



# **Drainage and Waste Water Disposal**

## **Building Regulations 2010**

## **Technical Guidance Document**



**Comhshaol, Oidhreachta agus Rialtas Áitiúil**  
Environment, Heritage and Local Government



# Building Regulations 2010

## Technical Guidance Document H

### Drainage and Waste Water Disposal

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BAILE ÁTHA CLIATH

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# Contents

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	Page
<b>Introduction</b>	<b>3</b>
Transitional arrangements	3
The guidance	3
Existing buildings	3
Technical specifications	3
Materials and workmanship	4
Interpretation	4
<b>Part H - the requirement</b>	<b>5</b>
<b>Section 1: Drainage systems</b>	<b>6</b>
<b>1.1 General</b>	<b>6</b>
1.1.1 Guidance	6
1.1.2 Foul wastewater drainage	6
1.1.3 Surface water drainage	7
<b>1.2 Foul wastewater drainage - pipework overground</b>	<b>7</b>
1.2.1 Traps	7
1.2.2 Branch pipes	8
1.2.3 Discharge stacks	11
1.2.4 Access for clearing blockages	12
1.2.5 Materials for pipes, fittings and joints	12
1.2.6 Airtightness	12
<b>1.3 Foul wastewater drainage - pipework underground</b>	<b>13</b>
1.3.1 General	13
1.3.2 Layout	13
1.3.3 Depth of pipe cover	13
1.3.4 Pipe gradients and sizes	14
1.3.5 Lifting installations	14
1.3.6 Materials for pipes and jointing	15
1.3.7 Bedding and backfilling	15
1.3.8 Clearance of blockages	15
1.3.9 Watertightness	18
1.3.10 Greywater recovery systems	18
<b>1.4 Additional guidance for large buildings</b>	<b>20</b>
1.4.1 Capacity of pipes	20
1.4.2 Traps	20
1.4.3 Branch pipes	20
1.4.4 Stub stacks	21
1.4.5 Ventilating stacks	21

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<b>1.5</b>	<b>Surface Water Drainage</b>	<b>21</b>
1.5.1	Gutters	21
1.5.2	Rainwater pipes	22
1.5.3	Siphonic roof drainage systems	22
1.5.4	Eaves drop systems	22
1.5.5	Rainwater recovery systems	23
1.5.6	Materials for gutters, rainwater pipes and joints	24
1.5.7	Design	24
1.5.8	Soakaways	25
<b>1.6</b>	<b>External Greywater and Rainwater Storage Tanks</b>	<b>25</b>
<b>1.7</b>	<b>Further guidance on drainage systems</b>	<b>26</b>
1.7.1	Special protection – settlement	26
1.7.2	Special protection - surcharging of drains	27
1.7.3	Special protection - ground loads	27
1.7.4	Repairs and alterations	28
1.7.5	Sealing disused drains	28
	<b>Section 2: Wastewater treatment systems</b>	<b>29</b>
2.1	Guidance	29
2.2	Septic tanks	30
2.3	Percolation areas and mounds	30
2.4	Constructed wetlands	30
2.5	Intermittent filter systems	31
2.6	Polishing filters	31
2.7	Packaged wastewater treatment systems	31
2.8	Tertiary treatment systems	32
2.9	General recommendations	32
2.10	Holiday homes	33
	<b>Standards and publications</b>	<b>34</b>
	<b>Other standards and publications</b>	<b>39</b>

# Building Regulations 2010

## Technical Guidance Document H

### Drainage and Waste Water Disposal

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#### Introduction

This document has been published by the Minister for the Environment under article 7 of the Building Regulations 1997. It provides guidance in relation to Part H of the Second Schedule to the Regulations. The document should be read in conjunction with the Building Regulations 1997 to 2010, and other documents published under these Regulations. In general, Building Regulations apply to the construction of new buildings and to extensions and material alterations to buildings. In addition, certain parts of the Regulations apply to existing buildings where a material change of use takes place. Otherwise, Building Regulations do not apply to buildings constructed prior to 1 June 1992.

#### Transitional arrangements

In general, this document applies to works, or buildings in which a material change of use takes place, where the works or the change of use commence or takes place, as the case may be, on or after 1 June 2011. Technical Guidance Document H - Drainage and Waste Water Disposal, dated 1997, also ceases to have effect from that date. However, the latter document may continue to be used in the case of works, or buildings in which a material change of use takes place: -

- where the works, material alteration or the change of use commences or takes place, as the case may be, on or before 31 May 2011, or
- where planning approval or permission has been applied for on or before 31 May 2011, and substantial work has been completed by 31 May 2012.

“Substantial work has been completed” means that the structure of the external walls has been erected.

#### The guidance

The materials, methods of construction, standards and other specifications (including technical specifications) which are referred to in this document are those which are likely to

be suitable for the purposes of the Regulations. Where works are carried out in accordance with the guidance in this document, this will, prima facie, indicate compliance with Part H of the Second Schedule to the Building Regulations. However, the adoption of an approach other than that outlined in the guidance is not precluded provided that the relevant requirements of the Regulations are complied with. Those involved in the design and construction of a building may be required by the relevant building control authority to provide such evidence as is necessary to establish that the requirements of the Building Regulations are being complied with.

#### Existing buildings

In the case of material alterations or changes of use of existing buildings, the adoption without modification of the guidance in this document may not, in all circumstances, be appropriate. In particular, the adherence to guidance, including codes, standards or technical specifications, intended for application to new work may be unduly restrictive or impracticable. Buildings of architectural or historical interest are especially likely to give rise to such circumstances. In these situations, alternative approaches based on the principles contained in the document may be more relevant and should be considered.

#### Technical specifications

Building Regulations are made for specific purposes, e.g. to provide, in relation to buildings, for the health, safety and welfare of persons, the conservation of energy and access for people with disabilities. Technical specifications (including harmonised European Standards, European Technical Approvals, National Standards and Agrément Certificates) are relevant to the extent that they relate to these considerations. Any reference to a technical specification is a reference to so much of the specification as is relevant in the context in which it arises.

Technical specifications may also address

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other aspects not covered by the Regulations. A reference to a technical specification is to the latest edition (including any amendments, supplements or addenda) current at the date of publication of this Technical Guidance Document. However, if this version of the technical specification is subsequently revised or updated by the issuing body, the new version may be used as a source of guidance provided that it continues to address the relevant requirements of the Regulations.

A list of other standards and publications that deal with matters relating to this Part of the Building Regulations is included at the end of this document. These standards and publications may be used as a source of further information but do not form part of the guidance.

### **Materials and workmanship**

Under Part D of the Second Schedule to the Building Regulations, building work to which the Regulations apply must be carried out with proper materials and in a workmanlike manner. Guidance in relation to compliance with Part D is contained in Technical Guidance Document D.

### **Interpretation**

In this document, a reference to a section, sub-section, part, paragraph or diagram is, unless otherwise stated, a reference to a section, sub-section, part, paragraph or diagram, as the case may be, of this document. A reference to another Technical Guidance Document is a reference to the latest edition of the document published by the Department of the Environment, Heritage and Local Government under article 7 of the Building Regulations (as amended). Diagrams are used in this document to illustrate particular aspects of construction - they may not show all the details of construction.

# Drainage and waste water disposal

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## Part H - the requirement

Part H of the Second Schedule to the Building Regulations 1997 to 2010, provides as follows for the disposal of foul and surface water: -

Drainage systems.	H1	(1)	A building shall be provided with such a drainage system as may be necessary for the hygienic and adequate disposal of foul wastewater from the building.
		(2)	A building shall be provided with such a drainage system as may be necessary for the adequate disposal of surface water from the building.
		(3)	No part of a drainage system conveying foul wastewater shall be connected to a sewer reserved for surface water and no part of a drainage system conveying surface water shall be connected to a sewer reserved for foul wastewater.
Wastewater treatment systems.	H2	(1)	A wastewater treatment system shall be so designed, sited and constructed that: (a) it is not prejudicial to the health of any person, (b) it does not cause a risk to public health or the environment, (c) it prevents unauthorised access but allows adequate means of access for emptying and maintenance, (d) it will function to a sufficient standard for the protection of health in the event of a system failure, (e) it has adequate capacity, (f) it is impermeable to liquids, and (g) it is adequately ventilated.
		(2)	Information on the wastewater treatment system and any continuing maintenance required to avoid risk to health and the environment shall be provided to the owner.
Definitions for this Part.	H3		In this Part – "combined drain" means a single private drain used for the drainage of two or more separate premises as defined in section 10 of the Local Government (Sanitary Services) Act 1948 (No. 3 of 1948); "drain" in relation to a building means any pipe, forming part of the drainage system of the building, which is either - (a) wholly underground, or (b) a continuation, in the direction of flow, of part of a drainage system that has been underground, and includes a "combined drain"; "drainage system", in relation to a building, means the system of pipes and drains used for the drainage of the building, including all other fittings, appliances and equipment so used but excluding subsoil water drains; "domestic wastewater" means water discharged from kitchens, laundry rooms, lavatories, bathrooms, toilets and similar facilities (soil water and wastewater); "foul wastewater" means any wastewater comprising domestic wastewater and / or industrial wastewater; "industrial wastewater / trade effluent" means wastewater discharge resulting from any industrial or commercial activity; "sewer" has the same meaning as in the Local Government (Sanitary Services) Acts 1878 to 1964; "surface water" means water from precipitation which has not seeped into the ground and which is discharged to the drain or sewer system directly from the ground or from the exterior building surfaces; "soil water" means water containing excreted matter, whether human or animal; "wastewater" means used water not being soil water or trade effluent.

This Technical Guidance Document is divided into two sections. Section 1 relates to the requirement in H1 (Drainage systems). Section 2 relates to the requirement in H2 (Wastewater treatment systems).

It is important to note that there are other legislative requirements relating to disposal of effluent and the relevant legislation should be consulted.



# Section 1

## Drainage systems

Drainage systems	H1	<p>(1) A building shall be provided with such a drainage system as may be necessary for the hygienic and adequate disposal of foul wastewater from the building.</p> <p>(2) A building shall be provided with such a drainage system as may be necessary for the adequate disposal of surface water from the building.</p> <p>(3) No part of a drainage system conveying foul wastewater shall be connected to a sewer reserved for surface water and no part of a drainage system conveying surface water shall be connected to a sewer reserved for foul wastewater.</p>
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### 1.1 GENERAL

#### 1.1.1 Guidance

**1.1.1.1** This Section of the Document gives some guidance on good practice in relation to noncomplex drainage systems.

Further guidance is contained in the following standards: -

I.S. EN 12056-1: 2000 Gravity drainage systems inside buildings - Part 1: General and performance requirements.

I.S. EN 12056-2: 2000 Gravity drainage systems inside buildings - Part 2: Sanitary pipework, layout and calculation.

I.S. EN 12056-3: 2000 Gravity drainage systems inside buildings - Part 3: Roof drainage, layout and calculation.

I.S. EN 752: 2008 Drain and sewer systems outside buildings.

I.S. EN 1610: 1998 Construction and testing of drains and sewers.

I.S. EN 1295-1: 1998 Structural design of buried pipelines under various conditions of loading - Part 1: General requirements.

Where vacuum systems are used they should meet the requirements of I.S. EN 12109: 1999 Vacuum drainage systems inside buildings or I.S. EN 1091: 1997 Vacuum drainage and sewerage systems outside buildings.

Where a building is being extended and the extension is to be built over or in close proximity to a drain / combined drain, the work should be carried out without endangering the integrity of the drain or limiting access to the drain for the purposes

of inspection or maintenance. Where the drain serves two or more dwellings / properties, (combined drain), the local authority should be consulted.

