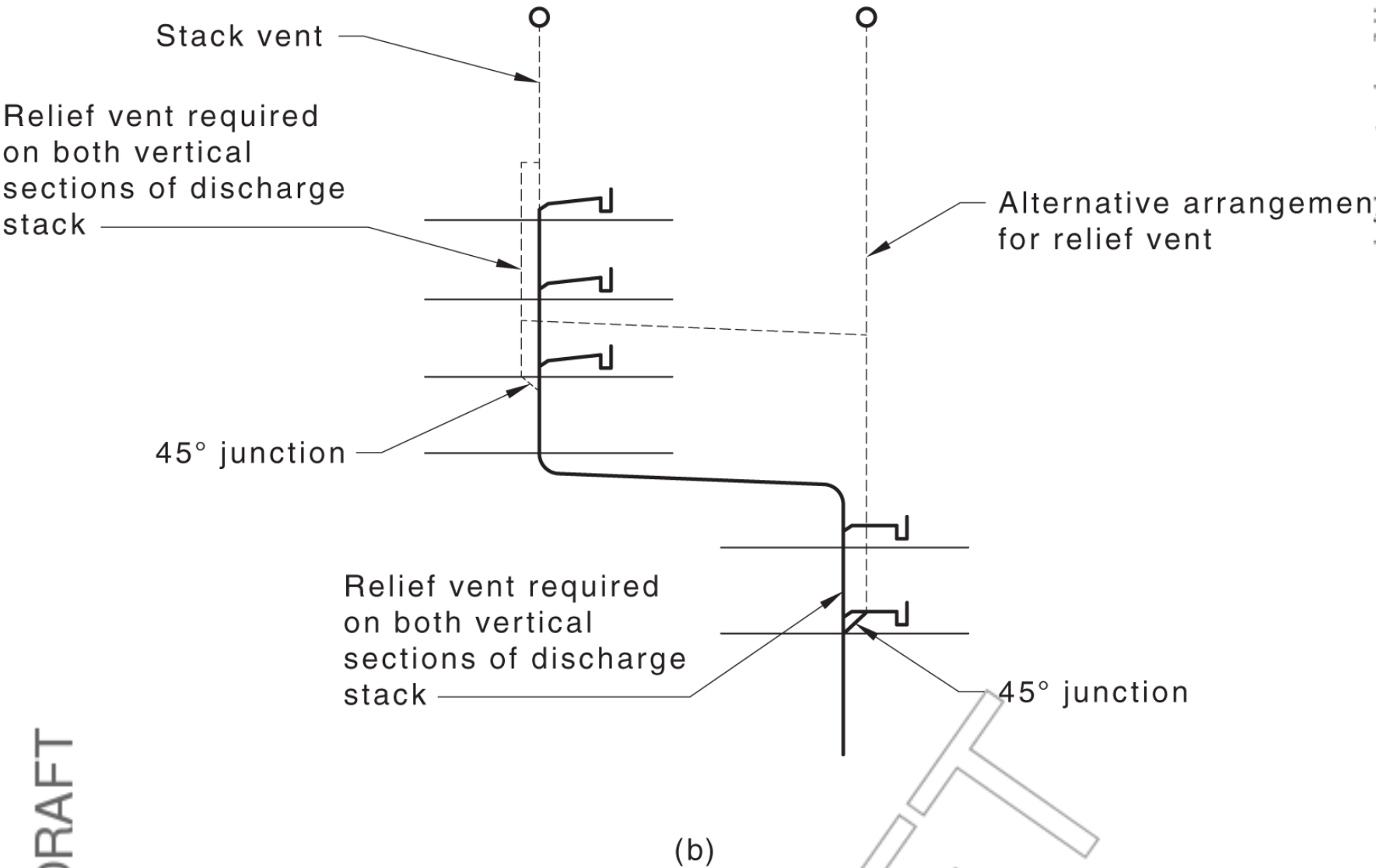
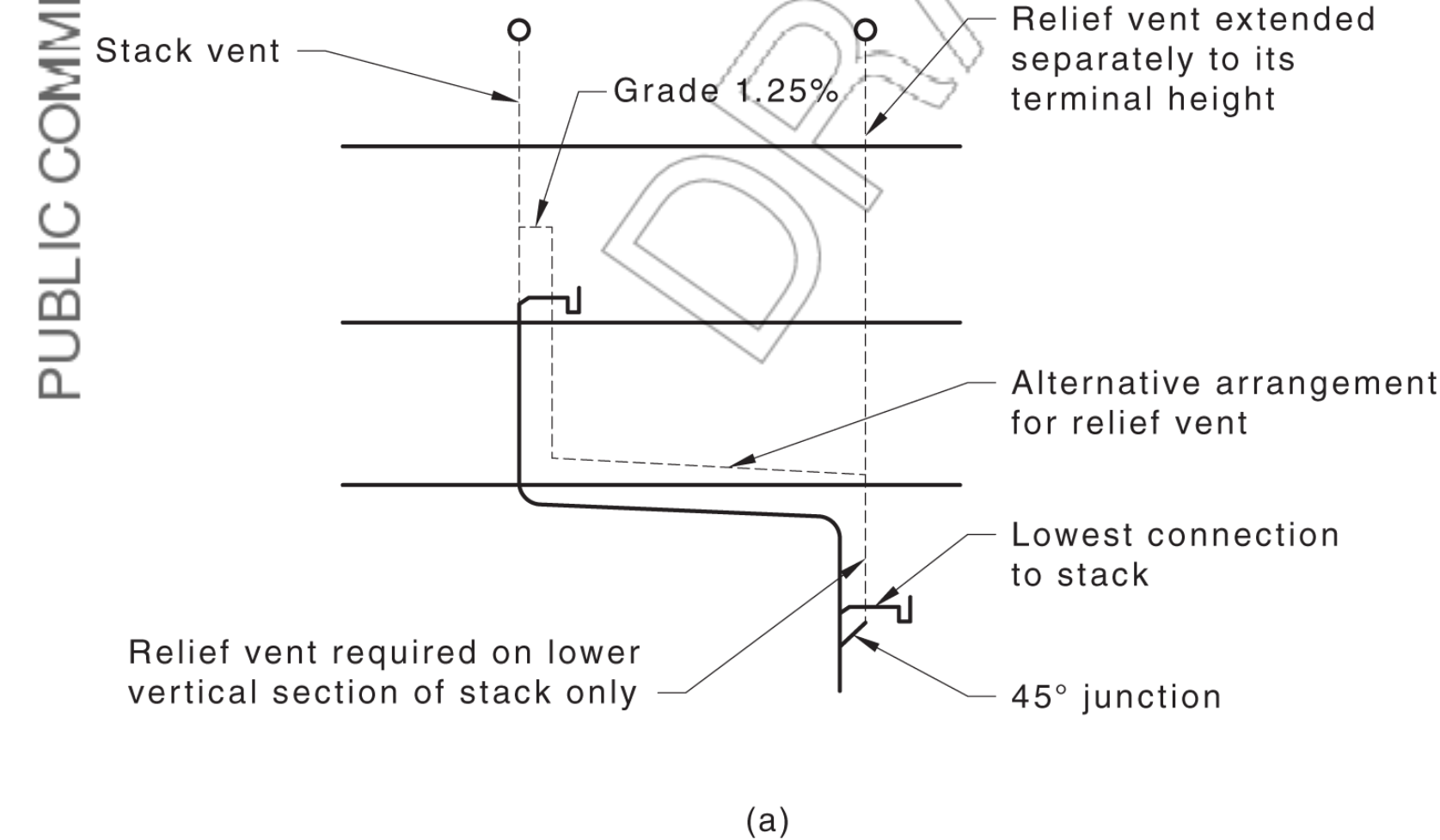


Figure 8.5.3.2 — Typical relief vent installations at stack offsets

### 8.5.3.3 Connection

Relief vents shall be connected to stacks, below the lowest connection, at an angle of 45°.

NOTE See [Figure 8.5.3.1](#) for an illustration of a typical relief vent installation.

### 8.5.3.4 Upper termination

Relief vents shall either —

- (a) extend upwards at a minimum grade of 1.25 % and interconnect with a stack vent, a header vent or another relief vent; or
- (b) extend upwards to the open air and terminate in accordance with [Clause 6.9.4](#).



8.5.3.5 Size

The size of any relief vent shall be in accordance with [Table 8.5.3.5](#), having regard to the size of the stack, the sum of the rating of all fixtures connected and the developed length of the vent measured along the pipework from its lowest connection to the stack to its upper termination point.

NOTE A relief vent need not be larger than the stack to which it is connected.

Table 8.5.3.5 — Size of relief vents and stack vents									
Size of stack DN	Maximum fixture units connected	Maximum developed lengths of vents, m							
		Required vent size, DN							
		32	40	50	65	80	100	125	150
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		
125	300				9	22	95	280	
125	750				7	19	72	230	
125	1 100				6	14	62	190	
150	700				4	9	37	155	300
150	1 300					7	30	130	250
150	2 400					6	24	100	200
225	1 700							16	62
225	4 000							14	43
225	7 000							6	31

8.5.4 Stack vents

8.5.4.1 Extension

The stack vent may extend separately to atmosphere or interconnect with the relief vent above the overflow level of the highest fixture connected to the stack, provided it is sized in accordance with [Table 8.5.3.5](#), except that the stack vent need not be larger than the stack.

8.5.4.2 Developed length

The developed length of the stack vent shall be —

- (a) for stacks with relief vents, the length of the relief vent; or
- (b) for stacks without relief vents, the length of stack vent and stack to the point of connection of the lowest branch.

8.5.5 Cross-relief vents

Cross-relief vents shall be installed in accordance with the following:

- (a) Vertical sections of stacks, 20 floor levels or more in height, measured between the highest graded pipe or branch connected and the point of connection of any relief vent shall be cross-relief vented to the relief vent at intervals of not more than 10 floor levels.
- (b) The size of the cross-relief vent shall be the size of the main relief vent or the size of the stack, whichever is the smaller.
- (c) Cross-relief vents shall connect into the stack at an angle of 45°.
- (d) Cross-relief vents shall commence from below the lowest branch connection to the stack from the floor level concerned and join into the main relief vent above the flood level rim of the lowest fixture, discharging into the stack at that floor.
- (e) For a stack with a steep offset, such stack shall be deemed to be straight with only one vertical section.

NOTE For a typical installation of a cross-relief vent, see [Figure 8.5.5](#).

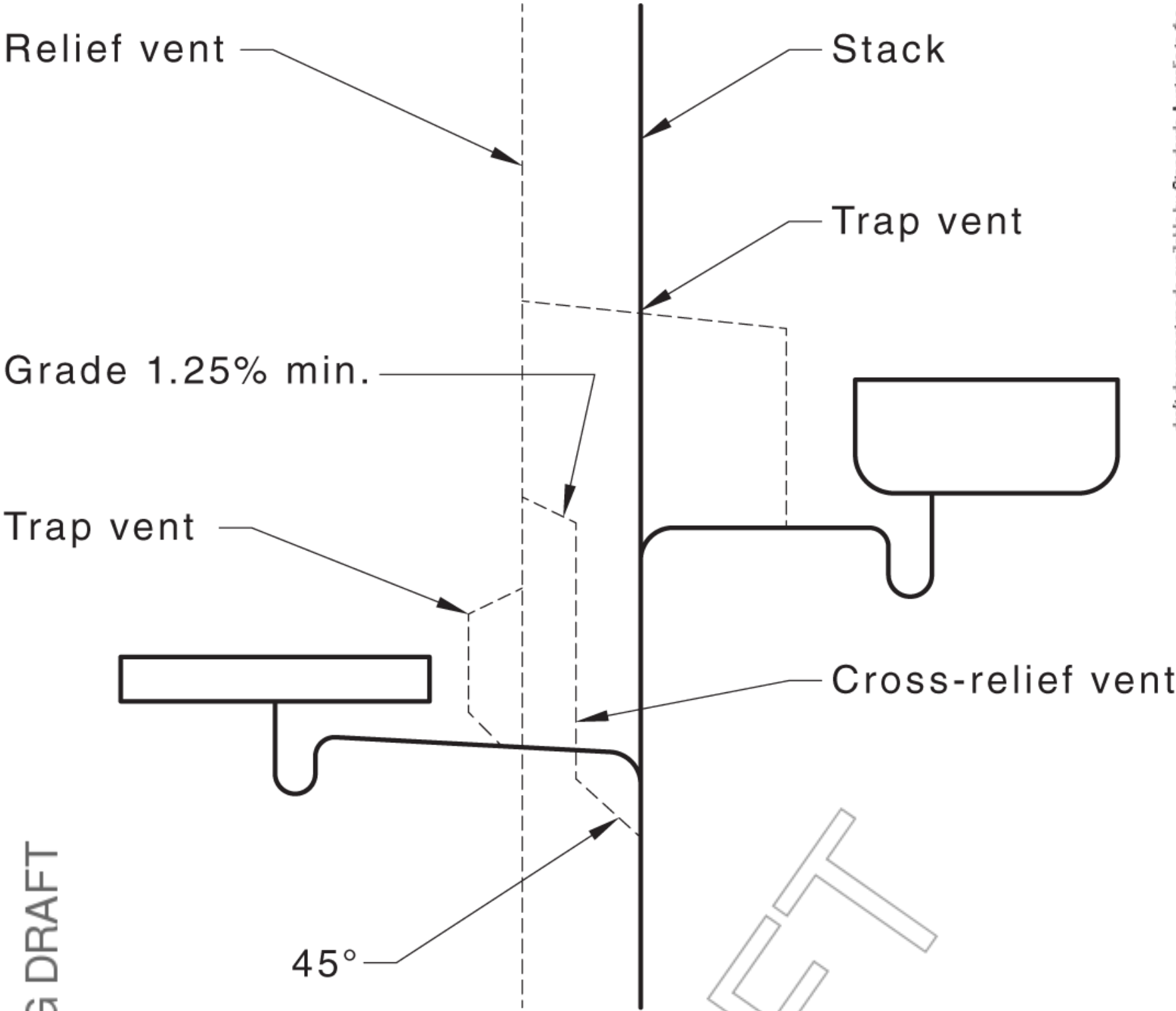


Figure 8.5.5 — Typical installation of cross-relief vent

8.5.6 Header vents

8.5.6.1 General

Stack vents may be connected at their uppermost end into a common header vent terminating at one point.

NOTE For a typical header vent size, see [Figure 8.5.6.1](#).

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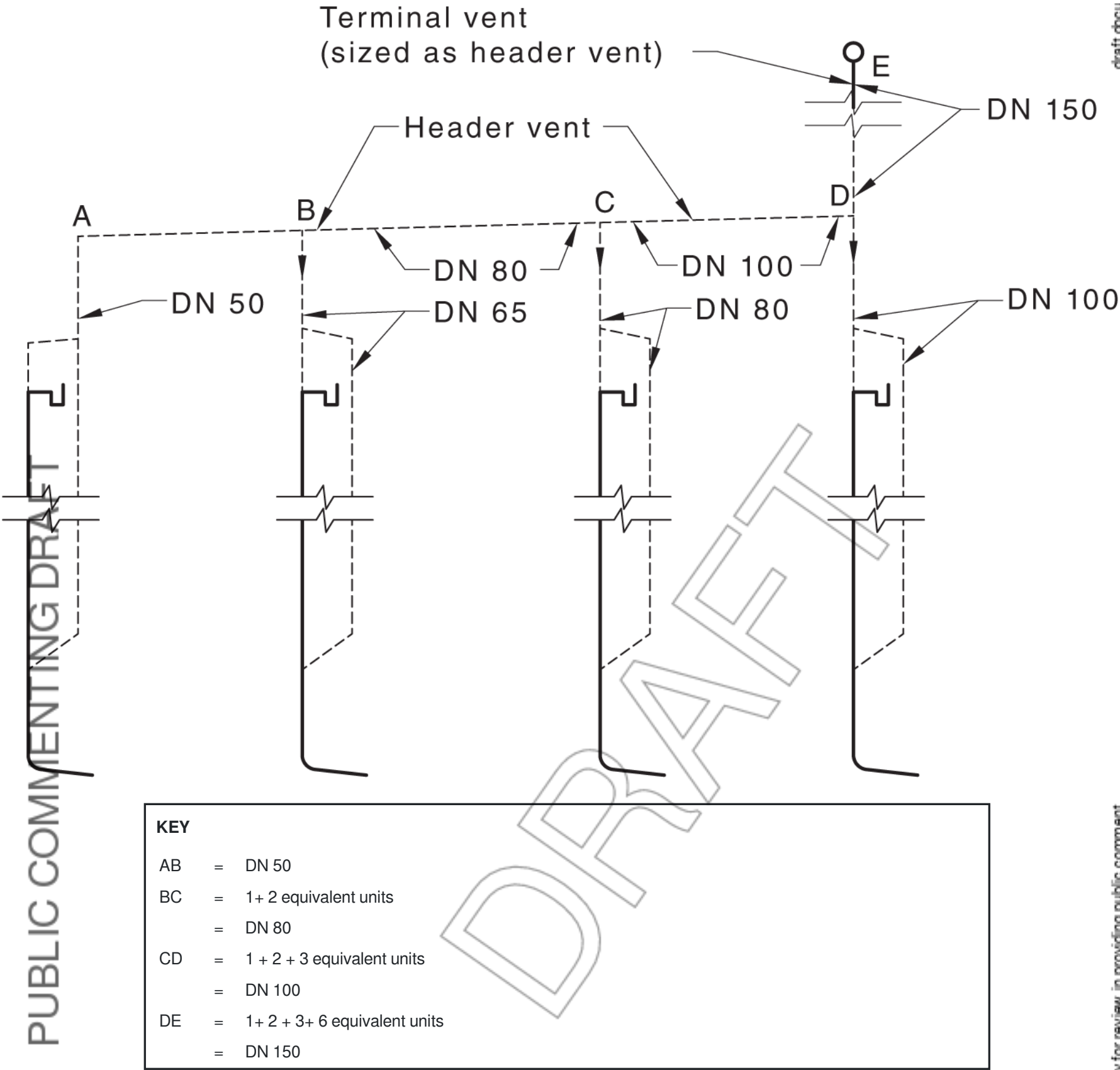


Figure 8.5.6.1 — Typical header vent size

8.5.6.2 Sizing

Header vents shall be sized in accordance with the following procedure:

- (a) Determine from Table 8.5.6.2 the number of DN 50 vents that are equivalent to individual stack vents or relief vents intercepted at lower level by the header vent.
- (b) Add together all such numbers.
- (c) From Table 8.5.6.2 note the size of single equivalent header vent.
- (d) Where a stack has a relief vent, take into account the size of only the relief vent in the determination of the equivalent number of DN 50 vents.
- (e) Where any change in size is to be made on the graded header vent, increase the size downstream of, and adjacent to, the vent junction.

NOTE Header vents need not be greater than DN 300.

Table 8.5.6.2 — Size of header vents		
Size of stack vent or relief vent DN	Equivalent number of DN 50 vents	Size of header vent DN
50	1	50
65	2	65
80	3	80
100	6	100
125	11	125
150	18	150
250	72	250
300	117	300

8.5.7 Group and common vents



### 8.5.7.1 General

One group vent shall be provided for each 10 fixtures, or part thereof, in any group connected to a common discharge pipe.

In order to determine which group of fixtures shall be group-vented, each fixture discharge pipe that is individually connected to the common discharge pipe shall be counted progressively from the fixture discharge pipe nearest the stack. Any vented fixture discharge pipe that is connected to the common discharge pipe shall not be included in such a method of counting.

### 8.5.7.2 Arrangement

Group vents shall be installed in accordance with the following:

- (a) The first group vent, for all types of fixtures, shall connect to the discharge pipe of the most upstream fixture or floor waste gully at a maximum distance of 1.5 m from the fixture trap.
- (b) The second group vent, and any additional group vents, shall be spaced along the common discharge pipe to divide the fixtures into approximately equal groups. Each group shall branch either from a fixture discharge pipe, increased in size where necessary to the size of the group vent, or from the top of the common discharge pipe.
- (c) Where any vertical drop occurs in a common discharge pipe and fixtures are connected to the lower section, a group vent shall be provided —

(i) from the top of the vertical drop;

NOTE 1 See [Clause 8.5.7.5.2](#) for maximum vertical drop.

(ii) between the vertical drop and the first downstream fixture; or

(iii) from the first downstream fixture discharge pipe.

NOTE 2 The common vent pipe from any two fixtures installed in accordance with [Clause 8.5.1.5](#) may also serve as a group vent.

### 8.5.7.3 Sizing

The size of group vents shall be determined by the size of the common discharge pipe in accordance with [Table 8.5.7.3](#).

Where a common discharge pipe varies in size along its length, the group vent shall be sized in relation to the largest section of the common discharge pipe.

Table 8.5.7.3 — Size group vents	
Size of common discharge pipe DN	Size of single group vent DN
40	32
50	40
65	40
80	50
100	50

### 8.5.7.4 Termination

Group vents shall terminate in the same manner as branch vents, as specified in [Clause 8.5.2.2](#), or with an air admittance valve (AAV) in accordance with [Clause 6.10](#).

### 8.5.7.5 Group-vented branches

#### 8.5.7.5.1 Size

Group-vented branches shall be sized in accordance with [Clause 8.5.7.3](#) except that, if the group vent is larger than the discharge pipe to which it connects, the discharge pipe shall be increased to the size of the group vent.

NOTE See [Figure 8.5.7.5.1](#) for a typical vented system showing group vents.

Dimensions in millimetres

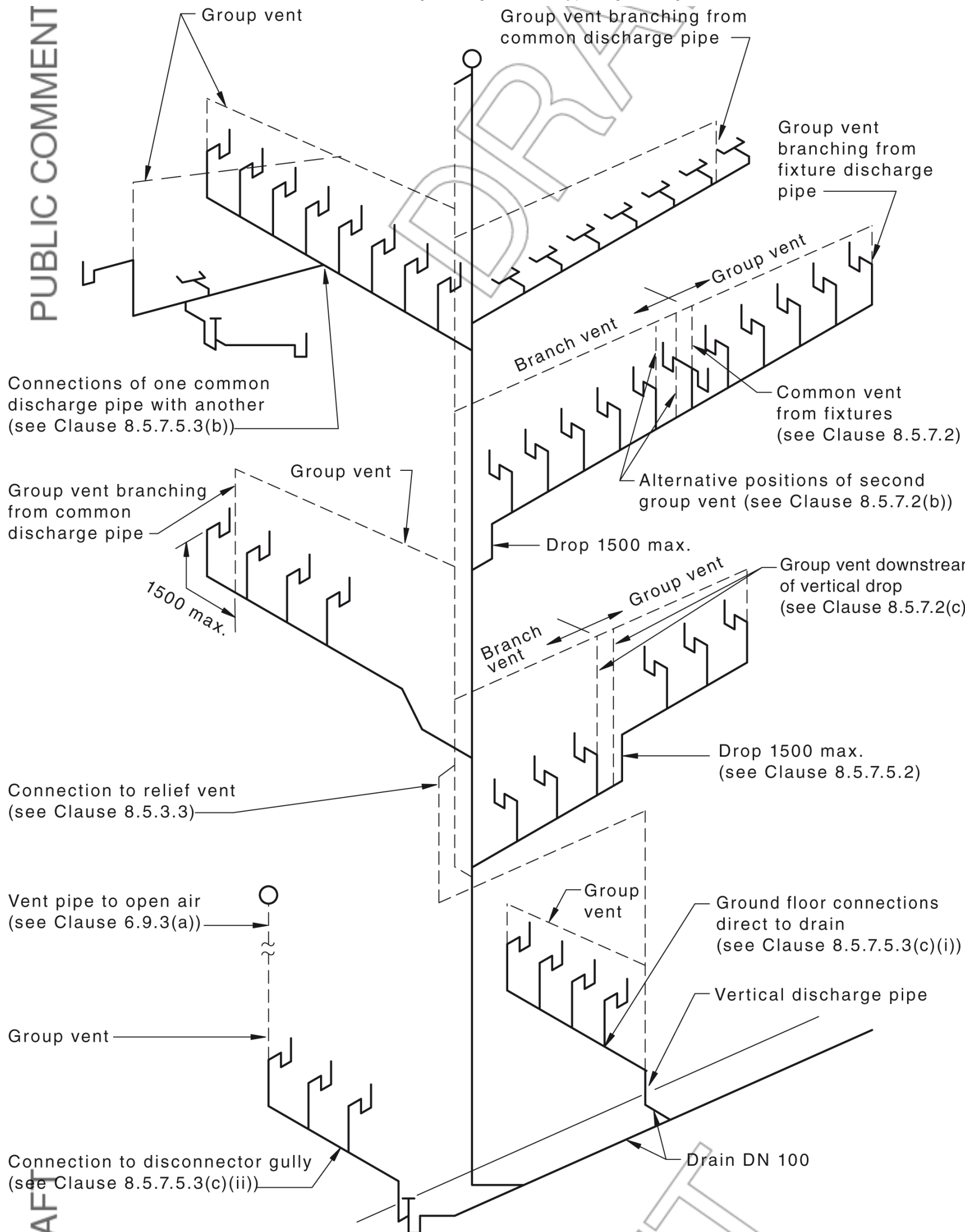


Figure 8.5.7.5.1 — Typical fully vented modified system showing group vents

#### 8.5.7.5.2 Arrangement

Group-vented branches shall be installed on a grade with a maximum vertical drop of 1.5 m.

#### 8.5.7.5.3 Connection of common discharge pipe

The common discharge pipe of any group-vented branch shall connect —

- (a) directly to a stack;
- (b) to a junction with another common discharge pipe; or
- (c) for ground floor fixtures —
  - (i) direct to drain; or
  - (ii) to a disconnector gully.

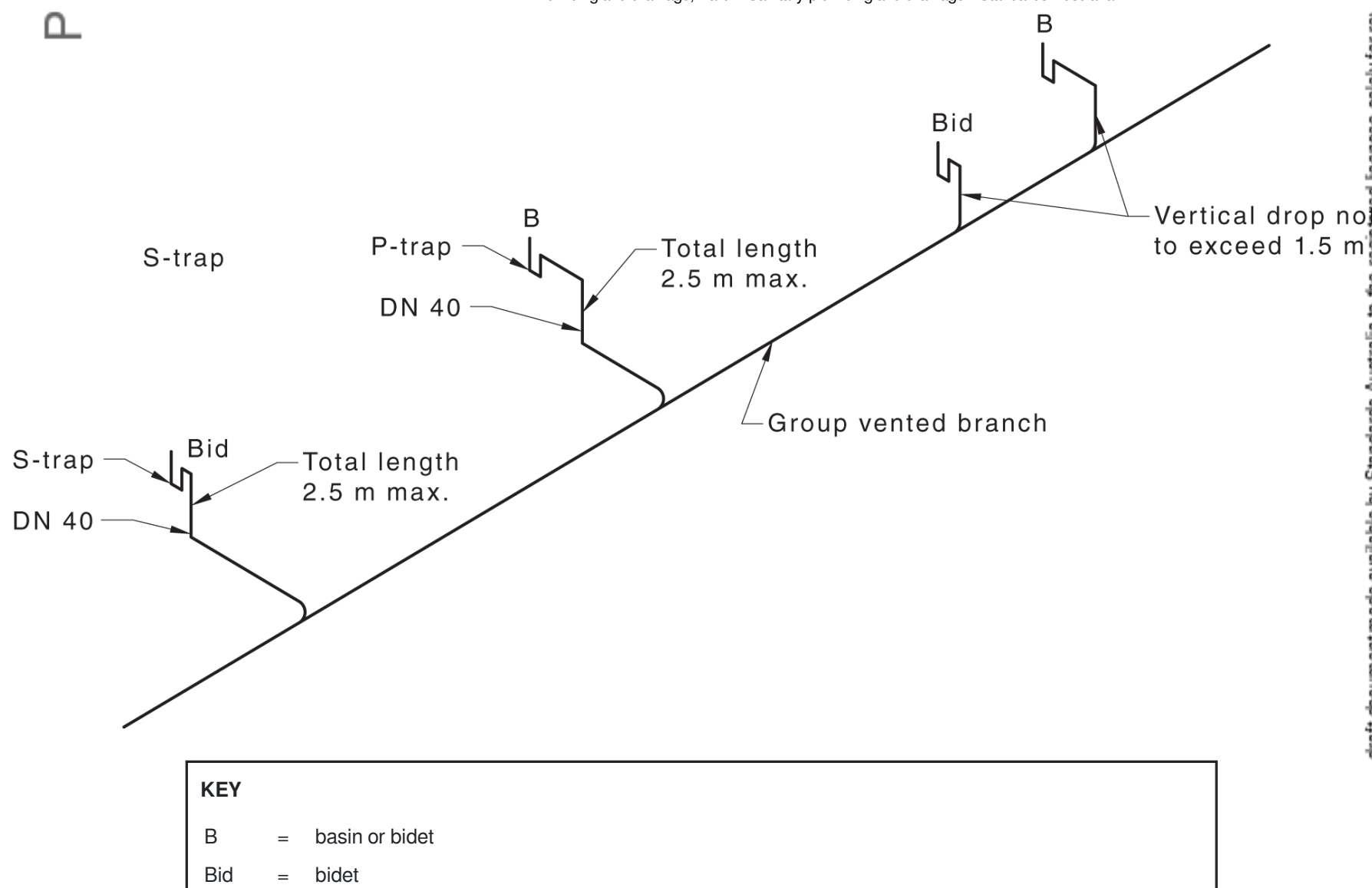
#### 8.5.7.5.4 Connection of basins and bidets

When connected to a group-vented branch, each basin and bidet shall have a DN 40 trap and fixture discharge pipe not greater than 2.5 m in length with a maximum vertical drop of 1.5 m. The maximum number of bends in a fixture discharge pipe shall be in accordance with [Clause 9.5.4](#).

NOTE A typical connection of a basin or bidet of a group-vented branch is depicted in [Figure 8.5.7.5.4](#).

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**Figure 8.5.7.5.4 — Typical connection of basin or bidet to a group-vented branch**

#### 8.5.7.5.5 Connection of all other fixtures

Fixtures other than basins and bidets shall —

- (a) be connected separately to the group-vented branch except as provided in [Clause 8.5.7.2](#);
- (b) have a length of any DN 100 fixture discharge pipe not greater than 6 m;
- (c) have a length of any fixture discharge pipe smaller than DN 100 not greater than 2.5 m;
- (d) have a maximum vertical interval between the crown of the trap and the top of the group vented branch of 2.5 m;
- (e) have the maximum number of bends in a fixture discharge pipe conform to [Clause 9.5.4](#); and
- (f) have a reducer fitting installed where a water closet pan with a DN 100 outlet connects to a graded pipe or branch of DN 80.

## 8.6 Offsets in stacks

### 8.6.1 Steep offsets

#### 8.6.1.1 General

A steep offset is any offset made at an angle of more than 45° to the horizontal.

### 8.6.1.2 Sizing of stack

The size of the steep offset stack shall be in accordance with [Clause 8.4\(g\)](#). The maximum fixture unit loading shall conform to [Table 8.2.2\(B\)](#).

### 8.6.1.3 Venting

The following apply to venting for the steep offset stack:

- (a) Provided a relief vent is installed below the lowest connection to the stack as specified in [Clause 8.5.3.1](#), additional relief vents in close proximity to the bends of the offset are not required.
- (b) Cross-relief vents shall be installed in accordance with [Clause 8.5.5](#).
- (c) Stack vents shall be installed in accordance with [Clause 8.5.4](#).

### 8.6.2 Graded offsets

### 8.6.2.1 General

A graded offset is any offset made at an angle of less than 45° to the horizontal.

#### 8.6.2.2 Minimum grade

The minimum grade of a graded offset shall be in accordance with [Table 8.6.2.2](#).



Table 8.6.2.2 — Minimum grade of offsets	
Size of graded section DN	Min. gradient %
≤ 80	2.50
100	1.65
125	1.25
150	1.25
225	0.60
300	0.40

8.6.2.3 Restricted connection zones above the graded offset

For graded offsets, no connection shall be made within —

- (a) 600 mm of the bend, when the stack extends not more than five floor levels above the offset;
- (b) 1 m of the bend when the stack extends more than five floor levels above the offset; or
- (c) 2.5 m, when foaming is likely to occur.

NOTE For restricted connection zone above the graded offset, see [Figure 8.6.2.3](#).

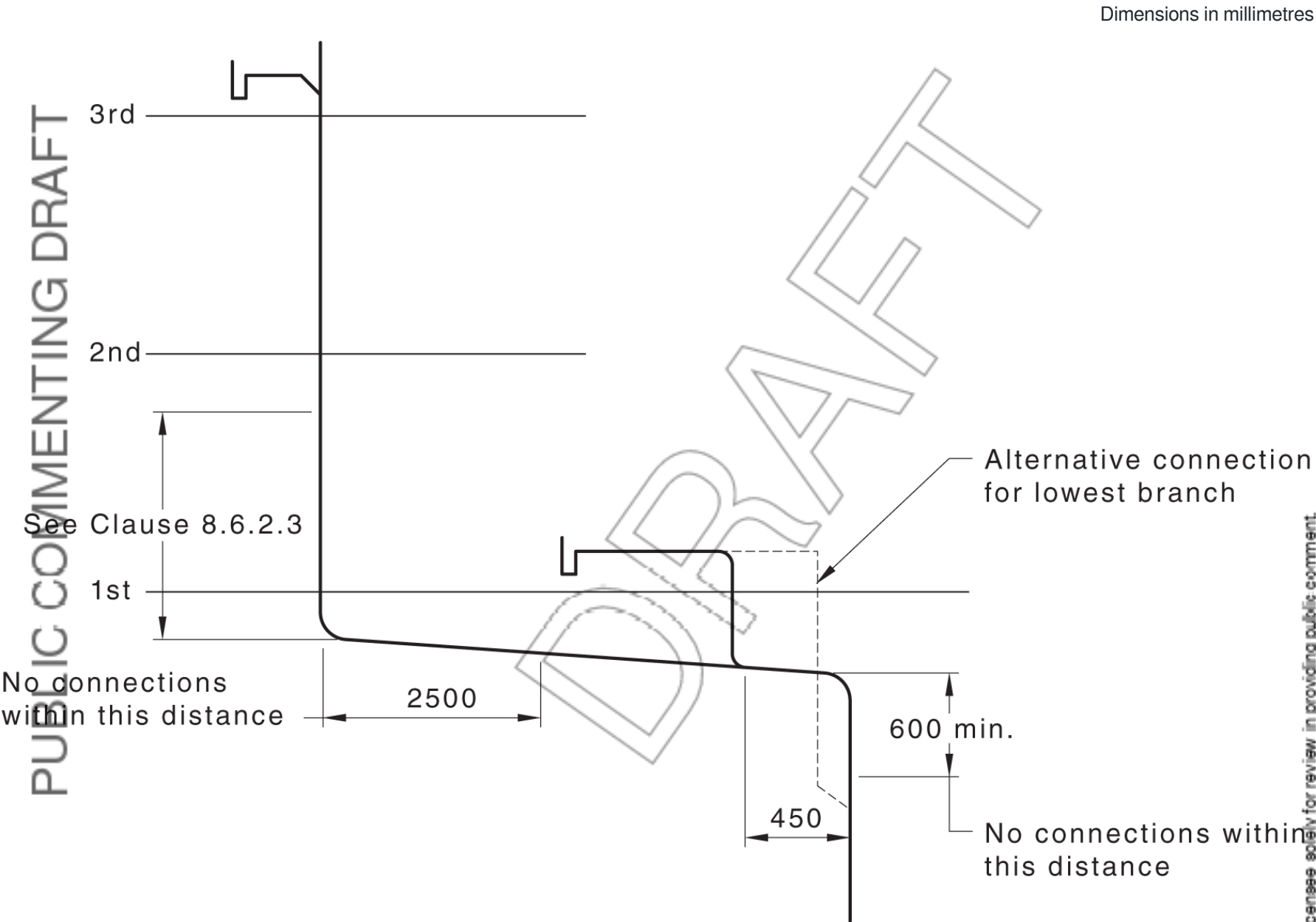


Figure 8.6.2.3 — Connections at graded offset

8.6.2.4 Restricted connection zone below the graded offset

No connection shall be made within 600 mm of the bend.

NOTE For restricted connection zone below the graded offset, see [Figure 8.6.2.4](#).

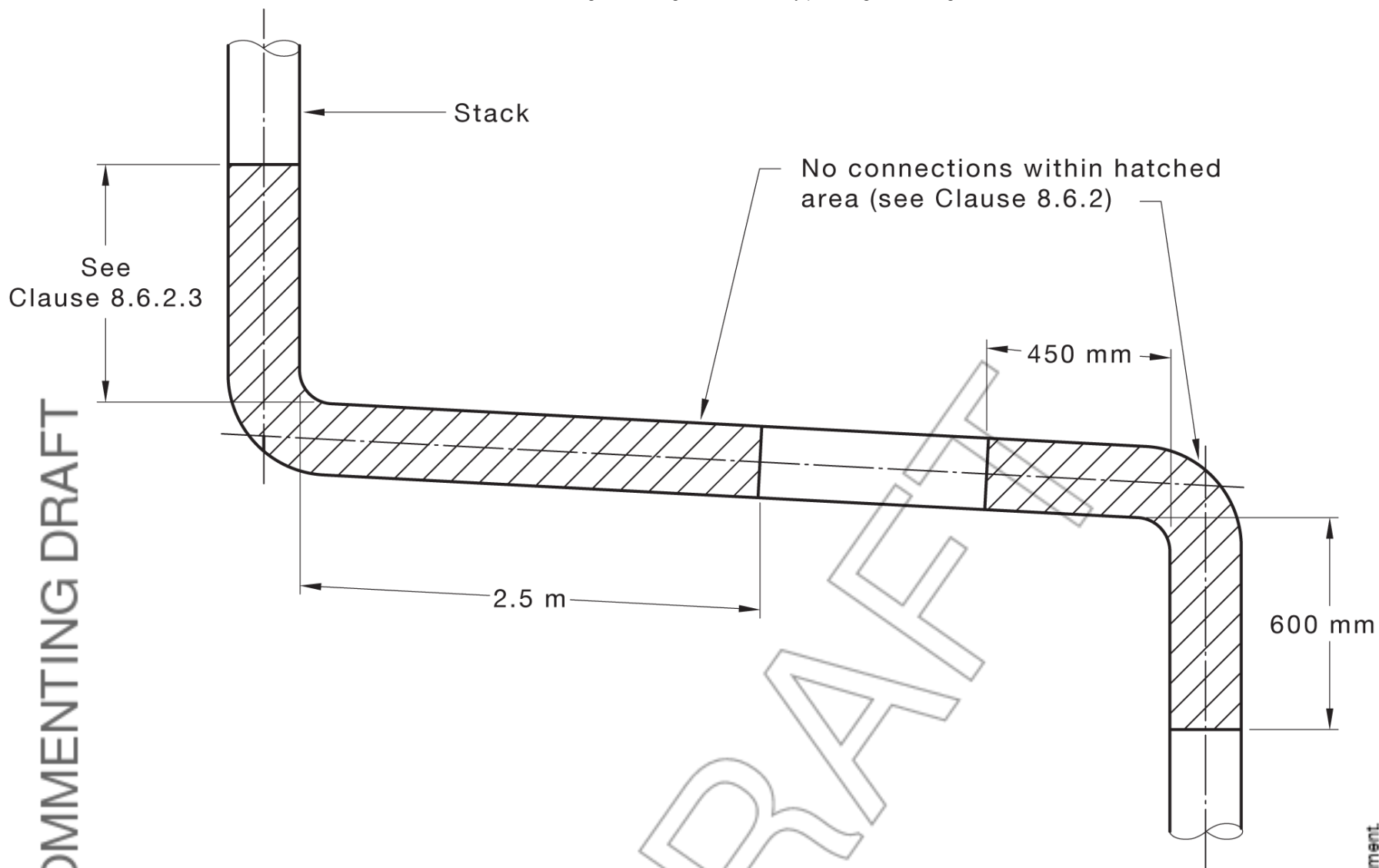


Figure 8.6.2.4 — Connections at offset of stack

8.6.2.5 Restricted connection zone within the graded offset

No connection shall be made within —

- (a) 2.5 m of the upper bend; or
- (b) 450 mm of the lower bend.

8.6.2.6 Sizing of stack

The size of the graded offset stack shall be in accordance with [Clause 8.4\(g\)](#). The maximum fixture unit loading on the graded section shall conform to [Table 8.2.2\(A\)](#).

8.6.2.7 Venting

Positive air pressure pulses in a stack with a graded offset shall be controlled by either one of the following methods:

- (a) Venting in accordance with the following:
  - (i) Relief vents shall be installed in accordance with the relevant clauses of [Clause 8.5.3](#).  
NOTE For typical installation, see [Figure 8.5.3.1](#) or [Figure 8.5.3.2](#).
  - (ii) Cross-relief vents shall be installed in accordance with [Clause 8.5.5](#).
  - (iii) Stack vents shall be installed in accordance with [Clause 8.5.4](#).
- (b) Using pressure attenuators in accordance with [Clause 6.11](#).

9 Single stack systems and single stack modified systems — Design and installation

9.1 Scope of section

This section specifies design and installation requirements for single stack systems and the single stack modified systems of sanitary plumbing.

9.2 System design

9.2.1 General

Single stack systems are designed on the principle that the stack is to be not less than DN 100; however, variations to these requirements are provided for in this document.

Single stack systems are also designed on the principle that the air within the discharge pipes from fixtures, the stack and the stack vent allow fixtures to be connected to the stack without the need for individual trap vents or, in the case of ranges of fixtures, venting of the common discharge pipe.

NOTE 1 In Australia, for the purpose of this section, buildings Class 2 to Class 9 are generally commercial and industrial buildings. Buildings Class 1 and Class 10 are generally domestic or residential buildings, as defined by the NCC.

NOTE 2 In New Zealand, refer to NZBC Clause A1 Classified Uses for information on building use categories.

9.2.2 Single stack system

In domestic or residential buildings, fixtures shall be connected to the stack individually or through floor waste gullies.

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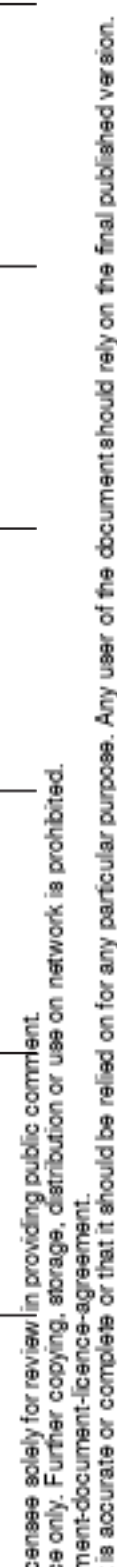
In commercial or industrial buildings, fixtures may be connected to the stack individually, through floor waste gullies or in ranges of the same type of fixtures. The maximum number of floor levels through which the stack passes shall be as specified in [Clause 9.2.5](#).

NOTE See [Figures 9.2.2\(A\) and \(B\)](#) for examples of single stack systems.