**1.1.1.2** The design of the drainage system can have an effect on the heat loss from the building fabric. Therefore consideration should be given to limiting the number of penetrations through the external envelope. Refer to Technical Guidance Document L - Building Envelope Air Permeability section for further guidance.

**1.1.1.3** In this Section: -

“branch pipe” means a discharge pipe connecting sanitary appliances to a discharge stack;

“branch ventilation pipe” means a ventilating pipe connected to a branch pipe.

**1.1.1.4** The pipe sizes quoted in this Section are nominal sizes used as a numerical designation in convenient round numbers approximately equal to a manufacturer's size. Equivalent pipe sizes for individual pipe standards will be found in I.S. EN 12056-2 for sanitary pipework and I.S. EN 752 for building drainage.

#### 1.1.2 Foul wastewater drainage

**1.1.2.1** A foul wastewater drainage system should: -

- (a) convey the flow of foul wastewater to a foul wastewater outfall, (a foul or combined sewer or a wastewater treatment system);

- (b) minimise the risk of blockage or leakage;
- (c) prevent foul air from the drainage system from entering the building under working conditions;
- (d) be ventilated to prevent the build up of gases;
- (e) be accessible for clearing blockages; and
- (f) be adequately protected from accidental damage from sources such as traffic, ground settlement and tree roots.

**1.1.2.2** The capacity of the foul wastewater drainage system should be large enough to carry the expected flow at any point (see also paragraph 1.4.1).

**1.1.2.3** The capacity depends on the size and gradient of the pipes. Minimum sizes and gradient limits are given in sub-section 1.3.4.

**1.1.2.4** The flow depends on the type, number and grouping of appliances.

**1.1.2.5** Appliances are seldom in use simultaneously and the minimum stack and drain sizes in normal use are capable of carrying the flow from large numbers of appliances. Table 1 shows approximate flow rates for numbers of dwellings based on the typical household group of 1 wc, 1 bath, 1 or 2 washbasins, 1 sink and 1 washing machine / dishwasher used for design purposes in I.S. EN 12056-2.

### **1.1.3 Surface water drainage**

**1.1.3.1** A surface water drainage system should: -

- (a) carry the flow of rainwater from the roof to an outfall (a surface water or combined sewer, a Sustainable Urban Drainage system, a soakaway, or a watercourse);

- (b) minimise the risk of blockage or leakage;
- (c) be accessible for clearing blockages;
- (d) be adequately protected from accidental damage from sources such as traffic, ground settlement and tree roots; and
- (e) be adequately protected from accidental pollution by means of a discharge from foul drains, oil spillage or other pollution sources.

<b>Table 1 Flow rates for dwellings</b>	
<b>Number of dwellings</b>	<b>Flow rate (litres/sec)</b>
1	2.5
5	3.5
10	4.1
15	4.6
20	5.1
25	5.4
30	5.8

**1.1.3.2** The flow depends on the area to be drained and the rainfall intensity which should be assumed to be 75 mm per hour for roof drainage design.

**1.1.3.3** The capacity of the surface water drainage system should be large enough to carry the expected flow at any point in the system.

**1.1.3.4** The capacity depends on the size and gradient of the gutters and pipes. Capacities and minimum sizes are given in sub-section 1.5.

**1.1.3.5** Rainwater or surface water should not be discharged to a wastewater treatment system.

## **1.2 FOUL WASTEWATER DRAINAGE – PIPEWORK OVERGROUND**

### **1.2.1 Traps**

**1.2.1.1** All points of discharge into the system

should be fitted with a water seal (trap) to prevent foul air from the system entering the building. Under working and test conditions, traps should retain a minimum seal of 25 mm.

**1.2.1.2** Table 2 gives minimum trap sizes and seal depths for the appliances which are most used (for other appliances see paragraph 1.4.2).

<b>Table 2 Minimum trap sizes and seal depths</b>		
<b>Appliance</b>	<b>Diameter of trap (mm)</b>	<b>Depth of Seal (mm)</b>
washbasin bidet	32	75
sink* bath* shower* food waste disposal unit urinal bowl washing machine dishwashing machine	40	75
wc pan	(min dimension) 100	50
<i>Note:</i> * Where these appliances are installed on a ground floor and discharge to a gully, the depth of seal may be reduced to not less than 40 mm.		

**1.2.1.3 Ventilation:** To prevent the water seal from being broken by the pressures which can develop in the system, branch pipes should be designed as described in sub-section 1.2.2.

**1.2.1.4 Access for clearing blockages:** If a trap forms part of an appliance, the appliance should be removable. All other traps should be fitted directly after the appliance and should be removable or be fitted with a cleaning eye.

## 1.2.2 Branch pipes

**1.2.2.1** Branch pipes should discharge into another branch pipe, or a discharge stack (including a stub stack), unless the appliances are on the ground floor.

**1.2.2.2** If the appliances are on the ground floor, the branch pipe(s) may discharge to a

discharge stack or directly to a drain, or, if the pipe carries only wastewater, to a gully (see paragraph 1.2.2.5).

**1.2.2.3** A branch pipe should not discharge into a stack in a way which could cause crossflow into any other branch pipe (see Diagram 1).

**1.2.2.4** A branch pipe should not discharge into a stack at a point lower than 450 mm above the invert of the tail of the bend at the foot of the stack in single dwellings of up to three storeys (see Diagram 1). For larger buildings, see sub-section 1.4.3.

**1.2.2.5** A branch pipe from a ground floor water closet should only discharge directly to a drain if the drop is 1.5 m or less (see Diagram 2). Where the drop is more than 1.5 m, the branch pipe should discharge into a ventilated discharge stack.

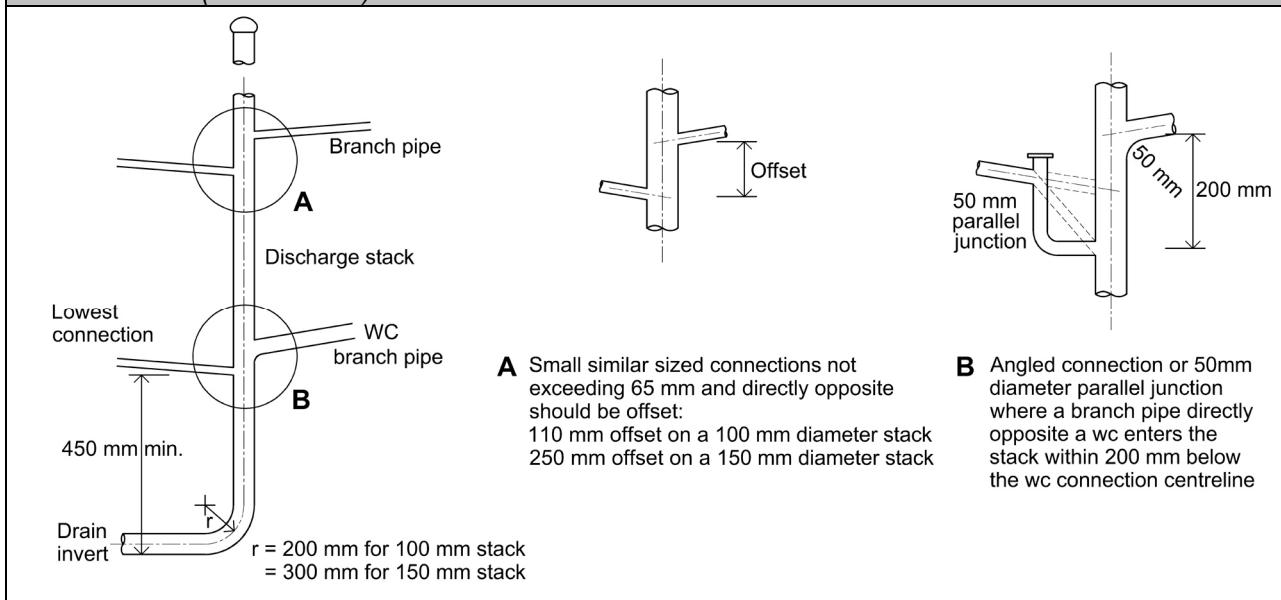
**1.2.2.6** A branch pipe discharging to a gully should terminate between the grating or sealing plate and the top of the water seal.

**1.2.2.7** Condensate drainage from boilers should be connected to wastewater pipework. The connection should be made using pipework of a minimum diameter of 22 mm. If an additional trap is provided externally to the boiler to provide the 75 mm seal, an air gap should be provided between the boiler and the trap. The pipe material should be resistant to acid as the condensate is slightly acidic, e.g. plastic. Copper and mild steel pipes and fittings should not be used. Further guidance is available in "Heating and Domestic Hot Water Systems - Achieving compliance with Part L 2008" (see Appendices A10 and A13).

**1.2.2.8 Sizes of branch pipes:** Pipes serving a single appliance should have at least the same diameter as the appliance trap (see Table 2). If a pipe serves more than one appliance and is unventilated, the diameter should be at least the size shown in Table 3.

**1.2.2.9** Bends in branch pipes should be avoided if possible but where they are

**Diagram 1 Branch connections to stacks**  
(Par. 1.2.2.3)



**Table 3 Common branch pipes (unvented)**

Appliance	Max Number to be connected	OR	Max length of branch (m)	Min size of pipe (mm)	Gradient limits (fall per metre)	
					min (mm)	max (mm)
wcs	8		15	100	9	to 90
urinals:						
bowls	5		5	*	50	to 90
stalls	6		*	65	18	to 90
Washbasins	4		4 (no bends)	50	18	to 45

*Note:*  
\* No limitation as regards venting but should be as short as possible.

essential they should have as large a radius as possible. Bends on pipes of 65 mm or less should have a centre line radius of at least 75 mm.

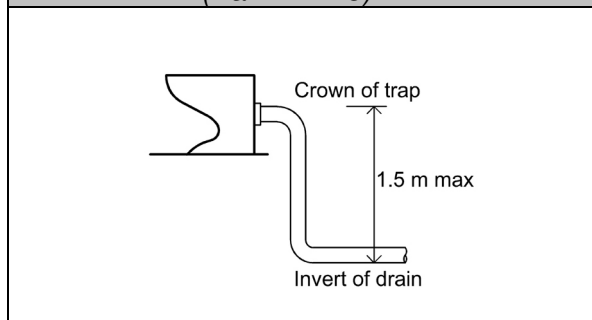
**1.2.2.10** Junctions on branch pipes should be made with a sweep of 25 mm minimum radius or at an angle 45°. Connection of branch pipes of 75 mm diameter or more to the stack should be made with a sweep of 50 mm minimum radius or at an angle 45°.

**1.2.2.11 Ventilation of branch pipes:**

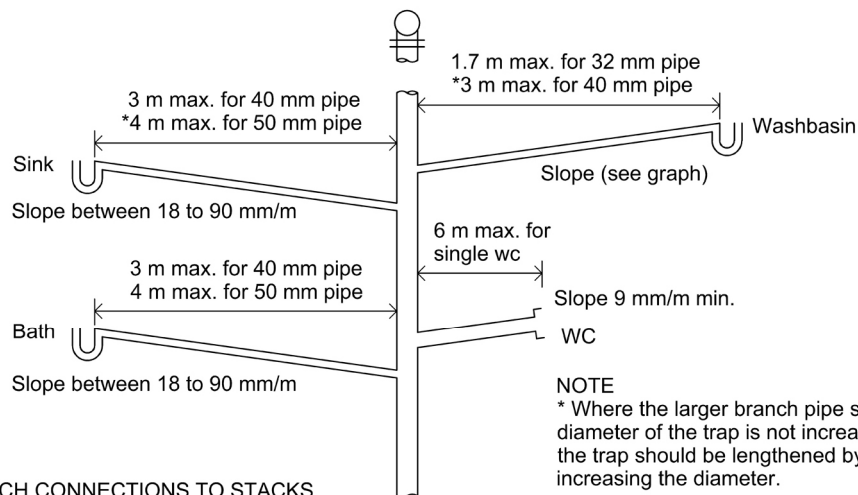
Where separate ventilation is not provided, the length and slope of the branch pipes should not exceed those shown in Diagram 3, in order to prevent the water seals in traps

from being lost by pressures which can develop in the system.

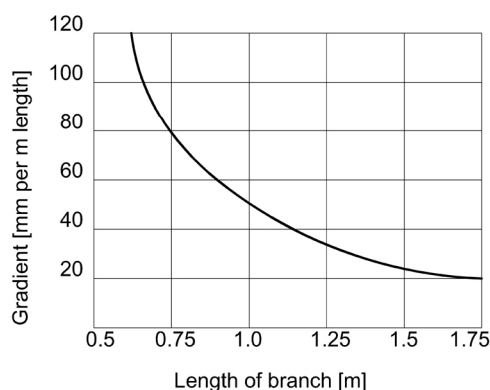
**Diagram 2 Direct connection of ground floor wc to a drain**  
(Par. 1.2.2.5)



**Diagram 3**    **Branch connections**  
(Par. 1.2.2.11)



(A) UNVENTED BRANCH CONNECTIONS TO STACKS



(B) DESIGN CURVE FOR 32 mm WASHBASIN WASTE PIPES

**1.2.2.12** If the values in Diagram 3 are exceeded, the branch pipe should be ventilated by a branch ventilating pipe to external air, to a discharge stack (modified single stack system), to a ventilating stack (ventilated system) or internally by an Air Admittance Valve complying with I.S. EN 12380: 2002 Air admittance valves for drainage systems - Requirements, test methods and evaluation of conformity.

**1.2.2.13** A separate ventilating stack is only likely to be preferred where the number of ventilating pipes is large and the distance from a discharge stack is significant (see sub-section 1.4.5).

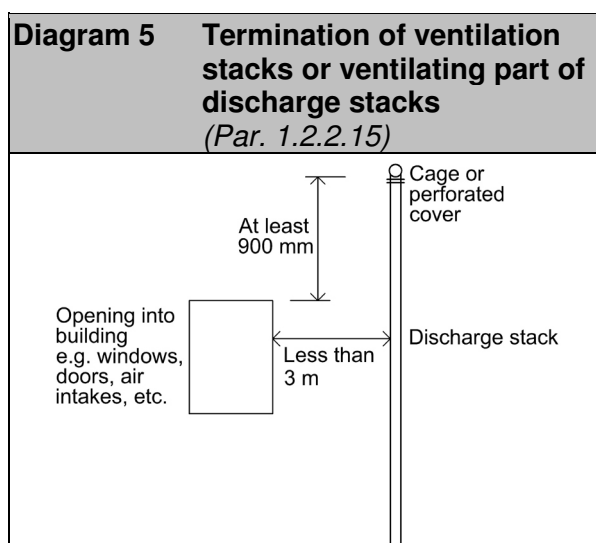
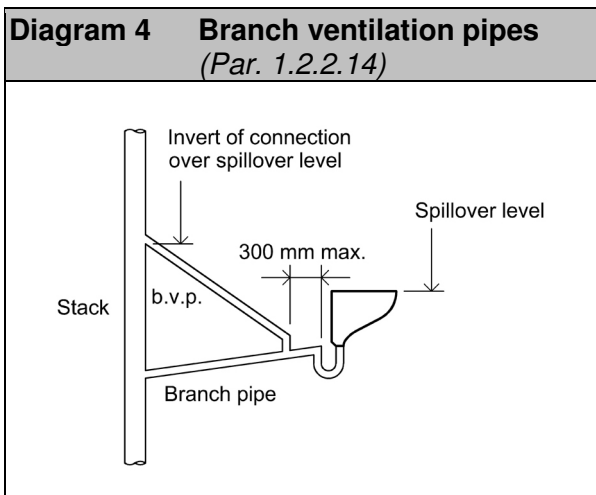
**1.2.2.14 Branch ventilating pipes:** A branch ventilating pipe should be connected to the branch pipe within 300 mm of the trap and

should not connect to the stack below the "spillover" level of the highest appliance served (see Diagram 4). The ventilation pipe should have a continuous incline from the branch pipe to the point of connection to the stack.

**1.2.2.15** Branch ventilation pipes which run direct to outside air should finish at least 900 mm above any opening into the building nearer than 3 m (see Diagram 5 and paragraph 1.2.3.5).

**1.2.2.16** Branch ventilating pipes to branch pipes serving one appliance should be at least 25 mm diameter or, where the branch is longer than 15 m or has more than five bends, should be at least 32 mm.

**1.2.2.17** Rodding points should be provided to give access to any lengths of branch pipes which cannot be reached by removing traps.



## 1.2.3 Discharge stacks

**1.2.3.1** All stacks should discharge to a drain. The bend at the foot of the stack should have as large a radius as possible and should be at least 200 mm at the centre line.

**1.2.3.2** Offsets in the 'wet' portion of a discharge stack should be avoided. If they are unavoidable then, in a building of not more than three storeys, there should be no branch connection within 750 mm of the offset. In a building of more than three storeys a ventilation stack may be needed with connections above and below the offset. In buildings over three storeys, discharge

stacks should be located inside the building.

**1.2.3.3 Sizes of discharge stacks:** Stacks should have at least the diameter shown in Table 4 and should not reduce in the direction of flow. Stacks serving urinals should be not less than 50 mm in diameter and stacks serving water closets should be not less than 100 mm in diameter.

**1.2.3.4 Ventilation of discharge stacks:** To prevent water seals in the traps from being lost by pressures which can develop in the system, stacks should be ventilated. Stacks connected to drains liable to surcharging or near an intercepting trap require ventilation pipes of not less than 50 mm diameter connected to the base of the stack above the likely flood level.

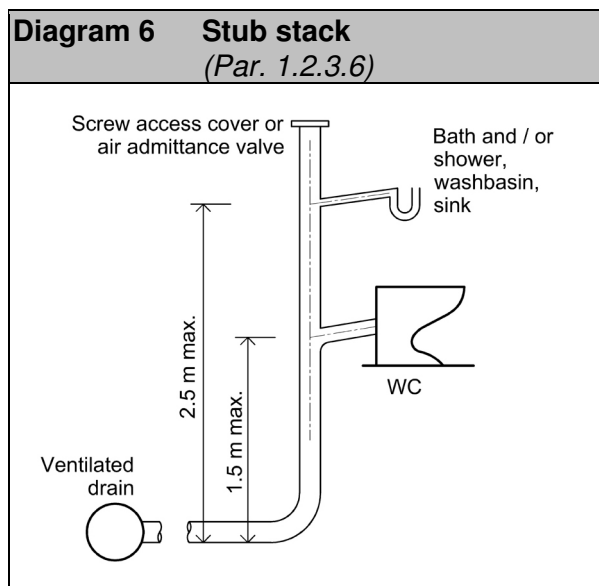
Table 4 Minimum diameters for discharge stacks	
Stack size (mm)	Max capacity (litres/sec)
50 *	1.2
65 *	2.1
75 †	3.4
90	5.3
100	7.2
Notes: * No wcs † See paragraph 1.3.4.2	

**1.2.3.5** Ventilating pipes open to external air should finish at least 900 mm above any opening into the building within 3 m and should be finished with a cage or other perforated cover which does not restrict the flow of air (see Diagram 5).

**1.2.3.6 Stub stacks:** A stub stack may be used if it connects into a ventilated discharge stack or into a ventilated drain not subject to surcharging and no connected water closet has a drop more than 1.5 m (see Diagram 6) and no other branch into the stub stack has a centre line more than 2.5 m (see Diagram 6) to the invert of the connection or drain.

**1.2.3.7 Size of stack ventilation pipes:** The diameter of the part of a discharge stack

which serves only for ventilation (the dry part above the highest branch) may be reduced in one and two storey houses, but should be at least 75 mm.



**1.2.3.8** Ventilated discharge stacks may be terminated inside a building when fitted with air admittance valves complying with I.S. EN 12380 Air admittance valves for drainage systems - Requirements, test methods and evaluation of conformity. Where these valves are used they should not adversely affect the amount of ventilation necessary for the below ground system which is normally provided by open stacks of the drainage pipework. Air admittance valves should be located in areas which have adequate ventilation, should be accessible for maintenance and should be removable to give access for clearance of blockages. Air admittance valves should not be used outside buildings or in dust laden atmospheres.

#### 1.2.4 Access for clearing blockages

Rodding points should be provided to give access to any lengths of pipe which cannot be reached from any other part of the system. All pipes should be reasonably accessible for repair.

#### 1.2.5 Materials for pipes, fittings and joints

**1.2.5.1** Any of the materials shown in Table 5

may be used. Different metals should be separated by non-metallic material to prevent electrolytic corrosion. Pipes should be firmly supported without restricting thermal movement.

<b>Table 5 Materials for sanitary pipework</b>	
<b>Material</b>	<b>Irish / British Standards</b>
<b>Pipes</b>	
cast iron	BS 416-1 I.S. EN 877
copper	I.S. EN 1254 I.S. EN 1057
galvanised steel	BS 3868
PVC-u	BS 4514 I.S. EN 1329-1
polypropylene plastics	I.S. EN 1451-1
ABS	I.S. EN 1455
PVC-C	I.S. EN 1566-1
polyethylene	I.S. 134 I.S. 135 I.S. EN 1519
<b>Traps</b>	
plastics	I.S. EN 274(1-3)
<i>Note:</i> Some of these materials may not be suitable for conveying trade effluent.	

Attention is also drawn to the requirements of Part B of the Second Schedule to the Building Regulations (Amendment) Regulations 2006, and guidance in Technical Guidance Document B relating to penetration of fire separating elements and of fire stopping provisions.

**1.2.5.2** Drainage pipes connected to WCs should not allow light to be visible through the pipe wall, as this is believed to encourage damage by rodents.

#### 1.2.6 Airtightness

The pipes, fittings and joints should be capable of withstanding an air or smoke test of positive pressure of at least 38 mm water gauge for at least three minutes. During this time every trap should maintain a water seal of at least 25 mm. Smoke testing is not recommended for PVC-u pipes.

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## **1.3 FOUL WASTEWATER DRAINAGE – PIPEWORK UNDERGROUND**

### **1.3.1 General**

**1.3.1.1** The provisions of this sub-section apply to foul wastewater drainage. However, some public sewers may carry foul wastewater and surface water in the same pipe. If the drainage system is to carry surface water to such a sewer, the following provisions still apply but the pipe sizes may need to be increased to carry the combined flows. Combined systems should not discharge to a wastewater treatment system.

**1.3.1.2** Where gravity connection to the sewer is impracticable, sewage lifting equipment will be needed. Guidance on sewage lifting equipment and installations is contained in I.S. EN 12050 (1-4) Wastewater lifting plants for buildings and sites and IS EN 12056-4 Wastewater lifting plants – Layout and calculation (see sub-section 1.3.5).

### **1.3.2 Layout**

**1.3.2.1** The layout of the drainage system should be as simple as possible. Changes of direction and gradient should be minimised and as easy as practicable. Access points should be provided only if blockages could not be cleared without them. Connections of drains to other drains or to sewers should be made obliquely, and in the direction of flow. They should be formed using a standard saddle connection.

**1.3.2.2** The system should be ventilated by a flow of air. A ventilating pipe (without an air admittance valve) should be provided, at or near the head of each main drain, to any branch longer than 6 m and on a drain fitted with an intercepting trap (particularly on a sealed system). Ventilating discharge stacks may be used (see paragraphs 1.2.3.4 and 1.2.3.5).