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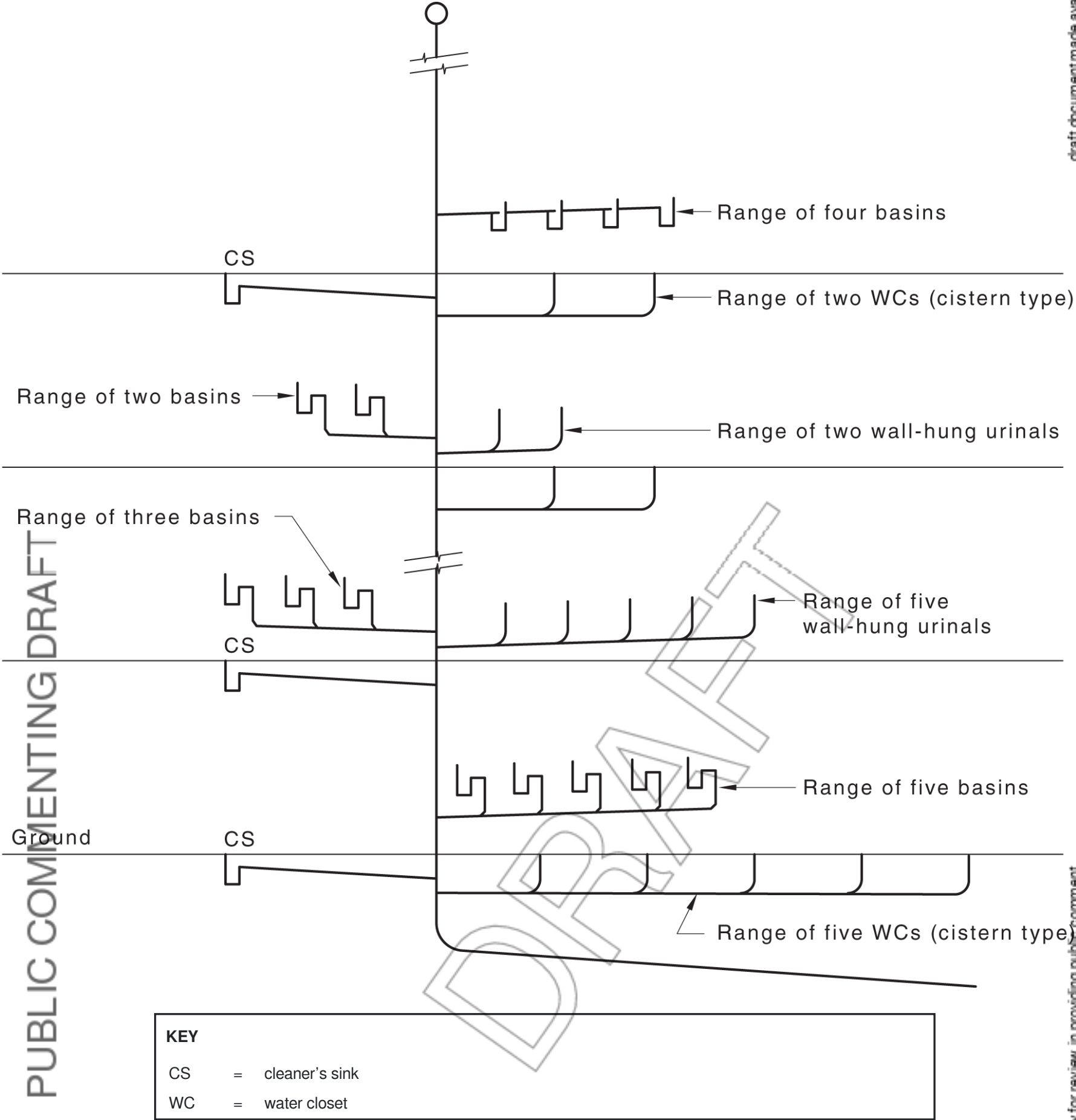




KEY	
B	= basin
Bth	= bath
FW	= floor waste
Shr	= shower
Tr	= trough
WC	= water closet

NOTE See Table 9.7.1(A) for single stack modified systems for domestic or residential buildings.

Figure 9.2.2(A) — Examples of single stack systems — Domestic or residential building



NOTE See Table 9.7.1(B) for single stack systems for commercial or industrial buildings.

Figure 9.2.2(B) — Examples of single stack systems — Commercial or industrial building

### 9.2.3 Single stack modified system

The single stack modified system permits stacks to receive a higher discharge loading or to be extended to serve a greater number of floor levels by introducing a relief vent and cross-vents, or by the use of pressure attenuators. Where cross-vents are used, they shall be installed between the relief vent and stack. Where pressure attenuators are used, they shall be installed in accordance with Clause 6.11.

NOTE 1 The single stack modified system allows these increases in loading or height without increasing the nominal size of the stack.

The maximum number of floor levels through which the stack passes shall be as specified in Clause 9.2.5.

NOTE 2 See Figures 9.2.3(A) and (B) for examples of single stack modified systems.

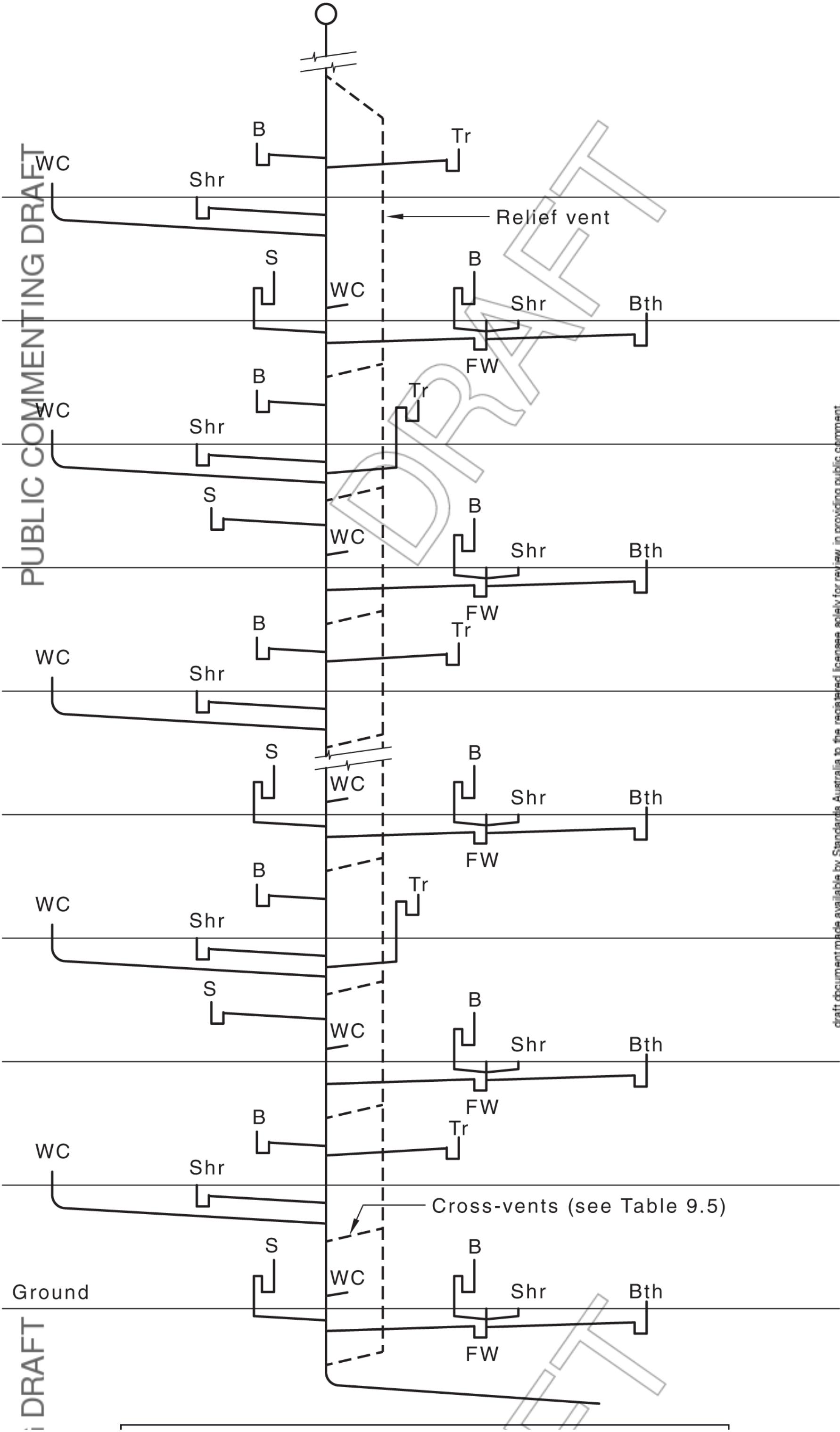
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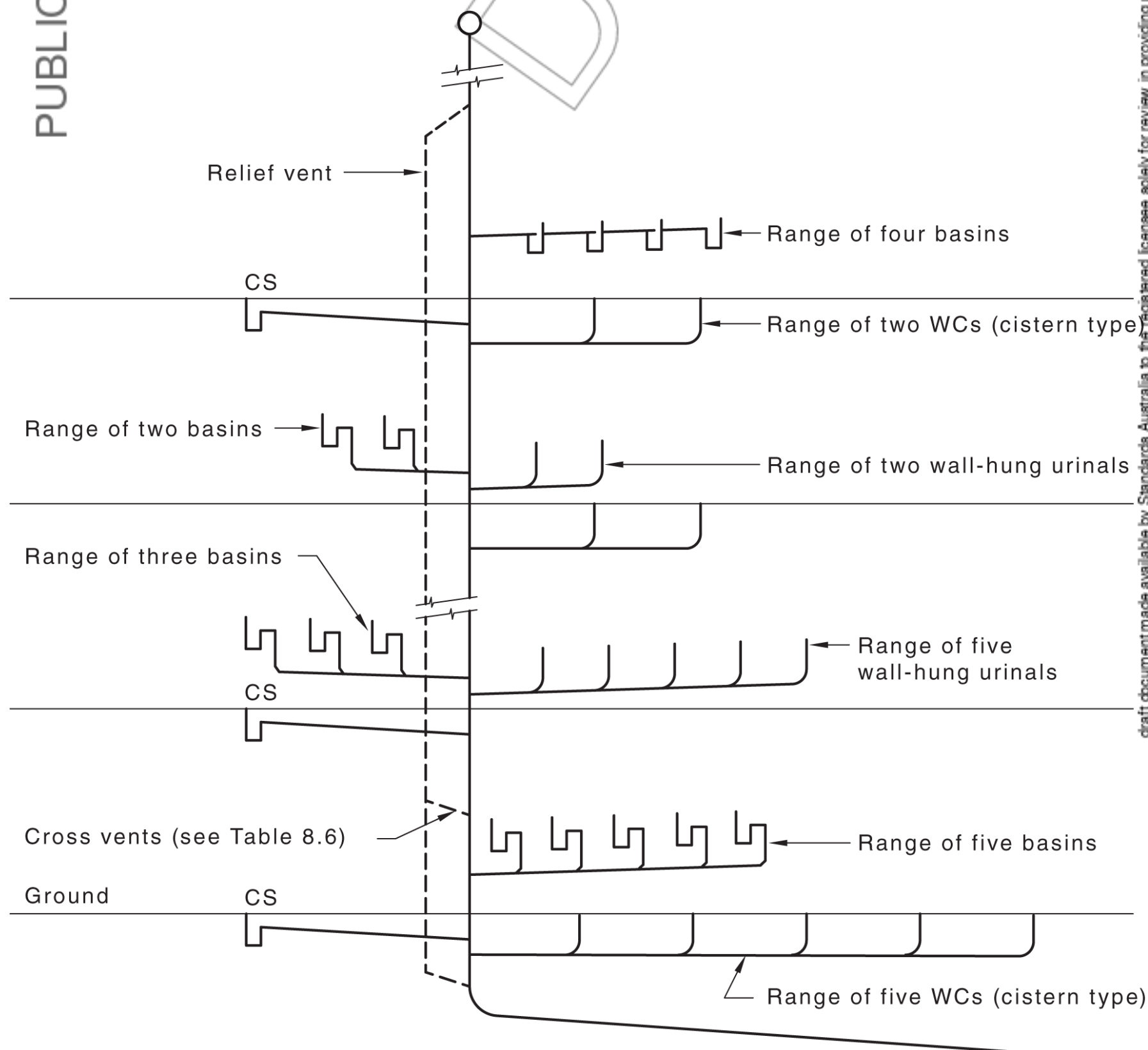
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**KEY**

B	=	basin
Bth	=	bath
FW	=	floor waste
Shr	=	shower
Tr	=	trough
WC	=	water closet

NOTE See [Table 9.7.2\(A\)](#) for single stack modified systems for domestic or residential buildings.

**Figure 9.2.3(A) — Single stack modified systems — Domestic or residential building**



**KEY**

CS = cleaner's sink  
WC = water closet

NOTE See Table 9.7.2(B) for single stack modified systems for other than residential-type buildings.

**Figure 9.2.3(B) — Single stack modified systems — Commercial or industrial building**

### 9.2.4 Design requirements

The following factors shall be addressed when sizing stacks —

- (a) the load-production effect of fixtures connected to the stack;
- (b) the maximum number of floor levels connected to the stack;
- (c) the type of building served; and

**NOTE** See [Clause 9.7](#) for information on sizing of stacks.

- (d) whether relief vents and cross-vents are installed.

### 9.2.5 Number of floor levels

The maximum number of floor levels through which the stack passes, as specified in [Tables 9.7.1\(A\), 9.7.1\(B\), 9.7.2\(A\) and 9.7.2\(B\)](#), shall be counted from the point at which the stack connects to the drain or graded pipe and the highest floor level on which a fixture is connected. Where the distance between the invert of the drain or graded pipe and the lowest floor level exceeds 2.4 m, that floor shall be counted as an additional floor level.

NOTE See [Figure 9.2.5](#) for examples of floor number levels.

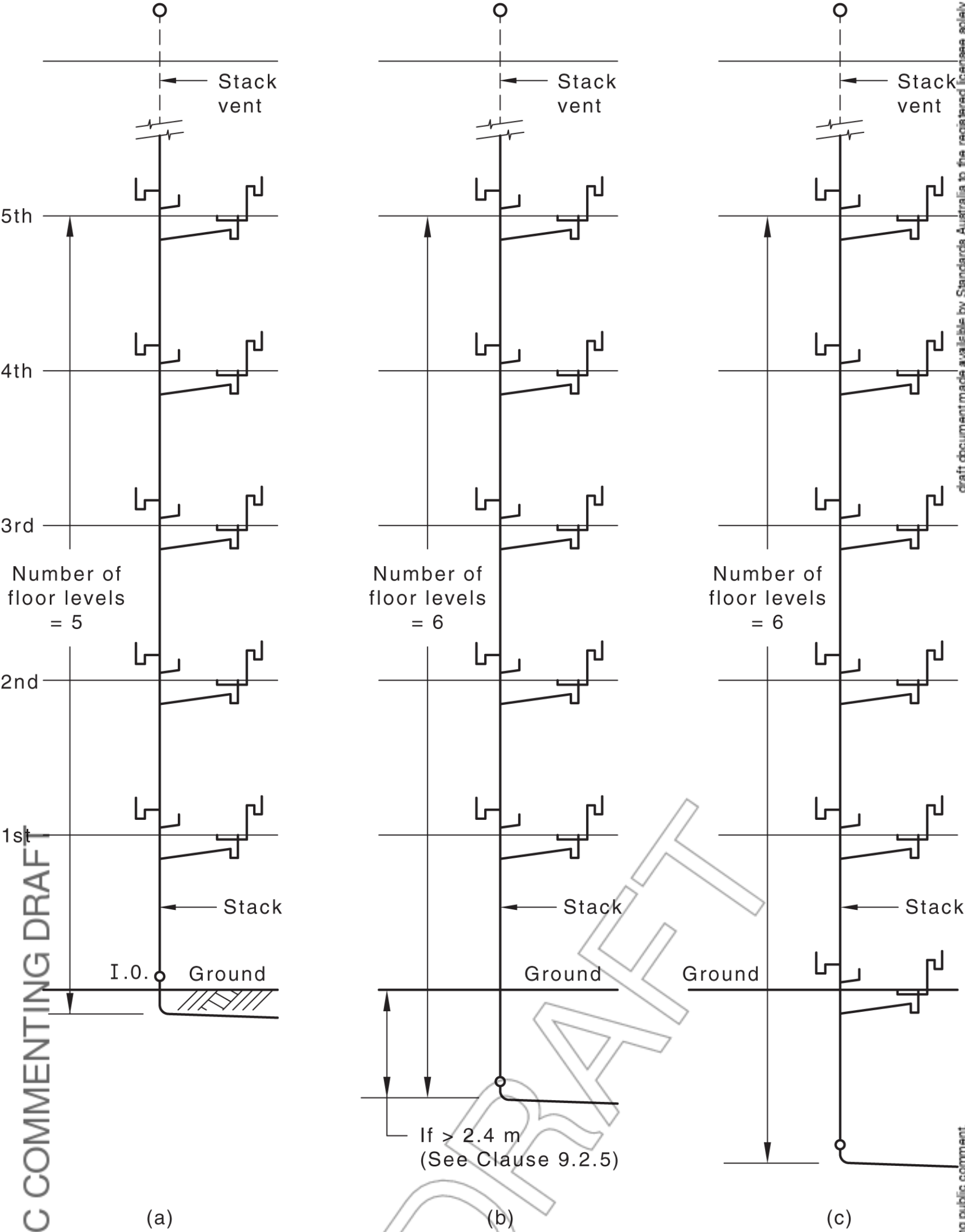


Figure 9.2.5 — Number of floor levels

### 9.3 Rating of fixtures

The fixture unit ratings set out in [Table 6.3\(A\)](#) shall apply to fixtures connected in accordance with this section.

Where the discharge from plant room equipment is connected to any single stack system, the loading in fixture units shall be determined in accordance with [Table 6.3\(B\)](#).

### 9.4 Fixtures to be connected

#### 9.4.1 Domestic or residential buildings

The type and total number of fixtures that may be connected to a single stack from any floor level in a residential building shall not exceed the following:

- (a) Two basins.



- (b) Two baths.
- (c) Two bidets.
- (d) Two clothes-washing machines.
- (e) Two dishwashing machines.
- (f) Two kitchen sinks (double or single domestic with or without food waste disposal units).
- (g) Two laundry troughs.
- (h) Two showers.
- (i) Two water closet pans.
- (j) Two floor waste gullies.
- (k) Two bar sinks.

NOTE See also [Table 9.7.1\(A\)](#).

## 9.4.2 Commercial or industrial buildings

The type and total number of fixtures that may be connected to a single stack from any floor level in a commercial building by fixture discharge pipes, common discharge pipes or ranges of fixtures shall not exceed the following:

- (a) For separate pipes —
  - (i) five basins;
  - (ii) one cleaner’s sink;
  - (iii) one drinking fountain;
  - (iv) one sink;
  - (v) five urinals (wall-hung);
  - (vi) five water closet pans;
  - (vii) two showers;
  - (viii) one 3 m slab type urinal;
  - (ix) two bar sinks; or
  - (x) four commercial dishwashers.

No additional or alternative fixtures shall be connected except tundishes receiving minor discharges.

At any floor level, the maximum discharge from all floor waste gullies shall not exceed five basins, one drinking fountain, one cleaner’s sink and two showers.

NOTE 1 See [Table 9.7.1\(B\)](#).

NOTE 2 See [Table 6.3\(A\)](#) Note 3.

- (b) For ranges of fixtures —
  - (i) five basins;
  - (ii) five urinals (wall-hung); and
  - (iii) five water closet pans.

## 9.5 Connection of fixtures without trap vents

### 9.5.1 Separate fixture discharge pipes

Each fixture shall be connected to the stack by a separate unvented fixture discharge pipe of a prescribed length, size and grade in accordance with [Table 9.5.1](#), except as specified in [Clause 9.5.2](#). Where the length of the discharge pipe exceeds that specified in [Table 9.5.1](#), a trap vent shall be provided in accordance with [Clause 8.5.1](#).

Table 9.5.1 — Fixture discharge pipes without trap vents to stacks		
Fixture DN	Maximum length m	Grade %
Waste fixtures	2.5	2.50 to 5.00
Water closet pans 100	6.0	1.65 to 5.00
80	2.5	1.65 to 5.00
Urinals 50–80	2.5	2.50 to 5.00
100	6.0	1.65 to 5.00

NOTE See [Table 6.3\(A\)](#) for sizes of fixture discharge pipes.

### 9.5.2 Acceptable variations

The following variations apply:

- (a) Stacks, either straight or with offsets as specified in [Clause 8.6](#) that receive only the discharge from waste fixtures may have unvented fixture discharge pipes installed in accordance with [Table 9.5.1](#).
- (b) Stacks without offsets may be sized having a maximum fixture unit loading in accordance with [Table 9.5.2](#).

The requirements of [Clause 9.4](#), whether the stack is straight or with an offset, as regards the maximum number and type of waste fixtures which may be connected to the stack from any floor level need not apply.

- (c) Not more than one-quarter of the maximum loading as shown in [Table 9.5.2](#) may discharge into the stack at any one floor level except where the stack is DN 50 or smaller or in accordance with [Clause 9.8.9](#).
- (d) Fixture discharge pipes jointed together close to the stack may be installed in accordance with [Clause 9.5.6](#).
- (e) Fixture discharge pipes connected to a stack by means of a short vertical pipe may connect to the stack in accordance with [Clause 9.5.7](#) and [Figure 6.7.3.2\(b\)](#).
- (f) For stacks of sizes between DN 65 and DN 100 only, two fixtures of the same type (fixture pairs) may jointly discharge to the common fixture trap and fixture discharge pipe in accordance with [Clause 6.5.4](#).
- (g) For stacks of sizes between DN 100 and DN 150 only, fixtures of the same type (ranges of fixtures in commercial-type buildings) that separately discharge to a common discharge pipe may be in accordance with [Clause 9.5.10](#).

Table 9.5.2 — Size of waste stack	
Size of stack DN	Maximum fixture unit loading
40	2
50	6
65	15
80	30
100	120

### 9.5.3 Opposed junctions

The size and location of junctions between discharge pipes and the discharge stack designed to prevent cross flow and water seal siphonage shall conform to [Clause 6.7.3](#).

### 9.5.4 Bends in fixture discharge pipes

The number of bends in a fixture discharge pipe shall conform to the following:

- (a) Other than the discharge pipes from basins and bidets, there shall be not more than two bends in the horizontal plane and three bends in the vertical plane.
- (b) Each basin and bidet shall have not more than two bends in the horizontal plane and two bends in the vertical plane.
- (c) For the purpose of this clause, a bend of 45° or less shall not be considered as a change in direction or grade.

### 9.5.5 Vertical dropper on fixture discharge pipes

The maximum length of a vertical dropper on any fixture discharge pipe shall be 2.5 m, except for basins and bidets where it shall be 1.5 m.

### 9.5.6 Connection from waste fixtures to stack

Two fixture discharge pipes, including discharge pipes from floor waste gullies, receiving the discharge from waste fixtures may connect to the stack within a distance of 1 m by means of a 45° junction, provided —

- (a) the angle between the two fixture discharge pipes is not greater than 45°;
- (b) the outlet of the junction is one size larger than the largest fixture pipe, except for a floor waste gully that does not receive the discharge from a fixture; and
- (c) the section of pipe downstream of the 45° junction is included as part of the maximum length of the fixture discharge pipe.

NOTE For a diagram of the above, see [Figure 9.5.6](#).

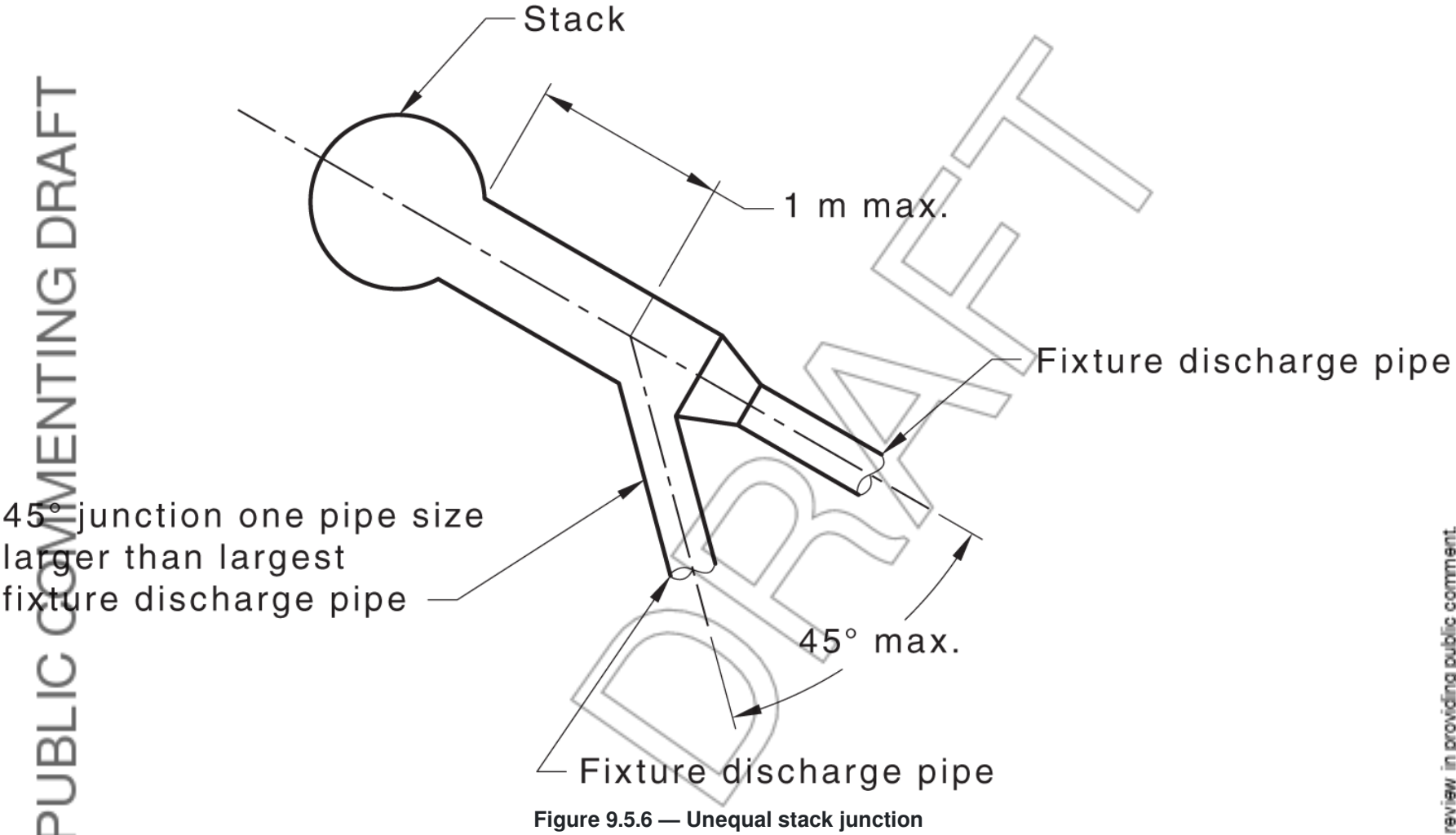


Figure 9.5.6 — Unequal stack junction

9.5.7 Connection from waste fixtures to stack below restricted zone

Fixture discharge pipes, including those from floor waste gullies, may be connected immediately below the restricted zone vertical depth by means of a short vertical drop adjacent to the stack, see [Table 6.7.3.2](#) and [Figure 6.7.3.2\(B\)](#).

9.5.8 Floor waste gullies

Floor waste gullies shall be installed in accordance with [Clause 4.6.7](#).

9.5.9 Traps

Traps shall be installed in accordance with [Clause 6.5](#).

9.5.10 Connection of ranges of fixtures

A range of fixtures of the same type in commercial buildings may discharge through a common discharge pipe without venting. The junction at the point of connection between a fixture discharge pipe and the common discharge pipe shall be a 45° or a sweep junction.

9.5.11 Ranges of basins

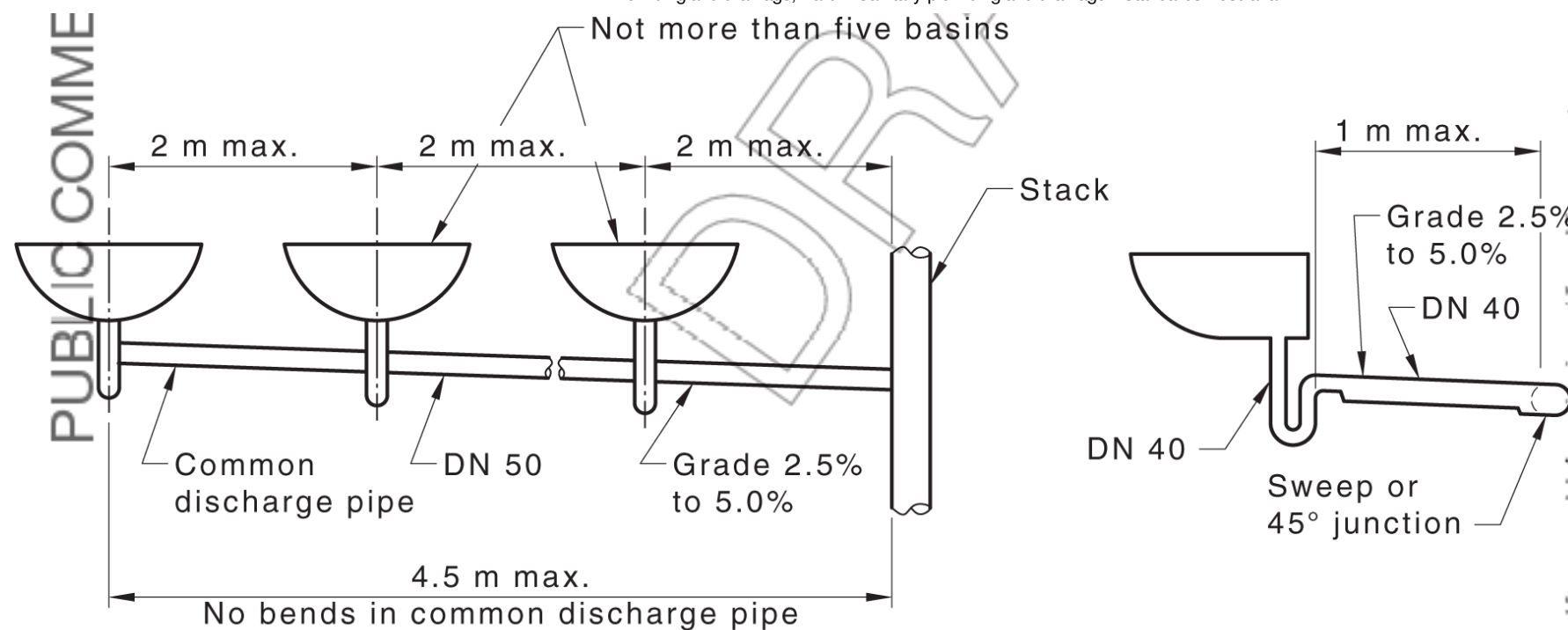
9.5.11.1 General

The maximum number of basins shall be five, as shown in [Figure 9.5.11.1](#).

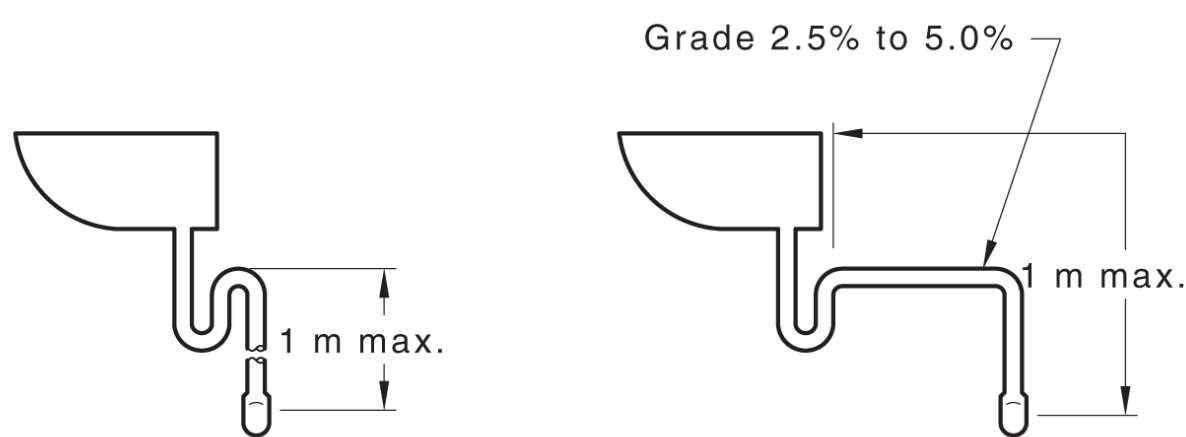
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(a) Range of unvented pluggable basins



**Figure 9.5.11.1 — Connection of basins**

#### 9.5.11.2 Fixture discharge pipe

The fixture discharge pipe from each basin to the point of connection to the common discharge pipe shall be —

- DN 40;
- not longer than 1 m;
- installed with not more than one bend; and
- graded within the range of 2.5 % to 5 %.

### 9.5.11.3 Common discharge pipe

The common discharge pipe shall be —

- (a) not smaller than DN 50;
- (b) not longer than 4.5 m;
- (c) installed without a bend; and
- (d) graded within the range of 2.5 % to 5 %.

#### 9.5.11.4 Spacing of traps

The distance between the centre-lines of adjacent traps and between the near face of the stack and the centre-line of the nearest trap shall not exceed 2 m.

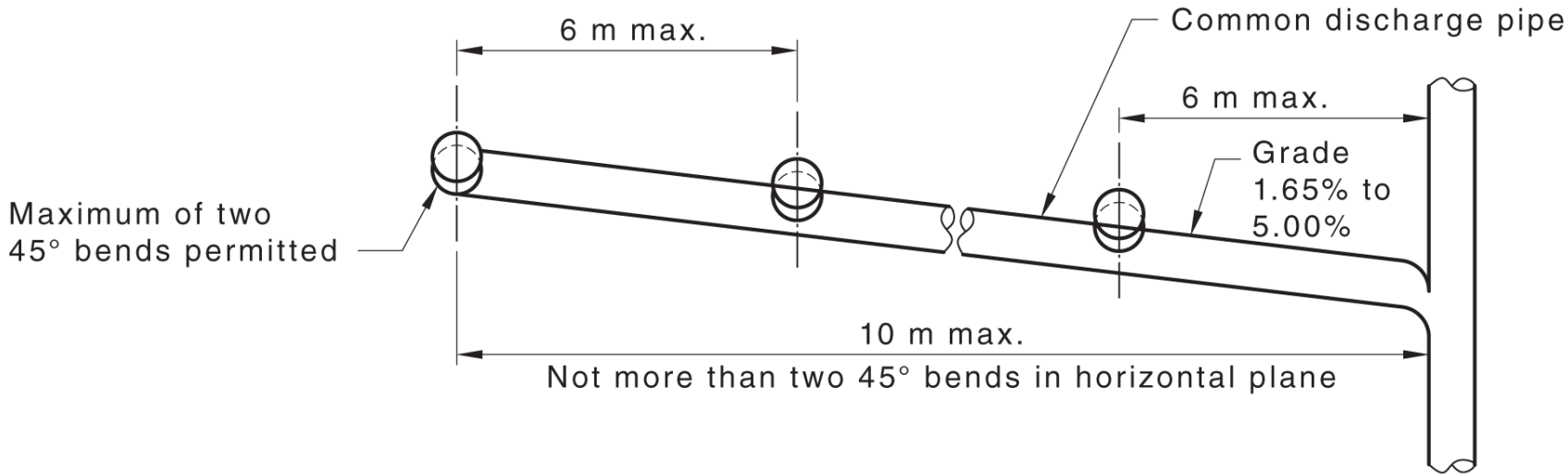
### 9.5.12 Range of water closet pans

### 9.5.12.1 General

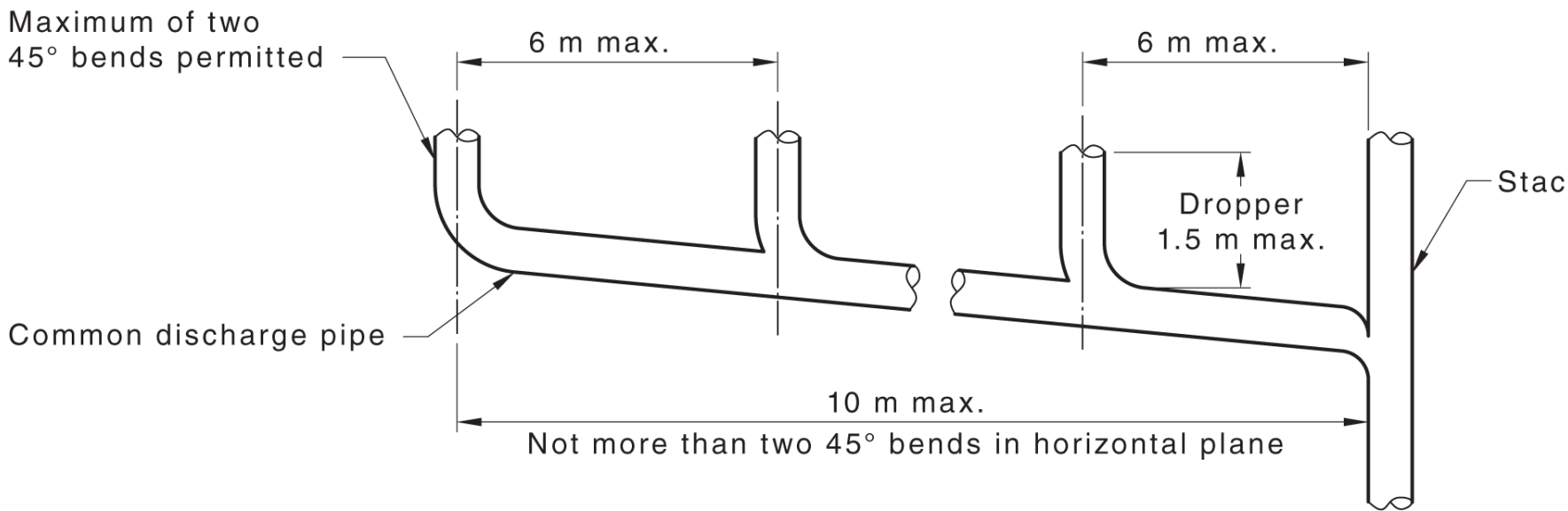
The maximum number of water closet pans shall be five, as shown in [Figure 9.5.12.1](#).

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(a) P-traps



(b) S-traps

Figure 9.5.12.1 — Connection of water closet pans

### 9.5.12.2 Fixture discharge pipe

The fixture discharge pipe from each water closet pan to the point of connection to the common discharge pipe shall be —

- (a) not longer than 1.5 m for S-trap pans and 2 m for P-trap pans;
- (b) installed with a maximum of two bends; and
- (c) graded within the range of 1.65 % to 5 %.

### 9.5.12.3 Common discharge pipes

The common discharge pipe shall be —

- (a) not smaller than DN 100;
- (b) not longer than 10 m;
- (c) installed with not more than two bends; and
- (d) graded within the range of 1.65 % to 5 %.

### 9.5.12.4 Spacing of traps

The distance between the centre-lines of adjacent traps and the near face of the stack and the centre-line of the nearest connected trap shall not exceed 6 m.

## 9.5.13 Range of wall-hung urinals

### 9.5.13.1 General

The maximum number of wall-hung urinals shall be five, as shown in Figure 9.5.13.1.

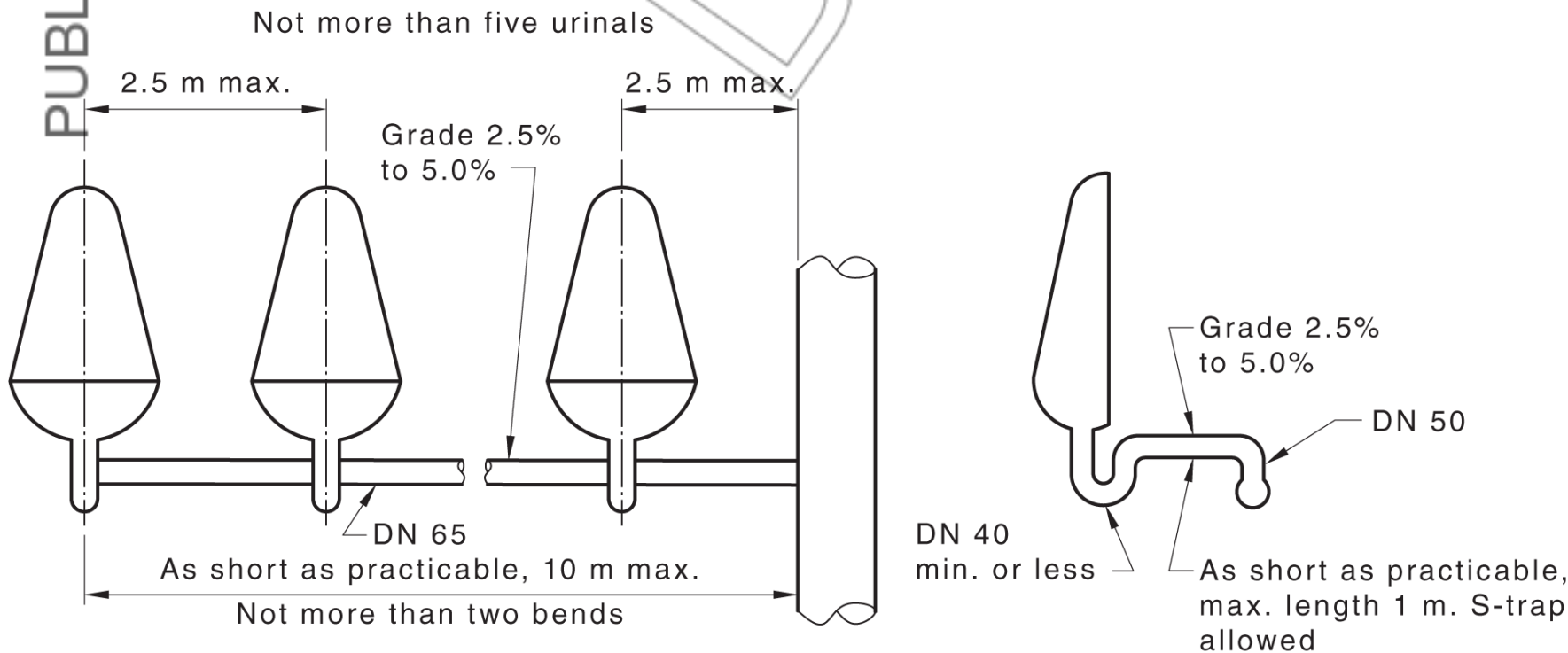


Figure 9.5.13.1 — Connection of wall-hung urinals

9.5.13.2 Fixture discharge pipe

The discharge pipe from each urinal to the point of connection to the common discharge pipe shall be —

- (a) DN 50;
- (b) not longer than 1 m;
- (c) installed with not more than one bend; and
- (d) graded within the range of 2.5 % to 5 %.

9.5.13.3 Common discharge pipe

The common discharge pipe shall be —

- (a) not smaller than DN 65;
- (b) not longer than 10 m;
- (c) installed with not more than two bends; and
- (d) graded within the range of 2.5 % to 5 %.

9.5.13.4 Spacing of traps

The distance between the centre-lines of adjacent traps and the near face of the stack and the centre-line of the nearest connected trap shall not exceed 2.5 m.

9.6 Venting of stacks

9.6.1 General

The stack shall continue to the vent cowl undiminished in size.