**1.3.2.3** Pipes should be laid to even gradients and any change of gradient should be combined with an access point (see paragraph 1.3.8.4).

**1.3.2.4** Pipes should be laid in straight lines where practicable but may be laid to slight curves if these can still be cleared of blockages. Any bends should be limited to positions in or close to inspection chambers or manholes (see paragraph 1.3.8.4) and to the foot of discharge and ventilating stacks. Bends should have as large a radius as practicable.

**1.3.2.5** Special precautions should be taken to accommodate the effects of settlement where pipes run under or near a building, on piles or beams, in common trenches or in unstable ground (see sub-section 1.7.1). Precautions may also be necessary in situations involving surcharging of drains (see sub-section 1.7.2).

**1.3.2.6** Drainage serving kitchens in commercial hot food premises should be fitted with a grease separator complying with I.S. EN 1825-1: 2004 Grease separators - Part 1: Principles of design, performance and testing, marking and quality control and designed in accordance with I.S. EN 1825-2: 2002 Grease separators - Part 2: Selection of nominal size, installation, operation and maintenance, or other effective means of grease removal. For further information refer to I.S. 351 (when available).

### **1.3.3 Depth of pipe cover**

**1.3.3.1** The depth of cover will depend on the levels of the connections to the system, the gradients at which the pipes are to be laid and the ground levels.

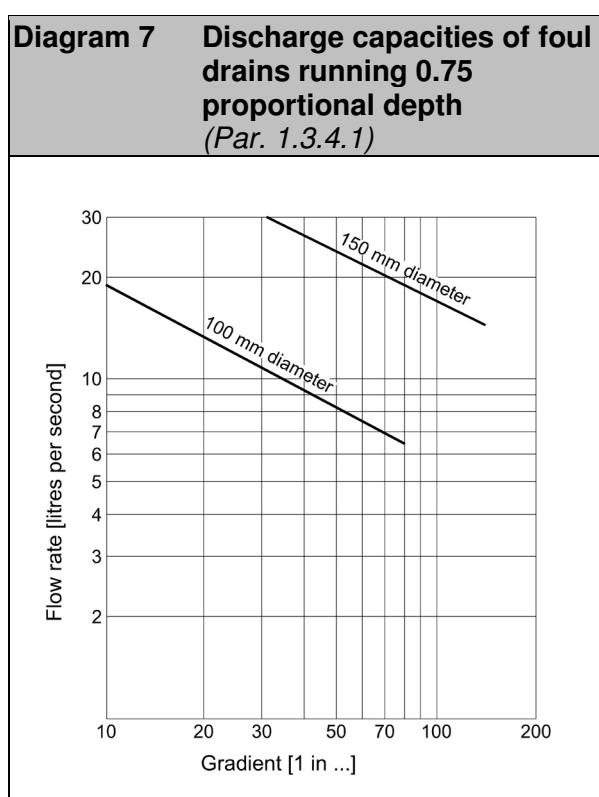
**1.3.3.2** Pipes need to be protected from damage and if the proposed bedding class gives too little cover (or too much, when the pipes could be damaged by the weight of backfilling) for one combination of cover, pipe strength and pipe bedding, it may be possible to choose another combination (see paragraph 1.3.7.1). I.S. EN 1295-1: 1998 Structural design of buried pipelines under various conditions of loading - Part 1: General Requirements gives details for design of pipe loadings.



Alternatively special protection can be provided (see sub-section 1.7.3).

### 1.3.4 Pipe gradients and sizes

**1.3.4.1** Drains should be laid to falls and have enough capacity to carry the flow. The flow depends on the appliances connected (see paragraphs 1.1.2.2 to 1.1.2.5 and Table 1) and the capacity depends on the size and gradient of the pipes (see Diagram 7).



**1.3.4.2** Notwithstanding the discharge capacities shown in Diagram 7, a drain carrying foul wastewater should have a diameter of at least 100 mm. The minimum size of a drain serving three or more dwellings should be 150 mm and no single drain should serve more than eight dwellings.

**1.3.4.3** Table 6 shows the flattest gradients at which foul drains should be laid, (depending on the flow and the appliances connected to them) and the capacity they will then have (see also paragraphs 1.1.2.2 to 1.1.2.5).

**1.3.4.4 Combined systems:** The capacity of systems carrying foul wastewater and surface

water should take account of the combined peak flow (see paragraph 1.3.1.1).

Table 6 Recommended minimum gradients for foul drains			
Peak flow (litres/sec)	Pipe size (mm)	Minimum gradient (1 in....)	Number of dwellings served
< 2.5	100	1:60*	1
> 2.5	100	1:100*	Up to 3
	150	1:150†	3 to 8

Notes:  
 \* Minimum of 1 wc  
 † Minimum of 5 wcs

### 1.3.5 Lifting installations

**1.3.5.1** Where gravity drainage is impracticable or protection against flooding due to surcharge in downstream sewers is required, a lifting (pumping) installation will be needed.

**1.3.5.2** Package lifting installations are available which are suitable for installation within buildings. Floor mounted units may be particularly suited for installation in basements. These should conform to I.S. EN 12050 (1-4) Wastewater lifting plants for buildings and sites. Pumping installations for use inside buildings should be designed in accordance with I.S. EN 12056-4 Wastewater lifting plants – layout and calculation, using a back-loop or non return valve to prevent flooding.

**1.3.5.3** Where foul drainage from a building is to be pumped, the effluent-receiving chamber should be sized to contain 24-hour inflow to allow for disruption in service. The minimum daily discharge of foul drainage should be taken as 150 litres per head per day for domestic use. For other types of building, the capacity of the receiving chamber should be based on the calculated daily demand of the water intake for the building. Where only a proportion of the foul sewage is to be pumped, then the capacity should be based pro-rata. In all pumped systems the controls should be so arranged to optimize pump efficiency and be fitted with a suitable alarm system to alert the owner of any malfunction.

### 1.3.6 Materials for pipes and jointing

Any of the materials shown in Table 7 may be used. Joints should be appropriate to the material of the pipes. To minimise the effects of any differential settlement, pipes should have flexible joints. All joints should remain watertight under working and test conditions and nothing in the pipes, joints or fittings should project into the pipe line or cause an obstruction. Different metals should be separated by non-metallic materials to prevent electrolytic corrosion.

Table 7 Materials for below ground gravity drainage	
Material	Irish / British Standard
<b>Rigid pipes</b>	
fibre cement	I.S. EN 588-1
vitified clay	I.S. EN 295 BS 65
concrete	I.S. 6 BS 5911 I.S. EN 1916 and for surface water drainage only I.S. 166
grey iron	I.S. 262 BS 437
ductile iron	I.S. EN 598 I.S. 262
<b>Flexible pipes</b>	
PVC-u	BS 4660 I.S. EN 1401-1 BS ISO 4065
PP	I.S. EN 1852
Structure walled plastic pipe	I.S. EN 13476
<i>Note:</i> <i>Some of these materials may not be suitable for conveying trade effluent.</i>	

### 1.3.7 Bedding and backfilling

**1.3.7.1** The choice of bedding and backfilling depends on the depth at which the pipes are to be laid and the size and strength of the pipes.

**1.3.7.2 Rigid Pipes:** The types of bedding and backfilling which should be used for rigid pipes of standard strength laid in a trench of any width are shown in Diagram 8 and Table 8. Minimum and maximum depths of cover

are also shown for each type. For special protection where pipes are laid with less cover (see paragraph 1.7.3.1).

**1.3.7.3 Flexible pipes:** Such pipes may become deformed under load and require support to limit the deformation to 5% of the diameter of the pipe. The bedding and backfilling should be as shown in Diagram 9. The minimum depth should be 900 mm under any road and 600 mm in fields and gardens. The maximum depth should be 10 m. For special protection where pipes are laid with less cover (see paragraphs 1.7.3.2 and 1.7.3.3).

### 1.3.8 Clearance of blockages

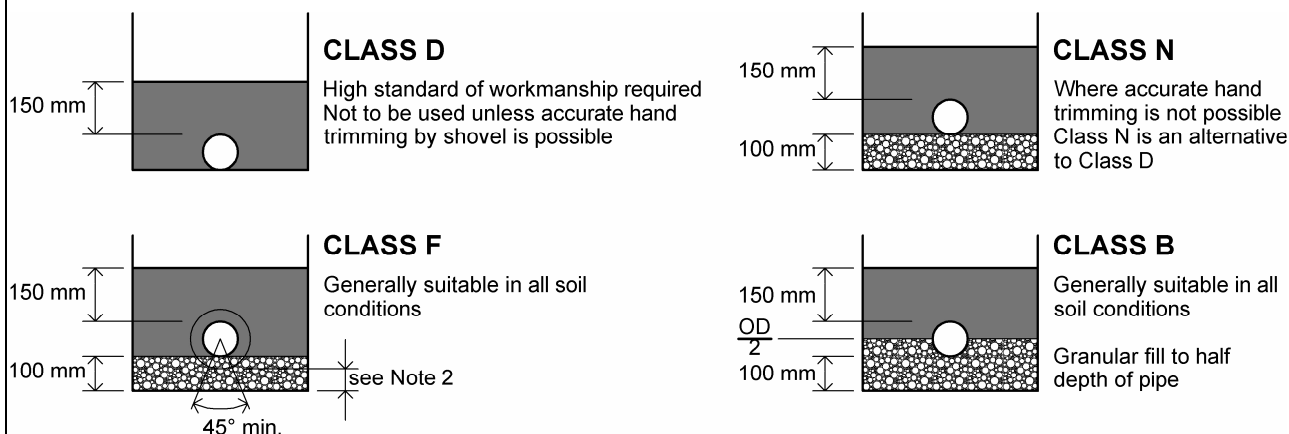
**1.3.8.1** Sufficient and suitable access points should be provided for clearing blockages from drain runs by rodding which cannot be reached by any other means. The siting, spacing and type of the access points will depend on the layout, depth and size of the runs.

**1.3.8.2** The provisions described below are for normal methods of rodding (which need not be in the direction of flow) and not for mechanical means of clearing.

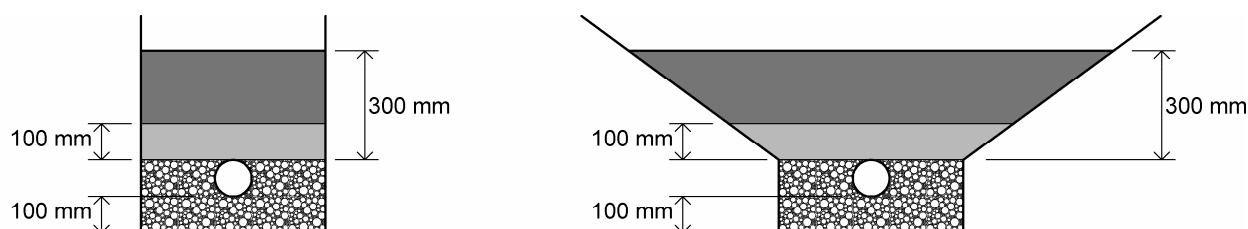
**1.3.8.3** Access points should be one of four types. Table 9 shows the depth at which each type should be used and the recommended dimensions. The dimensions should be increased at junctions if they do not allow enough space for branches. The types are: -

- (a) rodding eyes - capped extensions of the pipes;
- (b) access fittings - small chambers on (or an extension of) the pipes but not with an open channel;
- (c) inspection chambers - shallow chambers, e.g. an armstrong-junction, with working space at ground level;
- (d) manholes - large chambers with working space at drain level.




**Diagram 8 Bedding for rigid pipes**  
(Par. 1.3.7.2)



**Diagram 9 Bedding for flexible pipes**  
(Par. 1.3.7.3)



**Key to Diagrams 8 and 9**

-  Selected fill: free from stones larger than 40 mm, lumps of clay over 75 - 100 mm, timber, frozen material, vegetable matter.
-  Selected fill or granular fill free from stones larger than 40 mm.
-  The granular material should conform to I.S. EN 1610 Annex B table B 15 and should be single sized material or graded material from 5 - 10 mm for 100 mm pipes, 5 - 14 mm for 150 mm pipes and 5 - 20 mm for 150 - 600 mm pipes. Compaction fraction of 0.2 or less.

**NOTES:**

1. Provision may be required to prevent ground water flow in trenches with Class N, F or B type bedding.
2. Where there are sockets these should be not less than 50 mm above the floor of the trench.

**Table 8 Limits of cover in metres for standard strength rigid pipes in any width of trench**

Pipe bore (mm)	Bedding class	Fields and gardens		Light traffic roads		Heavy traffic roads	
		Min	Max	Min	Max	Min	Max
100	D or N	0.4	4.2	0.7	4.1	0.7	3.7
	F	0.3	5.8	0.5	5.8	0.5	5.5
	B	0.3	7.4	0.4	7.4	0.4	7.2
150	D or N	0.6	2.7	1.1	2.5	-	-
	F	0.6	3.9	0.7	3.8	0.7	3.3
	B	0.6	5.0	0.6	5.0	0.6	4.6

Note:

For limits of cover for flexible pipes see paragraph 1.3.7.3

<b>Table 9 Minimum dimensions for access fitting and chambers</b>					
Type	Depth to (m)	Internal Sizes		Cover Sizes	
		length x width (mm x mm)	circular (mm)	length x width (mm x mm)	circular (mm)
Rodding eye		As drain but min 100			
Access fitting					
small	0.6 or less	150 x 100	150	150 x 100	150
large		300 x 100	-	300 x 100	-
Inspection chamber	0.6 or less	300 x 300	190*	300 x 300	190*
	1.0 or less	450 x 450	450	450 x 450	450†
Manhole	1.5 or less	1200 x 750	1000	600 x 600	600
	over 1.5	1200 x 750	1200	600 x 600	600
	over 2.07	1200 x 840	1200	600 x 600	600
Shaft	over 2.7	900 x 840	900	600 x 600	600
Notes:					
† For clayware or plastics may be reduced to 430 mm in order to provide support for cover and frame.					
* Drains up to 150 mm.					

<b>Table 10 Maximum spacing of access points in metres</b>					
From	To	Access fitting		Junction	Inspection chamber
		large	small		
Start of external drain*		12	12	-	22
Rodding eye		22	22	22	45
Access fitting					
Small 150 mm diameter					
150 x 100 mm		-	-	12	22
Large 300 x 100 mm		-	-	22	45
Inspection chamber		22	45	22	45
Manhole		22	45	45	90
Notes:					
* See paragraph 1.3.8.5					

**1.3.8.4 Siting of access points:** Access should be provided at the following points: -

- (a) on or near the head of each drain run;
- (b) at a bend and at a change of gradient;
- (c) at a change of pipe size (but see below if it is at a junction); and
- (d) at a junction unless each run can be cleared from an access point (some junctions can only be rodded through from one direction).

**1.3.8.5** Access should be provided to long runs. The distances between access points depend on the types of access used but

should be not more than that shown in Table 10 for drains up to and including 300 mm.

**1.3.8.6 Construction of access points:**

These should contain the foul wastewater under working and test conditions and resist the entry of ground water and rainwater. Any of the materials shown in Table 11 may be used.

**1.3.8.7** Where half round channels are used in inspection chambers and manholes, the branches should discharge into the channel at or above the level of the horizontal diameter. Where the angle of the branch is more than 45°, a three quarter section branch should be used. Channels and branches

should be benched up at least to the top of the outgoing pipe and at a slope of 1 in 12. The benching should be rounded at the channel with a radius of at least 25 mm.

**1.3.8.8** Inspection chambers and manholes should have removable non-ventilating covers of durable material (such as cast iron, cast or pressed steel, precast concrete or PVC-u) and be of suitable strength. Inspection chambers and manholes in buildings should have mechanically fixed airtight covers unless the drain itself has watertight access covers. (I.S. EN 124: 1994 Gully tops and manhole tops for vehicular and pedestrian areas, gives further guidance.)

Manholes deeper than 1 m should have metal step irons or fixed ladders. (I.S. EN 14396: 2004 Fixed ladders for manholes, gives further guidance.)

<b>Table 11 Materials for access points</b>	
<b>Material</b>	<b>Irish / British Standard</b>
<b>Inspection chambers and manholes</b>	
- bricks and blocks	I.S. EN 771-1 & 3
- vitrified clay	BS 65 I.S. EN 295
- concrete <i>precast</i>	I.S. 6 I.S. 166 I.S. EN 1916 I.S. EN 1917 I.S. 420
<i>In situ</i>	I.S. EN 206-1
- plastics	I.S. EN 13598-1
<b>Rodding eyes and access fittings</b> (excluding frames and covers)	as pipes, see Table 7

### 1.3.9 Watertightness

**1.3.9.1** After laying drains and combined drains, including any necessary concrete or other haunching or surrounding and backfilling, all pipes up to 300 mm diameter should be capable of withstanding a final water test to a pressure equal to 1.5 m head of water measured above the invert at the head of the drain, or an air test ensuring that

head of water on a manometer does not fall by more than 25 mm in a period of five minutes for a 100 mm water gauge test pressure and 12 mm for a 50 mm water gauge test pressure.

**1.3.9.2** Where the drain is water tested using a stand pipe of the same diameter as the drain, the section of the drain should be filled and left to stand for two hours and topped up. The leakage over thirty minutes should then be measured and should not be more than 0.05 litres for each metre run of drain for a 100 mm drain - a drop in water level of 6.4 mm/m, and not more than 0.08 litres for a 150 mm drain - a drop in water level of 4.5 mm/m.

**1.3.9.3** To prevent damage to the drain, the head of water at the lower end of the section should not be more than 4 m and it may be necessary to test a drain in several sections.

### 1.3.10 Greywater recovery systems

**1.3.10.1** A greywater recovery system is an installation used to collect, store and treat greywater to a suitable quality and to distribute it for particular specified purposes. Greywater is water originating from the mains potable water supply that has been used for bathing, washing or laundering clothes. Water from dishwashers / sinks should be avoided.

**1.3.10.2** Where a greywater recovery system is installed the following guidance should be complied with: -

- Overground and underground drainage used to collect greywater for recovery and re-use within the building should be designed and constructed in accordance with the general guidance in Section 1;
- All pipework for greywater recovery systems should be easily distinguished and easily recognisable wherever it is physically located (inside a property, in the street, or on private land, etc) to avoid cross-connection and

contamination of the potable water supply systems, e.g. for greywater green/black/green bands and the words GREY WATER in black lettering on a grey background in accordance with BS 1710: 1984 Identification of pipelines and services;

Note that where the pipe is insulated, the colour coding should be applied to the outer surface of the insulation or protective covering. For further details refer to BS 1710: 1984 Identification of pipelines and services;

- (c) For security of the potable supply and to avoid accidental or deliberate operation in emergencies, all apparatus such as valves and washouts should be suitably marked and significantly different from the apparatus normally used on potable water distribution networks (see Diagram 10);
- (d) Greywater collection pipework should drain directly to the treatment system to avoid stagnation. Storage of untreated grey water prior to the treatment system should be minimised;
- (e) The maximum stagnation period for greywater water should be 10 days unless otherwise specified by the manufacturer. The water quality being supplied for end-use after this period should still meet the water quality requirements stated in Tables 12 and 13;
- (f) After 10 days of stagnation, or the period specified by the manufacturer, all stored reclaimed water (other than in the WC cistern) should be automatically dumped to the foul drain or sewer;
- (g) A back-up water supply should be incorporated. Where this is from a potable or mains water supply the back-up supply should be fitted with a backflow prevention device giving Category 5 protection (an air gap - see I.S. EN 1717: 2000 Protection against

pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow) such as -

- a type AA air gap conforming to I.S. EN 13076: 2003 Devices to prevent pollution by backflow of potable water - unrestricted air gap, or
- a type AB air gap conforming to I.S. EN 13077: 2008 Devices to prevent pollution by backflow of potable water - Air gap with non-circular overflow.

**Diagram 10 Signage for non-potable water**  
(Par. 1.3.10.2)



**1.3.10.3** Clear and comprehensive information on the operation and maintenance of these systems, including the appropriate use of mains water prior to long periods of non-operation, should be provided to the owner to facilitate the effective running of the system and to give adequate health protection.

**1.3.10.4 Fail safe operation:** System operation should be fail safe such that untreated water cannot be supplied to the points of use in the event of system failure, such as: -

- (a) interruption of power;

<b>Table 12 Maximum concentration of bacteria in reclaimed water</b>			
	<b>Class A</b>	<b>Class B</b>	<b>Class C</b>
<b>Applications</b>	<i>Vehicle washing sprays</i>	<i>Drip &amp; sub-surface irrigation</i>	<i>WC flushing (no taps)</i>
<b>Water quality guideline</b> Total coliforms cfu/100 ml	10	1000	1000
<b>Test criteria</b> Total coliforms cfu/100 ml	1	100	100

<b>Table 13 Maximum concentration of bacteria in reclaimed water</b>			
	<b>Class A</b>	<b>Class B</b>	<b>Class C</b>
<b>Applications</b>	<i>Vehicle washing sprays</i>	<i>Drip &amp; sub-surface irrigation</i>	<i>WC flushing (no taps)</i>
Total chlorine ppm	0.5	0.5	2
Other disinfectants	For disinfectants other than chlorine appropriate residual concentrations and suitable analytical methods must be declared by the supplier.		

- (b) loss of disinfection process;
- (c) detection of sewer backflow; and
- (d) other circumstances as defined by the manufacturer.

A visible warning indicator should alert the user that the system is in a fail safe condition (lockout) and will not restart without appropriate manual intervention as described in the operation and maintenance manual.

**1.3.10.5** Further guidance on greywater recovery systems can be found in: -

BSRIA Water Reclamation Guidance TN 6-2002 - Design and construction of systems using Greywater.

BSRIA Water Reclamation Standard TN 7-2002 - Laboratory testing of systems using Greywater.

BS 8525-1: 2010 Greywater systems - Code of Practice and Part 2 specification (when available).

**1.3.10.6** Guidance on external storage tanks is given in section 1.6.

## **1.4 ADDITIONAL GUIDANCE FOR LARGE BUILDINGS**

### **1.4.1 Capacity of pipes**

Flow rates for other commonly used appliances not covered in Table 1 are shown in Table 14.

### **1.4.2 Traps**

Minimum trap sizes and seal depths for appliances not listed in Table 2 are shown in Table 15.

### **1.4.3 Branch pipes**

**1.4.3.1** A branch pipe should not discharge into a stack less than 750 mm above the invert of the tail of the bend at the foot of the stack in a building of four or five storeys. Alternatively a branch pipe serving any ground floor appliance may discharge direct to a drain or into its own stack.

<b>Table 14 Flow rates from appliances</b>	
<b>Appliance</b>	<b>Flow rate (litres per sec)</b>
Spray basin	0.06
Washing machine	0.70
Dishwashing machine	0.25
Urinal	0.15

**1.4.3.2** If the building has more than five storeys, ground floor appliances, unless discharging to a gully or drain, should discharge into their own stack. In addition, if the building has more than 20 storeys the first floor appliances should also discharge into their own stack or a stack combined with the ground floor.