Stacks that extend not more than three floor levels with a maximum loading of 30 fixture units may have the vent reduced to DN 50.

9.6.2 Cross-vents (single stack modified system)

9.6.2.1 General

Cross-vents shall interconnect the stack with the relief vent. Cross-vents shall be installed commencing on the lowest floor level served and then from other floors as given in Table 9.7.2(A) or Table 9.7.2(B) as applicable.

NOTE A cross-vent need not be fitted above the highest fixture connected to the stack.

9.6.2.2 Installation

The following applies to cross-vents:

- (a) The cross-vent shall connect to the stack at a height of not less than 50 mm or more than 600mm above the flood level rim of the highest fixture connected to the stack at the floor concerned. The connection between the cross-vent and stack shall be at an angle of entry of 45°. The cross-vent shall be extended upwards at 45° to the point of connection with the relief vent.
- (b) The cross-vent may be omitted, provided a vent is connected to the highest graded pipe that receives the discharge from a water closet pan at the floor concerned, at a point that is as close to the stack as is practicable. The vent shall be connected to the soffit of the graded pipe and extended upwards to a height of not less than 50 mm above the flood level rim of the water closet pan served, before interconnecting with the relief vent.
- (c) Where there is no water closet pan connected at the floor concerned, the vent shall connect into the highest graded pipe on that floor, provided the graded pipe is not less than DN 80 at the point of connection to the vent.
- (d) Changes of direction and junctions or connections shall be made using the methods specified in this document.

9.6.3 Relief vents (single stack modified system)

Relief vents shall be installed in accordance with Clause 8.5.3.

9.7 Sizing of stacks

9.7.1 Single stack systems

Stacks shall be sized using the individual fixture unit ratings as given in Table 6.3(A). Stacks shall be as given in Table 9.7.1(A) or Table 9.7.2(B), as appropriate.

Table 9.7.1(A) — Single stack systems — Domestic or residential buildings		
Size of stack DN	Maximum fixture unit loading	Maximum number of consecutive floor levels
100	260	10
125	390	15
150	780	30
NOTE See Figure 9.2.2(A).		



Table 9.7.1(B) — Single stack systems — Commercial or industrial buildings		
Size of stack DN	Maximum fixture unit loading	Maximum number of consecutive floor levels
100	60	4
125	100	6
150	200	8

NOTE See [Figure 9.2.2\(B\)](#).

## 9.7.2 Single stack modified systems

Stacks shall be sized using the individual fixture unit ratings as specified in [Table 6.3\(A\)](#) and as given in [Table 9.7.2\(A\)](#) or [Table 9.7.2\(B\)](#), as appropriate.

Table 9.7.2(A) — Single stack modified systems — Domestic or residential buildings				
Size of stack DN	Maximum fixture unit loading	Number of consecutive floor levels	Size of relief vent and cross-vent DN	Location of cross- vents
100	290	up to 15	50	Alternate floors
100	390	up to 15	50	Each floor
100	320	16 to 20	65	Alternate floors
100	500	16 to 20	65	Each floor

NOTE See [Figure 9.2.3\(A\)](#).

Table 9.7.2(B) — Single stack modified systems — Other than residential type buildings				
Size of stack DN	Maximum fixture unit loading	Number of consecutive floor levels	Size of relief vent and cross-vent	Location of cross- vents
100	120	5 to 12	50	Each floor
125	250	13 to 18	65	Each floor
150	600	19 to 24	80	Each floor

NOTE See [Figure 9.2.3\(B\)](#).

## 9.8 Variations to single stack systems

### 9.8.1 General

The following variations to the requirements of this section apply:

NOTE 1 The variations are actual installations that have been subjected to performance testing.

- (a) A DN 80 stack up to three floors in height for domestic or residential buildings may have variations as detailed in [Clause 9.8.2](#).
- (b) A DN 80 stack up to two floors in height with top section graded (nominally horizontal) may have variations as detailed in [Clause 9.8.3](#).
- (c) A DN 100 stack up to three floors in height with top section graded (nominally horizontal), receiving a maximum discharge of 30 fixture units, may have variations as detailed in [Clause 9.8.4](#).
- (d) A DN 100 stack of one floor in height with top section graded (nominally horizontal), receiving a maximum discharge of 90 fixture units, may have variations as detailed in [Clause 9.8.5](#).
- (e) Connection of multiple fixtures located on the floor above a graded offset to a common branch pipe, which connects into or below the offset in a stack of not less than DN 100, may be applied with [Clause 9.8.6](#).
- (f) A waste stack up to DN 100, with graded offset between the highest and lowest connections, may have variations as detailed in [Clause 9.8.7](#).
- (g) A DN 65 waste stack up to two floors in height, receiving the discharge from kitchen sinks and laundry troughs, may have variations as detailed in [Clause 9.8.8](#).
- (h) Connection of waste fixtures to DN 50 stack vent in DN 80 and DN 100 stacks may be applied with [Clause 9.8.9](#).

Trap vent required on fixtures, connected at the change of direction in a DN 80 or DN 100 stack with top section nominally horizontal, shall be installed in accordance with [Clause 9.8.10](#).

NOTE 2 In areas where foaming is likely to occur, the minimum distance at or near the offsets may need to be increased.

### 9.8.2 DN 80 stack

A stack of DN 80, serving not more than three floor levels in domestic or residential buildings, may receive discharge pipes, provided the installation conforms with the following:

- (a) The stack shall not exceed three floor levels in height measured between the base of the stack and the highest floor level upon which a fixture is connected to the stack.
- (b) The stack loading shall not exceed 30 fixture units.
- (c) Not more than one fixture of each of the following types shall discharge into the stack at each floor level:



COMMENTING DRAFT

- (i) Basin.
- (ii) Bath.
- (iii) Dishwashing machine.
- (iv) Kitchen sink.
- (v) Shower.

- (d) A laundry trough or clothes-washing machine shall not be connected to the stack.
- (e) Each fixture shall discharge into the stack by means of an individual fixture discharge pipe.
- (f) The stack shall be straight between the discharge pipe of the highest fixture connected and the drain, and have no offset or other deviation from the vertical.
- (g) The graded section of the drain to which the base of the stack connects shall be not smaller than DN 100.
- (h) Offsets shall only be installed in the stack vent above the highest branch connection to the stack.

NOTE The offsets should preferably be greater than 45° (steep offsets).

### 9.8.3 DN 80 stack with the top section graded and installed in a domestic or residential building

A stack of DN 80, serving not more than two floor levels with the top section graded nominally horizontal, may receive the discharge from fixtures without vents on the fixture discharge pipes, provided the installation conforms with the following:

- (a) Fixtures shall discharge to the graded section by means of an individual fixture discharge pipe.
- (b) Not more than one of each of the following fixtures shall discharge to the graded section:
  - (i) Bath.
  - (ii) Basin.
  - (iii) Dishwashing machines.
  - (iv) Kitchen sink.
  - (v) Shower.
- (c) A laundry trough or clothes-washing machine shall not be connected to the stack.
- (d) Fixtures shall not be connected to the lower vertical section of the stack.
- (e) The connection of a fixture discharge pipe to the graded section of a stack shall be not less than 450 mm from the lower vertical section of the stack, measured from the inlet of the lower bend commencing the graded section.

The graded section of the stack may be reduced in size along its length towards the vent, according to the size of individual fixture discharge pipes connected to it, provided the graded section or vent is not smaller than DN 50.

NOTE For typical DN 80 stack with the top section graded and installed in a domestic or residential building, see [Figure 9.8.3](#).

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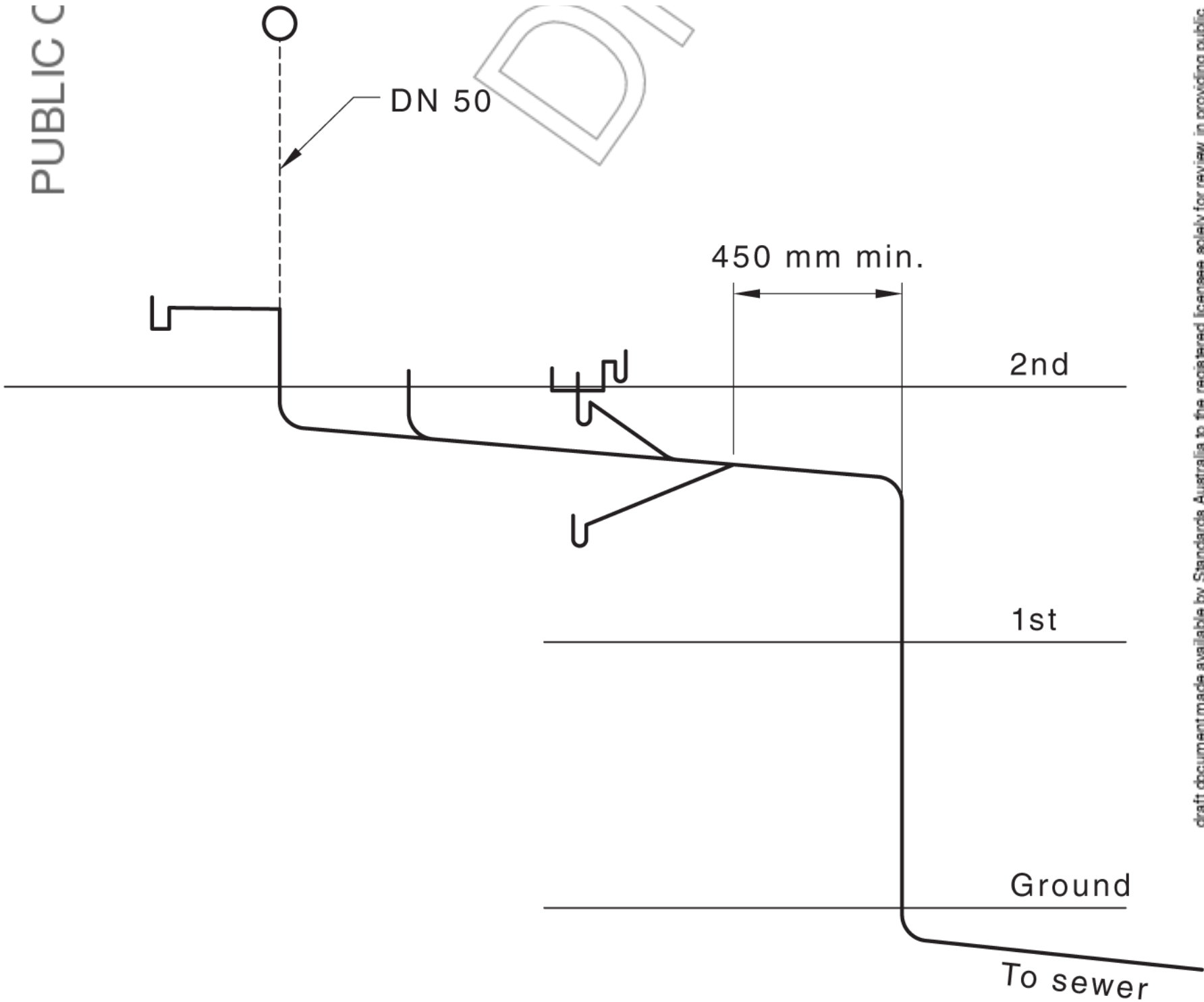


Figure 9.8.3 — Typical DN 80 stack up to two floor levels with topmost section nominally horizontal

### 9.8.4 DN 100 stack up to three floors with the top section graded and installed in a domestic or residential building receiving 30 fixture units

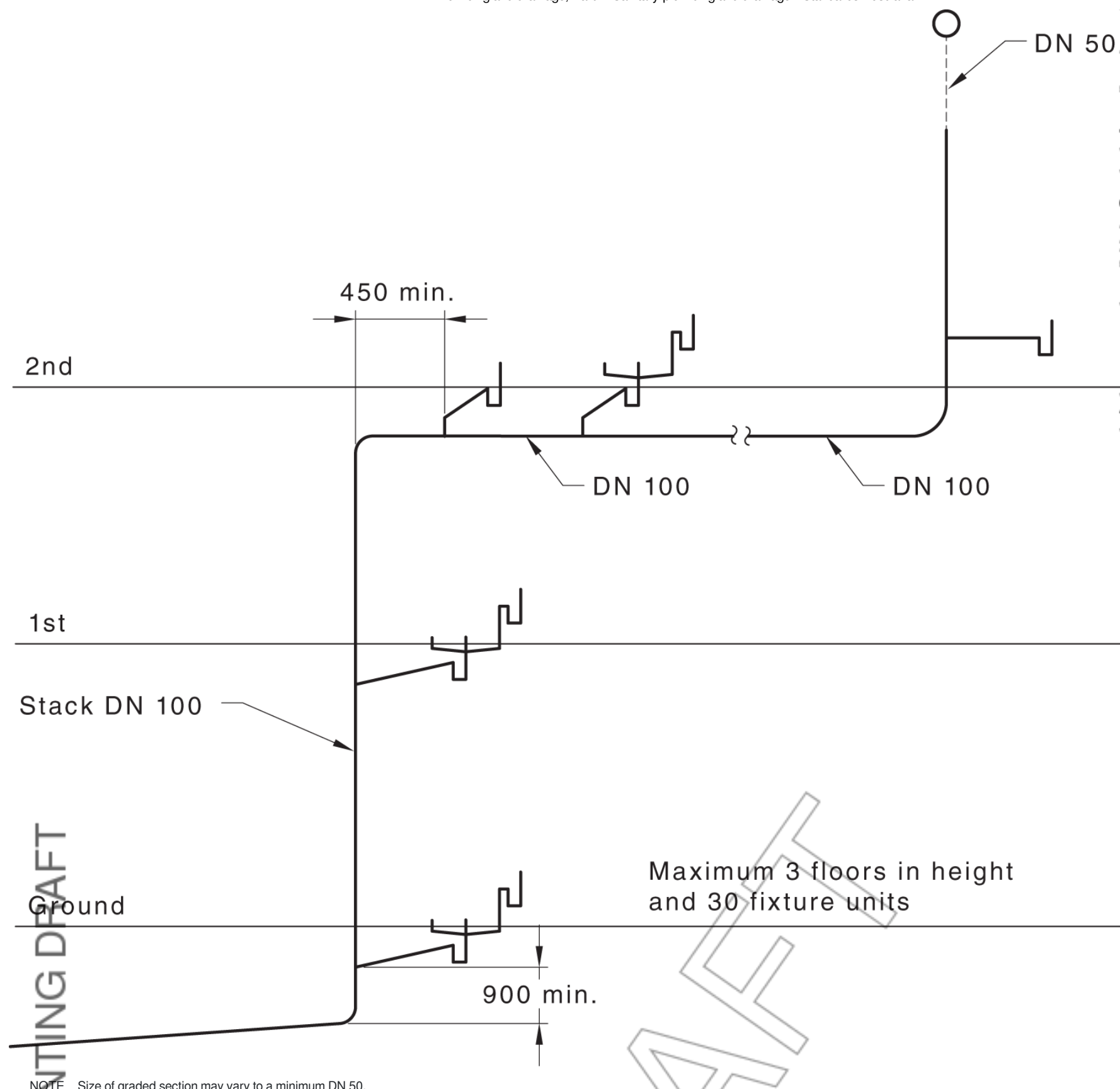
A stack of DN 100, serving not more than three floor levels with the top section graded nominally horizontal in a domestic or residential building, may receive the discharge from fixtures without vents on the fixture discharge pipes, provided the installation conforms with the following:

- (a) Fixtures shall discharge to the graded section by means of individual fixture discharge pipes.
- (b) The stack shall not exceed three floor levels in height and the stack loading shall not exceed 30 fixture units.
- (c) The connection of a fixture discharge pipe to the graded section of the stack shall be not less than 450 mm from the lower vertical section of the stack, measured from the inlet of the lower bend commencing the graded section.

The graded section of the stack may be reduced in size along its length towards the vent, according to the size of individual fixture discharge pipes connected to it, provided the graded section or vent is not smaller than DN 50.

NOTE See Figure 9.8.4 for a DN 100 stack up to three floors with the top section graded and installed in a domestic or residential building receiving 30 fixture units.

Dimensions in millimetres



**Figure 9.8.4 — Typical DN 100 stack with topmost section nominally horizontal**

9.8.5 DN 100 stack of one floor with top section graded

A stack of DN 100 serving the first floor above ground level in a domestic or residential building may receive the discharge from fixtures without vents on the fixture discharge pipes, provided the installation conforms with the following:

- (a) Fixtures shall discharge to the graded section by means of individual fixture discharge pipes.
- NOTE 1 See [Table 9.5.1](#).
- (b) The stack loading shall not exceed 90 fixture units.
- (c) The connection of a fixture discharge pipe to the graded section of the stack shall be not less than 450 mm from the lower vertical section of the stack, measured from the inlet of the lower bend commencing the graded section.
- (d) Branches shall not be connected to the vertical sections of the stack within 600 mm below the lower bend forming part of the offset.

The graded section of the stack may be reduced in size along its length towards the vent, according to the size of individual fixture discharge pipes connected to it, provided the graded section or vent is not smaller than DN 50.

NOTE 2 See [Figure 9.8.5](#) for a typical DN 100 stack of one floor with top section graded.

Dimensions in millimetre



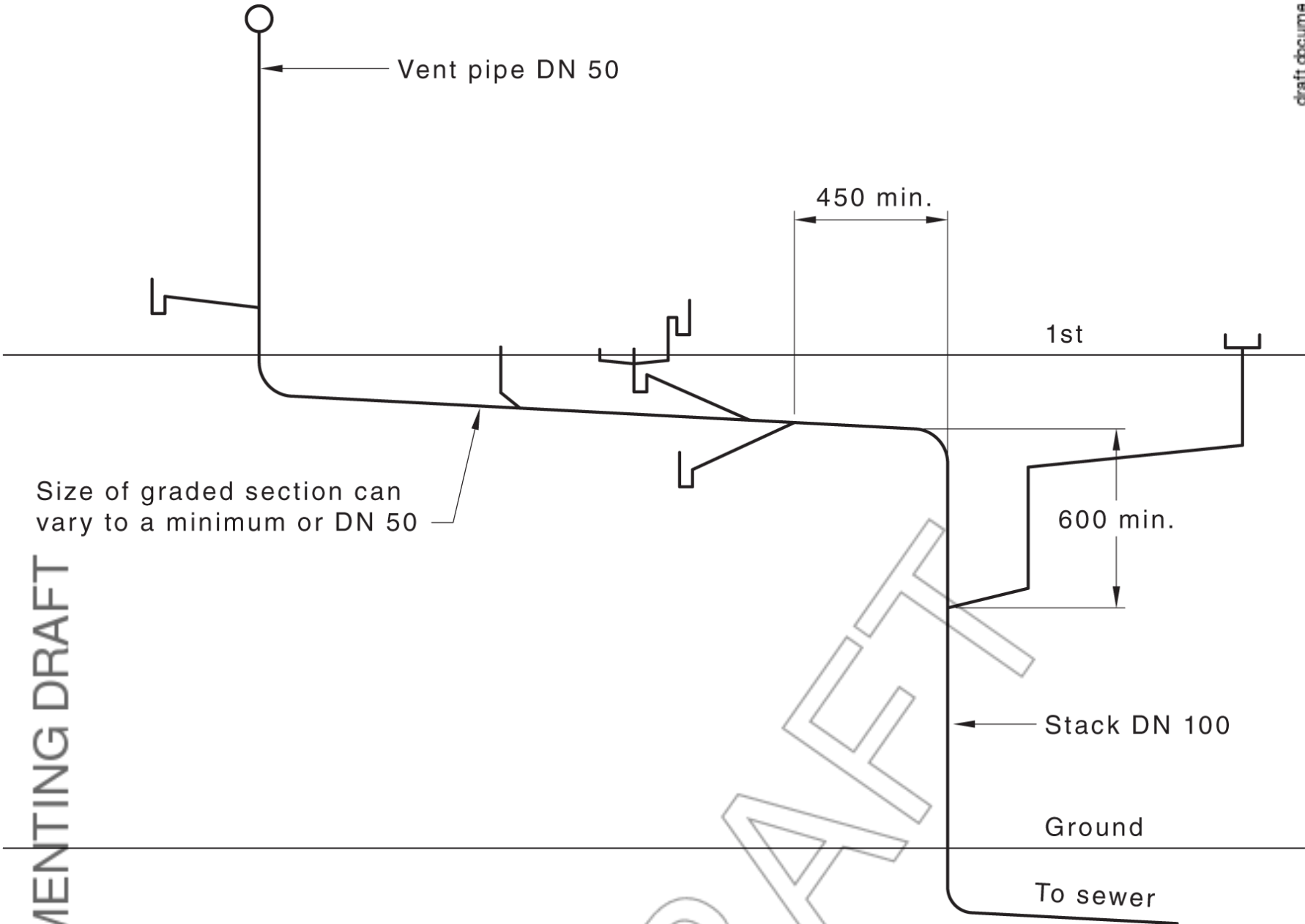


Figure 9.8.5 — Typical DN 100 stack with topmost section nominally horizontal for one floor — 90 fixture units

9.8.6 Connection of multiple fixtures into or below a graded offset (DN 100 stacks)

Multiple fixtures located on the floor above a graded offset may be connected by means of a common discharge pipe into or below the graded section of the offset in accordance with [Clause 8.6.2](#), provided the stack to which the branch pipe connects does not exceed —

- (a) five floors above the graded offset with a maximum loading of 90 fixture units; or
- (b) three floors above the graded offset with a maximum loading of 45 fixture units.

NOTE See [Figure 9.8.6](#) for a diagram of the above.

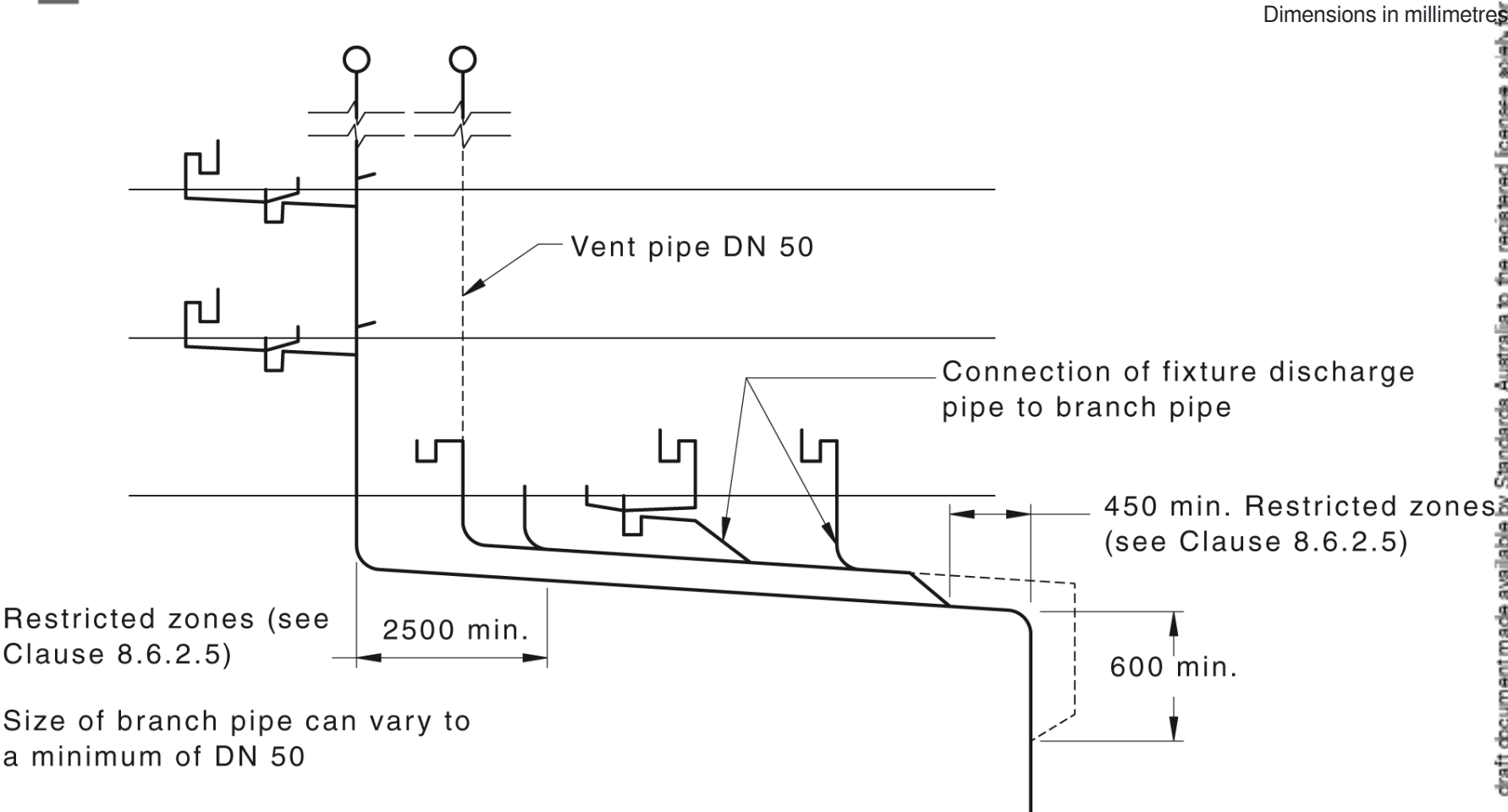


Figure 9.8.6 — Multiple fixture branch

9.8.7 Waste stack up to DN 100 with either graded or steep offset between the highest and lowest connections

9.8.7.1 Graded offsets

A waste stack up to DN 100 may have graded offsets installed between the highest and lowest graded pipes, provided the following requirements are met:

- (a) The maximum fixture unit loading to discharge through the graded section of the offset shall be as given in [Table 9.8.7.1\(A\)](#).

- (b) The distance between the centre-lines of the vertical sections of a stack each side of the graded offset shall be not less than 1 m.
- (c) For stacks DN 80 or smaller, no branch shall connect to the stack within 900 mm above the upper offset bend.

A DN 80 stack with offset may have the minimum vertical distance of 900 mm reduced to 600 mm, provided the height between the highest connection to the stack and the upper offset bend does not exceed three floor levels.
- (d) For DN 100 stacks only, the connection near the upper offset bend shall be in accordance with [Table 9.8.7.1\(B\)](#).
- (e) Where connections are made to the stack below the offset, the size of the offset and the stack above the offset and up to the vent cowl shall be as determined from [Table 9.8.7.1\(A\)](#). The fixture unit loading for the complete stack shall be determined from [Table 9.5.2](#). The stack size shall be the greater value, determined from [Tables 9.5.2](#) and [9.8.7.1\(A\)](#).
- (f) Branches shall not connect to the vertical sections of the stack within 600 mm below the lower bend forming part of the offset.
- (g) Where no connections are made to the stack below the offset, the maximum fixture unit loading to discharge through the offset shall be as given in [Table 9.5.2](#) for the upper vertical section and the offset shall be increased to the next larger size.
- (h) The connection of multiple fixtures into the offset shall be in accordance with [Clause 9.8.6](#).
- (i) Where unvented fixtures are connected into the graded section, the fixture discharge pipe shall conform to [Table 9.5.1](#).
- (j) Where a common discharge pipe is connected into the stack, and a relief vent and cross-vents are installed, the fixture loading discharging to the stack shall be as given in [Table 8.2.2\(B\)](#).

NOTE For a typical example of waste stack up to DN 100 with graded offset between the highest and lowest connections, see [Figure 9.8.7.1](#).

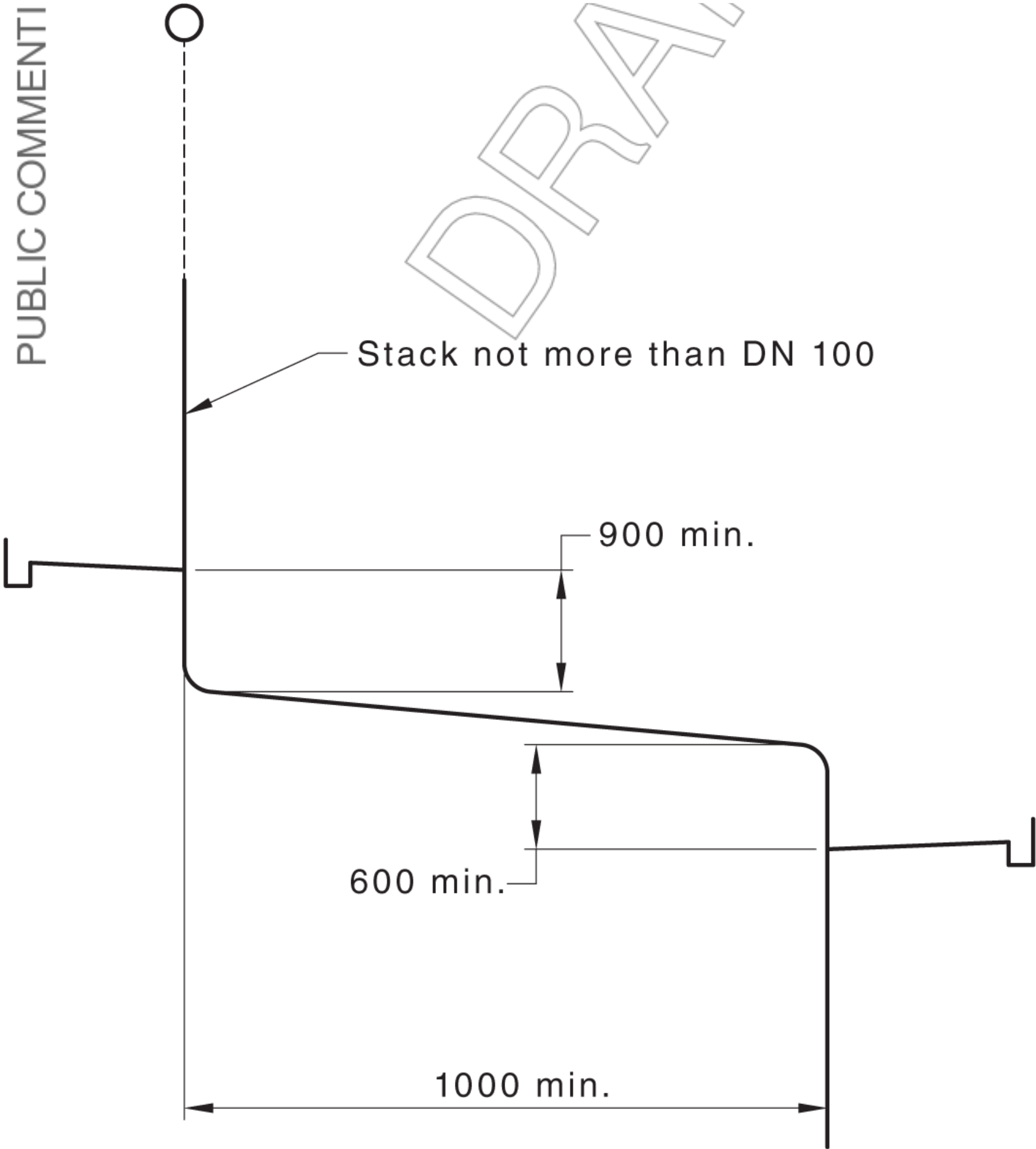
Table 9.8.7.1(A) — Waste stacks — Loading through graded offsets	
Size of graded section of offset DN	Maximum fixture unit loading permitted through the offset
40	1
50	3
65	8
80	24
100	60

Table 9.8.7.1(B) — DN 100 waste stacks — Offset requirements		
Maximum height in consecutive floor levels above upper offset bend	Minimum distance between upper offset bend and connection of fixture and discharge pipe mm	Maximum fixture unit loading <sup>a</sup>
5	450	60
10	600	60

<sup>a</sup> See [Table 9.9.3](#).

Dimensions in millimetre

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NOTE See Table 9.8.7.1(A) for fixture units discharging through graded section.

Figure 9.8.7.1 — Typical waste stack up to DN 100 with graded offset between the highest and lowest connections

9.8.7.2 Steep offsets

A waste stack of up to DN 100 may have steep offsets between the highest and lowest graded pipes connected, provided the following requirements are met:

- (a) Where the fixtures are unvented in accordance with Item (g), the maximum fixture unit loading to discharge to the stack shall not exceed 120 fixture units.
- (b) Steep offsets of 60° or more to the horizontal shall have no connections made above the offset within —
  - (i) 450 mm of the upper bend, when the stack extends through five floors or less above the offset; or
  - (ii) 600 mm of the upper bend, when the stack extends through more than five floors above the offset.
- (c) Steep offsets of less than 60° to the horizontal shall have no connections made above the offset within 150 mm of the upper bend for stacks of any height.
- (d) Steep offsets of less than 60° to the horizontal shall have no connections made into the offset within —
  - (i) 2.5 m of the upper bend; or
  - (ii) 450 mm of the lower bend.
- (e) Steep offsets of 60° or more to the horizontal shall have no restrictions within the offset, provided any such connection is made using a 45° or sweep junction.
- (f) Steep offsets shall have no connections made below the offset within 600 mm of the lower bend.
- (g) Where unvented single waste fixture discharge pipes are connected into the stack, the maximum length shall be in accordance with Table 9.5.1.
- (h) Where a common discharge pipe is connected into the stack and a relief vent is installed, the fixture unit loading discharging to the stack shall be in accordance with Table 8.2.2(B).

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### 9.8.8 DN 65 waste stack

A waste stack of DN 65 may receive the discharge from kitchen sinks and laundry troughs provided —

- (a) the stack does not exceed two floor levels in height measured between the base of the stack and the highest floor level upon which a fixture is connected; and
- (b) not more than two kitchen sinks, or one kitchen sink and one laundry trough, are separately connected at each floor level.

### 9.8.9 DN 50 vertical section of stack

Three waste fixtures only, being basins, showers or kitchen sinks, may be connected to the top DN 50 vertical section of a stack not more than three floor levels in height with a maximum loading of 30 fixture units.

NOTE See Figure 9.8.9 for a typical connection of a DN 50 vertical section of stack.

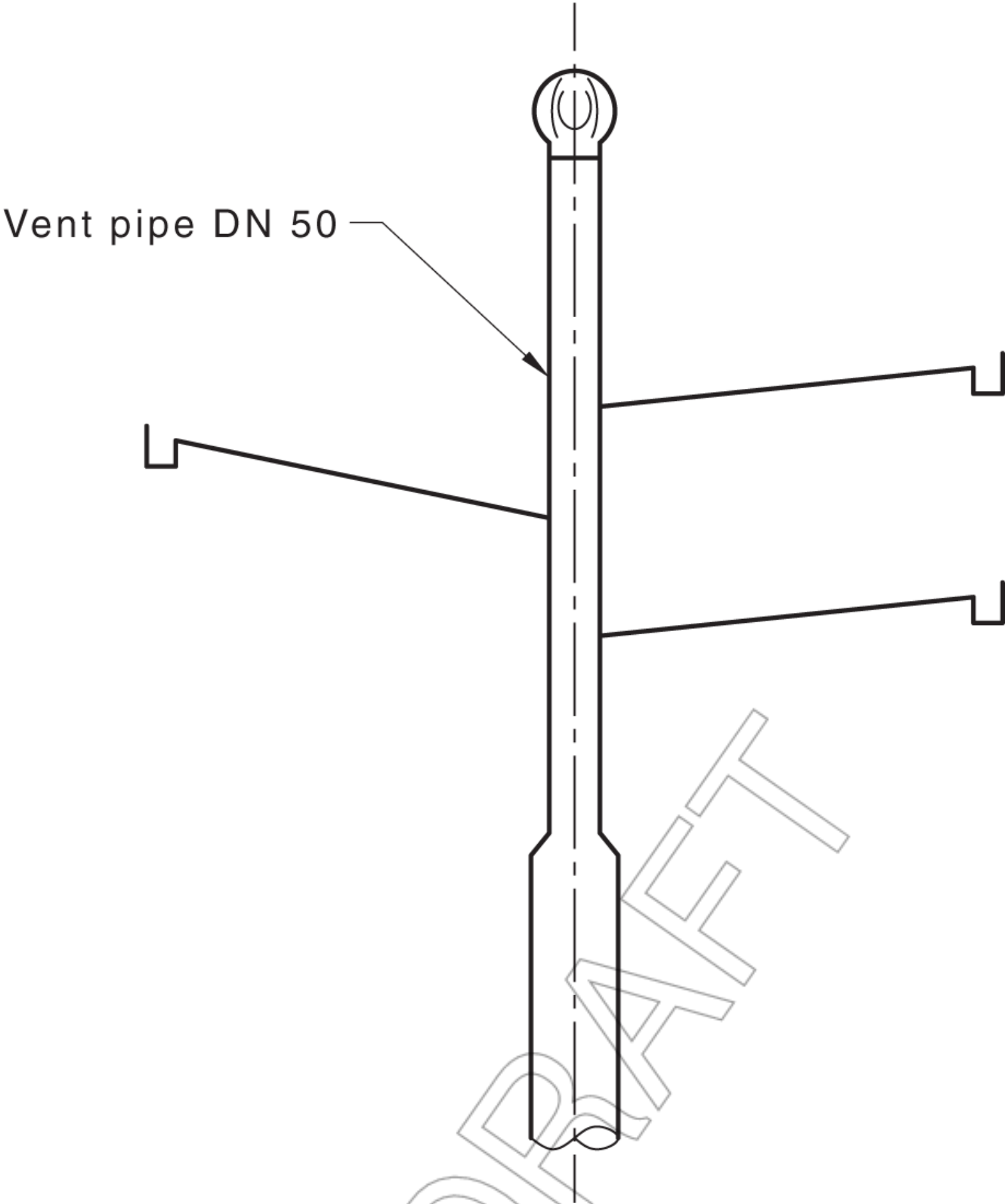


Figure 9.8.9 — Typical connection of waste fixtures to a DN 50 vertical section of stack

### 9.8.10 Connection at the change of direction in stack with top section graded

Where a DN 80 or DN 100 stack has the top section nominally horizontal, a trap vent or air admittance valve shall be required on a fixture discharge pipe that connects to the stack at the point at which the top graded section joins the vertical section of the stack.

NOTE See Figure 9.8.10 for a typical venting for fixture connected at change of direction in DN 80 or DN 100 stack.

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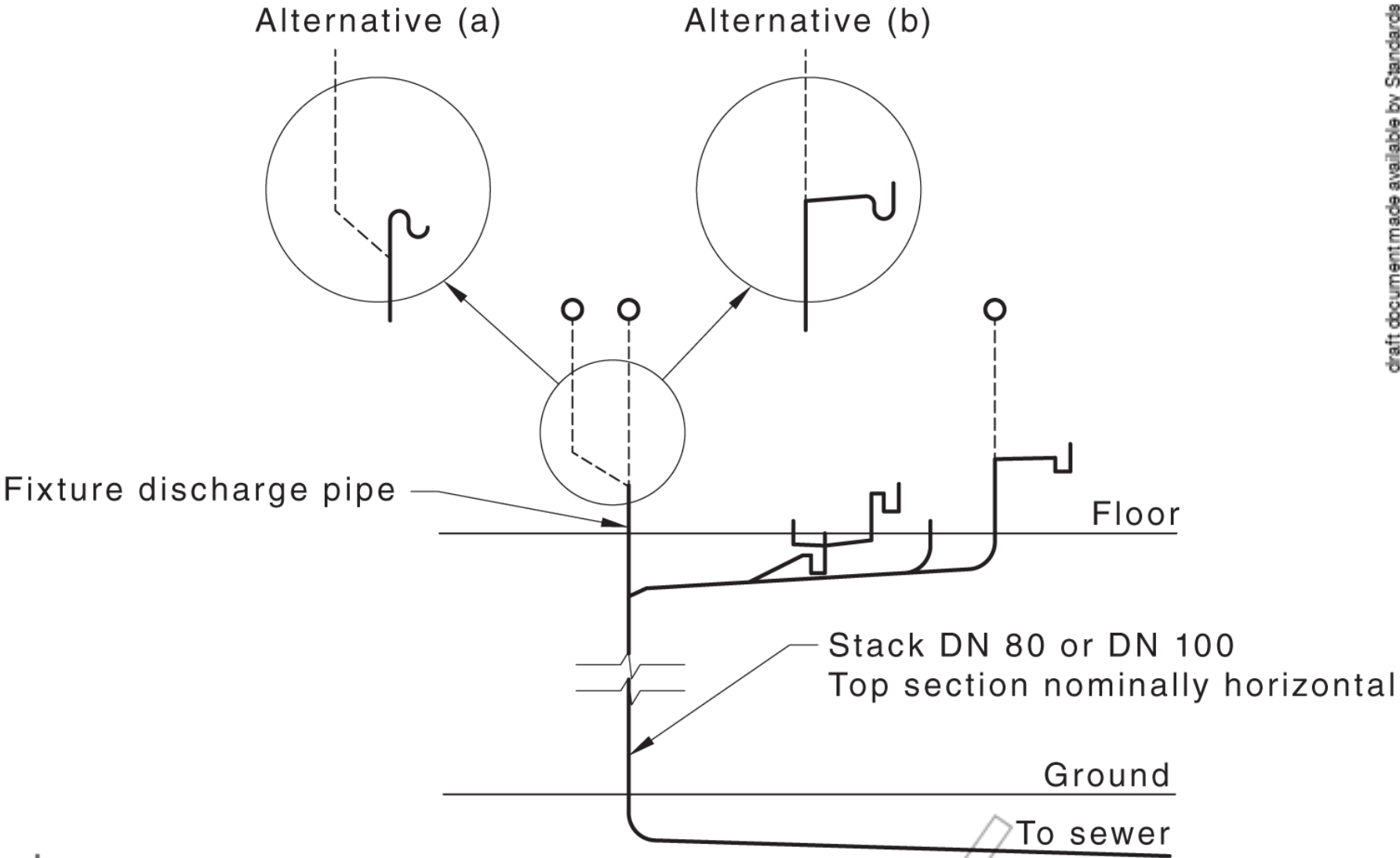


Figure 9.8.10 — Typical venting for fixture connected at change of direction in DN 80 or DN 100 stacks

## 9.9 Offsets in single stack systems only

### 9.9.1 General

Offsets may be used in single stack design. An offset may be either —

- (a) a steep offset made at an angle of 45° to the horizontal or greater; or
- (b) a graded offset made at an angle of less than 45° to the horizontal, the minimum grade of which shall be 2.5 % for waste stacks of DN 80 or smaller and 1.65 % for stacks of DN 100 or larger.

### 9.9.2 Steep offsets

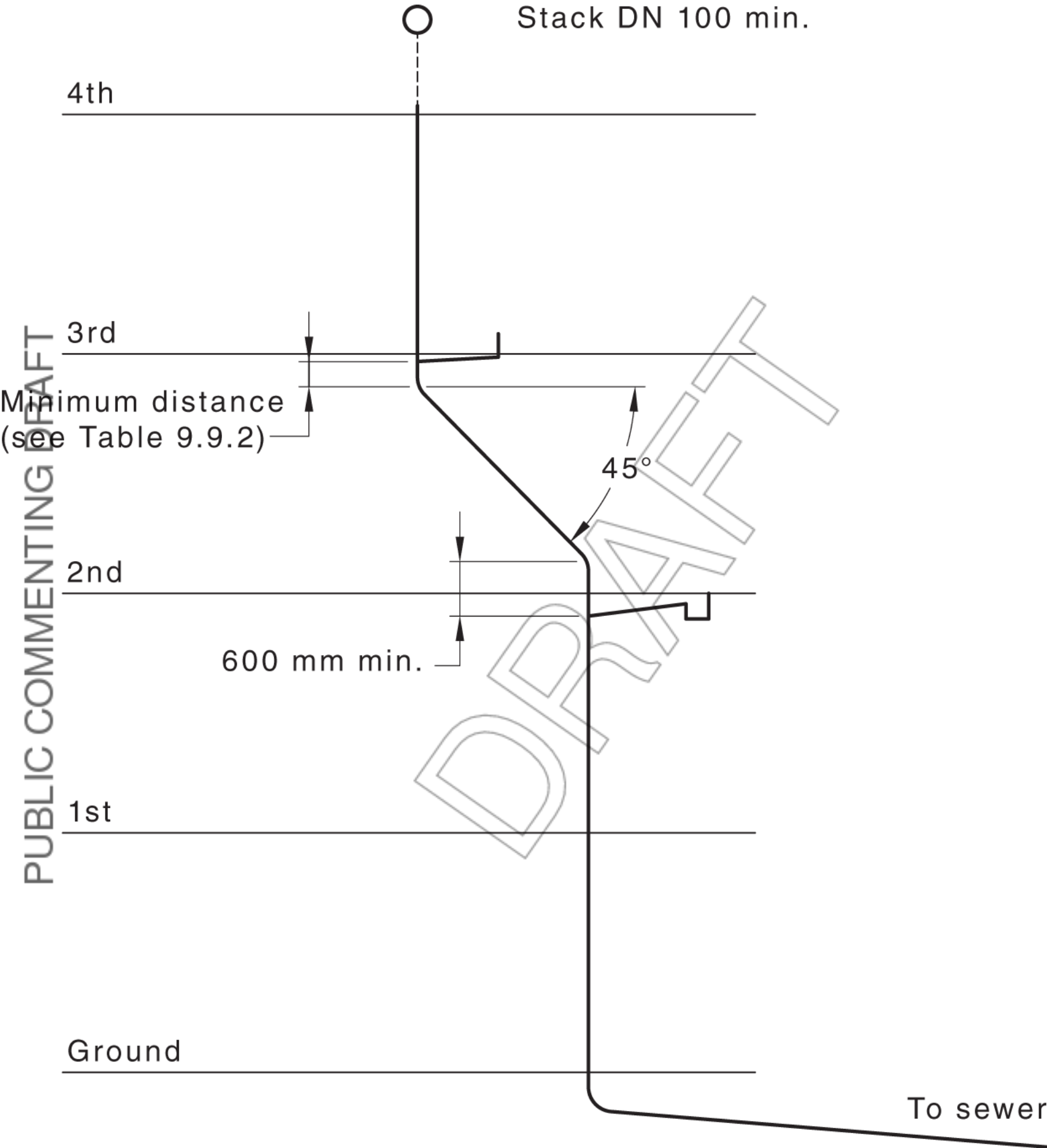
DN 100 stacks may be offset between the base of the stack and the highest connection in accordance with the following:

- (a) The height of the stack shall not exceed 10 consecutive floor levels.
- (b) Laundry troughs shall only be connected to the stack as specified in [Clause 9.9.3](#), except as provided in [Clause 9.9.4](#).
- (c) Connections near the upper and lower offset bends and the maximum fixture unit loading to the stack shall be in accordance with [Table 9.9.2](#), except as provided in [Clause 9.9.4](#).
- (d) The minimum distance between the connection of any fixture discharge pipe and the upper offset bend shall be no less than 100 mm, as shown in [Figure 9.9.2\(A\)](#).

NOTE See [Figure 9.9.2\(B\)](#) for a typical steep offset.

Table 9.9.2 — Offset requirements			
Maximum height in consecutive floor levels above upper offset bend	Minimum distance between upper offset bend and connection of fixture discharge pipe mm	Minimum distance between lower offset bend and connection of fixture discharge pipe mm	Maximum fixture unit loading
5	450	600	90
10	600	600	150
10	900	600	260

NOTE See also [Table 9.9.3](#) for laundry troughs.



NOTE Measurement increases with height of stack above offset and fixture unit loading.

Figure 9.9.2(A) — Near face measurement

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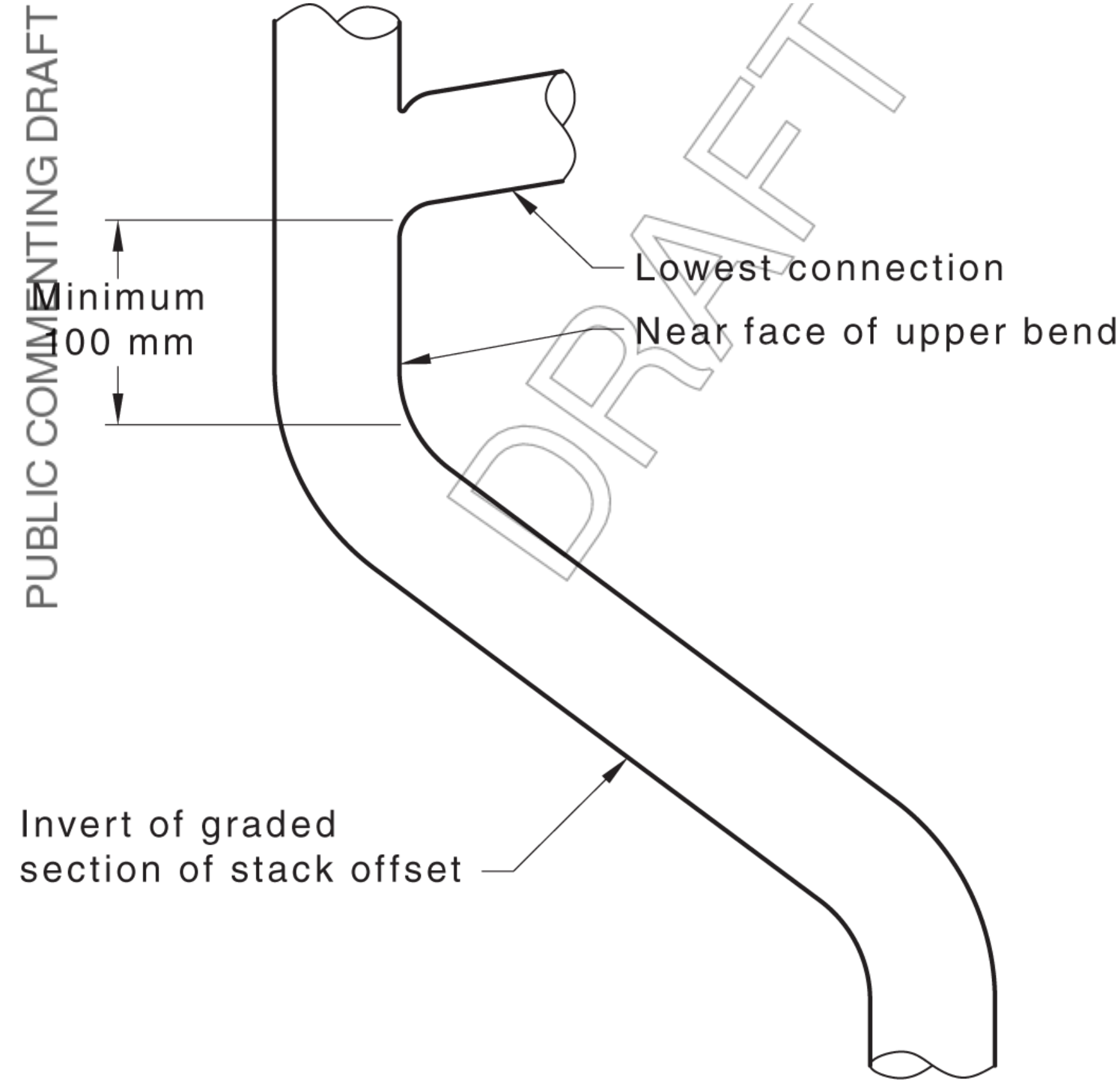


Figure 9.9.2(B) — Typical steep offset

9.9.3 Connection of laundry troughs to DN 100 stacks

Laundry troughs shall be connected into either the upper or lower vertical section of a steep offset stack.

Laundry troughs shall be connected only to the upper section of a DN 100 stack in accordance with [Table 9.9.3](#).

Table 9.9.3 — Offset requirements for laundry troughs		
Maximum height in consecutive floor levels above upper offset bend	Minimum distance between upper offset bend and connection of fixture discharge pipe mm	Maximum fixture unit loading
5	450	50
10	600	50

9.9.4 Steep offsets below the lowest connection

Where a steep offset is installed below the lowest connection to a stack of not less than DN 100, the minimum distance between the fixture connection and the upper offset bend shall be in accordance with [Table 9.9.2](#). This distance may be reduced to 100 mm, provided the following requirements are met:

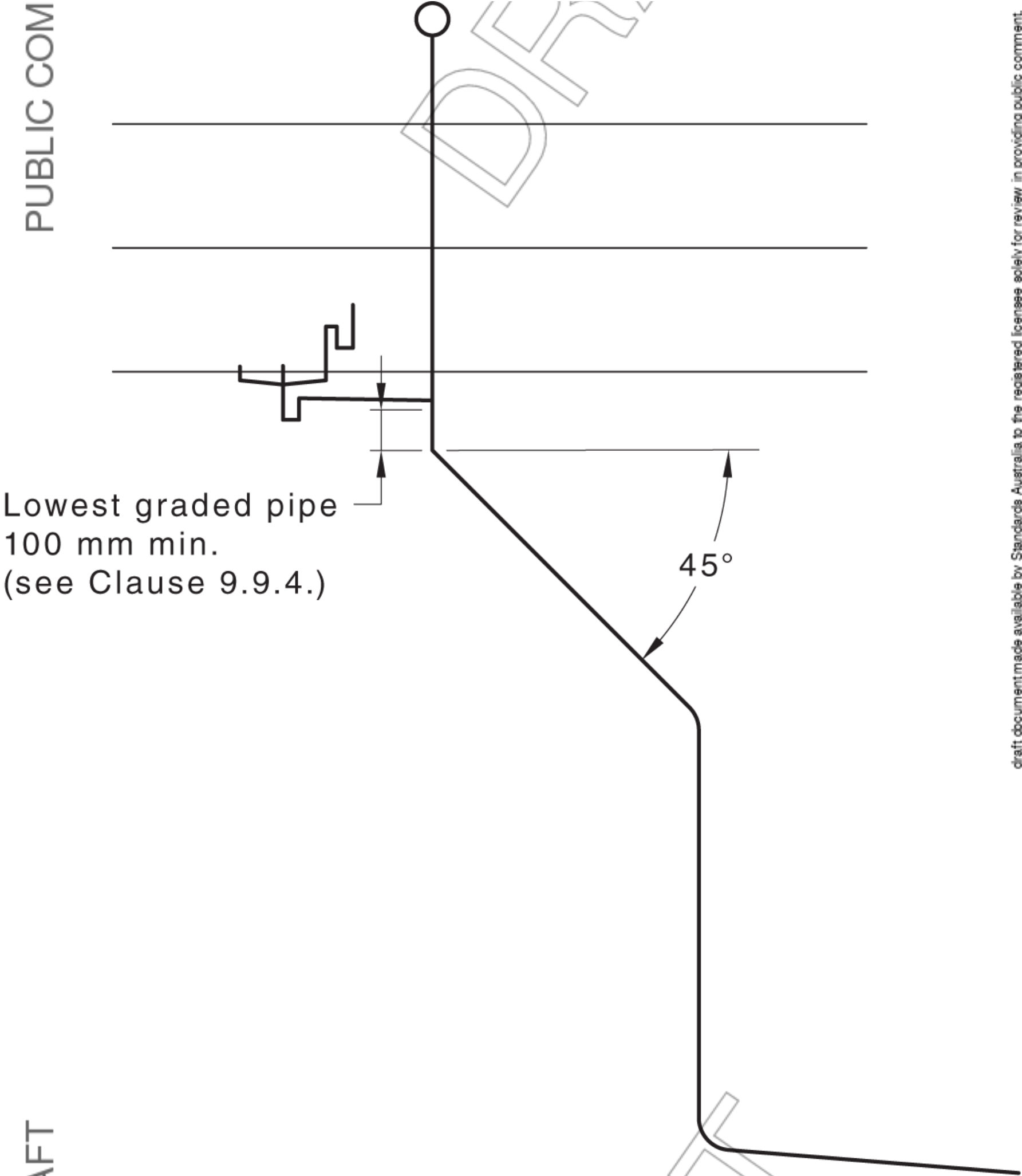
- (a) The number of consecutive floor levels above the upper offset bend served by fixtures shall be three or less.
- (b) The maximum loading shall not exceed 30 fixture units through the offset section.
- (c) A laundry trough shall not be connected.

NOTE See [Figure 9.9.4](#) for a typical steep offset below the lowest connection.

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### 9.9.5 Graded offsets

DN 100 stacks may be offset between the base of the stack and the highest connection, provided the following requirements are met:

- (a) Only one graded offset shall be installed in any stack.
- (b) The height of the stack shall not exceed 10 consecutive floor levels.
- (c) The minimum distance between the centre-lines of the vertical sections of the stack shall be 2 m.
- (d) Fixtures shall be connected in accordance with [Clause 8.6.2](#).

NOTE See [Figure 9.9.5](#) for a typical graded offset.

Dimensions in millimetre



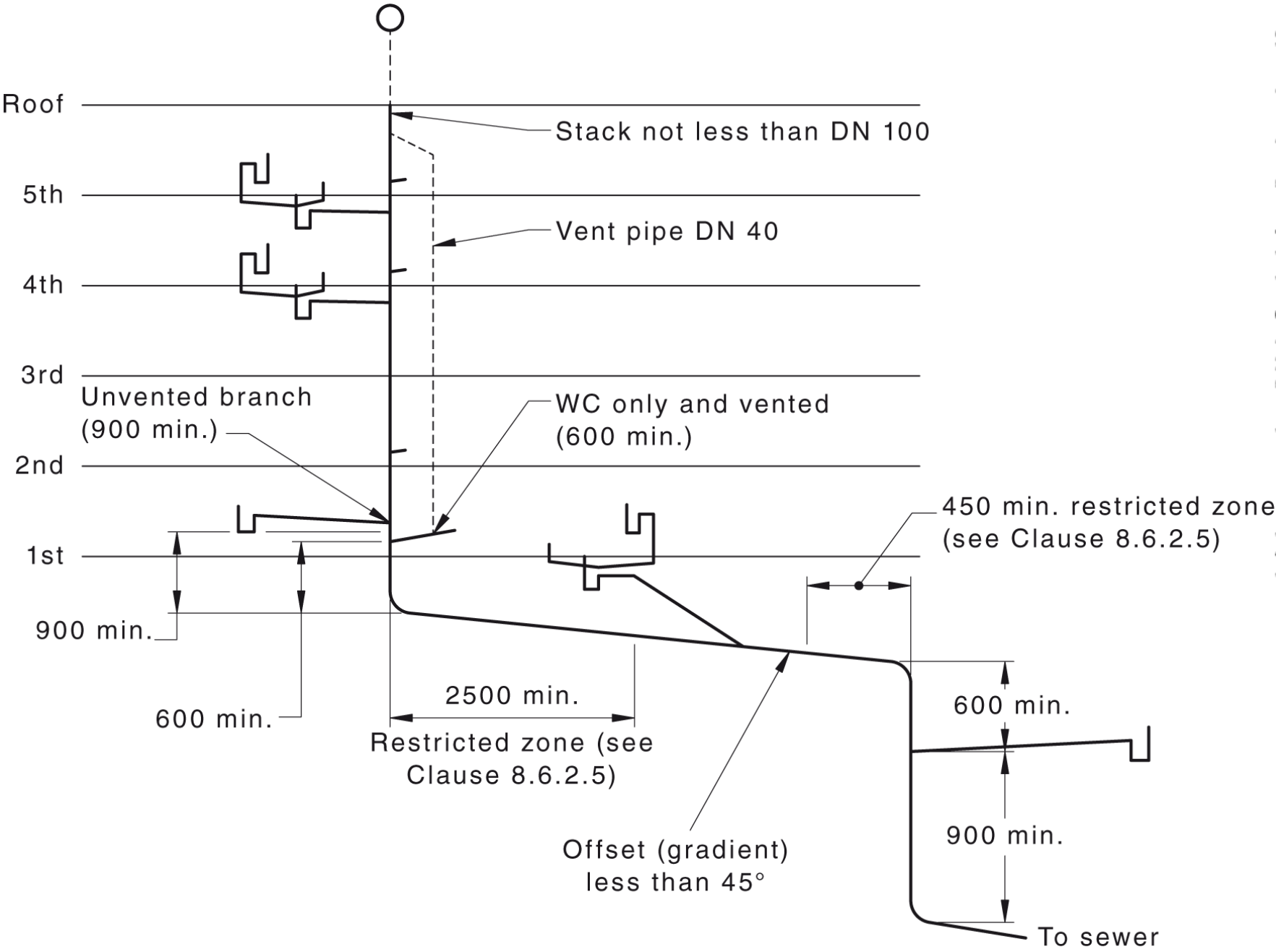


Figure 9.9.5 — Graded offset

9.9.6 Connections above the offset

Where fixtures are connected into the upper vertical section, the following apply:

- (a) The height of the vertical section of the stack above the upper offset bend shall not exceed five consecutive floor levels.
- (b) The maximum loading shall not exceed 90 fixture units.
- (c) No connection shall be made to the vertical section within 900 mm of the upper offset bend. Where a water closet pan is the lowest fixture connected, the distance may be reduced to 600 mm, provided the fixture discharge pipe from the water closet pan is fitted with a DN 40 trap vent (see Figure 9.9.5).

10 General installation of pipework

10.1 Scope of section

This section specifies requirements for the fixing, protection, spacing, and concealment of sanitary plumbing pipes and fittings.

NOTE See Section 16 for information on installation of vacuum drainage pipework.

10.2 Support and fixing of pipework

10.2.1 Brackets, clips and hangers

Brackets, clips and hangers shall be installed at the spacings specified in Table 10.2.1 and shall be —

- (a) securely attached to the building structure and not to any other service;
- (b) designed to withstand the applied loads;
- (c) protected against corrosion where exposed to a corrosive environment;
- (d) made from compatible materials;
- (e) clamped securely to prevent movement, unless designed to allow for thermal movement;
- (f) restrained to restrict lateral movement; and
- (g) designed so that pipes and fittings are supported with minimal load being taken by the joints.

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Table 10.2.1 — Maximum spacing of brackets, clips and hangers		
Pipework material	Maximum spacing of supports m	
	Vertical pipes	Graded pipes
Cast iron	3	3
Ductile iron	3	3
Copper, copper alloy	3	3
Stainless steel	3	3
FRC	4	4
PVC-U DN 40–50	2	1
PVC-U DN 65–150	2.5	1.2
PVC-U DN > 150	3	1.5
PP	2	1
PE	2	1

### 10.2.2 Limitation of pipe supports

The following applies to the limitation of pipe supports:

- (a) Pipes shall not be supported by brazing or welding short sections of any material to the pipe surface, nor by clamping, brazing or welding to adjacent pipes.
- (b) Brackets, clips and hangers incorporating PVC shall not be used in contact with stainless steel pipes.

### 10.2.3 Holes in framework

Where holes are formed in the framework to accommodate pipework, they shall be sized to allow free longitudinal movement of the pipework without affecting the structural integrity of the framework.

## 10.3 Location

Pipework shall be located —

- (a) so that it does not interfere with the operation of any door, window, access opening or with any other aspects of the operation of a building;
- (b) where it does not cause a nuisance or injury to persons;
- (c) not directly above drinking water storage tanks;
- (d) as close as practicable to the wall of any building or supporting structure;
- (e) so that it is protected from mechanical damage;
- (f) with clearance from other services in accordance with [Clause 3.6.1](#); and
- (g) when constructed of plastic —
  - (i) at a minimum distance of 75 mm from an insulated heated water pipe or 150 mm from an uninsulated heated water pipe; and
  - (ii) below a heated water pipe, at a minimum distance of 150 mm from an insulated heated water pipe or 300 mm from an uninsulated heated water pipe.

## 10.4 Concealment of pipes and fittings

### 10.4.1 General

Pipes and fittings installed in buildings may be concealed, provided inspection openings are accessible.

### 10.4.2 Extension of inspection openings

Inspection openings may be extended to a wall or slab surface, to facilitate ease of maintenance.

### 10.4.3 Structural concrete or brickwork

Pipework shall not be installed in any structural concrete slab, beam, column, concrete wall or loadbearing brickwork, unless specifically included in the design of the structural element.

### 10.4.4 Drywall construction

Pipework concealed in drywall construction shall not structurally interfere with the wall.

### 10.4.5 Multiple dwellings

Any discharge pipes that serve fixtures within only one dwelling in a domestic or residential building shall be located wholly within that dwelling.

### 10.4.6 Walk-in pipe ducts

Pipework concealed in walk-in pipe ducts shall be installed so that there is clear and adequate space remaining to facilitate access for any inspection.

## 10.5 Testing and inspection openings

### 10.5.1 General

This clause applies to plumbing systems, including elevated pipework, using drainage principles.

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NOTE See [Clause 4.7](#) for information on sanitary drains.

## 10.5.2 Location of testing and inspection openings

All common discharge pipes and stacks shall be provided with openings for inspection and testing in the following locations:

- (a) In any common discharge pipe where necessary for inspection and testing.
- (b) At the base of every stack.
- (c) At any level of a stack where necessary for inspection and testing.
- (d) At intervals not greater than 30 m in every common discharge pipe.
- (e) At every junction fitting that connects a common discharge pipe to a stack, or in the upstream section of the common discharge pipe.

NOTE 1 Inspection and testing openings may be raised to finished surface level and fitted with an airtight removable cap.

NOTE 2 Where testing or inspection openings are located within a tenancy occupied by another party, consideration should be given to raising the inspection or testing opening into the tenancy that it serves.

## 10.5.3 Size of testing and inspection of openings

Testing and inspection openings shall have a minimum clear diameter in accordance with [Table 10.5.3](#).

Table 10.5.3 — Testing and inspection openings minimum clear diameter	
Nominal size DN	Minimum clear diameter mm
40	24
50	29
65	60
80	75
100	100
150	150
175	150
225	150
300	150

## 10.5.4 Access to inspection openings

Every required inspection opening shall be accessible.

## 10.6 Installation of copper and copper alloy pipes

### 10.6.1 General

Copper and copper alloy pipes shall be installed in accordance with AS 4809 and [Clauses 10.6.2](#) to [10.6.4](#).

### 10.6.2 Fixing

Copper and copper alloy pipes shall be fixed in accordance with the following:

- (a) All brackets other than at expansion joints when fully tightened shall permit longitudinal movement of the tubing.
- (b) All brackets for use at expansion joints when tightened evenly shall securely clamp the expansion joint fitting and prevent movement.
- (c) All brackets shall be lined with PVC or other compatible non-abrasive and inert material, for the part of the fastener that is in contact with the pipe.

### 10.6.3 Expansion joints

#### 10.6.3.1 General

Expansion joints shall be provided for all copper and copper alloy pipes used for sanitary plumbing systems in accordance with [Clauses 10.6.3.2](#), [10.6.3.3](#) and [10.6.3.4](#), as appropriate.

#### 10.6.3.2 Stacks

Stacks shall be provided with expansion joints in accordance with the following:

- (a) Where any stack extends through more than two floors whether above its base or above any offset bend, expansion joints shall be fixed —
  - (i) at the base of the stack or in the vertical pipe above an offset bend; and
  - (ii) at each alternate floor level when the stack is unrestrained in accordance with [Clause 10.6.4](#), or at each floor level except the top floor when the stack is restrained or subjected to heated water discharges such as those from dishwashing machines.
- (b) The expansion joint at any intermediate floor shall be placed immediately above the junction of the highest discharge pipe connected at the floor concerned.

#### 10.6.3.3 Graded discharge pipes

Where graded discharge pipes are restrained and are more than 6 m in length, an expansion joint shall be installed in the graded pipe as close as practicable to the stack.

#### 10.6.3.4 Bedpan sanitizer and washer

Where a bedpan sanitizer and washer are supplied with steam and connected to a soil stack, soil vent or steam relief vent, an expansion joint shall be installed at each floor in the soil stack, soil vent and steam-relief vent pipe.



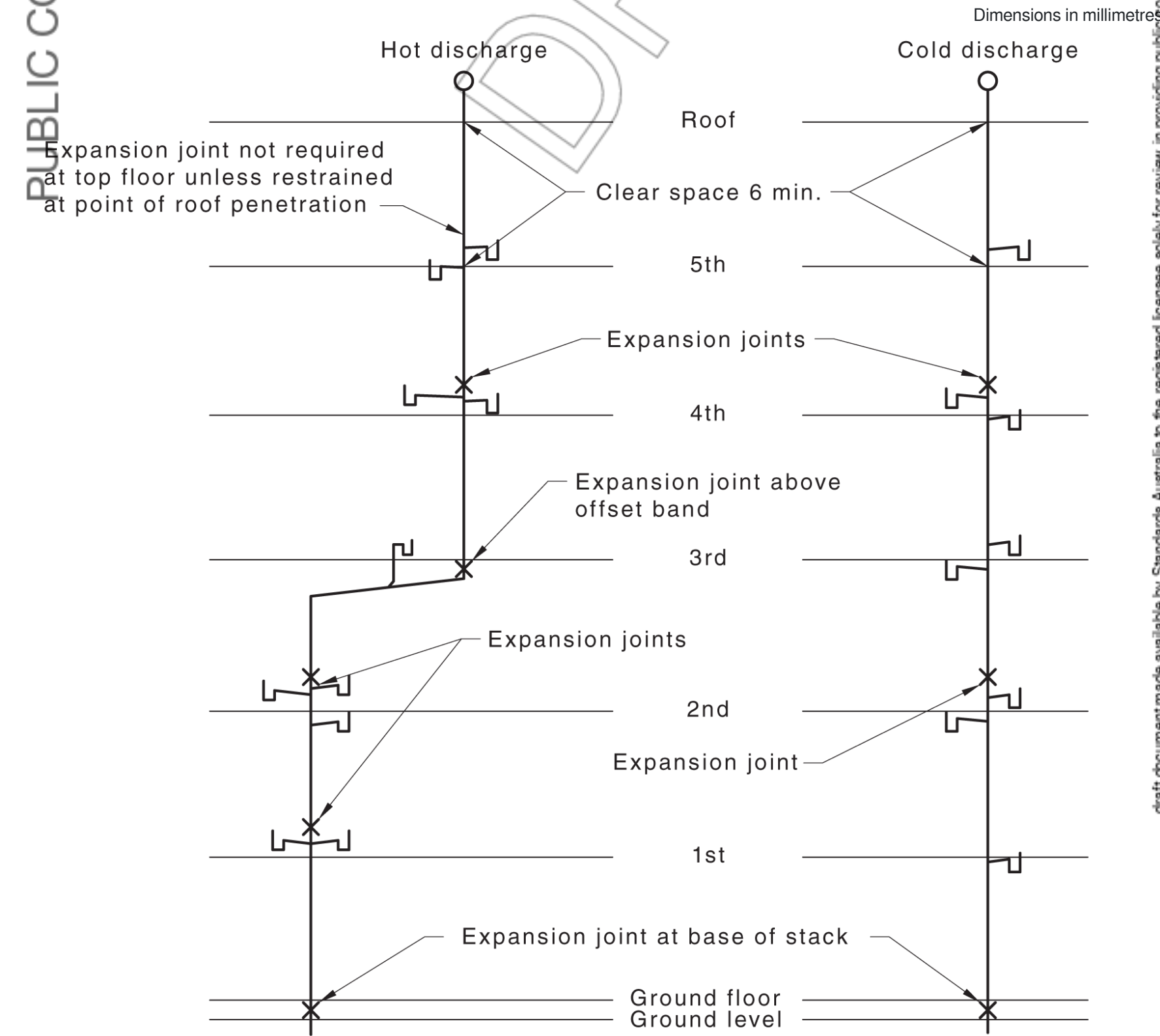
### 10.6.4 Freedom from restraint

A copper or copper alloy pipe shall be considered to be unrestrained, provided the following requirements are met:

- (a) Where the pipe passes through walls or floors, there shall be no restraint on longitudinal movement. An annular space of at least 6 mm shall be provided, and such space may be filled with flexible material.
- (b) There shall be no restraint on movement on any branch discharge pipe for a distance of 450 mm from its junction with a stack. Where the discharge pipe traverses any floor or wall within such a distance, an annular space of at least 6 mm shall be provided.

NOTE 1 See Figure 10.6.4 for an example layout of a copper pipe stack showing expansion joints.

NOTE 2 The annular space may be filled with flexible material.



(a) Location of expansion joints



(b) Freedom from restraint

NOTE Vents omitted for clarity.

Figure 10.6.4 — Expansion joints in copper and copper-alloy stacks



## 10.7 Installation of other metallic pipes and fittings

NOTE Installation should take into account manufacturer's instructions.

## 10.8 Installation of plastics pipes and fittings

### 10.8.1 PVC-U pipe systems

PVC-U piping systems shall be installed in accordance with AS/NZS 2032.

### 10.8.2 ABS pipe systems

ABS piping systems shall be installed in accordance with AS/NZS 3690.

### 10.8.3 PE pipe systems

PE piping systems shall be installed in accordance with AS/NZS 2033.

### 10.8.4 Installation of other plastics pipe systems

NOTE Installation should take into account manufacturer's instructions.

## 10.9 Disconnection of sanitary plumbing

Disused pipework shall be disconnected as near as practicable to the connecting pipe remaining in service, and the remaining fitting made watertight by using a cap or plug sealed in a manner appropriate for the material remaining in use.

## 10.10 Identification of pipes

In commercial and industrial buildings, accessible pipework shall be permanently marked so as to be readily identifiable as part of the sanitary and plumbing drainage service within:

- (a) In Australia, all Class 2 to Class 9 buildings (multi-unit, commercial and industrial buildings).
- (b) In New Zealand —

(i) multi-unit dwellings, including apartment buildings but excluding low rise multi-unit dwellings such as an attached dwelling or flat;

(ii) communal residential buildings, excluding holiday cabins and backcountry huts;

(iii) communal non-residential buildings;

(iv) commercial buildings; and

(v) industrial buildings.

NOTE 1 In Australia, refer to the NCC for information on building classes.

NOTE 2 In New Zealand, refer to NZBC Clause A1 Classified Uses for information on building use categories.

Identification markings shall be placed —

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

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

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

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

## 10.11 Installation of above-ground pipework and connection of fixtures using drainage principles

### 10.11.1 General

Above-ground (elevated) pipework and associated fixture connections installed within buildings shall be installed in accordance with [Clauses 10.11.2 to 10.11.4](#).

### 10.11.2 Maximum length and size

The maximum length and size of any unvented graded pipe, branch or fixture discharge pipe shall be in accordance with [Clause 3.10](#) and [Table 3.10.2](#).

### 10.11.3 Applicable installations

The requirements of [Clause 10.11](#) shall apply to the first four floor levels only above either the invert level of the connection point to the boundary trap riser or inspection shaft, and the uppermost floor only where connected into a discharge stack.

Branches serving the uppermost floor, which connect to a discharge stack, may use drainage principles.

Branches serving the floors below the uppermost floor shall conform to a nominated stack design in accordance with [Clause 10.11.4\(b\)](#).

### 10.11.4 Installation

Above-ground (elevated) pipework, materials, methods of support and fixing shall be in accordance with the relevant requirements of this document and the following:

- (a) No graded discharge pipe or branch, except a discharge stack, shall connect to any vertical section of pipework within the first four floor levels.
- (b) Any discharge stack system in excess of the maximum of four floor levels specified in [Clause 10.11.3](#) shall be installed as a stack in accordance with the relevant requirements of [Sections 6, 8, 9, 10 or 11](#), as applicable.

- (c) The loading in fixture units shall not exceed the maximum specified in [Tables 3.3.1, 3.10.2](#) and [Table 8.2.2\(B\)](#), as applicable.
- (d) The connection of any discharge pipe or branch to the elevated pipework shall be in accordance with the relevant requirements of [Clauses 6.6, 6.7, 8.6](#) and [9.9](#), and [Section 11](#).
- (e) The total length of an unvented branch pipe, including the length of the fixture discharge pipe that connects to the main section of graded elevated pipework, shall be in accordance with [Clause 3.10.3](#).

NOTE 1 The discharge stack may roll over on the top floor or carry on as a stack vent.

NOTE 2 A maximum loading of 30 fixture units, including not more than two WC pans or two slop hoppers, may discharge into any branch on the top floor of a discharge stack without further ventilation.

NOTE 3 See [Figure 10.11.4](#) for details of installation.

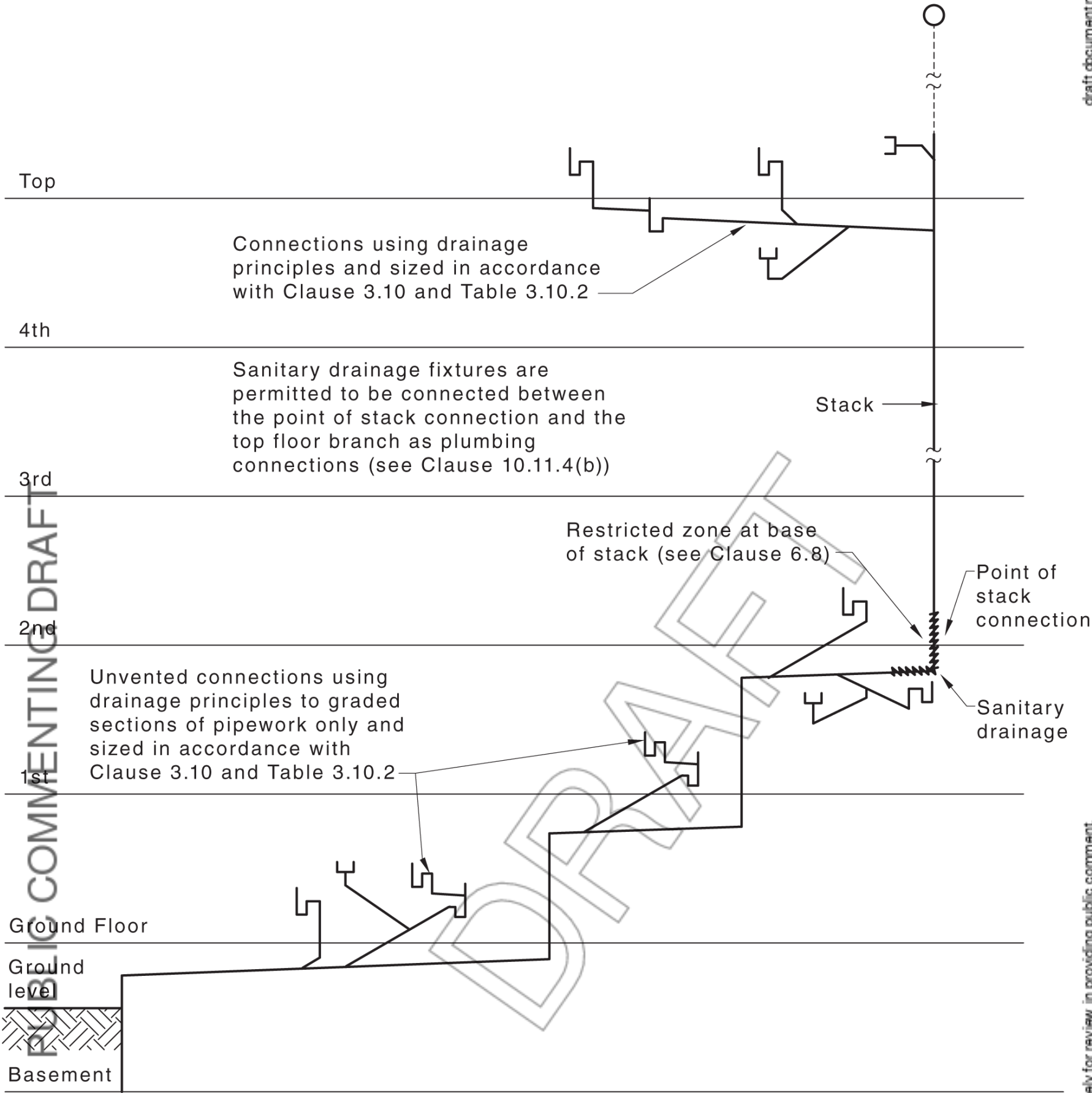


Figure 10.11.4 — Above-ground (elevated) pipework within building — Based on drainage principles

## 10.12 Installation of boundary traps, reflux valves and gullies above ground within buildings

### 10.12.1 Boundary traps

Boundary traps installed within a building and above ground or floor surface level shall conform to the relevant requirements of [Clause 4.4](#).

### 10.12.2 Reflux valves

Reflux valves within a building shall be installed in accordance with the following:

- (a) Where located above ground or floor surface level, the installation shall conform to the relevant requirements of [Clause 4.5](#).
- (b) Where installed immediately below any floor slab or other structure, a clear space shall be provided above the reflux valve to facilitate maintenance.

### 10.12.3 Gullies

Gullies located within buildings shall —

- (a) be installed above ground or floor surface level;
- (b) be supported in the same manner as for a boundary trap;

- (c) be provided with an overflow pipe that shall terminate at a height in accordance with [Clause 4.6.6.6](#); and
- (d) conform to the relevant requirements of [Clause 4.6](#).

## 10.13 Methods of jointing of pipes

### 10.13.1 General

The joints between discharge pipes, vent pipes, fittings, fixtures and appliances shall be made as appropriate for the materials being joined. Each joint shall be rendered airtight.

Joints between similar and dissimilar materials shall be made using one of the joint types specified in [Table 10.12.1](#).

Jointing materials shall be in accordance with [Clause 2.6](#).

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Table 10.12.1 — Joints for pipes and fittings of similar and dissimilar materials									
To — Material 2	From — Material 1								
	Cast and ductile iron	Copper and copper alloy	Galvanized steel	PP	PVC-U	PE	ABS/ASA	VC	FRC
Cast and ductile iron	BG RR ER	BG RR <sup>a</sup> SB/ER	BG RR <sup>a</sup> ER	BG RR	BG RR SC/ER BC	BG RR	BG RR SC/ER BC	RR/BG RR/ER RR CN BC	RR BC
Copper and copper alloy	BG RR <sup>a</sup> ER/SB	SB RR	BG TH/SB ER/SB	TH/SB RR	SC/TH/SB SC/ER/SB RR	RR SB/TH	SC/TH/SB SC/ER/SB RR	RR/SB RR/BG RR/ER CM	RR BC ER
Galvanized steel	BG RR <sup>a</sup> ER	BG SB/TH SB/ER	TH BG	TH	SC/TH SC/ER	TH	SC/TH SC/ER	CM RR RR/ER	RR BC
PP	BG RR	SB/TH RR	TH	RR TH EF	RR SC/TH	RR TH	RR SC/TH	RR CM	RR BC
PVC-U	BG RR ER/SC	SB/TH/SC SB/ER/SC RR	TH/SC ER/SC	RR TH/SC	SC RR BC	TH/SC RR BC	SC RR BC	RR/SC BC	RR BC ER
PE	BG RR	SB/TH RR	TH	RR TH	SC/TH RR BC	EF RR BG	SC/TH RR BC	RR CM	RR BC
ABS/ASA	BG RR ER/SC	SB/TH/SC SB/ER/SC RR	TH/SC ER/SC	RR TH	SC RR BC	TH/SC RR BC	SC RR BC	RR/SC BC	RR BC ER
VC	BG/RR ER/RR RR CM BC	SB/RR BG/RR ER/RR CM	CM RR ER/RR	RR CM	SC/RR BC	RR CM	SC/RR BC	RR CM BC	RR BC
FRC	RR BC	RR BC	RR BC	RR BC ER	RR BC ER	RR BC	RR BC ER	RR BC	RR BC ER

<sup>a</sup> Applies to vent connections only.  
**Key**  
BG = bolted gland  
RR = rubber ring  
ER = epoxy resin  
CM = cement mortar  
SB = silver brazed  
SC = solvent cement  
TH = threaded  
BC = band clamped sleeve  
EF = electrofusion  
  
NOTE Where more than one joint type is shown separated by one or more slashes, the joint between the two different materials requires an adaptor. The order of the joints is always shown from (Material 1) to (Material 2) as indicated in the table headings.

### 10.13.2 Bolted gland joints (BG)

The sealing rings used shall be appropriate for the material and dimensions of the pipes or fittings being joined.

### 10.13.3 Rubber ring joints (RR)

When used in sanitary drainage work, rubber ring joints used below ground shall be designed to inhibit root penetration.

### 10.13.4 Epoxy resin joints (ER)

Epoxy resin shall be appropriate to the materials being joined.

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

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### 10.13.5 Cement mortar joints (CM)

Cement mortar shall conform to [Clause 2.7.2](#).

### 10.13.6 Silver brazed joints (SB)

Silver brazed joints shall be made using silver brazing alloy conforming with [Clause 2.8.3.1](#). Joints shall be made by either —

- (a) using fittings; or
- (b) fabricating junctions from the pipes using tools specially designed for the purpose.

### 10.13.7 Solvent cement joints (SC)

Solvent cement and priming fluid used for jointing plastics pipes and fittings shall conform to [Clause 2.8.5](#) as appropriate.

### 10.13.8 Threaded joints (TH)

Threaded joints shall conform to the relevant Standards for the materials to be joined and sealed.

### 10.13.9 Band-clamped sleeve joints (BC)

NOTE Refer to AS 1646 for information on elastomeric seals suitable for waterworks purposes.

### 10.13.10 PE joints

PE joints shall be installed in accordance with AS/NZS 2033.

## 11 Reduced velocity aerator stack system

### 11.1 Scope of section

This section specifies design and installation requirements for the reduced velocity aerator stack system for sanitary plumbing.

### 11.2 General

Where the system uses an aerator junction fitting (a proprietary junction fitting) in the stack at each floor level for connection of graded discharge pipes, common discharge pipes or branch drains from sanitary fixtures, a de-aerator shall be included at the base of the stack.

NOTE Airflow requirements of the system are provided through the stack vent.

Discharge pipes, common discharge pipes and branch drains that exceed the maximum allowable length or fixture unit loading shall be vented.

### 11.3 Size of stacks

The stack shall be sized in accordance with [Tables 6.3\(A\)](#), [8.2.2\(A\)](#) and [8.2.2\(A\)](#), and [Clause 8.4](#) Items (a), (b), (c) and (e).

Where any stack is offset, the offset section shall be sized —

- (a) as a straight stack, if the offset is more than 45° to the horizontal; or
- (b) as a graded pipe, if the offset is less than 45° to the horizontal, and the stack shall continue undiminished in size.

The stack shall not be reduced in size in any direction.

### 11.4 Stack vents

Stacks shall extend unimpeded to atmosphere.

NOTE Stack vents may be connected at their uppermost end into a common header terminating at one point.

If interconnected, interconnection of stack vents shall occur not less than 1 m above the highest flood rim level of the highest fixture. The size of header vent shall increase by one pipe size downstream of each interconnection junction, as in [Figure 11.4\(A\)](#).

The number of interconnected stacks shall not exceed 5 × DN 100 stacks or 4 × DN 125 stack, with a maximum size vent of DN 300 terminating through the roof.

If the horizontal length of the stack vent offset exceeds 12 m, the size of the offset shall be increased by one pipe size as shown in [Figure 11.4\(B\)](#).