<b>Table 15 Minimum trap sizes and seal depths additional to Table 2</b>		
<b>Appliance</b>	<b>Diameter of Trap (mm)</b>	<b>Depth of seal (mm)</b>
Sanitary towel macerator	40	75
Food waste disposal unit (industrial type)	50	75
Urinal stall (1 to 6 person position)	65	50

#### **1.4.4 Stub stacks**

Stub Stacks may be used in paragraphs 1.4.3.1 and 1.4.3.2 subject to the restrictions in paragraph 1.2.3.6 and Diagram 6.

#### **1.4.5 Ventilating stacks**

**1.4.5.1** A dry stack may provide ventilation for branch ventilating pipes as an alternative to carrying them to outside air or to a ventilated discharge stack (ventilated system).

**1.4.5.2** Ventilation stacks serving buildings with not more than ten storeys and containing only dwellings should be at least 32 mm diameter.

**1.4.5.3** The lower end of a stack may be connected directly to a bend (see paragraph 1.2.3.1) or it may be connected to a ventilated discharge stack in which case the connection should be below the lowest branch pipe.

**1.4.5.4** The upper end of a stack may be carried to outside air (when it should finish as described in paragraph 1.2.2.15) or it may be connected to a ventilated discharge stack when the connection should be above the spill-over level of the highest appliance.

## **1.5 SURFACE WATER DRAINAGE**

### **1.5.1 Gutters**

**1.5.1.1** There is no requirement in this document for the provision of rainwater drainage for areas of 6 m<sup>2</sup> or less, i.e. small roofs, balconies etc., unless they receive a flow of rainwater from another pipe, roof or hard surface.

**1.5.1.2** The flow into a gutter depends on the area of surface being drained and whether the surface is flat or pitched (and, if it is pitched, on the angle of pitch). Table 16 shows a way of allowing for the pitch by working out an effective area. Where rain driven against a wall by the wind can run down onto the roof or into a gutter, 50% of the area of the wall shall be added to the effective area of the roof.

<b>Table 16 Calculation of area drained</b>	
<b>Type of surface</b>	<b>Effective design area (m<sup>2</sup>)</b>
flat roof	plan area of relevant portion
pitched roof at 30°	plan area of Portion x 1.15
pitched roof at 45°	plan area of portion x 1.40
pitched roof at 60°	plan area of portion x 2.00
pitched roof over 70° or any wall draining onto a roof or gutter	elevational area x 0.5

**1.5.1.3** Table 17 shows the largest effective areas which should be drained into the gutter sizes which are most often used. These sizes are for a gutter which is laid level, half round in section with a sharp edged outlet at only one end and where the distance from a stop end to the outlet is not more than 50 times the water depth. At greater distances, the capacity of the gutter should be reduced. The Table shows the smallest size of outlet which should be used with the gutter.

**1.5.1.4** Where the outlet is not at the end, the gutter should be of the size appropriate to the larger of the areas draining into it. Where there are two end outlets, they may be up to



one hundred times the depth of flow, apart.

**1.5.1.5** Gutters should be laid with any fall towards the nearest outlet. Where there is a fall, or the gutter has a section which gives it larger capacity than a half-round gutter, or the outlet is round edged, it may be possible to reduce the size of the gutter and pipe. Refer to I.S. EN 12056-3: 2000 Gravity drainage systems inside buildings - Part 3: Roof drainage, layout and calculation, for reduction calculations. Gutters should also be laid so that any overflow in excess of the design capacity caused by conditions such as above normal rainfall will be discharged clear of the building.

<b>Table 17 Gutter sizes and outlet sizes</b>			
<b>Max effective roof area (m<sup>2</sup>)</b>	<b>Gutter size (mm dia)</b>	<b>Outlet size (mm dia)</b>	<b>Flow Capacity (litres/sec)</b>
6.0	-	-	-
18.0	75	50	0.38
37.0	100	63	0.78
53.0	115	63	1.11
65.0	125	75	1.37
103.0	150	89	2.16

*Note:*  
Refers to normal half round eaves gutters laid level with outlets at one end sharp edged. Round edged outlets allow smaller downpipe sizes.

## 1.5.2 Rainwater pipes

**1.5.2.1** Rainwater pipes should discharge into a drain or gully but may discharge to another gutter or onto another surface if it is drained. Where a rainwater pipe discharges onto a lower roof or paved area, a pipe shoe should be fitted to divert water away from the building. Where rainwater from a roof with an effective area greater than 25 m<sup>2</sup> discharges through a single downpipe onto a lower roof, a distributor pipe should be fitted to the shoe to ensure that the flow width at the receiving gutter is sufficient so that it does not over-top the gutter. Any rainwater pipe which discharges into a combined system should do so through a trap (see sub-section 1.2).

**1.5.2.2** The size of a rainwater pipe should be at least the size of the outlet from the gutter. A down pipe which serves more than one

gutter should have an area at least as large as the combined areas of the outlets.

## 1.5.3 Siphonic roof drainage systems

Siphonic roof drainage systems should be designed in accordance with I.S. EN 12056-3: 2000 Gravity drainage systems inside buildings - Part 3: Roof drainage, layout and calculation. Such systems should take account of the surcharge in the downstream drainage system as this can reduce the flow in the downpipe. For long gutters the time taken for the system to prime the siphonic action may be excessive, therefore overflow arrangements should be provided to prevent gutters from over-flowing. For further guidance refer to BS 8490: 2007 Guide to siphonic roof drainage systems.

## 1.5.4 Eaves drop systems

Eaves drop systems allow rainwater from roofs to drop freely to the ground. Where these are used, they should be designed: -

- (a) to protect the fabric of the building from ingress of water, caused by water splashing on the external walls;
- (b) to prevent water from entering doorways and windows;
- (c) to protect persons using doorways etc. from falling water;
- (d) to protect persons and the fabric of the building from rainwater as it hits the ground by splashing, for example by provision of a gravel layer or angled concrete apron deflecting the water away from the building;
- (e) to protect the foundations from concentrated discharges such as those from valleys or valley gutters or from excessive flows due to large roofs (i.e. where the area of roof per unit length is high);
- (f) to protect against discharge of water onto neighbouring properties or buildings.

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## 1.5.5 Rainwater recovery systems

**1.5.5.1** Harvesting of rainwater consists of collecting rainwater from the external surfaces of buildings and hard-surface areas and diverting it via a filter system to a storage cistern or system. It is then pumped directly to the services using the reclaimed water or to a header tank to feed by gravity to the system.

**1.5.5.2** The recovered water, without treatment, can be used for: -

- (a) toilet flushing;
- (b) vehicle washing; and
- (c) landscape maintenance / irrigation.

It may also be used for washing machines but occasionally the colour and odour associated may be a problem.

**1.5.5.3 Treatment:** Where the water is collected from the roof only, i.e. not from hard surfaces where faecal contamination may occur, and is to be used for purposes where there is no possibility of it being consumed or used for personal hygiene, then rainwater does not need to be disinfected and the only treatment necessary is filtering to remove leaves and other solid debris. This filter should be: -

- (a) water and weather resistant;
- (b) removable and readily accessible for maintenance purposes;
- (c) at least 90% efficient; and
- (d) designed to permit a maximum particle size of <1.25 mm.

**1.5.5.4 Precautions:** To prevent contamination of the collected rainwater and the backup potable water supply and to prevent accidental ingestion, the system should: -

- (a) have pipe-work clearly marked in

accordance with BS 8515: 2009 Rainwater harvesting systems - Code of practice and BS 1710: 1984 Specification for identification of pipelines and services, e.g. for rainwater green / black / green bands and the words RAINWATER in black lettering;

- (b) have external taps supplying rainwater clearly labelled and consideration should be given to having a removable handle (see Diagram 10);
- (c) have category 5 protection (an air gap, see I.S. EN 1717: 2000 Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow) such as an AA type air gap conforming to I.S. EN 13076: 2003 Devices to prevent pollution by backflow of potable water - unrestricted air gap, or an AB type air gap conforming to I.S. EN 13077: 2008 Devices to prevent pollution by backflow of potable water - Air gap with non-circular overflow, fitted at the potable water top up point;
- (d) have a non-return valve fitted on the overflow;
- (e) have an anti-rodent device fitted to the overflow system;
- (f) have an automatic drainage system from the header tank, where used, in the event of stagnation.

**1.5.5.5** All systems should be adequately maintained to ensure effective and efficient operation.

Further guidance on Rainwater Harvesting Systems can be found in BS 8515: 2009 Rainwater harvesting systems - Code of practice.

**1.5.5.6** Guidance on external storage tanks is given in section 1.6.

### 1.5.6 Materials for gutters, rainwater pipes and joints

The materials used should be of adequate strength and durability and,

- (a) all gutter joints should remain watertight under working conditions, and
- (b) pipes inside a building should be capable of withstanding the airtightness test described in paragraph 1.2.6, and
- (c) gutters and rainwater pipes should be firmly supported without restricting thermal movement, and
- (d) different metals should be separated by nonmetallic material to prevent electrolytic corrosion.

### 1.5.7 Design

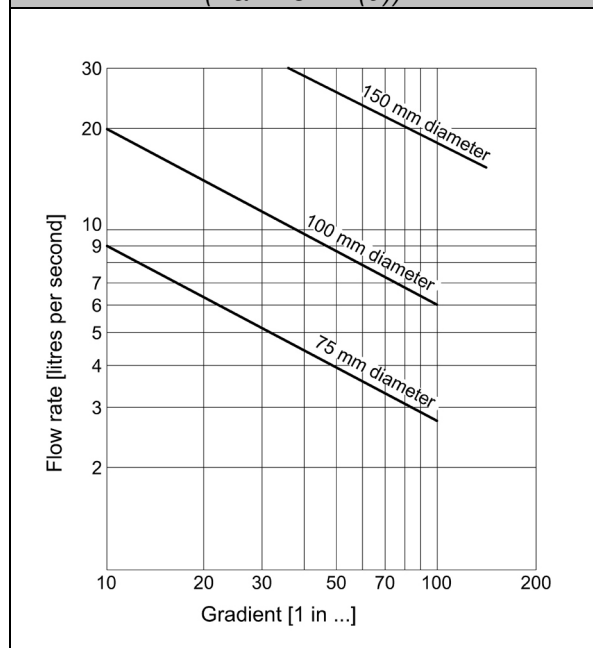
**1.5.7.1 Combined systems:** Some public sewers carry both foul wastewater and surface water (combined systems) in the same pipe (see paragraph 1.3.1.1). All new drainage systems should be designed and constructed on the basis of a separate system even where draining into a combined system.

**1.5.7.2** The following provisions apply if the drainage system is to carry only surface water: -

- (a) Where there is evidence of a liability to surcharging from sewers, or where levels in the building or on the site make gravity connection impracticable, surface water lifting equipment will be needed. For Guidance on surface water lifting installations see sub-section 1.3.5 and I.S. EN 12056-4 Wastewater lifting plants - Layout and calculation.
- (b) **Layout:** Refer to section 1.3 – sub-section 1.3.2.
- (c) **Depth of pipe cover:** Refer to section 1.3 – sub-section 1.3.3.

- (d) **Pipe gradients and sizes:** Drains should have enough capacity to carry the flow, which may include the run off from paved or other hard surfaces. A rainfall intensity of 50 mm/hour should be assumed for these areas (see paragraph 1.1.3.3). The capacity depends on the size and gradients of the pipes. Drains should be at least 75 mm diameter. Diagram 11 shows the capacities of drains of various sizes at different gradients. 75 mm and 100 mm rainwater drains should be laid at not less than 1:100. However, the capacity can be increased by increasing the gradient, or by using larger pipes (see I.S. EN 12056-3: 2000 Gravity drainage systems inside buildings - Part 3: Roof drainage, layout and calculation - Table C1 in Annex C).