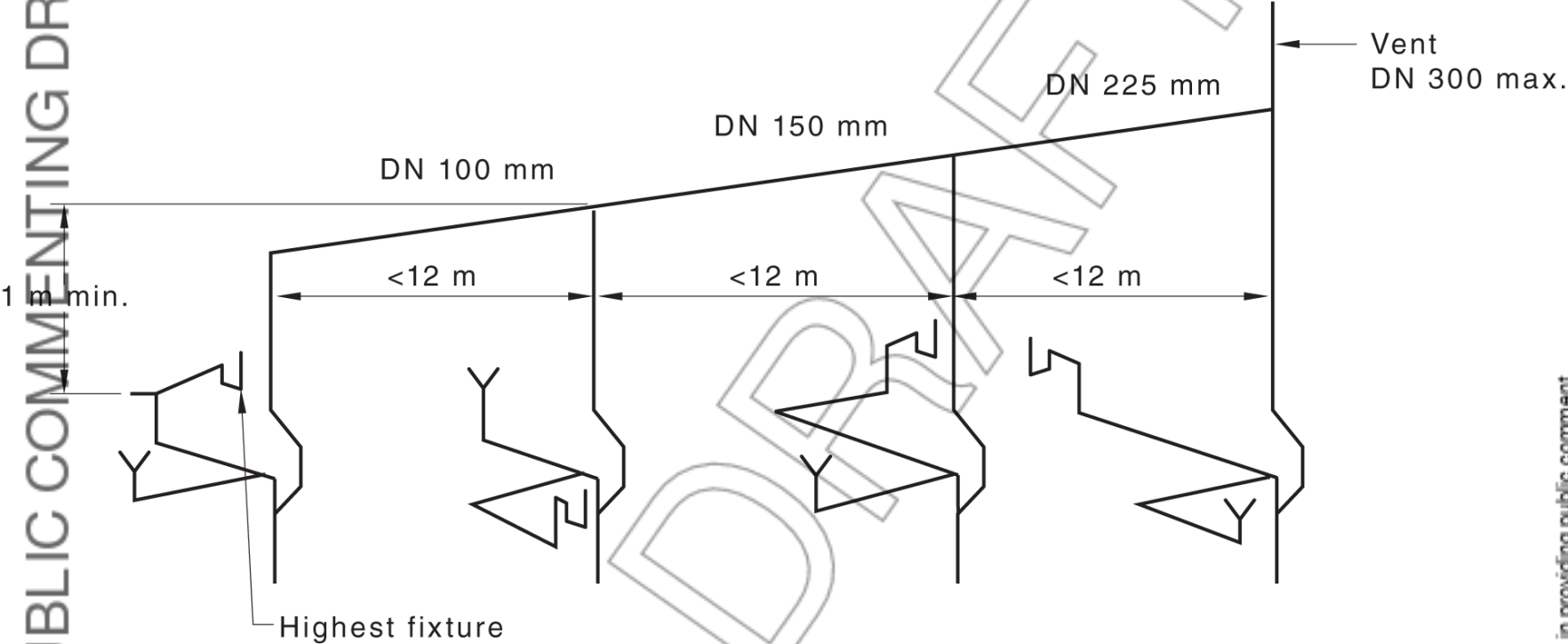
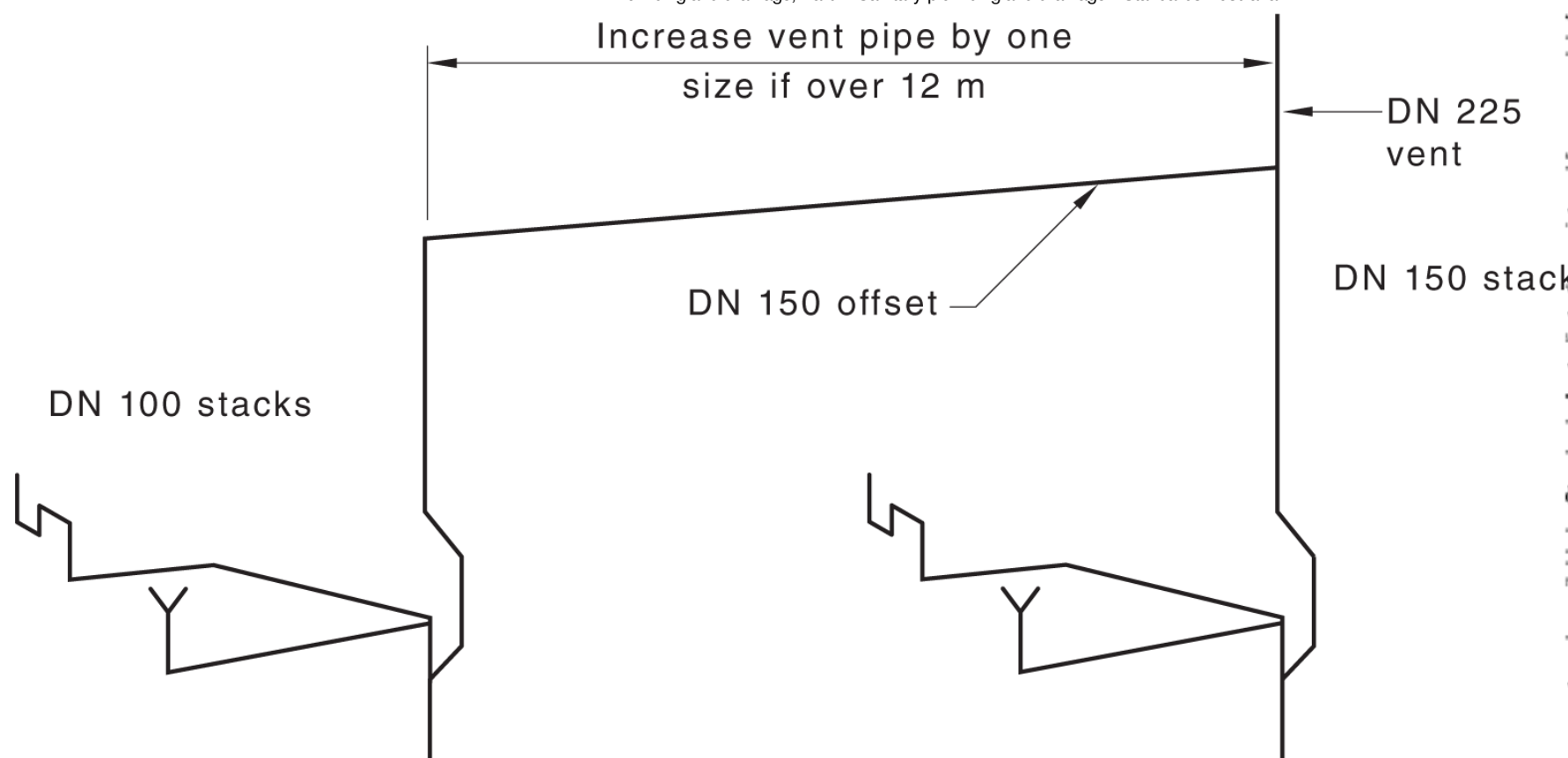


Figure 11.4(A) — Manifolding of stack vents



**Figure 11.4(B) — Stack vent offsets over 12 m**

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## 11.5 Offsets in stacks

### 11.5.1 General

The following applies for offsets in stacks:

- (a) A double inline offset shall be installed midway if the distance between any two aerators or an aerator junction fitting and a de-aerator exceeds 5 m as shown in [Figure 11.5.1\(A\)](#).
- (b) A pressure relief bypass pipe between the upper and lower sections of the stack shall be installed on every stack offset greater than 45° as shown in [Figure 11.5.1\(B\)](#).
- (c) The minimum grade of stack offsets shall be in accordance with [Table 8.6.2.2](#).

Connections near graded offsets shall be restricted in accordance with [Clauses 8.6.2.3, 8.6.2.4 and 8.6.2.5](#).

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Opposed connections of aerator junction fittings shall be connected only to equal numbers of fixtures of the same kind.

NOTE See [Figure 11.6.2](#) for a typical aerator junction fitting.

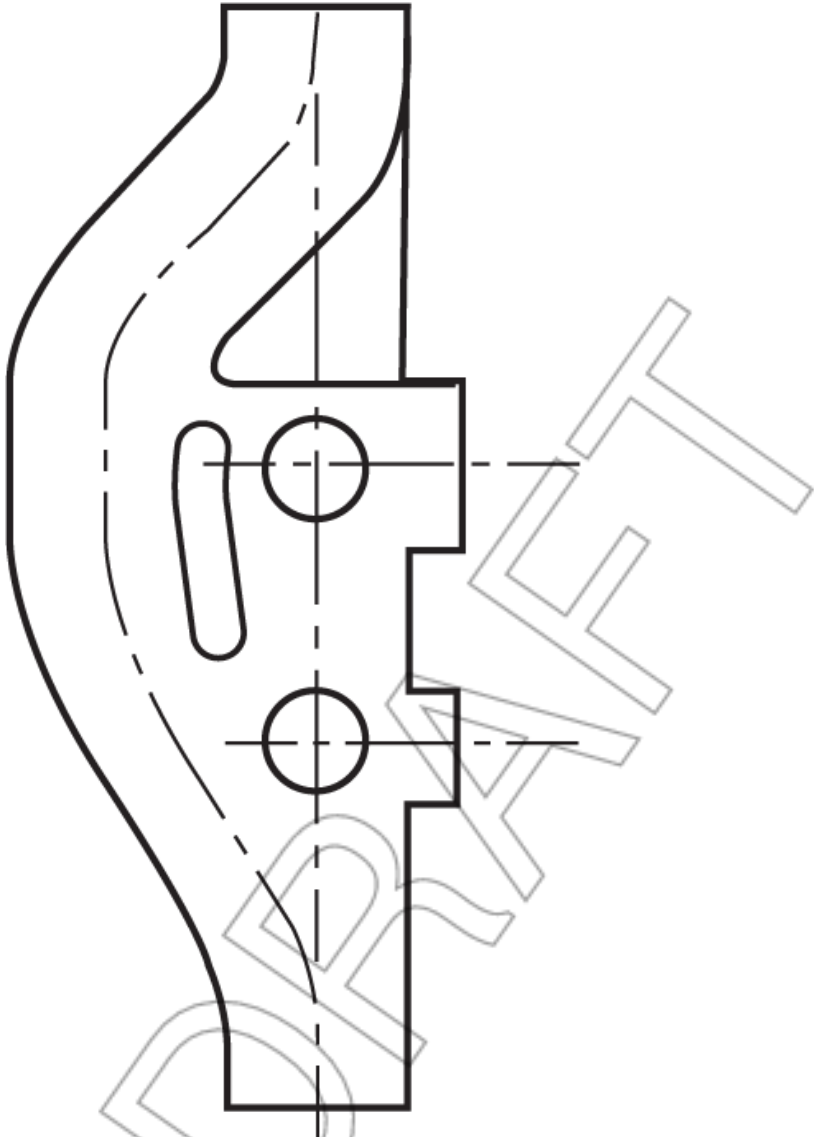


Figure 11.6.2 — Typical aerator junction fitting

## 11.7 Maximum length of discharge pipes

Any unvented discharge pipe or unvented common discharge pipe shall not exceed 10 m in length or include a vertical drop, between the crown of the trap and the invert of the junction, exceeding —

- (a) 2 m for water closet pans with DN 80 discharge pipes;
- (b) 1.5 m for basins and bidets; and
- (c) 2.5 m for all other fixtures.

The length of a graded discharge pipe shall be in accordance with [Appendix B](#).

## 11.8 Size of discharge pipes

The size of a graded discharge pipe, common discharge pipe or branch drain shall be in accordance with [Table 3.10.2](#) and [Table B.1](#).

## 11.9 De-aerators

A de-aerator shall be installed at the base of the stack to provide a pressure relief bypass between the stack and the drain to which it is connected, as shown in [Figure 11.9](#).

The distance from the de-aerator to the closest aerator or double offset shall not exceed 5 m, as shown in [Figure 11.4\(A\)](#).

The pressure relief bypass pipe on a de-aerator shall run at least 2.5 m from the centre-line of the stack to the centre of the pressure relief bypass inlet junction, as shown in [Figure 11.9](#). No connection shall be made into the bypass pipe.

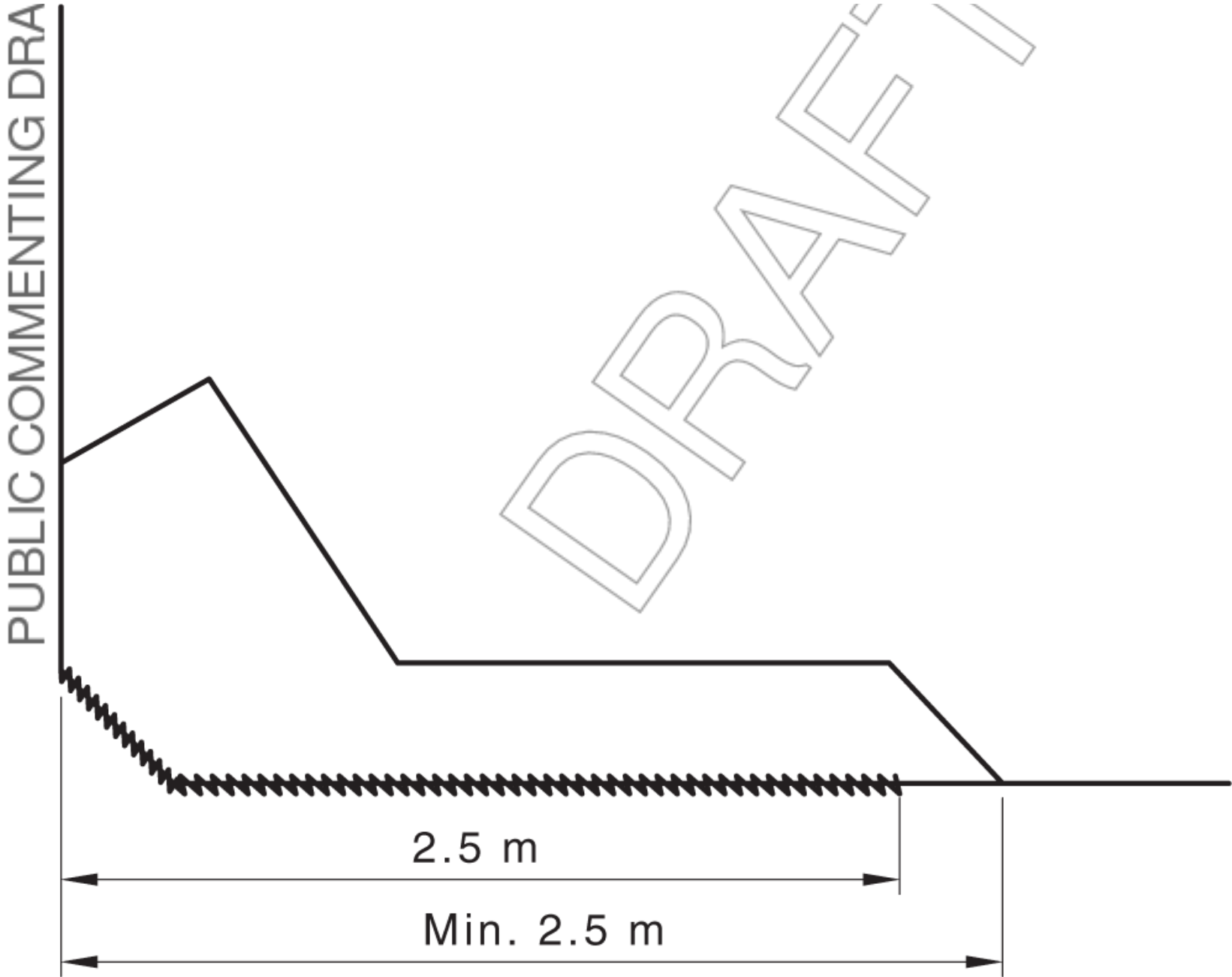
Connections shall not be made to the de-aerator graded pipe within 2.5 m of the stack base.

Pressure relief bypass pipes for de-aerators shall run parallel to the base of the de-aerator with the invert of the pressure relief bypass pipe no lower than the centre-line of the drain.

NOTE See also [Figures 11.4\(B\)](#) and [11.9](#).

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Key:

 Non-connection zone

Figure 11.9 — De-aerator with pressure relief bypass pipe at the base of the stack

## 12 Pumped discharge

### 12.1 Scope of section

This section specifies requirements for pumped discharge.

### 12.2 General

Pumping shall only be used where it is not practicable to gravitate to the connection. The pumping apparatus shall be positioned to facilitate easy connection to the gravity sewer.

The pumping apparatus may be one of the following:

- (a) Compressed air ejection system.
- (b) Wet well (including submersible pump).
- (c) Small bore macerator/pump.

### 12.3 Compressed air ejection

Ejector pots shall be sized according to maximum flow rates.

NOTE Ejector pots may be duplicated.

### 12.4 Ejector vent

The ejector vent shall be not less than DN 40. It shall either —

- (a) extend separately to open air; or
- (b) be interconnected with a relief or stack vent at least 10 m above the ejector pot.

### 12.5 Wet wells

#### 12.5.1 General

Wet wells shall be fit for purpose and installed in an accessible location.

#### 12.5.2 Construction

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The structure shall be precast, moulded or cast *in situ*. It shall be sound and constructed of materials that will resist corrosion from the sewage and sewage gases internally and aggressive soils externally.

NOTE 1 Suitable materials include reinforced concrete, corrosion resistant metals, fibre glass, or suitable plastics such as PE or PP.

NOTE 2 When using plastics, care should be taken to ensure that the design and installation addresses durability and avoids problems with buckling and long-term creep. WSA 137 provides further information on the design and performance requirements for maintenance shafts, maintenance chambers and maintenance holes, and WSA 129 provides information on plastics collection tanks.

### 12.5.3 Base

The base shall be constructed of, or finished with, a self-cleansing grade towards the pump inlet.

### 12.5.4 Cover

The cover shall be constructed of similar materials to that of the wet well. The cover shall have access openings with removable airtight covers sized for maintenance purposes.

### 12.5.5 Ladders

Where a wet well exceeds a depth of 1.2 m, a ladder shall be provided in accordance with [Clause 4.8.3.3](#).

## 12.6 Installation of pumps

### 12.6.1 General

Pumps shall be suitable for unscreened sewage. Pumps shall be installed as follows:

- (a) The pumping apparatus shall be securely fixed using corrosion-resistant fixings.
- (b) Each pump shall be fitted with an isolating valve and check valve on the delivery side.
- (c) Pumps shall be installed with connections to permit removal and replacement of the pumps.
- (d) Pumps shall be controlled so as to limit the number of starts per hour to within the capacity of the pump. They shall, as far as practicable, empty the contents of the wet well at each operation.

NOTE 1 Pumps may be duplicated.

NOTE 2 The required pumping rate should be based on an assessment of the expected inflow, holding capacity of the well and allowable discharge.

### 12.6.2 Inlet to wet well

The invert of the gravity discharge pipe to a wet well shall be located at least 100 mm above the highest working level and terminate with a square junction.

### 12.6.3 Venting

The wet well shall have a minimum DN 80 vent.

NOTE Manufactured wet wells that are watermarked may be approved with a smaller vent size.

### 12.6.4 Sealing

All pipes or apparatus passing through the wet well walls or cover shall be sealed with a compatible material.

## 12.7 Pumped discharges or rising mains

The pump discharge pressure piping shall conform to the relevant sections of AS/NZS 3500.1 and this document. The outlet pipe shall discharge to one of the following locations:

- (a) An inspection chamber.
- (b) A boundary trap shaft.
- (c) A stack below the lowest fixture connection on any floor.
- (d) A drain or combined discharge pipe, provided the connection is at least 2.5 m from any other connection.
- (e) Downstream of a reflux valve or at least 2.5 m upstream of a reflux valve.
- (f) A minimum of 1 m downstream of a boundary trap.
- (g) Direct to the network utility operator's sewer where approved by the network utility operator.

## 12.8 Pump discharge from waste fixtures

### 12.8.1 General

Pumping shall only be used where gravity connection from a waste fixture is not possible. The pumping apparatus shall be positioned in the same room adjacent to the waste fixture.

### 12.8.2 Holding tank

The holding tank shall conform to [Clauses 12.5.2](#), [12.5.4](#) and [12.5.5](#).

### 12.8.3 Provision of valves

Valves shall be provided as follows:

- (a) Where the pump is located inside the holding tank, a non-return valve and isolating valve shall be located on the outlet side of the pump.
- (b) Where the pump is located outside of the holding tank, an isolating valve shall be located on the inlet and outlet of the pump. A non-return valve shall be located on the downstream of the outlet isolating valve.

### 12.8.4 Inlet

The invert of each waste inlet shall be located at least 100 mm above the highest working level of the holding tank.

12.8.5 Outlet size

The pump discharge pipes shall be at least DN 25 and not less than the pump outlet size.

12.8.6 Venting

The holding tank shall be provided with a vent having a minimum size of DN 50. The holding tank shall conform to the venting requirements for waste fixtures. The vent shall be positioned a minimum of 100 mm above the waste inlet.

12.8.7 Pump discharge pipe

The pump discharge pipe from waste fixtures or swimming pools shall be connected in accordance with Clause 12.7, or connected to a gully riser, as shown in Figure 12.8.7(A) or Figure 12.8.7(B).

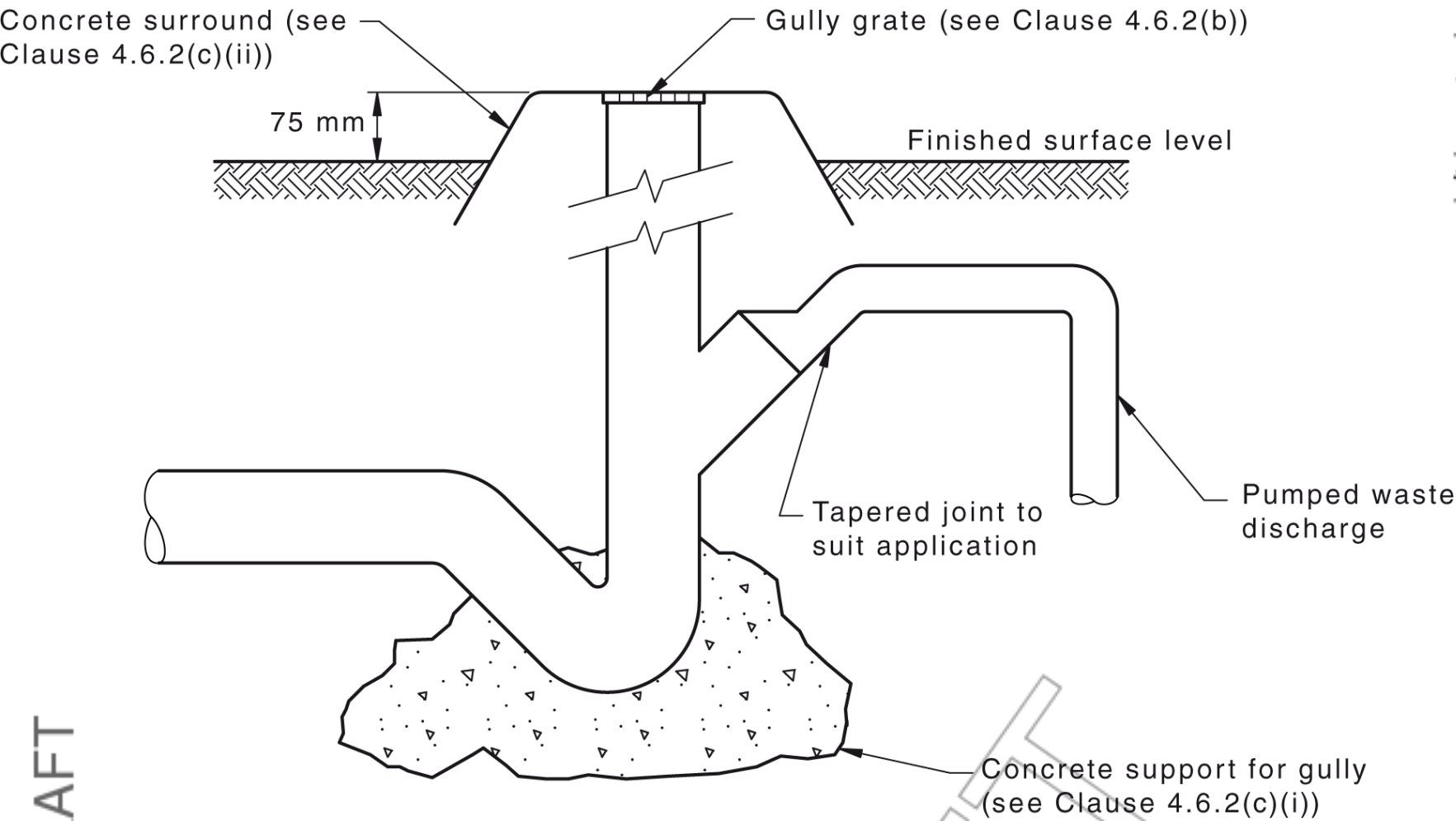


Figure 12.8.7(A) — Connection of pumped waste discharge

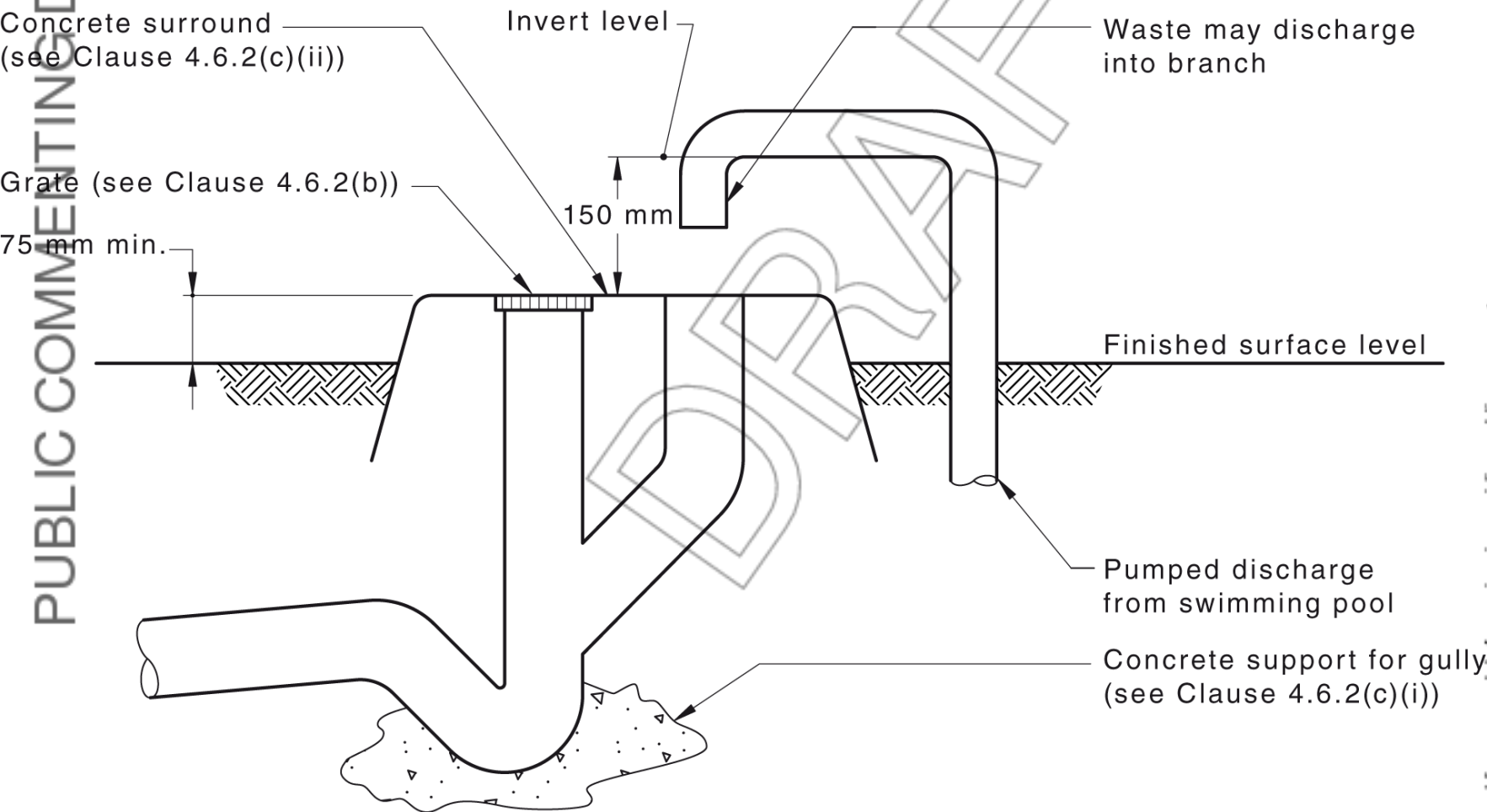


Figure 12.8.7(B) — Connection of pumped waste discharge from swimming pools

12.9 Small bore macerator pumps

Small bore macerator pumps shall discharge in accordance with Clause 12.7.

A vent pipe to a macerator pump shall terminate in accordance with Clause 6.9.4 or interconnect with any other vents other than those specified in Clause 6.9.3.

NOTE Small bore macerator pumps may not operate if air admittance valves are the sole means of venting the unit.

13 Fixtures and appliances

13.1 Scope of section

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This section specifies requirements for the installation of sanitary fixtures and appliances, and their connection to the sanitary plumbing or sanitary drainage system.

The maximum lengths of discharge pipes without venting shall be in accordance with [Appendix B](#).

Water supply for the sanitary flushing shall be in accordance with AS/NZS 3500.1.

## 13.2 Installation of sanitary fixtures for people with a disability

NOTE 1 In Australia, the installation of sanitary fixtures for people with a disability are specified by the National Construction Code (NCC) Volume 3, Plumbing Code of Australia.

NOTE 2 In New Zealand, the installation of sanitary fixtures for people with a disability are specified by the New Zealand Building Code (NZBC) Clause G1 Personal Hygiene.

## 13.3 General installation requirements

### 13.3.1 Installation of fixtures

Fixtures and appliances shall be secured in position, independent of support from their traps, waste and discharge pipes or water supply connections. They shall be installed in a manner that facilitates disconnection.

### 13.3.2 Location of fixture traps or self-sealing devices

Fixture traps or self-sealing devices shall be installed downstream of the fixture outlets in accordance with [Clause 6.5.3](#).

### 13.3.3 Untrapped fixtures

Untrapped fixtures that discharge through a floor waste gully shall be connected in accordance with [Table 4.6.3](#).

### 13.3.4 Connection of combination fixtures in pairs

Where a combination of waste fixtures is connected in pairs to a single fixture trap, the arrangement shall be in accordance with [Clause 6.5.4](#).

### 13.3.5 Connection of soil fixtures

Soil fixtures shall not discharge through floor waste, or overflow relief or disconnector gullies.

### 13.3.6 Fixture grates

Excluding water closet pans, slop hoppers, bedpan washers, bedpan sterilizers, tundishes, soil dump points and sanitary napkin disposal units, the outlet of each fixture shall be provided with a grate.

Where the fixture trap is not accessible, the grate shall be removable.

### 13.3.7 Fixture discharge pipes

Fixture and appliance discharge pipes shall be installed in accordance with the following:

- (a) [Clause 3.10](#) for direct to drain connections.
- (b) [Clause 3.11](#) and [Clause 3.12](#) for unvented drains discharging to gullies.
- (c) [Clause 4.6.7](#) for floor waste gully connections.
- (d) [Table 4.6.3](#) for disconnector gully connections.
- (e) [Clause 6.6](#) for graded discharge pipe connections.
- (f) [Clause 8.4](#) for fully vented and fully vented modified stack connections.
- (g) [Clause 9.6](#) for single stack and single stack modified stack connections.
- (h) [Clause 10.10](#) for above-ground pipework and connection of fixtures using drainage principles.
- (i) [Section 11](#) for reduced velocity aerator stack systems.
- (j) [Appendix B](#) for maximum length of fixture discharge pipe without venting.

## 13.4 Plant rooms

Discharges from plant rooms shall drain to a tundish, trapped sump or floor waste gully.

Fixture unit ratings shall be determined from [Table 6.3\(B\)](#).

## 13.5 Pressurized chambers

Where a floor waste gully is located in a pressurized chamber, the trap shall be in accordance with [Clause 6.5.2](#).

## 13.6 Autopsy tables

Autopsy tables shall be connected to sanitary drains in accordance with the following:

- (a) Each autopsy table shall drain through an untrapped waste pipe not smaller than DN 50 and a maximum length of 1.2 m to a flushing floor waste gully with an outlet not smaller than DN 65.
- (b) The water supply to the flushing floor waste gully shall be from a flush valve, cistern or break tank.

## 13.7 Bain-maries and boiling water units

Bain-maries and boiling water units shall drain to a tundish installed in accordance with [Clause 13.21](#).

## 13.8 Basins

Basins shall be fitted with a DN 40 (or DN 32 for New Zealand only) trap and a waste pipe not smaller than DN 40 or connected as fixture pairs in accordance with [Clause 6.5.4](#).



## 13.9 Baths

Baths shall be connected by —

- (a) an untrapped waste pipe not smaller than DN 40 to a floor waste gully in accordance with [Table 4.6.7.2](#); or
- (b) a trap and waste pipe not smaller than DN 40.

Where a bath trap is not accessible, the bath shall discharge untrapped to a floor waste gully (FWG) in accordance with [Table 4.6.7.2](#) and [Appendix B](#).

## 13.10 Bedpan washers and sanitizers

Bedpan washers and sanitizers shall be fitted with traps and discharge pipes not smaller than DN 80.

## 13.11 Bidets

Bidets and bidettes shall be connected by —

- (a) an untrapped waste pipe not smaller than DN 40 (or DN 32, New Zealand only) to a floor waste gully; or
- (b) a trap and waste pipe not smaller than DN 40 (or DN 32, New Zealand only).

## 13.12 Dental units

### 13.12.1 Single

A single dental unit shall discharge through a sealed trap not smaller than DN 40.

### 13.12.2 Multiple

Multiple dental units draining to a common point shall discharge through a sealed trap not smaller than DN 50.

## 13.13 Drinking fountains

Drinking fountains shall be fitted with a DN 40 (or DN 25, New Zealand only) trap and a waste pipe not smaller than DN 40 (or DN 32, New Zealand only).

## 13.14 Food waste disposal units (domestic type)

The outlet of a waste disposal unit may be connected directly to the trap of an adjoining kitchen sink.

NOTE See [Figure 13.25.2.1\(c\)](#) for an example.

## 13.15 Refrigerated air conditioners, heat pumps, refrigerators, deep-freeze cabinets, commercial coffee-making machines and ice-making machines

### 13.15.1 General

Outlet pipes from refrigerated air conditioners, heat pumps, refrigerators, deep-freeze cabinets, commercial coffee-making machines and ice-making machines shall be connected to a tundish installed in accordance with [Clause 13.21](#) or discharge above the inlet to a self-sealing device.

### 13.15.2 Shower groups

Shower groups may drain individually as fixture pairs in accordance with [Clause 6.5.4](#) or to a common channel.

## 13.16 Macerating sanitary napkin disposal units

Macerating sanitary napkin disposal units shall not discharge to a floor waste, or overflow relief or disconnector gully.

## 13.17 Showers

### 13.17.1 Individual showers

An individual shower shall be fitted with a minimum DN 80 grate or channel grate and be connected by —

- (a) an untrapped waste pipe not smaller than DN 40 to a floor waste gully; or
- (b) a trap and waste pipe not smaller than DN 40.

NOTE Prefabricated shower bases will need to be supported in accordance with the manufacturer's instructions.

### 13.17.2 Common channels

Common channels shall —

- (a) be graded to the outlet; and
- (b) discharge through a removable grate, trap and discharge pipe as specified in [Table 13.17.3](#).

Table 13.17.3 — Size of shower drainage channel outlets		
Numbers of showers	Sizes of grate DN	Size of trap and discharge pipe DN
1	80	40
2 or 3	80	50
4 to 6	100	65

## 13.18 Sinks

## 13.18.1 Kitchen sinks

Kitchen sinks shall be connected using a fixture trap and waste pipe not smaller than DN 50 (or DN 40, New Zealand only) or as fixture pairs in accordance with [Clause 6.5.4](#) directly to a stack, sanitary drain or overflow relief or disconnecter gully.

Triple bowl domestic kitchen sinks shall be connected —

- (a) as three single bowl sinks;
- (b) as a fixture pair and one single bowl sink; or
- (c) through a single fixture trap, provided the length of discharge pipe between the sink outlets and the fixture trap seal is not greater than 1.2 m.

## 13.18.2 Bar sinks

Bar sinks (domestic) shall be connected by —

- (a) an untrapped waste pipe, not smaller than DN 40, to a floor waste gully; or
- (b) a trap and waste pipe not smaller than DN 40.

Bar sinks (commercial) shall be connected by —

- (i) an untrapped waste pipe, not smaller than DN 50, to a floor waste gully; or
- (ii) a trap and waste pipe not smaller than DN 50.

## 13.18.3 Cleaners' sinks

Cleaners' sinks shall be connected to drains by —

- (a) an untrapped waste pipe, not smaller than DN 50, to a floor waste gully; or
- (b) a trap and waste pipe not smaller than DN 50.

## 13.18.4 Pot, utility and laboratory sinks

Pot, utility or laboratory sinks shall be connected using a trap and waste pipe not smaller than DN 50.

Pot, utility or laboratory sinks shall not be connected as fixture pairs.

NOTE Trade waste discharge from pot, utility or laboratory sinks may require pre-treatment as determined by the network utility operator.

## 13.19 Slop hoppers

### 13.19.1 Connection

Slop hoppers shall be connected directly to soil stacks or drains with a discharge pipe not smaller than DN 100.

### 13.19.2 Installation

Slop hoppers shall be securely fixed.

## 13.20 Instrument sterilizers and autoclaves

Instrument sterilizers and autoclaves shall discharge over a tundish installed in accordance with [Clause 13.21](#).

## 13.21 Connection of tundishes

Tundishes may be connected —

- (a) to a waste pipe, not smaller than DN 25, in accordance with [Clause 4.6.7.8](#);
- (b) to a trapped waste pipe, not smaller than DN 40, in accordance with [Appendix B](#); or
- (c) to a fixture trap.

When the tundish and discharge pipe is connected to a fixture trap —

- (i) the connection shall be made above the level of the water seal; and
- (ii) the top of the tundish shall be above the flood level rim of the fixture.

Pipes discharging over a tundish shall have an air gap of a size at least twice the internal diameter of the discharging pipe.

Tundishes shall be accessible.

## 13.22 Domestic swimming pools

The discharge pipe from swimming pools shall be installed in accordance with [Clause 12.8.7](#).

Overflows from skimmer boxes of domestic swimming pools should discharge to a discharge point nominated by the authority having jurisdiction.  
The discharge from swimming pools to the sanitary plumbing and drainage system may require the approval of the network utility operator.

## 13.23 Troughs

### 13.23.1 Ablution

Ablution troughs shall be connected by —

- (a) an untrapped waste pipe, not smaller than DN 40, to a floor waste gully; or
- (b) a trap and waste pipe not smaller than DN 50.

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## 13.23.2 Laundry

Laundry troughs shall be connected by —

- (a) an untrapped waste pipe, not smaller than DN 40, to a floor waste gully; or
- (b) a trap and waste pipe not smaller than DN 40.

## 13.24 Urinals

### 13.24.1 Slab type

Slab type urinals shall be connected directly to soil stacks or drains with a trap and discharge pipe not smaller than DN 65 for urinal walls up to 5 m in length. Where the urinal wall is more than 5 m in length, additional outlets shall be connected.

### 13.24.2 Wall-hung

#### 13.24.2.1 General

The floor of a room containing one (or more) wall-hung urinal shall grade to a floor waste gully installed in accordance with [Clause 4.6.7](#).

#### 13.24.2.2 Flushing wall-hung urinals

Flushing wall-hung urinals (other than those with an integral trap) shall be connected to a trap not smaller than DN 40 (or DN 32, New Zealand only).

#### 13.24.2.3 Non-flushing (waterless) urinals

Waterless wall-hung urinals with an integral cartridge seal or integral self-sealing mechanical device may be installed without an additional fixture trap or self-sealing mechanical device.

Prior to installing a waterless wall-hung urinal to an existing system, the materials of the pipes in the existing system shall be determined.

The undiluted discharge from the urinal shall not be transported through copper pipework.

### 13.24.3 Conversion to waterless urinals

Urinals shall not be converted into waterless urinals unless the requirements of [Clauses 13.24.2.1](#) and [13.24.2.3](#) have been satisfied.

## 13.25 Washing machines

### 13.25.1 Clothes-washing machines

The pumped discharge from domestic clothes-washing machines shall be connected —

- (a) over the rim or into the suds-saver connection of a laundry trough;
- (b) into a trapped waste pipe not smaller than DN 40; or
- (c) into trapped or untrapped waste pipe, not smaller than DN 40, connected to a floor waste gully.

NOTE Trade waste discharge from commercial clothes-washing machines may require pre-treatment as determined by the network utility operator.