**Diagram 11 Discharge**  
(Par 1.5.7.2(d))



- (e) **Materials for pipes and jointing:** Refer to sub-section 1.3.6.
- (f) **Bedding and backfilling:** Refer to sub-section 1.3.7.
- (g) **Clearance of blockages:** Refer to sub-section 1.3.8.

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- (h) **Watertightness:** Refer to sub-section 1.3.9.

### **1.5.8 Soakaways**

**1.5.8.1** Soakaways should not be built: -

- (a) within 5 m of a building or road or in areas of unstable land;
- (b) in ground where the water table reaches the bottom of the soakaway at any time of the year;
- (c) within 5 m of any drainage fields (percolation area), drainage mounds or other soakaways and should be sited down gradient to ensure that the overall soakage capacity of the ground is not exceeded and the effectiveness of any drainage fields is not impaired;
- (d) where the presence of any contamination in the runoff could result in pollution of a groundwater source or resource.

**1.5.8.2** Soakaways for areas less than 100 m<sup>2</sup> are generally formed from square or circular pits, filled with rubble or lined with dry-jointed masonry or perforated ring units. Soakaways serving larger areas are generally lined pits or trench type soakaways.

For soakaways serving larger areas reference should be made to BRE Digest 365 Soakaway design.

## **1.6 EXTERNAL GREYWATER AND RAINWATER STORAGE TANKS**

**1.6.1** The following guidance is for the storage of greywater and rainwater for re-use within a building. It does not apply to water butts used for storage of rainwater for landscape maintenance / irrigation use.

**1.6.2** Greywater and rainwater external storage tanks should: -

- (a) prevent leakage of the contents and ingress of subsoil water, and should

have screened ventilation;

- (b) have an anti-backflow device (anti-surge valve conforming to I.S. EN 13564: 2002 Anti-flooding devices for buildings - Part 1: Requirements) on any overflow connected to a drain or sewer to prevent contamination of the stored greywater or rainwater in the event of surcharge in the drain or sewer;
- (c) be provided with access for emptying and cleaning. Access covers should be of durable quality having regard to the corrosive nature of the tank contents. The access should be lockable or otherwise engineered to prevent unauthorised entry;
- (d) be provided with a calmed inlet device in order to minimise turbulence and slow the water flow into the tank;
- (e) be fitted with a floating extraction filter (where feasible) extracting between 100-150 mm below the surface;
- (f) have a pump equipped with dry-run protection;
- (g) be sited so that the stored water does not attain temperatures that could encourage multiplication of legionella.

**1.6.3** Above ground tanks should be insulated and opaque to minimize the potential problems of freezing, warming and algal blooms.

**1.6.4** Below ground tanks should be of adequate strength to resist likely ground and / or traffic loadings and resist flotation. They provide frost protection, are cooler in Summer and restrict algal bloom due to lack of sunlight.

**1.6.5** For further information refer to BS 8515: 2009 Rainwater harvesting systems - Code of Practice and BS 8525: 2010 Greywater systems Part 1 - Code of practice and Part 2

- Specification and method of test for treatment equipment (when published).

Further guidance on systems for greywater and rainwater re-use can be found in the CIBSE Knowledge Series "Reclaimed Water" and the CIRIA Project Report 80 "Rainwater and Greywater use in buildings: Decision making for water conservation".

## 1.7 FURTHER GUIDANCE ON DRAINAGE SYSTEMS

### 1.7.1 Special protection – settlement

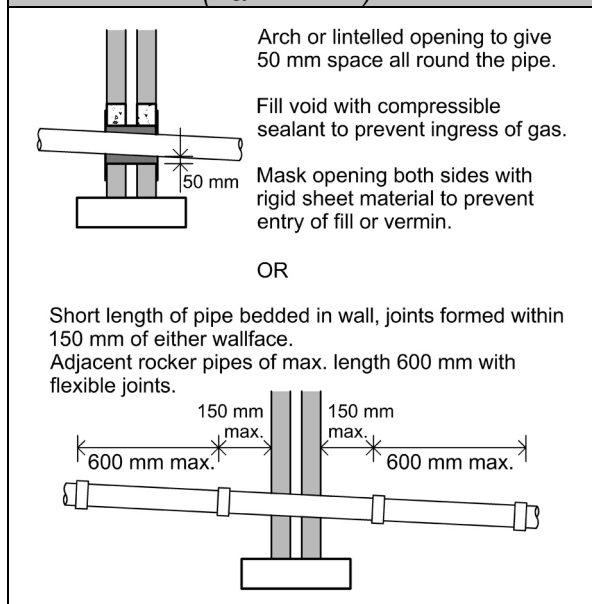
**1.7.1.1** A drain may run under a building if at least 100 mm of granular or other flexible filling is provided round the pipe. On sites where excessive subsidence is possible, additional flexible joints may be advisable or other solutions such as suspended drainage should be considered. Where the crown of the pipe is within 300 mm of the underside of a slab, concrete encasement should be used integral with the slab. Concrete for pipe encasement should be composed of cement (conforming to I.S. EN 197-1: 2001 Cement - Part 1: Composition, specifications and conformity criteria for common cements) and fine and coarse aggregate (conforming to I.S. EN 12620: 2002/A1: 2008 Aggregates for concrete) and should have a characteristic 28 day strength of C8/10 N/mm<sup>2</sup> (as per I.S. EN 206-1: 2002 Concrete - Specification, performance, production and conformity), cement content of 160 kg/m<sup>3</sup> and a water / cement ratio of 0.85. Where volumetric mixing is required for small projects, a 1:10 cement aggregate mix may be used.

**1.7.1.2** A drain may run through a wall or foundation. If it is necessary to build the pipe into the wall or foundation either -

- (a) an opening should be formed to give at least 50 mm clearance all round the pipe and the opening masked with rigid sheet material to prevent the ingress of fill or vermin. The void should also be filled with a compressible sealant to prevent ingress of gas, or
- (b) a length of pipe (as short as possible)

should be built in with its joints as close as possible to the wall faces (within at most 150 mm) and connected on each side to rocker pipes with a length of at most 600 mm and flexible joints (see Diagram 12).

**Diagram 12 Pipes penetrating**  
(Par. 1.7.1.2)

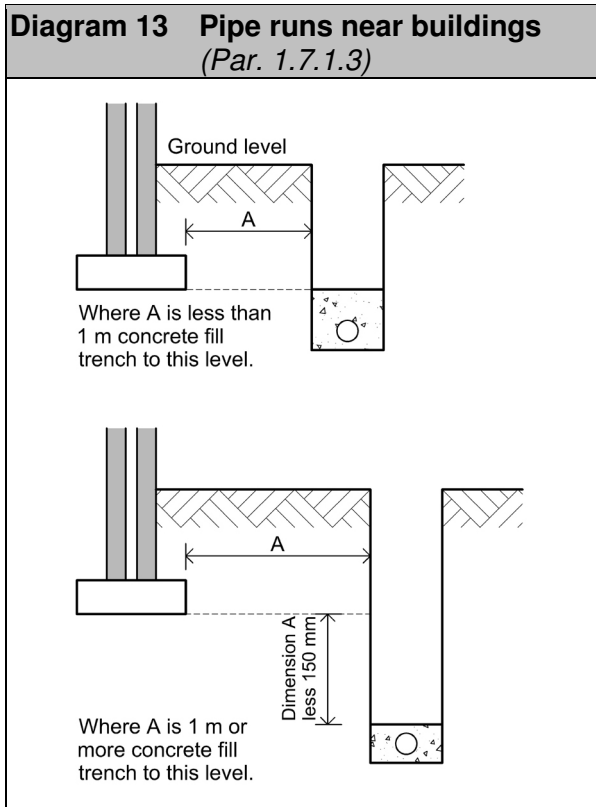


**1.7.1.3** A drain trench should not be excavated lower than the foundations of any building nearby (see Diagram 13) unless either: -

- (a) where the trench is within 1 m of the foundations of the building, the trench is filled with concrete up to the lowest level of the foundations; or
- (b) where the trench is further than 1 m from the foundation of the building, the trench is filled with concrete to a level below the lowest level of the foundation equal to the distance from the building, less 150 mm. See paragraph 1.7.1.1 for specification of concrete.

**1.7.1.4** Where pipes are to be laid on piles or beams or in a common trench, or where the ground may prove unstable, particularly where there is a high water table, the local authority may be able to provide information

regarding the site.



## 1.7.2 Special protection - surcharging of drains

**1.7.2.1** Where a drain is liable to surcharge, measures should be taken to protect the building.

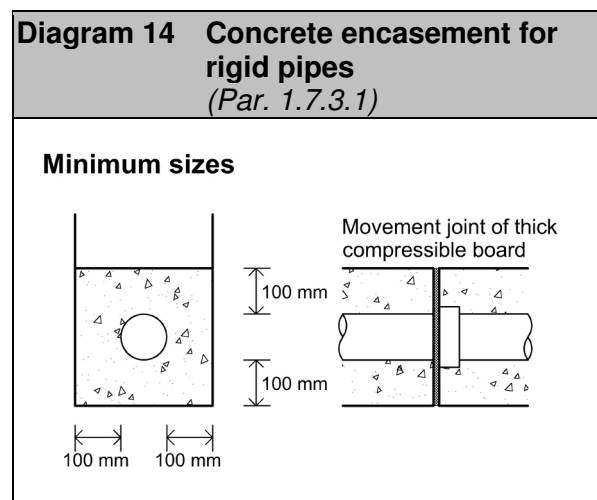
**1.7.2.2** Combined and surface water sewers are designed to surcharge (i.e. the water level in the manhole rises above the top of the pipe) in heavy rainfall. Some foul sewers also receive surface water and therefore surcharge. For low-lying sites (where the ground level of the site or the level of the basement is below the ground level at the point where the drainage connects to the public sewer) care should be taken to ensure that the property is not at risk of flooding.

**1.7.2.3** For basements containing sanitary appliances, where the risk of flooding due to surcharge of the sewer is considered high, the drainage from the basement should be pumped. Where the risk is considered to be low an anti-flood valve should be installed on

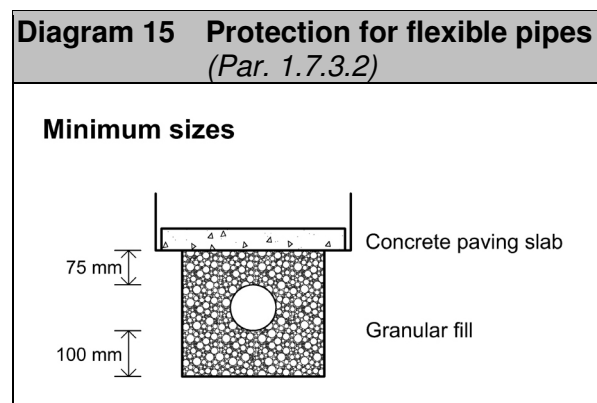
the drainage from the basement (see paragraphs 1.3.5.1 and 1.3.5.2).

## 1.7.3 Special protection - ground loads

**1.7.3.1** Where rigid pipes have less than the recommended cover in Table 8, the pipes should be protected by concrete encasement not less than 100 mm thick and having movement joints formed with compressible board at each socket or sleeve joint face (see Diagram 14).



**1.7.3.2** Where flexible pipes are not under a road and have less than 600 mm cover, they should have concrete paving slabs laid as bridging above the pipes with at least 75 mm of granular material between the top of the pipe and the underside of the slabs (see Diagram 15). The slabs should have adequate bearing on the original ground to cater for the overburden.



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**1.7.3.3** Where flexible pipes are under a road and have less than 900 mm cover, reinforced concrete bridging or a reinforced concrete surround should be used instead of paving slabs. For specification of concrete see paragraph 1.7.1.1.

event of collapse.