### 13.25.2 Domestic dishwashing machines

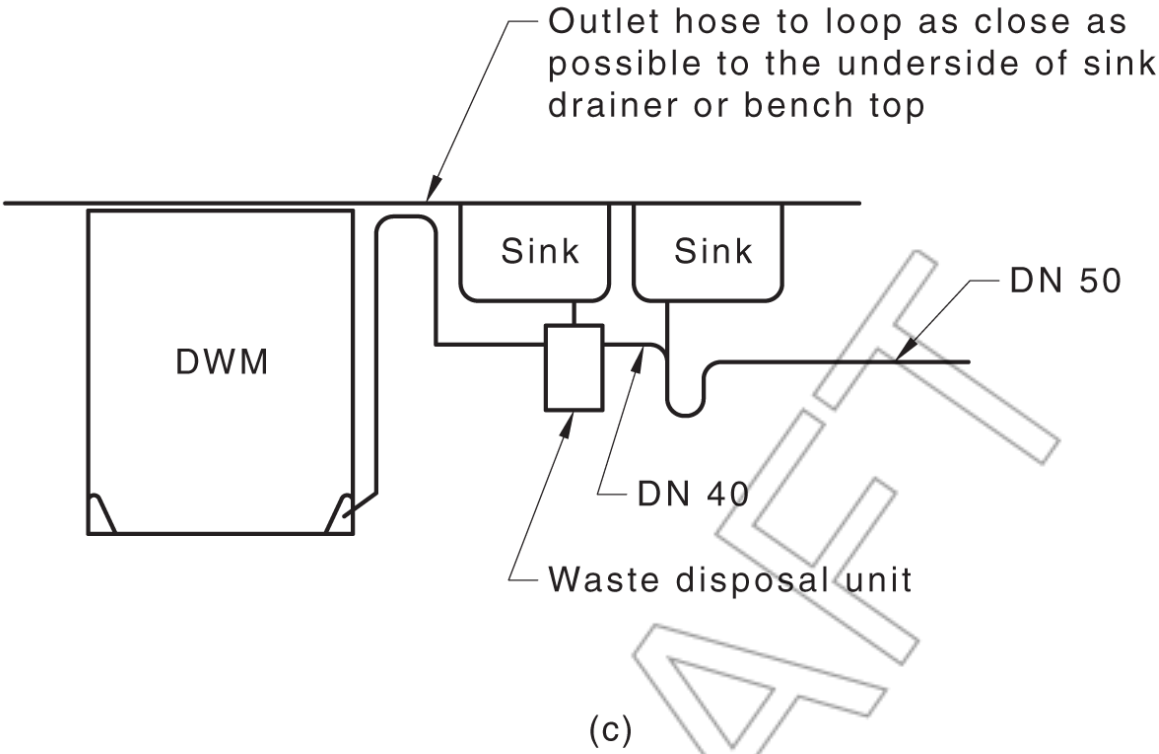
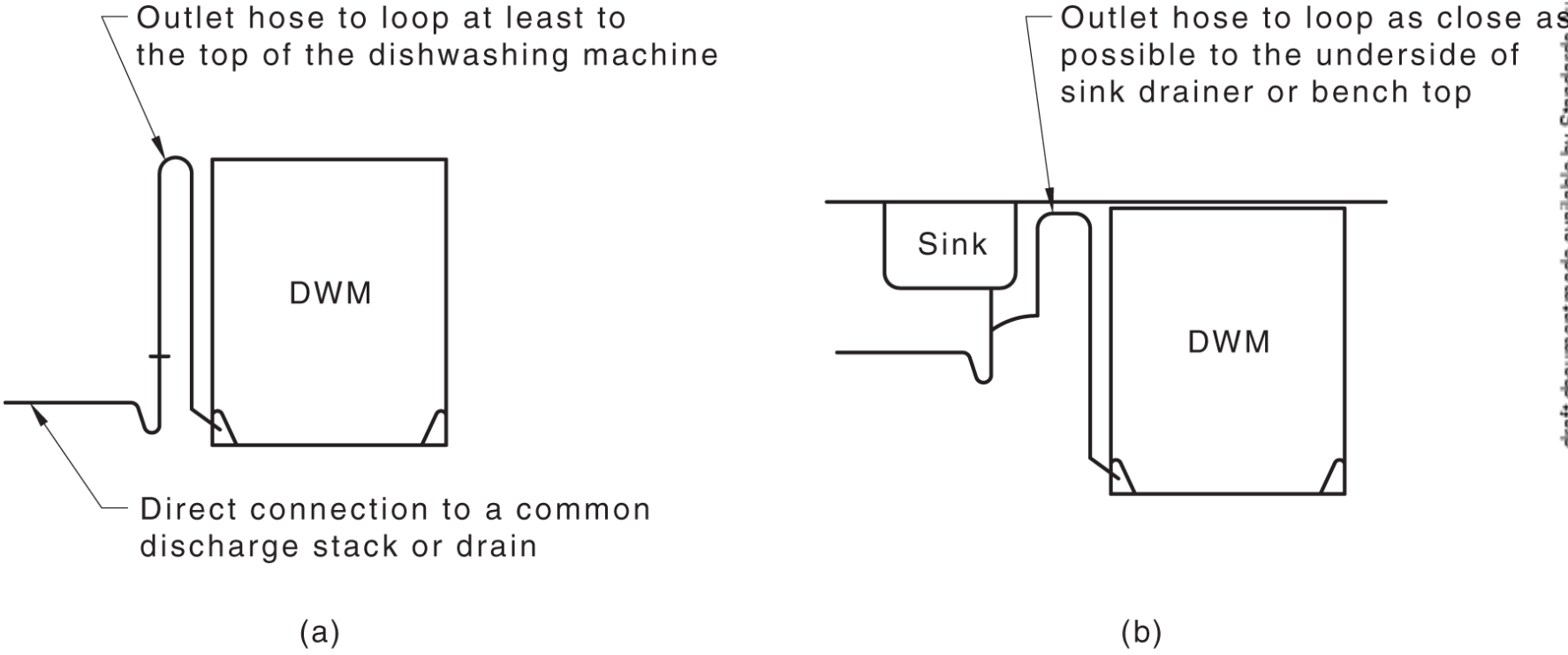
#### 13.25.2.1 Discharge

The pumped discharge from domestic dishwashing machines shall be connected —

- (a) into a trapped waste pipe not smaller than DN 40;
- (b) above the water seal of a DN 50 trap fitted to the outlet of a kitchen sink; or
- (c) through a domestic type food waste disposal unit.

NOTE See [Figure 13.25.2.1](#) for typical connections of domestic dishwashing machines.





KEY	
DWM	= dishwashing machine

Figure 13.25.2.1 — Typical connections of domestic dishwashing machines

13.25.2.2 Connection of outlet hose

Outlet hoses of domestic dishwashing machines shall be connected in accordance with the following:

- (a) Where the outlet hose is connected above the water seal of a sink trap, it shall be looped as close as possible to the underside of the sink drainer or benchtop before being extended downwards to the connection.
- (b) If the trapped waste pipe to which the connection is made discharges directly to the drain, stack or common discharge pipe, the outlet hose shall be extended at least to the top of the dishwashing machine before looping downwards to the trapped waste pipe.

13.25.3 Commercial dishwashing machines

The maximum length of commercial dishwashing machine discharge pipes without venting and with the nominated minimum DN sizes shall be in accordance with [Appendix B](#).

NOTE Trade waste discharge from commercial dishwashers may require pre-treatment as determined by the network utility operator.

13.25.4 Glass-washing machines

Glass-washing machines shall be connected by —

- (a) an untrapped waste pipe not smaller than DN 40 to a floor waste gully;
- (b) a trap and waste pipe not smaller than DN 40; or
- (c) a pump-out hose fitted in the same manner as domestic dishwashing machine.

NOTE See [Clause 13.25.2.2](#) for connection of outlet hose.

13.26 Untrapped floor drains

13.26.1 General

An untrapped floor drain may be installed for the purpose of draining wastewater spillage from a floor in case of overflow.

13.26.2 Restrictions on use



- An untrapped floor drain shall not be —
- (a) connected to any stack or discharge pipe that connects directly to the drain; or
  - (b) installed in any room that contains a urinal.

13.26.3 Installation

- Each untrapped floor drain shall —
- (a) be fixed and supported in accordance with [Clause 10.2](#);
  - (b) have a removable grate of at least DN 40; and
  - (c) be connected to a separate, graded discharge pipe of at least DN 40.

13.26.4 Termination of discharge pipe

- The outlet from an untrapped floor drain shall be located so that the discharge cannot cause damage or be a nuisance. The outlet shall terminate either —
- (a) internally over a tundish connected to a floor waste gully in accordance with [Clause 4.6.7.8](#); or
  - (b) externally with a flap and within 100 mm above finished surface level.

13.27 Water closet pans

13.27.1 Connection

Water closet pans shall be connected directly to soil stacks or sanitary drains with a discharge pipe not smaller than DN 80.

13.27.2 Installation

- Water closet pans shall be securely fixed by —
- (a) bedding not thicker than 20 mm;
  - (b) brackets; or
  - (c) corrosion-resistant fasteners.

14 Multi-unit developments

14.1 Scope of section

This section specifies minimum requirements for the main lines of a sanitary drain located in a multi-unit development of three or more residential buildings.

NOTE Where two or more Class 1 dwellings are located under the same roof, each individual dwelling is considered to be an individual building.

14.2 Methods of design

14.2.1 General

In a multi-unit development, provision shall be made for an inspection shaft, an overflow relief gully and an open upstream vent, as specified in [Clause 14.2.3](#) at each individual residential building.

NOTE Solutions for design of multi-unit developments are also set out in the Sewerage Code of Australia.

14.2.2 Maintenance shafts

In multi-unit developments of 20 or more residential buildings, a maintenance shaft having ready access at ground surface for drain clearing equipment and television inspection shall be provided on the main lines of the sanitary drainage system, at each change of direction and main line junctions. The spacing of maintenance shafts along straight sections shall not exceed 150 m.

NOTE No additional inspection openings are required if openings are on the main line of sanitary drains where maintenance shafts are installed.

14.2.3 Inspection shafts and overflow relief gullies and open upstream vents at each individual residential building

In multi-unit developments, provision shall be made at each individual residential building for the following:

- (a) An inspection shaft in accordance with [Clause 4.4.2](#), immediately upstream of the junction with the main line of the sanitary drain.
- (b) Additional overflow relief from sewerage surcharge.
- (c) An open upstream vent.

NOTE Provided protection against sewage overflow has been made as specified in [Clause 4.6.6](#), any additional gully may have a lesser vertical separation than that specified in [Clause 4.6.6](#).

15 Testing of sanitary plumbing and sanitary drainage installations

15.1 General

This section specifies requirements for the inspection and testing of sanitary plumbing and sanitary drainage installations.

NOTE 1 See [Section 16](#) for testing of vacuum drainage systems.

All new, repaired or replaced sanitary plumbing and sanitary drainage installations shall be tested by hydrostatic, air pressure or vacuum testing to demonstrate that they are watertight. Testing shall be conducted prior to the placement of the trench fill (backfill).

Any defects shall be either repaired or replaced with pipes and fittings of a suitable material, and the repaired or replaced section retested until it conforms with this section.

Sanitary fixtures shall be tested by subjecting them to normal use. After each test, the residual water seal in the trap of the fixture concerned or in any other trap connected to the same system shall, under normal operating conditions, retain a water seal of not less than 25 mm.

Where a water seal of not less than 25 mm cannot be retained under normal operating conditions, inspect the sanitary plumbing and drainage system to determine the cause and undertake modifications or repairs, or both, and retest the sanitary fixture until it conforms with this clause.

In some cases, it may be more cost-effective to renovate the existing drain using an approved trenchless rehabilitation technique. A renovated drain shall be tested and inspected after renovation.

Any renovation defects shall be either repaired or replaced with pipes and fittings of a suitable material and the repaired or replaced section retested and re-inspected until it conforms with this section.

NOTE 2 Where closed circuit television inspection of sanitary plumbing and drainage is required, it should be carried out in accordance with [Appendix D](#).

## 15.2 Hydrostatic test (water test)

Where hydrostatic testing is used as a means for testing sanitary plumbing and sanitary drainage installations, non-drinking water may be used.

The sanitary plumbing and sanitary drainage shall be filled with water —

- (a) for sanitary drainage, to a height of not less than 1 m above the soffit level at the highest point of the section being tested;
- (b) for sanitary plumbing, to the spill level of the highest fixture or to the flood level of the lowest sanitary fixture, whichever is higher; and
- (c) in either case, not exceeding 3 m at the lowest point of the test section.

The pressure shall be maintained without leakage for at least 15 min. The source of any leak shall then be ascertained and any defects repaired. The section under test shall then be retested.

NOTE Where the authority having jurisdiction or the network utility operator has a water management strategy that prohibits the use of water for specific purposes or has instituted water restrictions, hydrostatic testing of pipework may not be permitted, in which case an air or vacuum test should be undertaken to verify that the sanitary plumbing and drainage pipework is satisfactory.

## 15.3 Air pressure test

### 15.3.1 Sealing inlets and outlets

All sanitary plumbing and drainage inlets, outlets and access openings shall be capped and sealed. Air shall be introduced slowly into the section being tested.

### 15.3.2 Air pressure test procedure

The air test procedure shall be as follows:

- (a) Apply an initial test pressure of approximately 15 kPa to the section being tested.
- (b) When approximately 15 kPa has been reached, shut off the air pump and supply valve.
- (c) Allow the air pressure to stabilize for a minimum of 3 min while checking for leaks.
- (d) After the pressure has stabilized, commence the test to allow the pressure to fall to 10 kPa and then begin recording the time and drop in pressure over the minimum test duration specified in [Table 15.3.2](#).

Table 15.3.2 — Air pressure and vacuum air testing acceptance times for 3 kPa pressure change						
Pipe size  DN	Test length m					
	50	100	150	200	250	300
	Minimum test duration min					
100	2	2	2	2	3	3
150	3	3	3	6	6	6
225	4	5	8	10	13	15
300	6	9	14	18	23	29

### 15.3.3 Maximum pressure drop

The section of sanitary plumbing or sanitary drainage being tested shall not have a drop in pressure greater than 3 kPa over the minimum test duration specified in [Table 15.3.2](#).

## 15.4 Vacuum test

### 15.4.1 Sealing inlets and outlets

All sanitary plumbing and drainage inlets, outlets and access openings shall be capped and sealed.

### 15.4.2 Vacuum test procedure

The vacuum test procedure shall be as follows:

- (a) Apply an initial vacuum test pressure of approximately 15 kPa to the section being tested.
- (b) When approximately 15 kPa has been reached, shut off the vacuum pump and supply valve.
- (c) Allow the vacuum to stabilize for a minimum of 3 min while checking for leaks.

(d) After the pressure has stabilized, commence the test to allow the vacuum to fall to 10 kPa and then begin recording the time and drop in vacuum over the minimum test duration specified in [Table 15.3.2](#).

### 15.4.3 Maximum vacuum drop

The section of sanitary plumbing or sanitary drainage being tested shall not have a drop in vacuum greater than 3 kPa over the minimum test duration specified in [Table 15.3.2](#).

## 16 Vacuum drainage design and installation

### 16.1 Scope of section

This section specifies the design and installation requirements and the components of a vacuum drainage system within a property for the removal of wastewater from the collection points to the discharge point connecting to the sanitary drainage system.

NOTE 1 This document specifies the installation requirements for new systems and alterations and additions to existing systems. Care should be taken that any alteration or addition may have an impact on plant requirements and this should be taken into consideration prior to any works.

NOTE 2 See [Clause 16.4.2\(f\)](#) for temperature limitations in vacuum drainage systems.

### 16.2 Materials and products for vacuum drainage systems

Vacuum pipelines shall be constructed of one of the following:

- (a) PVC-U pressure pipe and fittings with a minimum pressure rating of PN 10.

NOTE 1 Refer to the following Standards for more information:

- (a) AS 1477 — PVC pipes and fittings for pressure applications.
- (b) ASTM D1785 — poly (vinyl chloride) (PVC) plastic pipe, Schedule 40/80.
- (c) CSA B181.2 — PVC drain, waste, and vent pipe and pipe fittings.

- (b) PVC-U DWV pipe and fittings of diameters equal to or greater than DN 100 shall have a pipe stiffness classification of not less than SN8.

NOTE 2 Refer to AS/NZS 1260 for information on PVC-U pipes and fittings for drain, waste and vent applications.

- (c) Polyethylene pipes and fittings with a maximum standard dimension ratio (SDR) 17.

NOTE 3 Refer to the following Standards for more information:

- (a) AS/NZS 4130 — polyethylene (PE) pipes for pressure applications.
- (b) AS/NZS 4129 — fittings for polyethylene (PE) pipes for pressure applications.

- (d) Stainless steel (SS) pipes and push fit ring seal fittings.

NOTE 4 Refer to AS 3495 for information on stainless-steel non-pressure pipes and fittings.

NOTE 5 Refer to ASTM A269/A269M for information on seamless and welded austenitic stainless-steel tubing.

### 16.3 System design

#### 16.3.1 General

A vacuum drainage system is designed to collect and transport soil and wastewater from vacuum soil fixtures and waste fixtures.

The following components comprise a typical vacuum drainage system:

- (a) Vacuum station — provides and maintains the vacuum pressure within the piping network.
- (b) Vacuum piping network.
- (c) Vacuum soil fixtures.
- (d) Vacuum automatic interface unit for wastewater fixtures.

NOTE See [Figures 16.3.1\(A\)](#) and [16.3.1\(B\)](#) for examples of vacuum drainage systems.

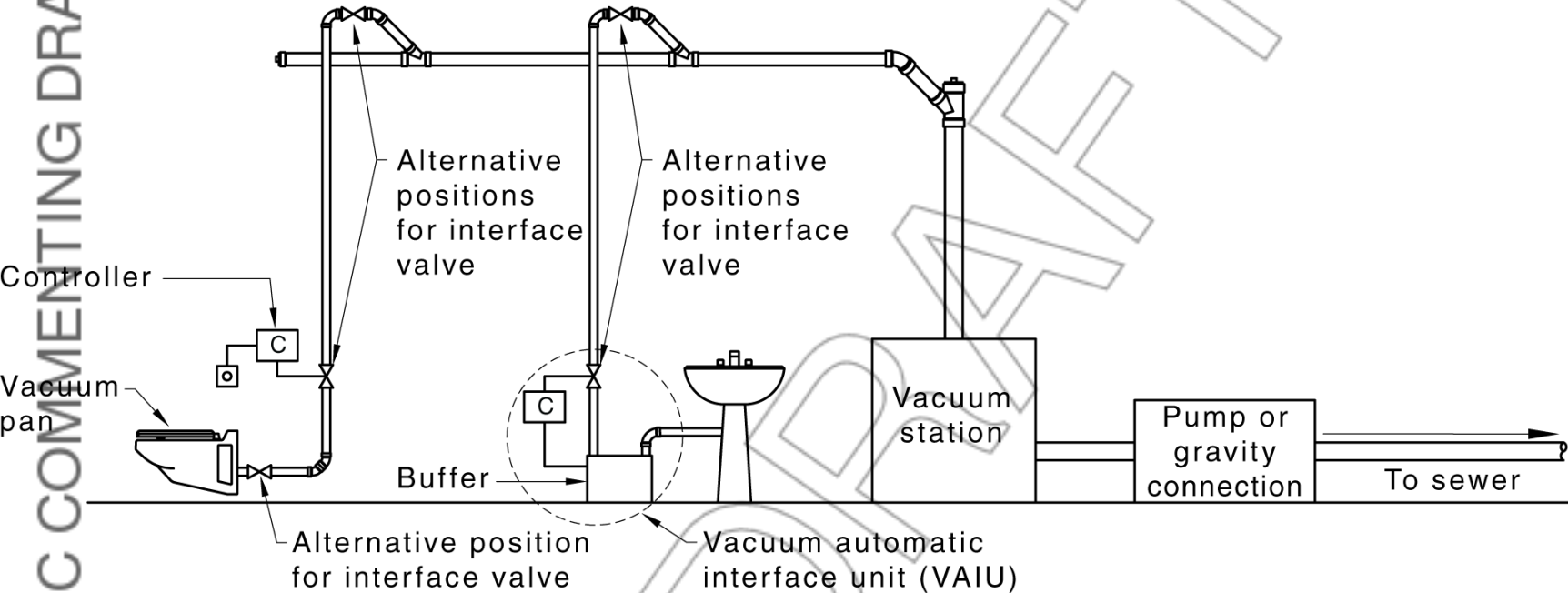


Figure 16.3.1(A) — Typical single level vacuum drainage system

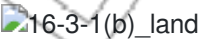


Figure 16.3.1(B) — Typical multi-level vacuum drainage system

#### 16.3.2 Design requirements



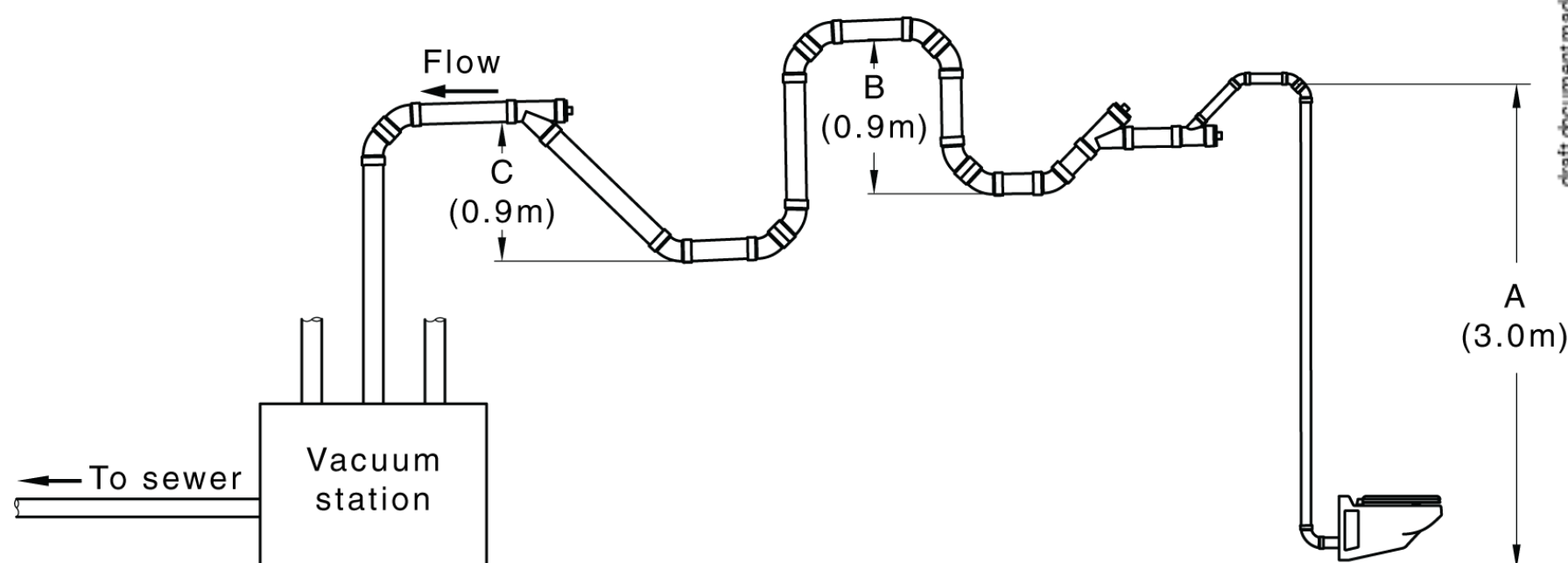
A vacuum drainage system shall conform to the following:

- (a) The operating static pressure shall be between  $-35$  kPa and  $-70$  kPa throughout the system, except for vacuum generator over-run time periods (usually less than 2 min).
  - (b) The accumulative vacuum lift shall not exceed 6.0 m.
- NOTE See [Figure 16.3.2](#).
- (c) The pipework shall not include  $90^\circ$  junctions.
  - (d) At changes of direction in the pipework, the bend radius shall be at least twice the pipe diameter.
  - (e) The pipework shall have not more than one  $90^\circ$  change of direction between inspection openings.
  - (f) The maximum temperature of wastewater conveyed shall not exceed  $60^\circ\text{C}$  at any point.

NOTE See [Figure 16.3.2](#).

## Example of accumulative lift

A (3.0 m) + B (0.9 m) + C (0.9 m) = total 4.8 m accumulative lift



**Figure 16.3.2 — Maximum accumulative lift example**

### 16.3.3 Vacuum recovery

NOTE The minimum vacuum pressure should be maintained during operational conditions at every vacuum interface valve except for a maximum of 10 s following interface valve actuation.

### 16.3.4 Vacuum pipework

The pipework shall transport the air and wastewater, including solids, from vacuum automatic interface units and vacuum soil fixtures to the vacuum station.

The pipework shall be airtight and watertight when tested.

NOTE See [Clause 16.15](#) for testing of vacuum drainage systems.

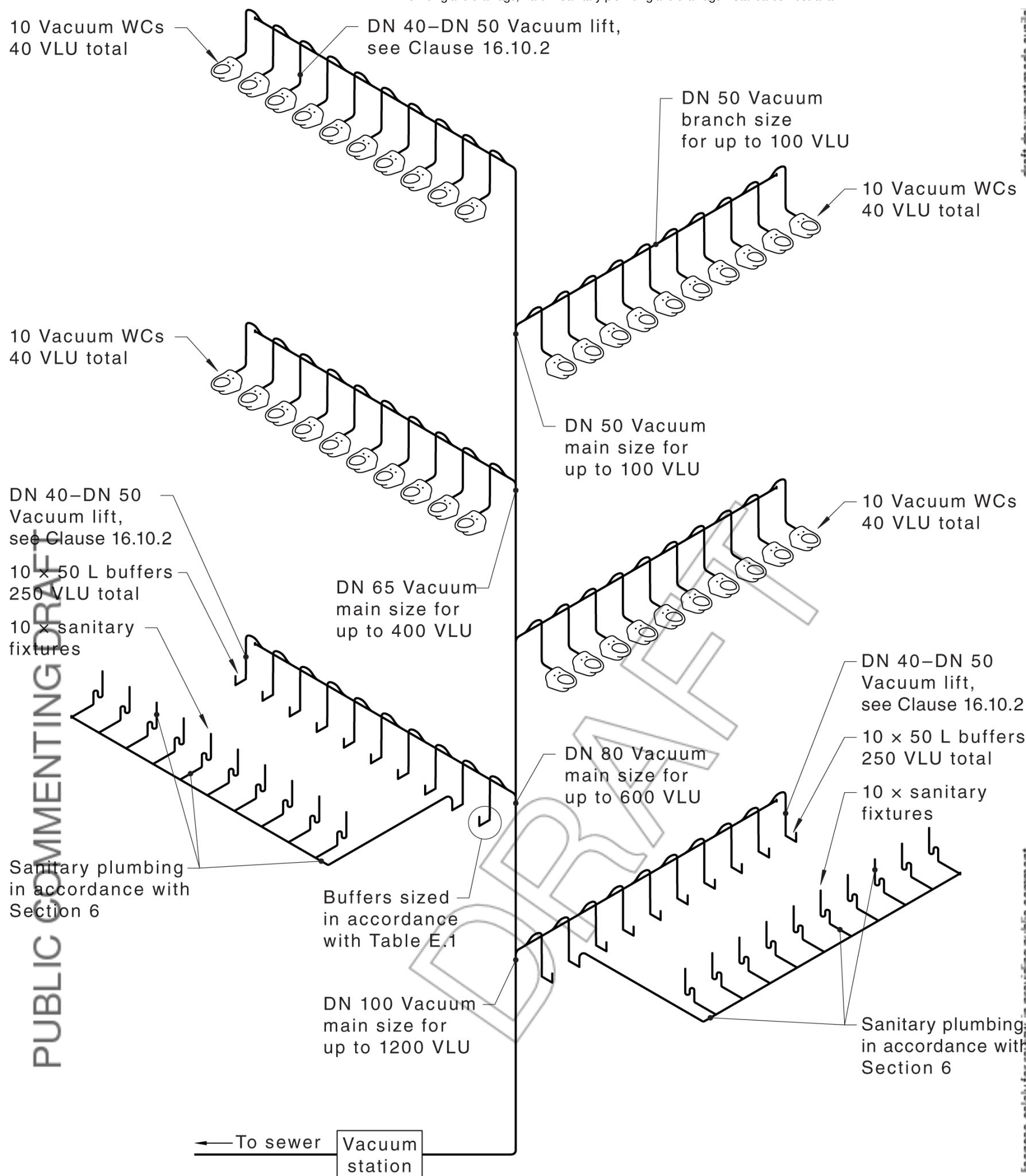
### 16.3.5 Vacuum pipe sizing

Vacuum pipelines shall be sized in accordance with [Appendix E](#) to accommodate the maximum continuous flow. Discharge pipes draining to buffers shall be sized in accordance with [Clause 8.3](#). Soil vacuum fixtures shall be directly connected to the vacuum pipeline.

**NOTE 1** | Soil vacuum fixtures connected to a vacuum system should conform to SA TS 100.

NOTE 2 See [Figure 16.3.5](#) for sizing examples.





**Figure 16.3.5 — Example of sizing**

### 16.3.6 Location of vacuum pipes

Any vacuum pipe located under or inside a building shall only serve fixtures within that building.

**NOTE** Vacuum pipework in the ground should be located externally to the building, wherever practical.

### 16.3.7 Eccentric tapered fittings

Eccentric tapered fittings shall be in common alignment with the soffit of the pipe to which it is connected except where connected to a buffer.

### 16.3.8 Change in pipe size

Pipes shall not diminish in size in the direction of flow.

Lift pipes shall not change size from the Vacuum Automatic Interface Unit (VAIU) or vacuum soil fixture before they connect to the main vacuum pipe or a branch vacuum pipe.

### 16.3.9 Grades of vacuum pipes

Vacuum pipes shall be not less than 1 % grade in the direction of flow, see [Figure 16.3.9](#).



**Figure 16.3.9 — Grade in direction of flow**

## 16.4 Inspection openings

#### 16.4.1 Location and installation requirements

Pipework in the vacuum system shall be provided with accessible inspection openings (IO) in the following locations:

- (a) Upstream end of all graded pipework.
- (b) Top of all vertical droppers.
- (c) Top (downstream) end of all open lifts.
- (d) At maximum intervals of 30 m in graded pipe.
- (e) Upstream end of any graded pipe receiving waste from a dropper.
- (f) Upstream end of a closed reforming pocket.
- (g) Wherever necessary for testing purposes, see [Clause 10.5.2](#).

NOTE See [Figure 16.4.1](#) for typical locations of IO.

A removable interface valve which serves a soil fixture or a buffer may be used as an inspection opening, provided it is located within 500 mm of a junction connection to a vacuum branch or main pipeline.

Dimensions in millimetre

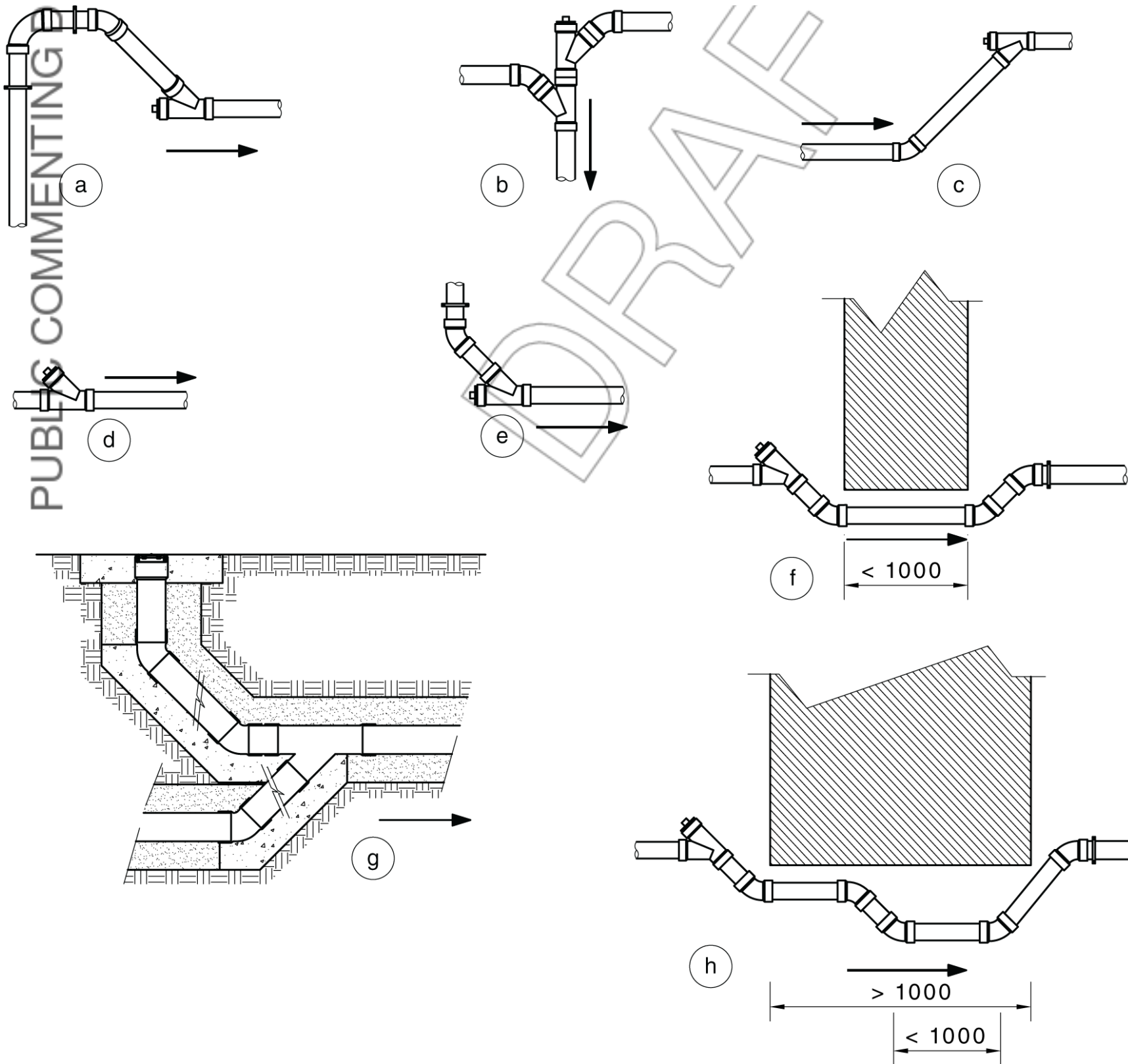


Figure 16.4.1 — Typical locations of inspection openings

16.4.2 Size

The minimum size of the inspection opening in vacuum drainage pipelines shall be equal to the nominal size of the pipe up to DN 80. Pipe sizes greater than DN 80 shall have a minimum DN 100 inspection opening.

16.4.3 Access to inspection openings

The following applies to inspection openings access:

- (a) Inspection openings, where raised to ground level or floor surface level, shall be provided with airtight removable caps and protected by a cover and surrounded in such a manner that no traffic or structural load can be transmitted to the vacuum drainage pipe.
- (b) When located in a concealed location, inspection openings shall be provided with a removable access panel.

16.4.4 Sealing

Inspection openings shall be sealed with plugs or caps fitted with a gasket or sealing ring.

Unused sockets shall be sealed with caps.

When a plug or cap with a rubber ring or gasket is removed, a new rubber ring or gasket shall be fitted.

16.5 Connections to vacuum system

Connections to a vacuum system shall be as follows:

- (a) Flexible connections shall be installed when connecting from vacuum soil fixtures.
- (b) Flexible connections or sealed threaded joints in the relevant material shall be used when connecting discharge pipes or drains to buffers.

NOTE 1 See Figure 16.5 for typical connection of gravity drainage to vacuum drainage buffer.

NOTE 2 Refer to AS/NZS 4327 for metal-banded flexible couplings for low-pressure applications.

- (c) Flanged connections in accordance with Clause 2.6.1 when connecting the vacuum station to the downstream drain or sewer.

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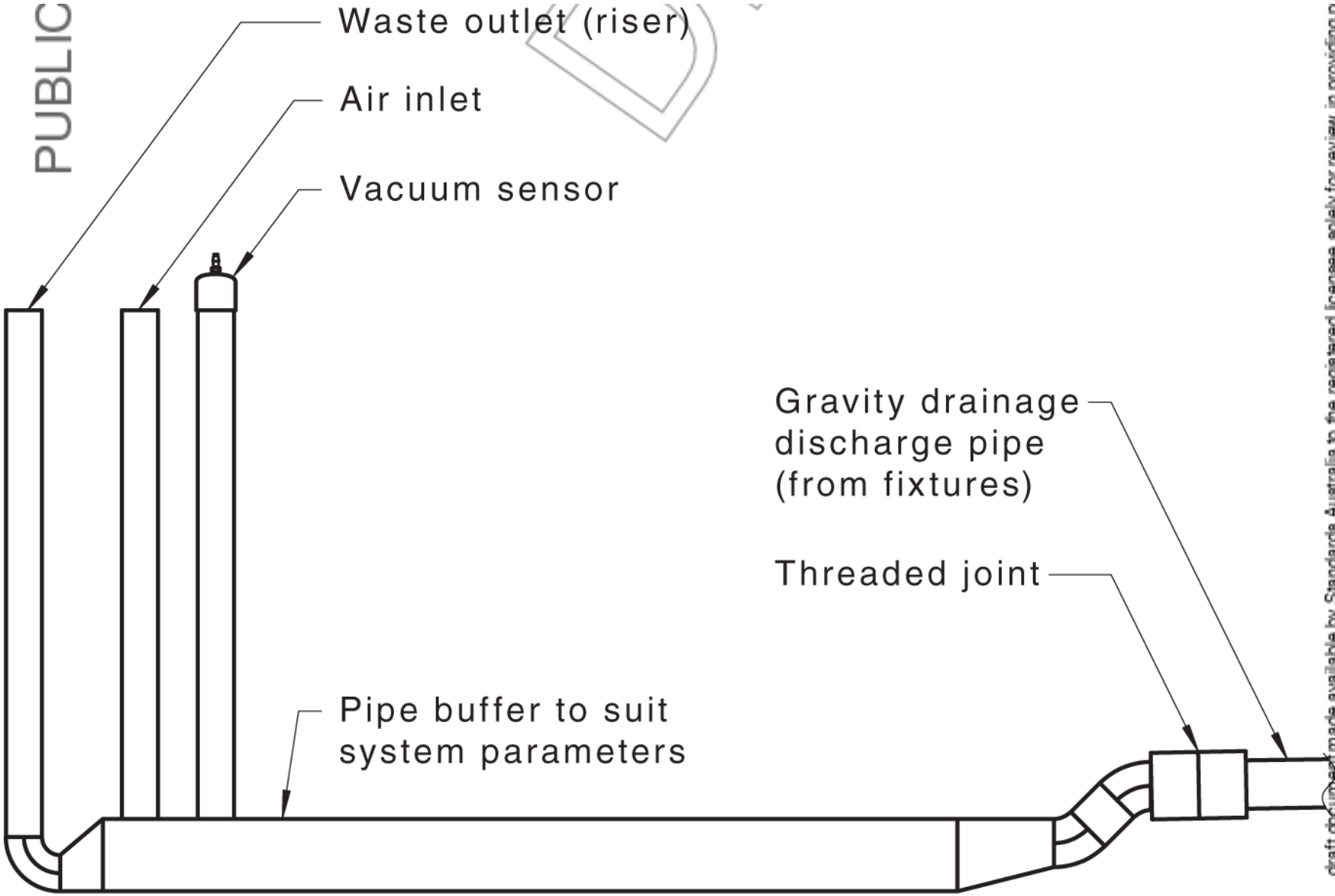


Figure 16.5 — Typical connection of gravity drainage to vacuum drainage buffer

## 16.6 Connections within a vacuum system

Flexible connections shall be provided in the following locations:

- (a) Inlet and outlet of a vacuum buffer or vacuum soil fixture, interface valve unit.
- (b) Connection to a vacuum soil fixture.
- (c) Connection of the vacuum main pipeline to a vacuum station.

## 16.7 Vacuum automatic interface unit

Vacuum automatic interface units (VAIU), with the exception of the buffer, shall be —

- (a) accessible; and
- (b) have access to ambient air.

## 16.8 Buffers

### 16.8.1 General

Buffers shall be either box type, fabricated from stainless steel, or pipe type, fabricated from piping materials listed in accordance with [Clause 16.3.1](#). Buffers shall incorporate the following requirements within their design:

- (a) Sensor pipe.
- (b) Air inlet.
- (c) Gravity drainage inlet.
- (d) Vacuum waste outlet.

NOTE See [Figure 16.8.1](#) for examples of buffers.

16-8-1\_land

Figure 16.8.1 — Examples of buffers

### 16.8.2 Sizing

Buffers shall be sized based on the maximum potential waste inflow from all fixtures that drain to the buffer in accordance with [Table E.1](#).

## 16.9 Vacuum soil fixtures

### 16.9.1 General

Vacuum soil fixtures shall —

- (a) have access to ambient air; and
- (b) be provided with access to ambient air via the secondary safety air inlet port.

Vacuum interface valves, vacuum soil fixture rinse valves, vacuum controller and actuator shall be accessible.



## 16.9.2 Vacuum soil fixture backflow prevention

Backflow prevention for vacuum soil fixture rinse valves shall conform to AS/NZS 3500.1:2021 Section 4.

## 16.10 Vacuum lift pipe

### 16.10.1 Vacuum soil fixture lift pipe

Each vacuum soil fixture shall be provided with a vacuum lift pipe between DN 40 and DN 50 in diameter, connected to a vacuum main or branch pipe, see [Figure 16.10.1](#).

NOTE 1 DN 40 is preferred.

NOTE 2 If a branch line has fixture connections from below and above it, or if there are fixture connections on the same branch line following a second stage lift, the lifts from below or those preceding the second stage lift should include either a vacuum check valve or vacuum interface valve at the highest point of the lift upstream of the slope junction connection, see [Figure 16.3.1\(B\)](#).

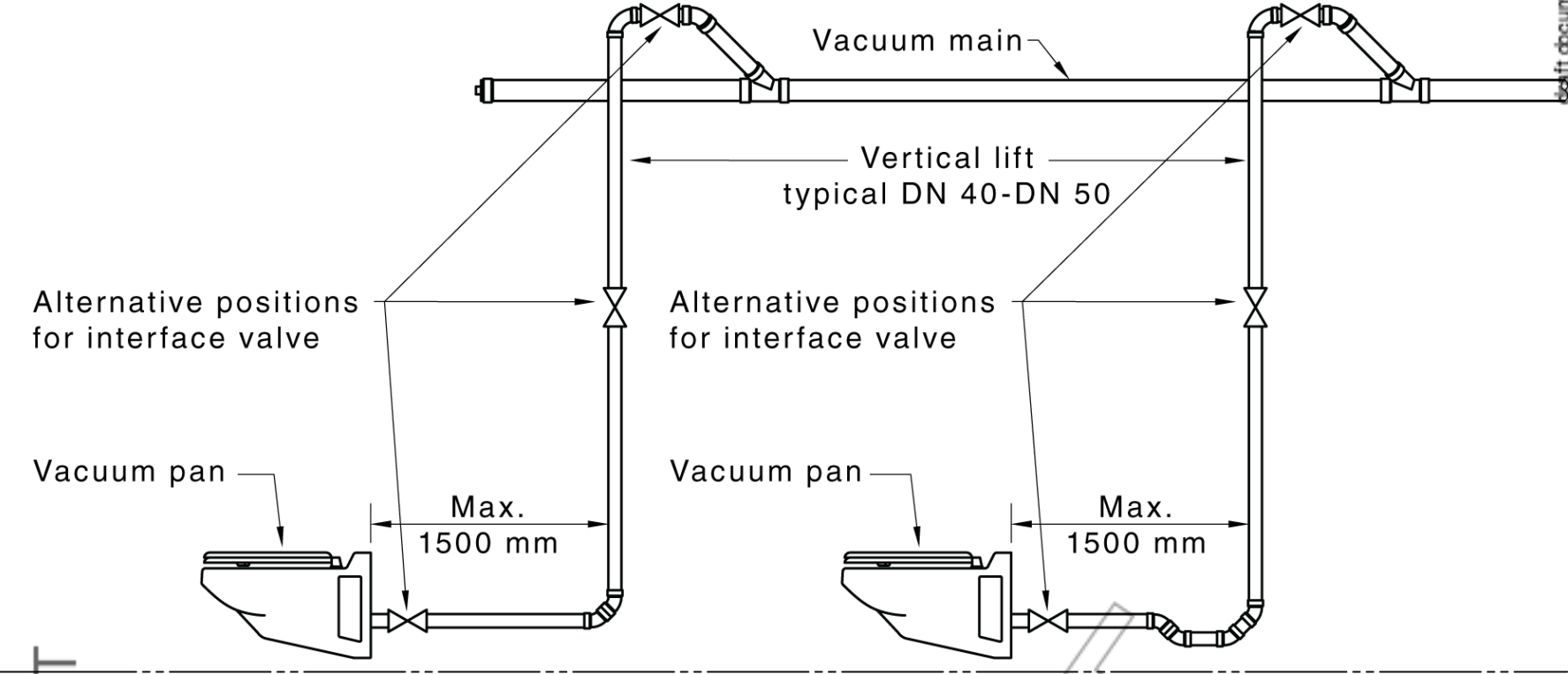


Figure 16.10.1 — Alternative lift pipe for vacuum soil fixture

### 16.10.2 Vacuum lift pipe connected to vacuum automatic interface unit

A vacuum lift pipe connected to VAIU shall have the following:

- (a) A maximum horizontal distance from the VAIU of 1 500 mm.
- (b) A maximum of one horizontal offset of up to 300 mm in any vacuum lift pipe, which shall be achieved using two 45° bends.
- (c) Offsets greater than 300 mm discharging horizontally and grading into a collection pocket before resuming vacuum lift.
- (d) Diameters between DN 40 and DN 50.

NOTE 1 DN 40 is preferred.

NOTE 2 See [Figure 16.10.2](#) for typical arrangements for vacuum automatic interface unit lift pipe.

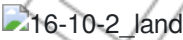


Figure 16.10.2 — Typical arrangements for vacuum automatic interface unit lift pipe

### 16.10.3 Vacuum lift pipe connection to horizontal vacuum pipe

Vacuum lift pipes connecting to a horizontal vacuum branch or main pipeline shall —

- (a) connect to the soffit of a horizontal vacuum pipe with a 45° junction in the direction of flow;
- (b) not be connected to a horizontal vacuum pipe in a location that holds water;
- (c) rise a minimum of 80 mm above soffit of the horizontal vacuum pipe it is connecting to; and
- (d) not less than 150 mm between vacuum lift pipe connections on a common horizontal vacuum pipe.

NOTE Connecting 45° junctions may be rolled to either side, a maximum of 45° from the vertical plane, see View X-X of [Figure 16.10.3](#).

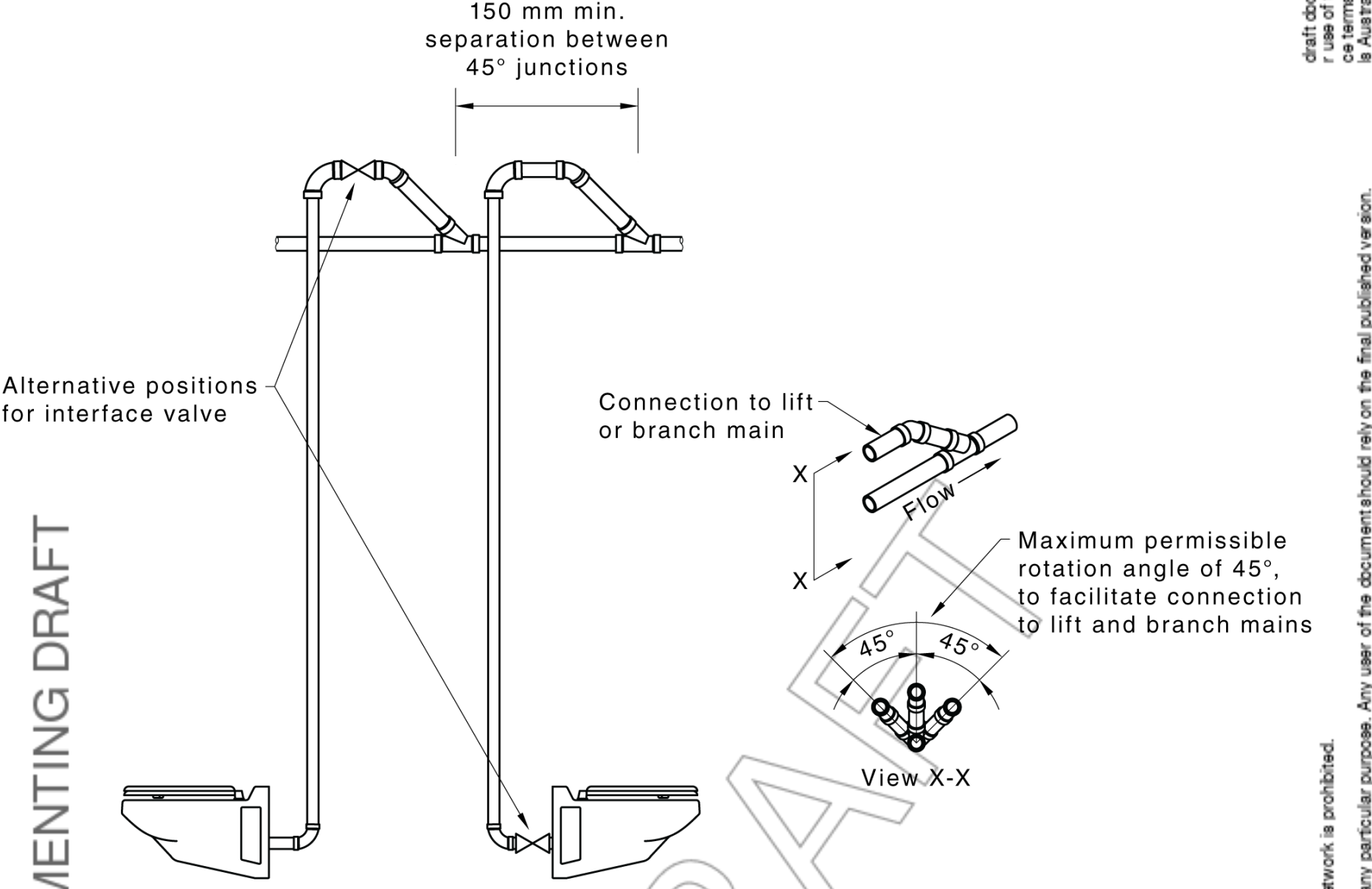


Figure 16.10.3 — Example of vacuum lift pipes connecting to horizontal vacuum pipes

16.10.4 Two-stage lift pipe

When a branch line incorporates a second stage lift, the first stage lift shall be in accordance with [Clauses 16.10.1](#), [16.10.2](#) and [16.10.3](#). The second stage lift pipe shall be —

- (a) DN 40 or DN 50;
- (b) vertical;
- (c) a maximum of 2 m; and
- (d) installed with a vacuum reforming pocket when greater than 900 mm as shown in [Figure 16.10.4\(A\)](#).

The horizontal branch between the first stage lift and a second stage lift shall —

- (i) include connections with a maximum vacuum loading unit value not exceeding 20 as specified in [Table E.2](#); and
- (ii) not include a connection further than 20 m from the base of the second stage lift.

NOTE A second stage lift of less than 900 mm in height does not require a vacuum reforming pocket, see [Figure 16.10.4\(B\)](#).

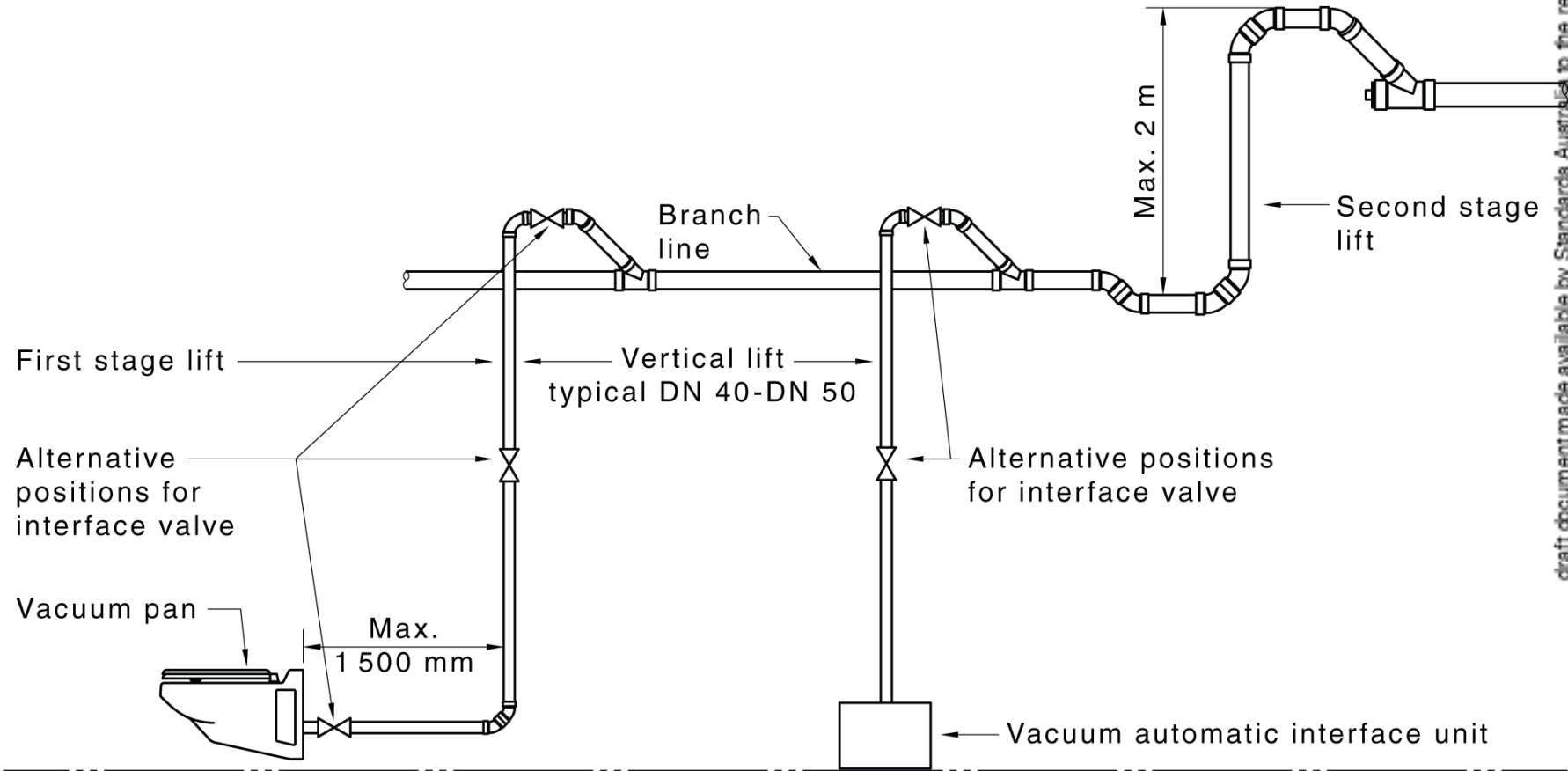


Figure 16.10.4(A) — Second stage lift above 900 mm

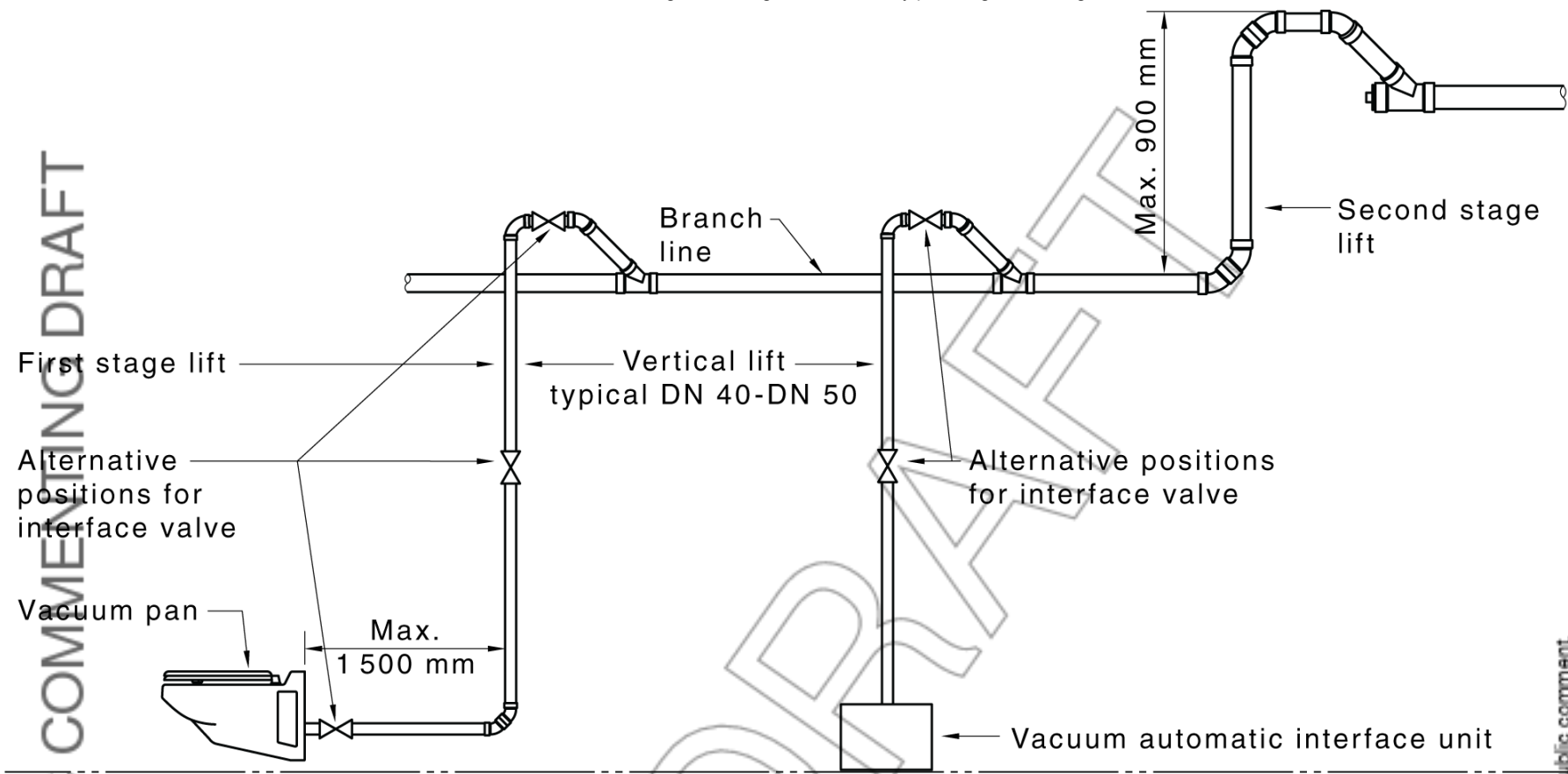


Figure 16.10.4(B) — Second stage lift below 900 mm

16.11 Vacuum reforming pocket

16.11.1 General

Reforming pockets shall be installed at low points within the graded vacuum pipework.

Reforming pockets, either open type or closed type, shall be located within vacuum pipelines —

- (a) at the base of every vertical lift; and
- (b) at maximum intervals in horizontal main and branch pipelines in accordance with Table 16.11.1.

NOTE See Figures 16.11.2 (open type) and 16.11.3 (closed type) for typical vacuum reforming pockets.

Table 16.11.1 — Maximum distance, m, between reforming pockets in horizontal piping					
Type of vacuum pocket	Nominal size of vacuum pipeline				
	DN				
	50	80	100	150	200
Open	55	55	60	60	80
Closed	20	25	30	30	30

16.11.2 Open type vacuum reforming pocket

Open type vacuum reforming pockets shall —

- (a) be constructed of 45° bend and 45° junction;
- (b) have a maximum height of 900 mm;
- (c) be supported at each end of the vacuum reforming pocket; and
- (d) include an inspection opening on the downstream end (top) of the vacuum reforming pocket.

NOTE See Figure 16.11.2 for typical open type vacuum reforming pocket.

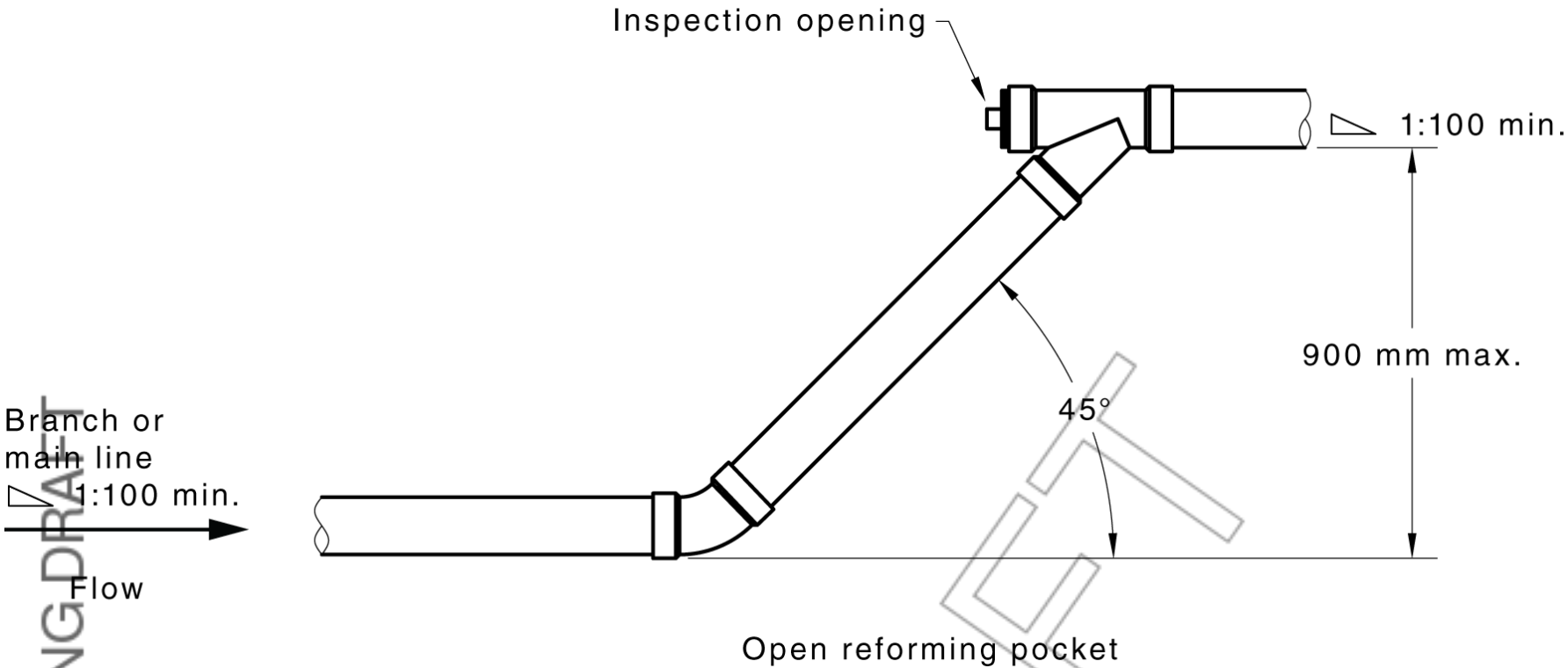


Figure 16.11.2 — Typical open type vacuum reforming pocket



### 16.11.3 Closed type vacuum reforming pocket

Closed type vacuum reforming pockets shall —

- (a) be constructed of 45° bends and 45° junction;
- (b) be a minimum of 600 mm in length;
- (c) have a minimum waste water storage depth of 60 mm;
- (d) include an inspection opening on the upstream end of the vacuum reforming pocket; and
- (e) be supported at each end of the vacuum reforming pocket.

NOTE See Figure 16.11.3 for typical closed type vacuum reforming pocket.

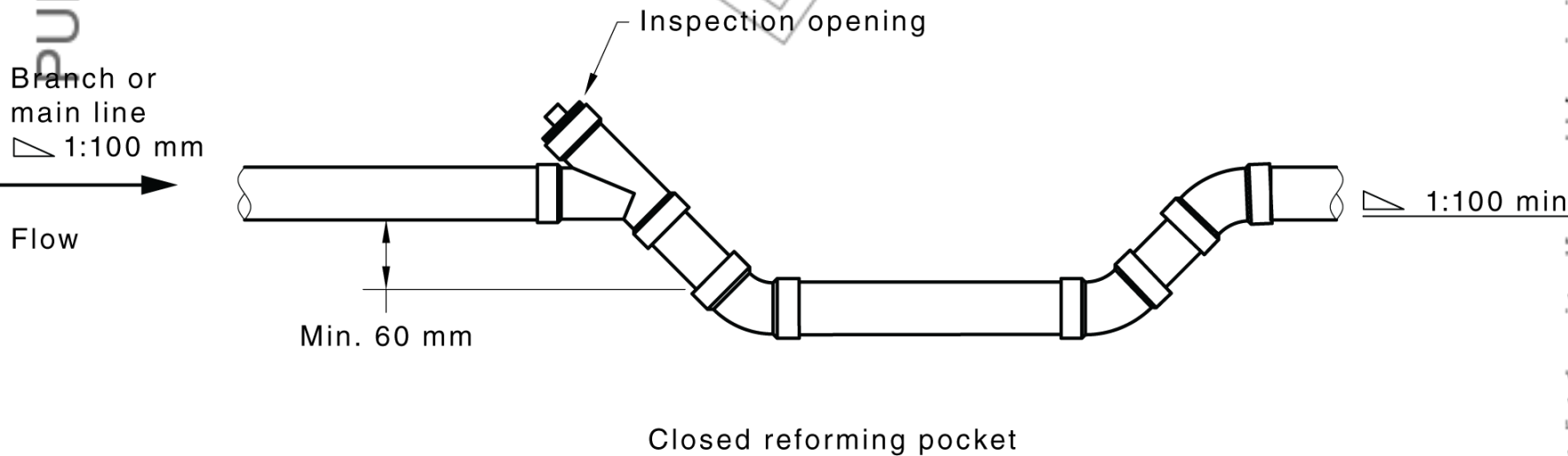


Figure 16.11.3 — Typical closed type vacuum reforming pocket

### 16.12 Vacuum branch connections

Vacuum branch connections shall —

- (a) connect from above to the soffit of a horizontal vacuum main pipe with a 45° junction in the direction of flow;
- (b) not be located within 500 mm of a change of direction (bend) in the main;
- (c) connect to the vacuum main dropper with a full bore isolation valve at each floor level for multi-level systems; and
- (d) be braced bilaterally on each side of the 45° junction within 500 mm, see Figure 16.13.2.

NOTE See Figure 16.12 for typical vacuum branch connections.

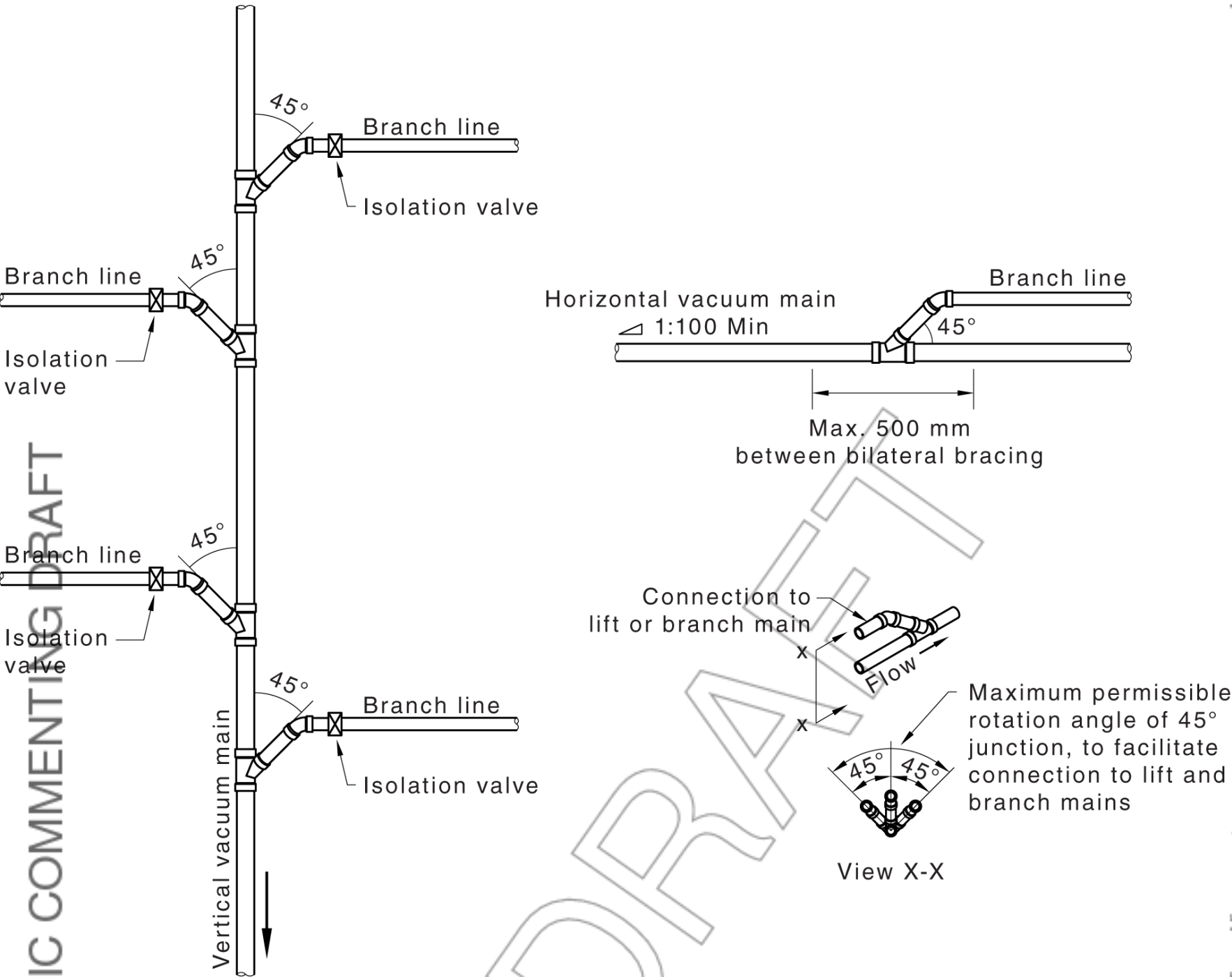


Figure 16.12 — Typical vacuum branch connections to a vertical or horizontal vacuum main pipeline

### 16.13 Vacuum pipes installed above ground



### 16.13.1 General

For above-ground installation, vacuum drainage pipes shall be installed in accordance with [Clauses 3.6, 10.2, 10.3, 10.4, 10.7, 10.8, 10.9, 10.10 and 10.13](#).

### 16.13.2 Bracketing and supports

In addition to [Clause 16.13.1](#), vacuum drainage pipes shall have bilateral bracing within 500 mm each side of change of direction or branch connection, see [Figure 16.13.2](#).

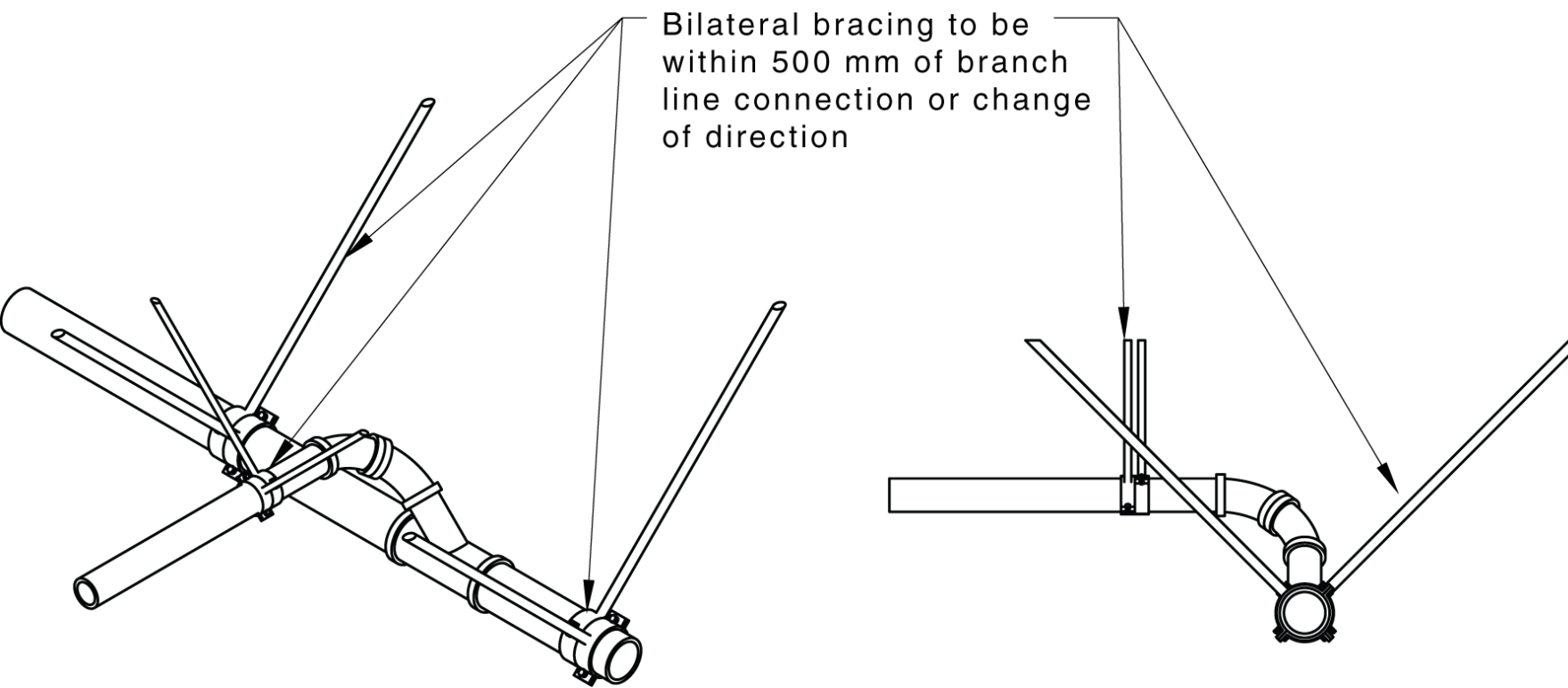


Figure 16.13.2 — Bilateral bracing details

### 16.13.3 Brackets and supports

Brackets and supports shall be installed in accordance with [Clause 10.2.1](#).

### 16.13.4 Securing of pipes and fittings

Any pipe or fitting that may be subjected to strain or torsion shall be positively fastened against twisting or any other movement.

## 16.14 Vacuum pipes installed below ground

### 16.14.1 General

For below-ground installation, vacuum drainage pipes shall be installed in accordance with [Clauses 3.4.4, 3.5, 3.6, 3.7, 3.8.1 and 3.8.2](#).

### 16.14.2 Anchor blocks

Anchor blocks shall be installed in accordance with [Clause 3.4.4](#) at —

- (a) all lifts in main line exceeding 500 mm;
- (b) changes of directions equal to or greater than 90°; and
- (c) grades in excess of 20 %, see [Figure 3.4.4](#).

## 16.15 Vacuum test for vacuum drainage systems

### 16.15.1 Sealing inlets

All vacuum sanitary plumbing and drainage inlets, outlets and access openings shall be capped and sealed.

### 16.15.2 Vacuum test pressure

An initial vacuum test pressure of  $-55 \pm 5$  kPa shall be applied to the section being tested. When  $-55 \pm 5$  kPa has been reached, the vacuum pump and supply valve shall be shut off. The vacuum shall be allowed to stabilize for a minimum of 3 min while checking for leaks.

After the pressure has stabilized, the test shall be commenced by allowing the vacuum to fall to  $-50$  kPa and then begin recording the time and drop in vacuum over the minimum test duration specified in [Table 16.15.3](#).

### 16.15.3 Maximum vacuum drop

The section of sanitary plumbing or sanitary drainage being tested shall not have a drop in vacuum greater than  $-1$  kPa over the minimum test duration specified in [Table 16.15.3](#).

Table 16.15.3 — Vacuum drainage system vacuum testing — Acceptance times for 1 kPa pressure change						
Pipe size DN	Test length m					
	50	100	150	200	250	300
	Minimum test duration min					
40	2	2	2	2	3	3
50	2	2	2	2	3	3
65	2	2	2	2	3	3
80	2	2	2	2	3	3
100	2	2	2	2	3	3
150	3	3	3	6	6	6
225	4	5	8	10	13	15
300	6	9	14	18	23	29

## Appendix A

(informative)

# Demonstrating products and materials are fit for purpose

## A.1 General

The products and materials used should be selected to ensure that they are fit for their intended purpose (see [Clause 2.2](#)) taking into account the following factors:

- (a) the type of usage likely to occur;
- (b) the nature and temperature of the water to be conveyed and the risk of corrosion, degradation and leaching;
- (c) the nature of the environment, the ground and the possibility of chemical attack therefrom;
- (d) the physical and chemical characteristics of the materials and products;
- (e) compatibility of materials and products;
- (f) the pressure rating of pipes and fittings; and
- (g) accessibility for inspection and maintenance.

Information on some of the items listed above may be obtainable from the manufacturer or supplier of the product or material.

## A.2 Australia

The WaterMark Certification Scheme is a mandatory certification scheme for plumbing and drainage products to ensure they are fit for purpose and appropriately authorized for use in plumbing and drainage installations.

Volume Three of the National Construction Code, the Plumbing Code of Australia (PCA), requires that any product intended for use in contact with drinking water must conform to the relevant requirements of AS/NZS 4020. The PCA also requires certain plumbing and drainage products to be certified and authorized for use in a plumbing or drainage system. These products are certified through the WaterMark Certification Scheme and listed on the WaterMark Product Database.

A comprehensive listing of products predetermined as requiring WaterMark is contained on the WaterMark Schedule of Products which mandates the specification to which the products must be certified. Products listed on the WaterMark Schedule of Products are deemed by the PCA to be fit for its intended purpose if it has a WaterMark Licence.

The WaterMark Schedule of Excluded Products details products that have been predetermined as not requiring WaterMark certification, however, the PCA requires evidence of suitability.

The Australian Building Codes Board update these documents on an irregular basis. The updates generally include the addition of new products that have undergone a risk assessment and that are determined to require WaterMark certification, as well as updates to specifications that are approved for use, revised or suspended.

Products not included on the WaterMark Schedule of Products or the WaterMark Schedule of Excluded Products, which are proposed to be used in a plumbing or drainage system, require an assessment to be undertaken by a WaterMark Conformity Assessment Body to determine if WaterMark certification is necessary.

The WaterMark Product Database lists products that have been certified and marked in accordance with the requirements of the WaterMark Certification Scheme. These products are recognized by authorities as being authorized for use in a plumbing or drainage system.

NOTE The Plumbing Code of Australia, WaterMark Schedule of Products, Schedule of Excluded Products, and Database can be accessed at <https://www.ABCB.gov.au>

## A.3 New Zealand

Plumbing and drainage systems must be constructed using materials and products fit for their intended purpose to achieve the relevant requirements of the New Zealand Building Code (NZBC).

For the purposes of conformance to this document, a material or product for plumbing or drainage systems may be deemed fit for purpose if it —

- (a) has been manufactured in accordance with a Standard cited within a current NZBC Acceptable Solution or Verification Method;
- (b) has current certification in accordance with the New Zealand CodeMark Certification Scheme;

- (c) has been certified and marked in accordance with the requirements of the Australian WaterMark Certification Scheme and is listed on the [WaterMark Product Database](#); or
- (d) has been accepted by the approving authority as meeting the performance criteria of the NZBC.

Any product that is intended for use in contact with drinking water must conform to the relevant requirements of AS/NZS 4020. A test report provided by a certification body or an accredited testing laboratory must be provided to demonstrate conformance.

All products must be suitable for use in the location they are used.

An approving authority may prohibit the use of particular materials where local conditions are likely to cause the materials to corrode or otherwise deteriorate.

## Appendix B

(normative)

# Maximum length of fixture discharge pipe without venting

Table B.1 — Maximum length — Graded discharge pipes, common discharge pipes or branch drains, m							
Fixture	Floor waste gully <sup>a</sup>	Disconnecter gully <sup>b</sup>	Vented drain <sup>c</sup>	Reduced velocity aerated stack system <sup>d</sup>	Fully vented (modified) <sup>e</sup>	Single stack <sup>f</sup>	Single stack (modified) <sup>g</sup>
AUTOPSY TABLE — shall discharge through a flushing floor waste gully							
Untrapped DN 50 waste to flushing floor waste gully	1.2	NA	NA	NA	NA	NA	NA
Untrapped DN 50 waste to minimum DN 65 flushing floor waste gully	NA	NA	10.0	10.0	2.5	NA	NA
BAIN-MARIE and WATER BOILER							
Untrapped DN 40 waste	1.2	NA	NA	NA	NA	NA	NA
DN 40 Trap and waste	2.5	6.0	NA	NA	NA	NA	NA
DN 40 trap and DN 65 waste	NA	NA	10.0	10.0	2.5	NA	NA
BASIN							
DN 40 trap and waste	2.5	3.5	NA	NA	2.5	2.5	2.5
DN 32 outlet DN 40 trap and waste	2.5	3.5	NA	NA	NA	2.5	2.5
DN 32 trap and DN 40 waste (NZ only)	NA	3.5	NA	NA	NA	2.5	2.5
DN 40 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	2.5	2.5
DN 32 outlet DN 40 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	2.5	2.5
BATH							
Untrapped DN 40 waste	1.2	NA	NA	NA	NA	NA	NA
DN 40/50 trap and waste	2.5	6.0	NA	NA	2.5	2.5	2.5
			10.0	10.0			
DN 40/50 trap and DN 65 waste	NA	10.0			2.5	2.5	2.5
BEDPAN and WASHER/STERILIZER							
DN 80 trap and waste	NA	NA	10.0	10.0	2.5	NA	NA
DN 100 trap and waste	NA	NA	10.0	10.0	6.0	NA	NA
BIDETTE/BIDET							
Untrapped DN 40 waste	1.2	NA	NA	NA	NA	NA	NA
DN 40 trap and waste	2.5	3.5	NA	NA	2.5	2.5	2.5
DN 32 outlet DN 40 trap and waste	2.5	3.5	NA	NA	2.5	2.5	2.5
DN 32 trap and DN 40 waste (NZ only)	NA	3.5	NA	NA	2.5	2.5	2.5
DN 40 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	2.5	2.5
DN 32 outlet DN 40 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	2.5	2.5
DENTAL UNITS							
Cuspidors DN 25 or DN 40 untrapped waste							
To sealed trap not smaller than DN 40	NA	6.0	NA	NA	NA	NA	NA
Evacuators (trapped tundish)	2.5	NA	NA	NA	NA	NA	NA
DN 40 trap and waste	1.2	6.0	NA	10.0	2.5	2.5	2.5
DN 25, DN 32 and DN 40 trap and waste (NZ only)	2.5	3.5	NA	NA	NA	NA	NA
DN 40 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA



4/11/2021 Plumbing and drainage, Part 2: Sanitary plumbing and drainage - Standards Australia								
DRAINING FOUNTAINS and BUBBLERS	DN 40 trap and waste	2.5	6.0	NA	NA	2.5	2.5	2.5
	DN 25 and DN 32 trap and waste (NZ only)	2.5	3.5	NA	NA	NA	NA	NA
	DN 40 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	2.5	2.5
DISPOSAL UNITS Domestic food waste	DN 40 trap and waste (NZ only)	NA	6.0	NA	NA	2.5	NA	NA
	DN 50 trap and waste (Australia only)	NA	6.0	NA	NA	2.5	NA	NA
	DN 50 trap and waste (NZ only)	NA	10.0	NA	NA	2.5	NA	NA
	DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
Commercial food waste	DN 50 trap and waste	NA	6.0	NA	NA	2.5	NA	NA
	DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
Sanitary napkin	DN 50 trap and DN 65 waste	NA	NA	10.0	10.0	2.5	NA	NA
DISCONNECTOR GULLY TRAPS	DN 100 outlet	NA	NA	10.0	10.0	6.0	NA	NA
FLOOR WASTE GULLY TRAPS	DN 50 outlet	NA	6.0	NA	NA	2.5	2.5	2.5
	DN 65/80 outlet	NA	10.0	10.0	10.0	2.5	2.5	2.5
	DN 100 outlet	NA	10.0	10.0	10.0	6.0	6.0	6.0
SHOWERS 80/100 mm grates	Untrapped DN 40 waste	1.2	NA	NA	NA	NA	NA	NA
	DN 40/50 trap and waste	2.5	6.0	NA	NA	2.5	2.5	2.5
	DN 40/50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	2.5	2.5
	2-3 showers to graded channel with DN 50 trap and waste	NA	6.0	NA	NA	2.5	NA	NA
	4-6 showers to graded channel with DN 65 trap and waste	NA	10.0	10.0	10.0	2.5	NA	NA
SINKS Kitchen	Untrapped DN 40 waste	NA	NA	NA	NA	NA	NA	NA
	DN 40 trap and waste (NZ only)	NA	6.0	NA	NA	2.5	2.5	2.5
	DN 50 trap and waste	NA	6.0	NA	NA	2.5	2.5	2.5
	DN 40 trap and DN 65 waste (NZ only)	NA	10.0	10.0	10.0	2.5	2.5	2.5
	DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	2.5	2.5
Bar (domestic)	Untrapped DN 40 waste	1.2	NA	NA	NA	NA	NA	NA
	DN 40 trap and waste	2.5	6.0	NA	NA	2.5	2.5	2.5
	DN 40 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NP	NA
Bar (commercial)	Untrapped DN 50 waste	1.2	NA	NA	NA	NA	NA	NA
	DN 50 trap and waste	2.5	6.0	NA	10.0	2.5	NA	NA
	DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
(Cleaner's)	Untrapped DN 40 waste (NZ only)	1.2	NA	NA	NA	NA	NA	NA
	Untrapped DN 50 waste	1.2	NA	NA	NA	NA	NA	NA
	DN 40 trap and waste (NZ only)	2.5	6.0	NA	NA	2.5	2.5	2.5
	DN 50 trap and waste	2.5	6.0	NA	NA	2.5	2.5	2.5
	DN 40 trap and DN 65 waste (NZ only)	NA	10.0	10.0	10.0	2.5	2.5	2.5
	DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	2.5	2.5
Pot or utility	DN 50 trap and waste	NA	6.0	NA	NA	2.5	NA	NA
	DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
Laboratory	DN 50 trap and waste	NA	6.0	NA	NA	2.5	NA	NA
	DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
SLOP HOPPER	DN 100 trap and waste	NA	NA	10.0	10.0	6.0	NA	NA



SWIMMING POOLS Limits determined by network utility operator (see Note 5) DN 40 waste	NA	Unlimited	NA	NA	NA	NA	NA
TROUGHS Ablution Untrapped DN 40 waste Untrapped DN 50 waste DN 40 trap and waste DN 50 trap and waste DN 40 trap and DN 65 waste DN 50 trap and DN 65 waste	1.2 1.2 2.5 2.5 NA NA	NA NA 6.0 6.0 10.0 10.0	NA NA NA NA 10.0 10.0	NA NA NA NA 10.0 10.0	NA NA 2.5 2.5 2.5 2.5	NA NA NA NA NA NA	NA NA NA NA NA NA
Laundry Untrapped DN 40 waste Untrapped DN 50 waste DN 40 trap and waste DN 50 trap and waste DN 40 trap and DN 65 waste DN 50 trap and DN 65 waste	1.2 1.2 2.5 2.5 NA NA	NA NA 6.0 6.0 10.0 10.0	NA NA NA NA 10.0 10.0	NA NA NA NA 10.0 10.0	NA NA 2.5 2.5 2.5 2.5	NA NA 2.5 2.5 2.5 2.5	NA NA 2.5 2.5 2.5 2.5
URINALS Wall hung DN 40 trap and waste DN 50 trap and waste DN 40 trap and DN 65 waste	NA NA NA	NA NA NA	NA NA 10.0	NA NA 10.0	2.5 2.5 2.5	2.5 2.5 2.5	2.5 2.5 2.5
DN 50 trap and DN 65 waste Slab (see Note 8) Up to 5 m in length minimum DN 65 trap and waste (see Note 6)	NA NA	NA NA	10.0 10.0	10.0 10.0	2.5 2.5	2.5 NA	2.5 NA
Waterless urinals (see <a href="#">Clause 13.24.2.3</a> ) DN 40 trap and DN 65 waste DN 50 trap and DN 65 waste	NA NA	NA NA	10.0 10.0	10.0 10.0	2.5 2.5	2.5 2.5	2.5 2.5
WASHING MACHINES (Domestic clothes) hose connecting to: Untrapped DN 40 waste Untrapped DN 50 waste DN 40 trap and waste DN 50 trap and waste DN 40 trap and DN 65 waste DN 50 trap and DN 65 waste	1.2 1.2 2.5 2.5 NA NA	NA NA 6.0 6.0 10.0 10.0	NA NA NA NA 10.0 10.0	NA NA NA NA 10.0 10.0	NA NA 2.5 2.5 2.5 2.5	NA NA 2.5 2.5 2.5 2.5	NA NA 2.5 2.5 2.5 2.5
Commercial clothes laundrette Untrapped DN 50 waste DN 50 trap and waste DN 50 trap and DN 65 waste	NA NA NA	NA 6.0 10.0	NA NA 10.0	NA NA 10.0	NA 2.5 2.5	NA NA NA	NA NA NA
Industrial laundry To graded channel and 225 mm silt trap with DN 100 outlet (Domestic dishwasher) waste outlet hose connecting to riser of kitchen sink trap — Above the water seal of a DN 50 trap and waste DN 40 trap and waste DN 40 trap and DN 65 waste	NA NA NA NA NA NA	10.0 6.0 6.0 10.0	NA NA NA 10.0	NA NA NA 10.0	NA 2.5 2.5 2.5	NA 2.5 2.5 2.5	NA 2.5 2.5 2.5
Commercial dishwasher DN 50 trap and DN 65 waste DN 50 trap and DN 50 waste Glass Untrapped DN 50 waste DN 50 trap and waste DN 50 trap and DN 65 waste	NA NA 1.2 2.5 NA	10.0 6.0 NA 6.0 10.0	10 NA NA NA 10.0	10 2.5 NA NA 10.0	NA 2.5 NA 2.5 2.5	NA 2.5 NA NA NA	NA 2.5 NA NA NA
COMBINATION PAN ROOM SINK DN 100 outlet	NA	NA	10.0	10.0	6.0	NA	NA
POTATO PEELER — shall discharge							

through a peel trap							
DN 50 trap and waste	NA	6.0	NA	NA	2.5	NA	NA
DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
RANGES OF FIXTURES (see Note 6)							
5 × basins DN 40 traps and wastes connected to a DN 50 common discharge pipe	NA	NA	NA	NA	NA	4.5	4.5
5 × water closets DN 100 outlets connected to a DN 100 common discharge pipe	NA	NA	NA	10.0	NA	10.0	10.0
5 × wall-hung urinals DN 50 traps connected to a DN 65 common discharge pipe	NA	NA	NA	10.0	NA	10.0	10.0
REFRIGERATED CABINETS and STERILIZERS							
Untrapped minimum DN 40 waste	1.2	NA	NA	NA	NA	NA	NA
Minimum DN 40 trap and waste	2.5	6.0	NA	NA	2.5	NA	NA
DN 40 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
STERILIZERS							
Untrapped minimum DN 40 waste	1.2	NA	NA	NA	NA	NA	NA
Minimum DN 40 trap and waste	2.5	6.0	NA	NA	2.5	NA	NA
DN 40 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
TUNDISHES (minor discharge)							
Untrapped DN 25 to DN 50 waste	10.0	NA	NA	NA	NA	NA	NA
DN 40 trap and waste	10.0	6.0	NA	NA	2.5	2.5	2.5
DN 40 trap and DN 65 waste	10.0	10.0	10.0	10.0	2.5	2.5	2.5
WATER CLOSET PAN							
DN 100 outlet	NA	NA	10.0	10.0	6.0	6.0	6.0
WOK BURNERS (Approx. 1 fixture unit per burner) (see Note 5)							
Minimum DN 50 trap and waste	NA	6.0	NA	NA	NA	NA	NA
DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
COMBINATION OVENS and STEAMERS (see Notes 5 and 7)							
DN 50 trap and waste	NA	6.0	NA	NA	NA	NA	NA
DN 50 trap and DN 65 waste	NA	10.0	10.0	10.0	2.5	NA	NA
<div><div>Key</div><div>NA = Not allowed</div><div><sup>a</sup> See <a href="#">Clause 4.6.7.3</a>, <a href="#">Figure 4.6.7.1</a>, and <a href="#">Table 4.6.7.2</a>.</div><div><sup>b</sup> See <a href="#">Clause 4.6</a> and <a href="#">Table 4.6.3</a>.</div><div><sup>c</sup> See <a href="#">Clause 3.9</a> and <a href="#">Figure 3.9.3.2</a>.</div><div><sup>d</sup> See <a href="#">Clause 11.6</a>.</div><div><sup>e</sup> See <a href="#">Clauses 8.5.7.5.4</a> and <a href="#">8.5.7.5.5</a> and <a href="#">Figure 8.5.7.5.4</a>.</div><div><sup>f</sup> See <a href="#">Clause 9.2</a>, <a href="#">Figures 9.2.2(A)</a> and <a href="#">(B)</a>, and <a href="#">Table 9.5.1</a>.</div><div><sup>g</sup> See <a href="#">Clause 9.2.3</a>, <a href="#">Figures 9.2.3(A)</a> and <a href="#">(B)</a>, and <a href="#">Table 9.5.1</a>.</div><div>NOTE 1 For the topmost fixture to fully vented modified stacks, see <a href="#">Clause 8.5.1.2</a>.</div><div>NOTE 2 Waste pipes to floor waste gullies shall not be extended by venting.</div><div>NOTE 3 “Minor discharge”, approximately a minimum of 1 L per day and not more than 20 L per day.</div><div>NOTE 4 For submerged-inlet floor waste gullies the requirements are specified in <a href="#">Table 4.6.7.2</a>.</div><div>NOTE 5 For connections of fixtures in range, see <a href="#">Clause 9.5.10</a>.</div><div>NOTE 6 Over 5 m of urinal wall additional outlets required.</div><div>NOTE 7 Discharge through a DN 100 tundish.</div><div>NOTE 8 See <a href="#">Clause 9.4.2</a> Item (a) for connection of slab type urinals to single stacks.</div></div>							

Appendix C

(informative)

Pipe grades conversion

Table C.1 — Conversion of pipe grades from a percent to a ratio	
Conversion of pipe grades	
Percent (%)	Ratio (gradient)
20.00	1 in 5
6.65	1 in 15
5.00	1 in 20
3.35	1 in 30
2.50	1 in 40
2.00	1 in 50
1.65	1 in 60
1.45	1 in 70
1.25	1 in 80
1.10	1 in 90
1.00	1 in 100
0.85	1 in 120
0.70	1 in 140
0.65	1 in 150
0.60	1 in 160
0.50	1 in 200
0.40	1 in 250
0.35	1 in 300

NOTE The percentage figures have been rounded off to the nearest 0.05 %.

Appendix D

(informative)

Conduct of inspections using closed circuit television

D.1 General

Closed circuit television (CCTV) inspections are effective ways to identify the structural condition of sanitary plumbing and drainage installations and to identify and report on any specific defects or features.

Inspections should be conducted under no-flow conditions, that is the sanitary plumbing system is not being used so that the flow (water) level may be measured and reported.

Typical applications for CCTV surveys include —

- (a) inspection of drains, sewers and pipelines;
- (b) inspection of deep shafts;
- (c) inspection of ducts;
- (d) monitoring specialist repair works in sewers; and
- (e) surveys of industrial process pipelines.

Where required, specialized instruments, apparatus and/or software should be used to facilitate the survey. Hardware and software used in measuring the parameters have to be correctly calibrated for each application using the manufacturer’s recommended methods.

NOTE It is recommended that CCTV operators are trained to conduct CCTV inspections and investigations.

D.2 Operator’s report

The operator should provide a written report.

The report should contain, but not be limited to, the following:

- (a) Location of the sanitary plumbing and drainage installation.
- (b) The dates of inspections.
- (c) Details, as required, to identify the drains inspected.
- (d) Size and type of material installed.
- (e) Condition of the sanitary plumbing and drainage installation including the location and characteristics of reportable features such as defects.
- (f) Where required, a determination for acceptance.

Appendix E

(normative)



# Sizing vacuum drainage pipes and buffers

## E.1 General

The sizing methods given in [Tables E.1](#) to [E.4](#) shall be used for buffer and pipe sizing.

Table E.1 — Maximum inflow to a single vacuum buffer	
Buffer volume L	Maximum inflow L/s
5	0.25
10	1.25
20	2.5
50	3.5
100	4.5

NOTE — For a bath, laundry tub, sink or similar appliance the average discharge rate in L/s at which the appliance will empty should be determined to calculate the buffer size. This will typically be the rate of discharge when a drain plug is removed from a full appliance. This can be calculated by dividing the volume (L) by the total number of seconds taken to empty the full appliance with waste outlet fitted.

Table E.2 — Vacuum loading units	
Vacuum fixture	Vacuum loading units (VLUs)
5 L buffer	4
10 L buffer	8
20 L buffer	12
50 L buffer	25
100 L buffer	60
Vacuum water closet pan	4
Vacuum bedpan washer	4
Vacuum slop hopper	4

Table E.3 — Mains and branch lines sizing	
Nominal size of vacuum pipeline DN	Maximum vacuum loading units (VLUs)
50	100
65	400
80	600
100	1 200
150	7 000
200	20 000

Table E.4 — Maximum number of vacuum toilets connected to main and branch pipelines	
Nominal size of vacuum pipeline DN	Maximum vacuum loading units (VLUs)
50	25
65	100
80	125
100	225
150	500
200	1 500

## Appendix F

(normative)

# Renovation of sanitary plumbing and drainage systems using structural plastics liners

## F.1 General

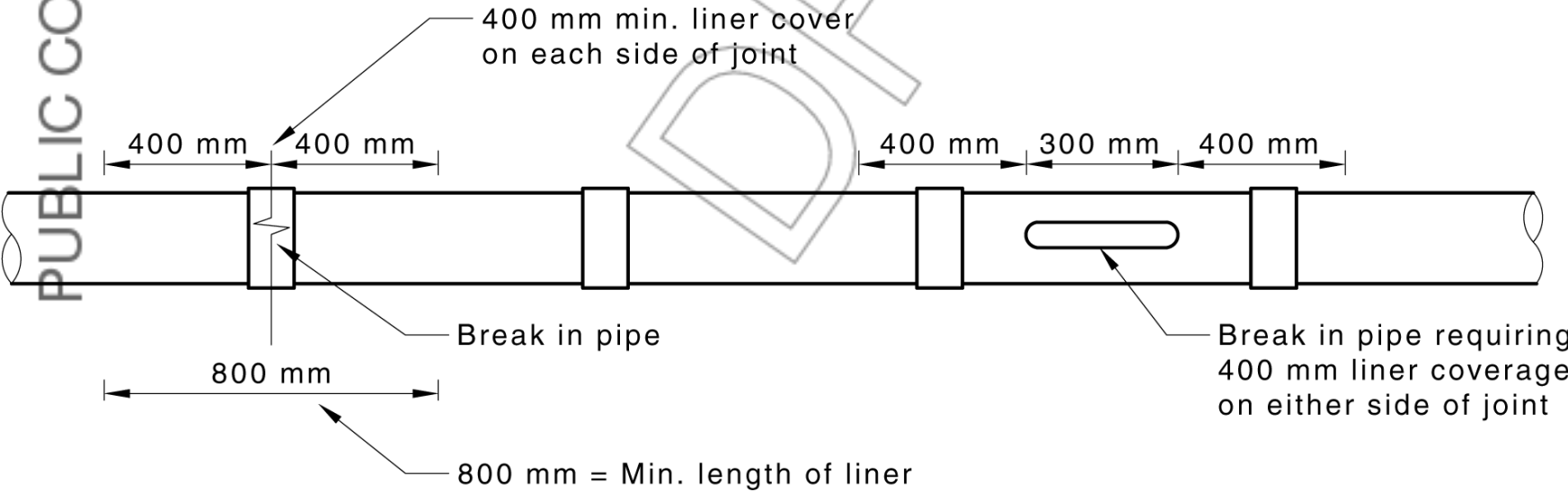
Renovation of sanitary plumbing and drainage systems using cured-in-place pipe (CIPP) liners (see [Clause 3.16.3.1](#)) and other structural plastics liners (see [Clause 3.16.3.2](#)) shall be performed on complete systems or as a repair of a section. The repair shall extend a minimum of 400 mm beyond the damaged

section of pipe in both directions with the minimum repair length to be 800 mm. Where a junction is within the repair length, all arms of the junction shall be included in the repair.

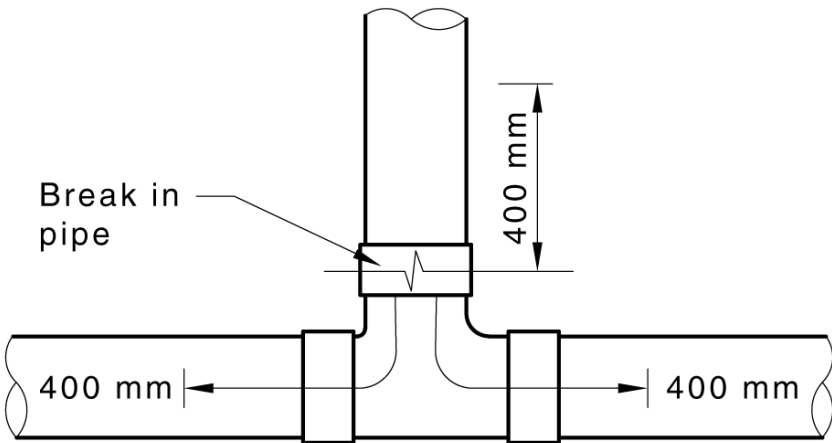
- NOTE 1 See [Figure F.1](#).
- NOTE 2 A structural plastics liner may bridge a gap caused by damage to an existing pipeline or to line drains that may be built over.

NOTE 3 The internal diameter of the host pipe will be reduced by twice the wall thickness of the liner. It may be necessary to consider the effect this has on the hydraulic capacity of the piping system, especially for very small diameter pipes.

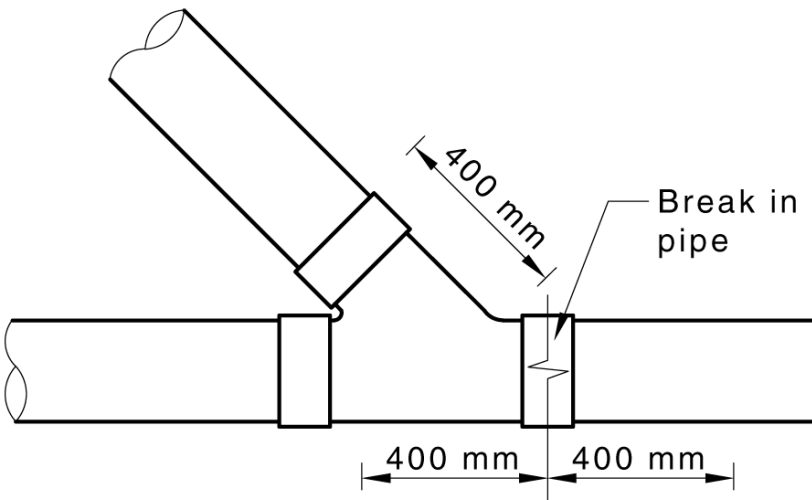
NOTE 4 There may be limitations on the use of some lining materials in trade waste applications.



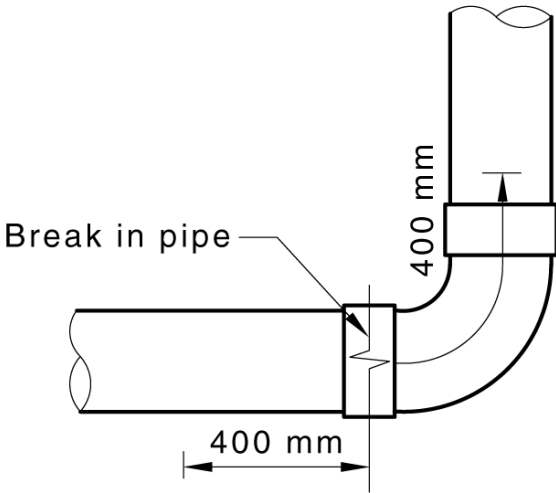
(a)



(b)



(c)



(d)

Figure F.1 — Minimum length of liner for a damaged pipe or fitting

## F.2 Liner

CIPP liners shall conform to WMTS-518.

When measured in accordance with ISO 7685 for thermosets (CIPP) or with ISO 9969 for thermoplastics, the minimum ring stiffness of an unsupported structural liner for below ground applications shall be 4 kN/m/m. For above-ground applications the minimum pipe stiffness of the unsupported liner shall be in accordance with the appropriate product specification.

## F.3 Relining procedure

The pipe system shall be prepared for relining as follows:

- (a) A CCTV inspection shall be performed to determine whether the pipe system is in a condition suitable for renovation and to identify the location of all relevant junctions.
- (b) The pipe system shall be cleaned with a high pressure jetter.

- (c) When the renovation is to be performed using a CIPP liner, the internal surface of non-porous host pipes (e.g. PVC or PE) shall be roughened or mechanically etched using sanding discs or wire brushes.
- (d) The system shall be flushed to remove any debris.
- (e) A second CCTV inspection shall be undertaken to ensure the pipe system is ready for the liner to be installed.
- (f) The liner shall be installed.
- (g) For CIPP liners, the resin shall be cured (i.e. cross-linked) by heat, UV radiation, ambient temperature or other means.
- (h) For liners other than CIPP, the ends of the liner shall be anchored and sealed in such a way as to provide a watertight connection to the existing pipeline. The method of anchoring the pipe ends shall take account of the residual effects of installation, especially unrelieved winching and thermal stresses, and be capable of resisting the associated longitudinal forces without movement, i.e. contraction.
- (i) A third CCTV inspection shall be performed to ensure the liner has been correctly installed.
- (j) The laterals shall be reinstated by opening to the full internal diameter of the lateral. Alternatively, a one piece lateral junction liner shall be installed.
- (k) The renovated pipe system shall be flushed.
- (l) A fourth CCTV inspection shall be performed to confirm the integrity of the renovation and satisfactory condition of all laterals.

NOTE Testing in accordance with [Section 15](#) should be undertaken particularly in major or complete system renovations.

Appendix G

(informative)

Drains in unstable soils

G.1

Scope

This appendix applies only to Residential (Class 1) buildings in Australia.

This appendix provides guidance on how to install products intended to reduce the risk of soil or ground movement effecting the sanitary drainage system. It covers flexible connections, lagging, and water ingress under the slab via trenches to accommodate a total range of differential soil movement for Classes M, M-D, H1, H1-D, H2, H2-D, E and E-D.

This appendix does not provide specific designs for Class P sites. Class P sites are problem sites (e.g. filled soil or potential to collapse). A classification of P, by itself, will not usually provide sufficient information to enable an appropriate sanitary drainage system design to be prepared. Additional information will usually be required, according to the nature of the factors leading to the P classification.

Guidance is provided in this appendix to assist sanitary drainage systems up to 225 mm in diameter in accommodating for a range of differential soil movement .

NOTE Refer to AS 2870 for information on requirements for residential slabs and footings.

This appendix does not provide design advice. Advice from a suitably qualified engineer is recommended to ensure that the solution proposed is appropriate for the conditions of the site.

G.2

Site classification based on soil reactivity

Prior to the commencement of work, the site classification should be obtained.

Classification of sites will assist in determining when additional protection for the sanitary drainage system may be needed, such as where ground movement is anticipated due to soil reactivity under normal moisture conditions. Sites are classified based on the expected level of ground movement.

For some sites further classification may be needed based on the depth of the expected moisture change, deep-seated moisture changes characteristics in dry climates and the design depth of suction.

Typical examples of site classifications are provided in [Table G.1](#).

Table G.1 — Typical soil classification by characteristic surface movement		
Soil classification	Soil foundation	Characteristic surface movement (ys) mm
A	Most sand and rock sites with little or no ground movement from moisture changes	0
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes	0–20
M	Moderately reactive clay sites, which may experience moderate ground movement from moisture changes	21–40
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes	41–60
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes	61–75
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes	76+
P		a
a Refer to <a href="#">Clause G.1</a> for information on Class P sites.		



# G.3 Drainage for buildings on sites with predicted differential ground movement

Drains should be located external to the building wherever practicable.

Sanitary drainage on sites classified M, H1, H2, and E should be provided with protection from ground movement.

To protect the building from increased ground moisture, the base of trenches should be sloped away from the building to prevent water ponding under the slab or footing.

To prevent surface water entering the trenches around slabs and footing, trenches can be backfilled with compacted clay in the top 300 mm from the edge of the slab for 1.5 m away from the building.

NOTE See [Figure G.3\(A\)](#) for an example.

Where drains are to be laid in water charged ground, methods of support and bedding should be designed to withstand and suit the ground conditions.

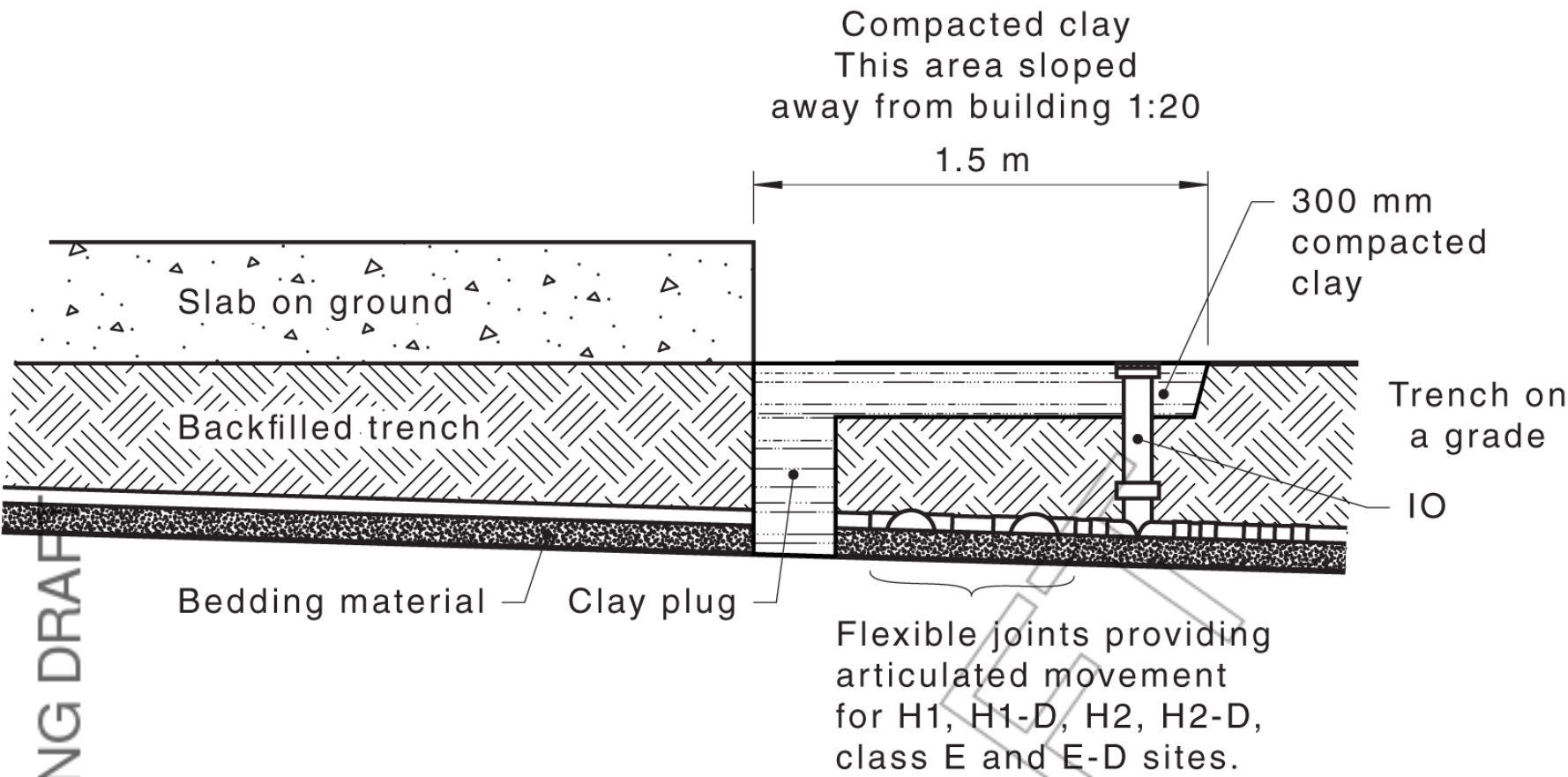


Figure G.3(A) — Typical installation of clay plug

Where a sanitary drainage system passes under footing systems, a barrier to prevent the ingress of water under a barrier can be created by—

- (a) backfilling the width of the trench to full depth with clay of thickness not less than 300 mm; or
- (b) installing a damp-proofing membrane across the cross-section of the trench, taped to the pipe with an inert waterproof tape and keyed into the sides and base of the trench.

NOTE See [Figure G.3\(B\)](#) for a typical example.

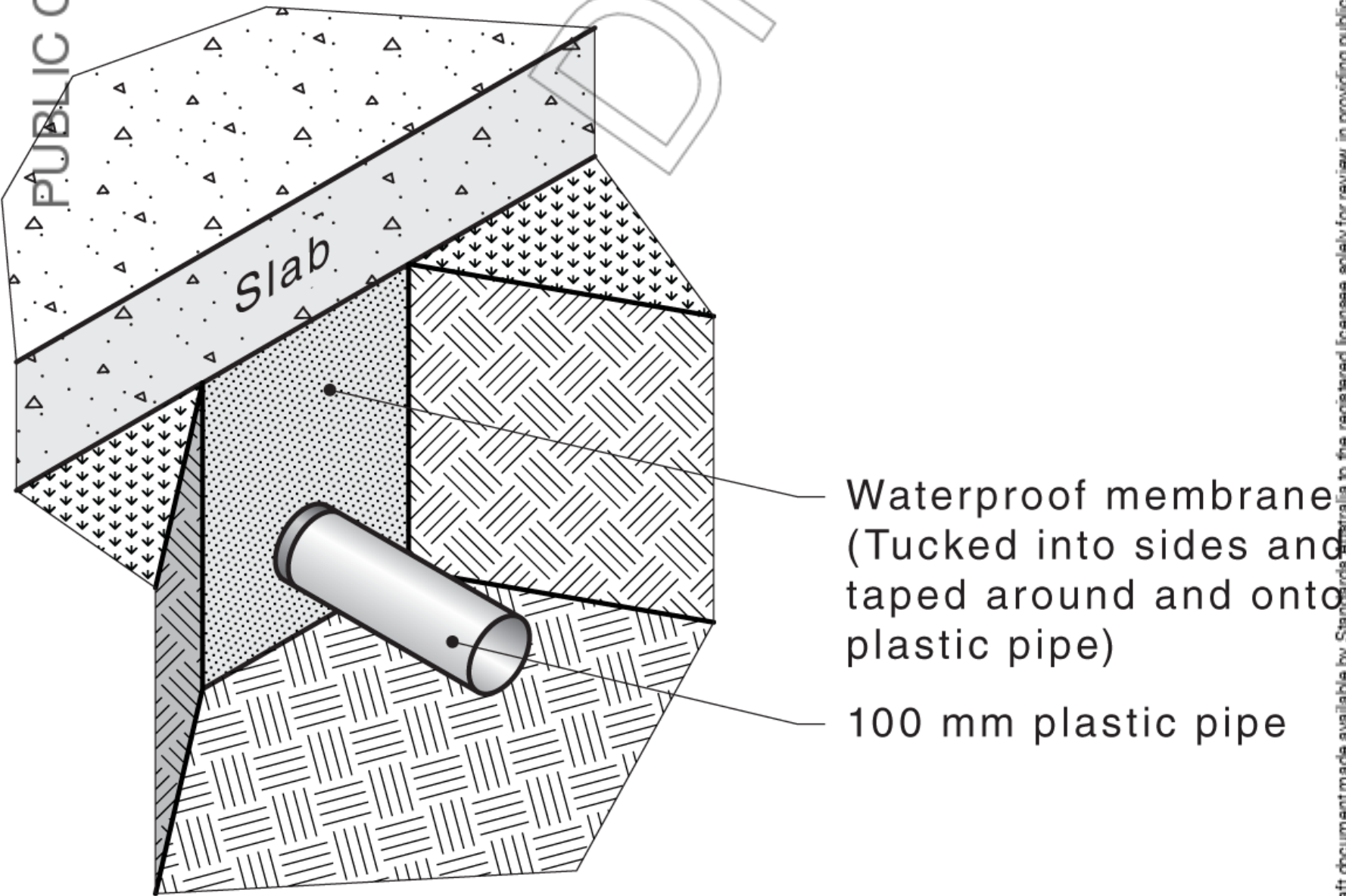


Figure G.3(B) — Typical installation of damp-proofing membrane

Penetrations through beams of a raft and perimeter strip footings should be avoided where practicable, but where necessary, should allow for movement and protect the pipework from the expansion and contraction of the footing.

Closed-cell polyethylene lagging can be wrapped around all sanitary drainage pipework at penetrations (excluding vertical) to allow for movement. Lagging should be a minimum of —

- (a) 20 mm thick on Class M, Class H1 sites; or
- (b) 40 mm thick on Class H2 and Class E sites.

For Class H1, H2 and E sites, one method of protecting the sanitary drainage pipework from damage from ground movement where attached to or emerging from underneath the building is to incorporate flexible joints. Two flexible joints can be installed with a spacing between the joints of 2.5 times the pipe diameter.

Flexible joints should be installed externally and commencing within 1 m outside the footing. Such joints should accommodate for a total range of differential movement in any direction and be not less than the estimated characteristic surface movement of the site ( $y_s$ ).

Flexible joints that are provided to allow for the movement should be set at the mid-position of their range of possible movement at the time of installation, to allow for movement equal to 0.5 of the maximum  $y_s$  value specified as applicable to the site classification.

## G.4 Differential movement—inspection chambers or similar structures

Where a drain passes through the wall of an inspection chamber, septic tank, pre-treatment devices, wet well, or similar structure, two flexible joints should be installed with a spacing between the joints not exceeding 2.5 times the pipe diameter to reduce the effects of ground movement on the pipework and connections.

NOTE See Figure G.4 for a typical example

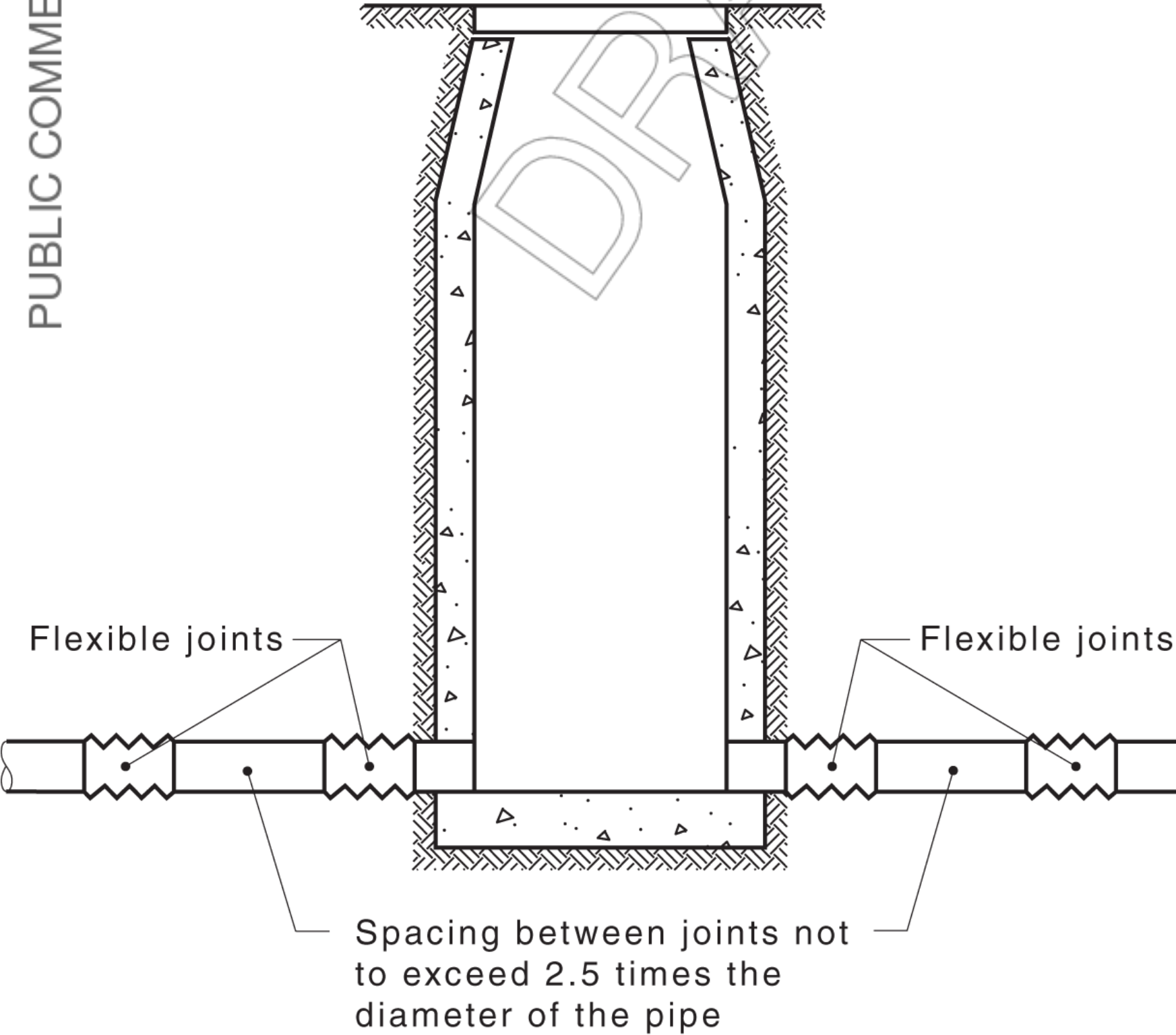


Figure G.4 — Typical installation of flexible joints in inspection chambers or similar structures

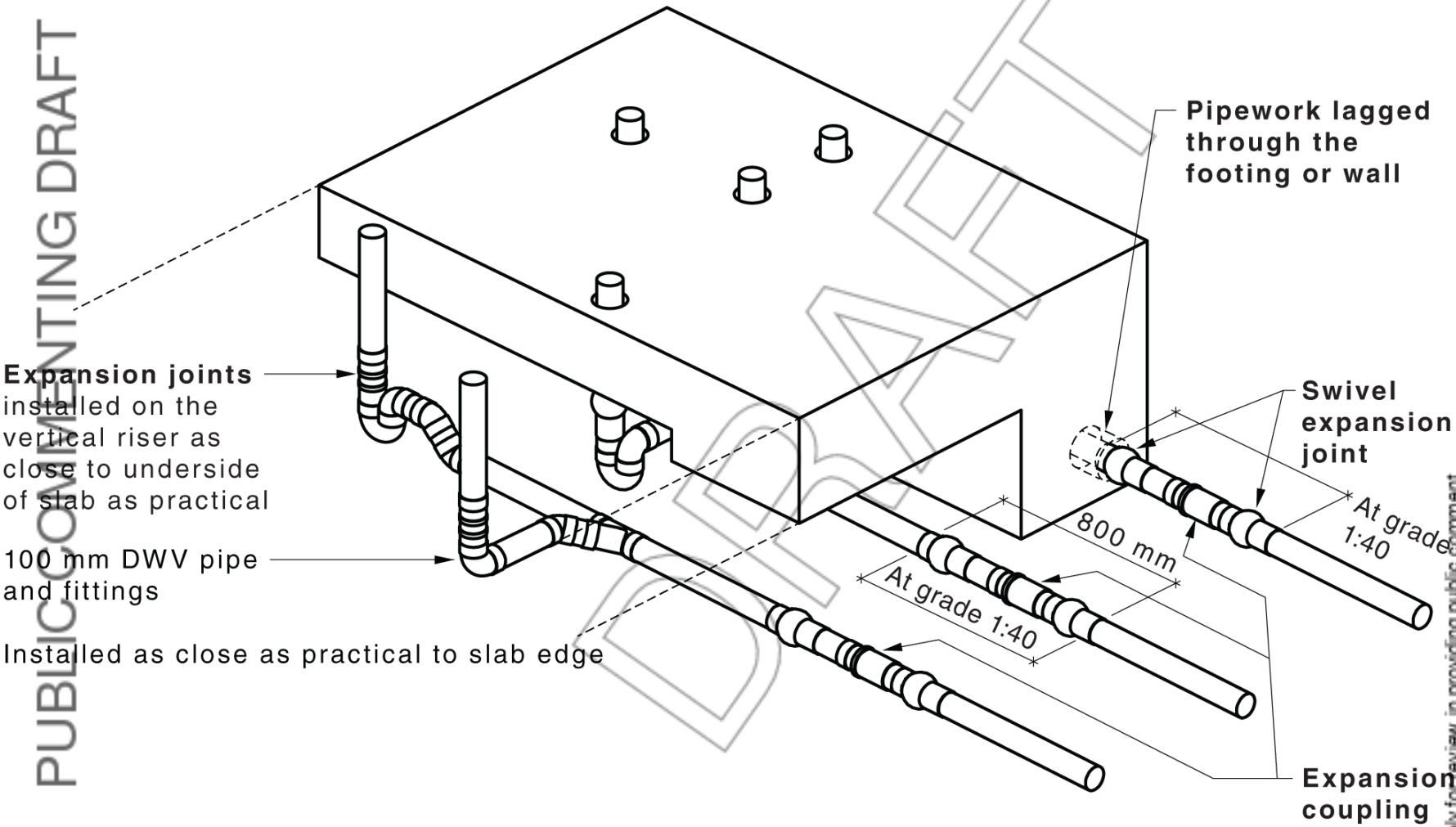
## G.5 Vertical risers

For sites classified as H1, H2, and E, to reduce the effects of ground movement on external branches with vertical risers connected to a junction, flexible joints could be provided in the locations below—

- (a) the downstream side of the bend or junction forming the branch drain is connected to the main drain; and
- (b) immediately either side of the junction forming part of the main drain; or
- (c) immediately downstream of the bend on the main drain.



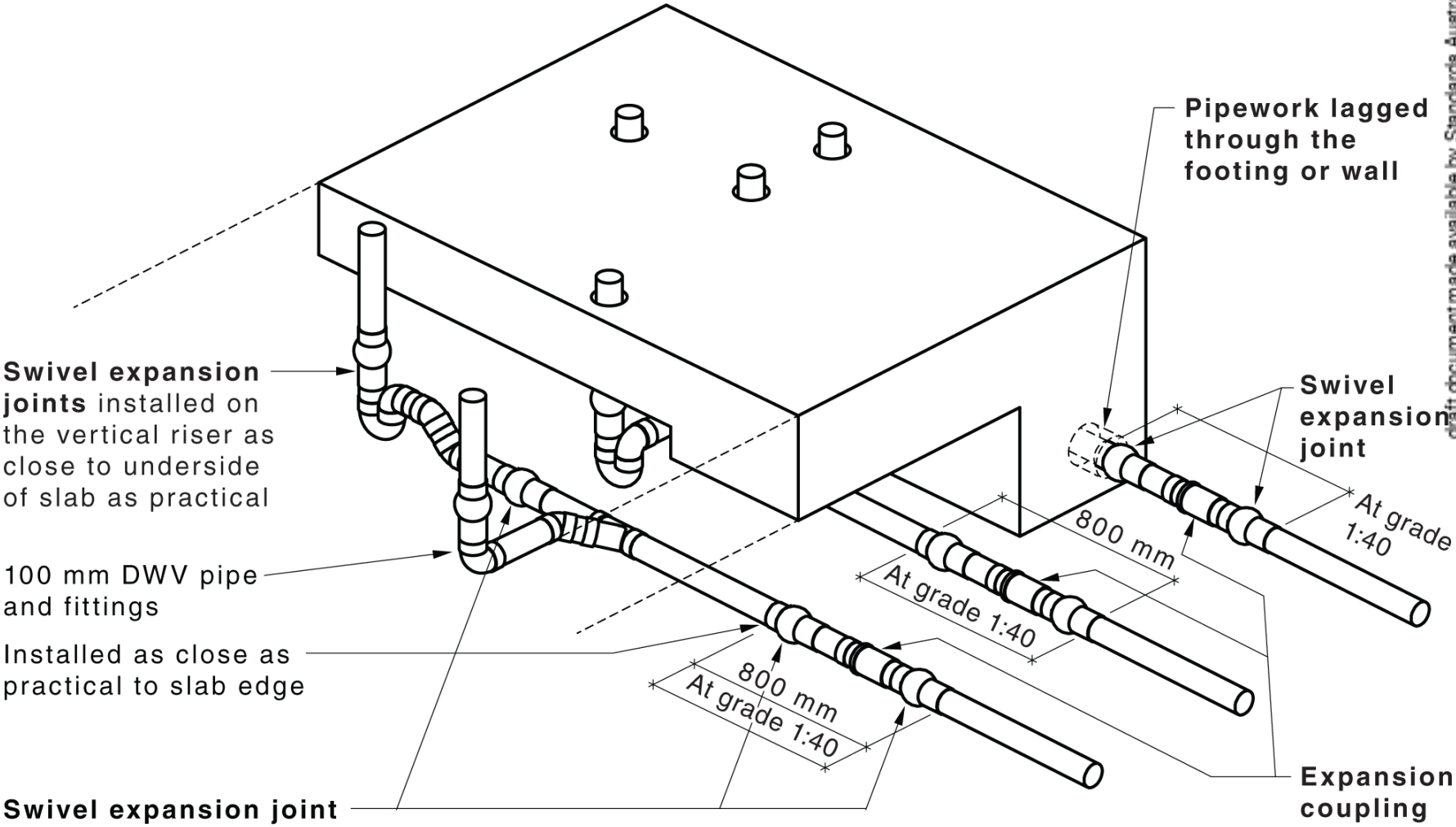
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- NOTE 1 Drain grade should be 1:40 for the first 800 mm external to the slab.
- NOTE 2 Swivel expansion joints installed on grade should not be used to correct pipe misalignment.
- NOTE 3 Swivel expansion joints and expansion joints should be installed at 50 % of their telescopic movement.
- NOTE 4 Expansion joints installed on vertical risers should have a minimum of 40 mm telescopic movement.

Figure G.5(A) — Potential locations of below-ground swivel and expansion joints for sites classified as H



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- NOTE 1 Drain grade should be 1:40 for the first 800 mm external to the slab.
- NOTE 2 Swivel expansion joints installed on grade should not be used to correct pipe misalignment.
- NOTE 3 Swivel expansion joints and expansion joints should be installed at 50 % of their telescopic movement.
- NOTE 4 Swivel expansion joints installed on vertical risers should have a minimum of 75 mm telescopic movement.

Figure G.5(B) — Potential locations of below-ground swivel and expansion joints for sites classified as E

## G.6 Graded risers

For sites classified as H1, H2, and E, to protect external branches with graded risers connected to a junction from ground movement, flexible joints could be provided —

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- (a) the downstream side of the first bend outside the footing on the branch drain and immediately upstream from the inlet to the junction forms part of the main drain; and
- (b) immediately either side of the junction forming part of the main drain; or
- (c) immediately downstream of the bend on the main drain.

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

AS 1646, *Elastomeric seals for waterworks purposes*

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

AS 2870, *Residential slabs and footings*

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