#### **1.7.4 Repairs and alterations**

Repairs, reconstruction and alterations to existing drains and sewers should be carried out to the same standards as new drains and sewers where possible. Where new pipework is connected to existing pipework, particular consideration should be given to the following points: -

- (a) the existing pipework should not be damaged, for example by using proper cutting equipment;
- (b) the resulting joint should be water tight, for example by using purpose made repair couplings;
- (c) differential settlement should not occur between existing and new pipework, for example by proper bedding of the pipework.

#### **1.7.5 Sealing disused drains**

**1.7.5.1** Disused drains or sewers provide ideal nesting sites for rodents. In order to prevent this, disused drains or sewers should be disconnected from the sewer system as near as possible to the point of connection. This should be done in a manner which does not damage any pipe which is still in use and ensures that the sewer system is water tight. This may be carried out, for example, by removing the pipe from a junction and placing a stopper in the branch of the junction fitting. Drains or sewers less than 1.5 m deep which are in open ground should as far as practicable be removed. Other pipes should be sealed at both ends and at any point of connection, and grout filled to ensure that rodents cannot gain access.

**1.7.5.2** Larger pipes (225 mm and above) should be grout filled to prevent subsidence or damage to the buildings or services in the

## Section 2

# Wastewater treatment systems

### Wastewater Treatment Systems

- H2
- (1) A wastewater treatment system shall be so designed, sited and constructed that:
    - (a) it is not prejudicial to the health of any person,
    - (b) it does not cause a risk to public health or the environment,
    - (c) it prevents unauthorised access but allows adequate means of access for emptying and maintenance,
    - (d) it will function to a sufficient standard for the protection of health in the event of a system failure,
    - (e) it has adequate capacity,
    - (f) it is impermeable to liquids, and
    - (g) it is adequately ventilated.
  - (2) Information on the wastewater treatment system and any continuing maintenance required to avoid risks to health and the environment shall be provided to the owner.

## 2.1 Guidance

**2.1.1** A wastewater treatment system is a septic tank system or a packaged wastewater system. In general a septic tank system is a wastewater treatment system that includes a septic tank mainly for primary treatment, followed by a percolation system in the soil providing secondary and tertiary treatment. A packaged wastewater treatment system, generally uses media and mechanical parts to enhance the treatment of the domestic wastewater and is followed by a polishing filter.

**2.1.2** In general, the design and installation of wastewater treatment systems for single houses should comply with the relevant parts of the Environmental Protection Agency's (EPA) Code of Practice 2009 Wastewater Treatment and Disposal Systems Serving Single Houses. This publication also includes guidance relating to site assessment, test holes, the appropriate distances between the wastewater treatment systems and critical targets including dwellings, wells and site boundaries. It also gives design criteria for filters and wetlands. This Code of Practice has superseded previous guidance given in SR 6: 1991 Septic tank systems - Recommendations for

domestic effluent treatment and disposal from a single dwelling house. Where the proposed system requires energy for operation, consideration should be given to the energy consumption and energy efficiency of the system.

**2.1.3** Guidance on the design and installation of wastewater treatment systems capable of serving larger buildings or more than one house is contained in I.S. EN 12566 Parts 1-4, BS 6297: 2007 Code of Practice for the design and installation of drainage fields for use in wastewater treatment and the EPA's Wastewater treatment manual - Treatment systems for small communities, business, leisure centres and hotels: 1999.

**2.1.4** The design, installation and commissioning of wastewater treatment systems should be carried out and / or supervised by a suitably qualified person or persons.

**2.1.5** The owner of the building should be provided with sufficient, clear and comprehensive information on any continuing maintenance required to facilitate the effective operation of the system in order to protect health and the environment.



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## **2.2 Septic tanks**

**2.2.1** Septic tanks provide suitable conditions for the settlement, storage and partial decomposition of solids which need to be removed at regular intervals. The effluent discharge from the septic tank can still be harmful and further treatment from either a percolation area, percolation mound, constructed wetland or intermittent filter will be required. In general, where a site is suitable for the development of a septic tank system, these systems designed and constructed in accordance with this guidance, and properly maintained, have been found, through national research, to achieve satisfactory effluent quality in terms of BOD, SS and NH<sub>4</sub> as N, equivalent to Table 18. In nutrient-sensitive areas, the local authority may require further treatment of the effluent.

**2.2.2** An effluent screen on the outlet of the tank is optional but is recommended as it gives extra protection to the percolation / filter system and gives early warning of the need for de-sludging. The screen may incorporate an alarm system. Septic Tanks must conform to I.S. EN 12566 Part 1 or 4 including their national annexes and comply with the EPA Code of Practice - Section 7.

**2.2.3** The tank should rest on a uniform surface capable of bearing the weight of the tank and its contents. After setting the tank, leveling and joining the drains from the house and the tank outlet to the distribution box, the joints and seals should be tested for water tightness before backfilling. The backfilling material should be free flowing and carried out in lifts to prevent disturbance of the tank. Precautions should be taken to prevent flotation of the tank either during or after construction.

**2.2.4** The distribution device, which divides the effluent evenly between the percolation pipes where a percolation area or mound is used, should be laid on a stable foundation and be leveled accurately to ensure the incoming effluent is evenly diverted to the outlet percolation pipes. Access / inspection covers should be visible, watertight and flush

with ground level. This distribution device requires on-going maintenance.

## **2.3 Percolation areas and mounds**

**2.3.1** A percolation area typically consists of a system of sub-surface irrigation pipes which allow the effluent to percolate gradually into the surrounding soil. Biological treatment takes place naturally in the aerated layers of soil.

**2.3.2** Percolation mounds are essentially percolation areas placed above the natural surface of the ground providing an aerated layer of soil to treat the effluent. Percolation areas should comply with the EPA Code of Practice - Section 7 and I.S. CEN/TR 12566 Part 2 Soil infiltration systems.

**2.3.3** Land drainage pipes should not be used in a percolation trench. Access / inspection pipes should be fitted to the end of the percolation pipes to facilitate the assessment of the proper functioning of the percolation area and to facilitate rodding or scouring of the pipes. There should be a maximum of five trenches attached to each distribution box when designing a gravity system for a percolation area. On sloping sites the pipework should be installed parallel to the contour to aid distribution of the effluent. The infiltration pipes should be inspected before installation to ensure a clean and smooth finish on all cuts and drill holes.

## **2.4 Constructed wetlands**

Constructed wetland is the generic term used to describe both (gravel- and sand-based) horizontal and vertical flow reed bed systems and soil-based constructed wetlands. The main difference between a constructed wetland and other filter systems is the planting of vegetation in the media where the thick root mass acts as a pathway for the transfer of oxygen from the atmosphere to the root zone (rhizosphere). Pumping may or may not be required for constructed wetland systems depending on the slope of the site and the wetland configuration. They can be used to provide secondary or tertiary

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treatment to effluent from septic tank or tertiary treatment to packaged wastewater treatment systems. The design and construction of wetlands should comply with the EPA Code of Practice - Section 8 or Section 10 for secondary or tertiary treatment respectively and / or SR CEN TR 12566 Part 5 - Pre-treated effluent filtration systems.

## **2.5 Intermittent filter systems**

**2.5.1** This comprises a pump chamber which transfers the partially treated effluent, (generally from a septic tank), onto the filter at regular intervals. The filter may consist of soil, sand, peat or other media.

A range of configurations may be considered:

- (a) an intermittent soil filter system (soil polishing filter is built in);
- (b) an intermittent sand filter followed by a polishing filter (may be inbuilt or offset);
- (c) an intermittent peat filter followed by a polishing filter;
- (d) an intermittent plastic or media filter followed by a polishing filter;
- (e) a constructed wetland or reed bed followed by a polishing filter.

**2.5.2** Where a pumped distribution system is used an alarm should be fitted to alert the user to any malfunction. Intermittent Filter Systems should comply with the EPA Code of Practice - Section 8 and / or SR CEN TR 12566 Part 5 - Pre-treated effluent filtration systems. Packaged filter systems should conform to prEN 12566 Part 6 - Prefabricated treatment units for septic tank effluent (when available). A polishing filter should be used in conjunction with all intermittent filters.

## **2.6 Polishing filters**

A polishing filter is a filter system the purpose of which is to provide additional treatment of the effluent and to reduce pollutants such as micro-organisms, phosphorous and in certain cases nitrate nitrogen. It also provides for the

hydraulic conveyance of the treated effluent to the ground. Polishing filters should comply with the EPA Code of Practice - Section 10 and prEN 12566 Part 7 - Prefabricated tertiary treatment units (when available).

## **2.7 Packaged wastewater treatment systems**

**2.7.1** Packaged wastewater treatment systems may be used to treat wastewater from a building where the site is unsuitable for a septic tank system or they may be used as an alternative to septic tank systems. These systems should conform to I.S. EN 12566-3: 2005/A1: 2009 Packaged and / or site assembled domestic wastewater treatment plants, and its National Annex.

**2.7.2** The system should be designed for a minimum hydraulic daily load of 150 l/person/day based on the number and size of bedrooms and a minimum organic daily load of 60g BOD/person/day to ensure adequate treatment is provided.

**2.7.3** All such systems must have a treatment efficiency capable of meeting the minimum performance effluent standards set out in Table 18 below. Monitoring and maintenance of these systems is required to ensure that the effluent is treated to this standard. In nutrient sensitive areas, more stringent performance standards for nitrogen and phosphorous may be necessary.

**2.7.4** The sludge storage capacity should be checked with the manufacturer to establish the necessary frequency of de-sludging. All package wastewater treatment systems should be provided with an alarm to indicate operation failure in line with the requirements of I.S. EN 12566-3: 2005/A1: 2009 Packaged and / or site assembled domestic wastewater treatment plants.

Many systems are available including: -

- (a) Biofilm Aerated Filter (BAF) systems;
- (b) Rotating Biological Contactor (RBC) systems;

**Table 18 Minimum performance standards**

Parameter	Standard (mg/l)	Comment
Biochemical Oxygen Demand (BOD)	20	
Suspended Solids (SS)	30	
NH <sub>4</sub> as N	20	Unless otherwise specified by Local Authority
Total nitrogen as N	5	Only for nutrient-sensitive areas
Total Phosphorous	2	Only for nutrient-sensitive areas

(c) Sequencing Batch Reactors (SBR) systems;

(d) Membrane filtration systems.

Packaged Wastewater Treatment Systems should comply with the EPA Code of Practice - Section 9 and be installed in accordance with the manufacturer's instructions.

**2.7.5** The effluent from all packaged wastewater treatment systems should discharge to a polishing filter to allow for further treatment of the wastewater and to convey the treated wastewater to groundwater (refer to sub-section 2.6).

## **2.8 Tertiary treatment systems**

The term tertiary treatment system includes polishing filters, constructed wet lands and packaged tertiary treatment systems. They provide additional treatment to wastewater from secondary treatment systems. Tertiary treatment systems should comply with the EPA Code of Practice – Section 10 and prEN 12566 Part 7 - Prefabricated tertiary treatment units (when available).

## **2.9 General recommendations**

**2.9.1** Household garbage grinders / sink macerators can increase the BOD loading rate of wastewater by up to 30%. Their use is not recommended for buildings where wastewater treatment systems are used, unless specifically designed to do so, as they result in additional maintenance requirements due to the increased solids. Excessive amounts of waste fats, oils and grease

(FOGs) should be avoided as they impair the treatment process and require desludging more frequently. Where this is not practicable (e.g. commercial kitchens etc.) a grease trap should be used.

**2.9.2** Under no circumstances should rainwater or surface water be discharged to wastewater treatment systems.

**2.9.3** The siting of systems should allow for access for a sludge tanker and maintenance equipment to de-sludge the tank. (A maximum distance of 30 m from a hardstand with 3 m invert level is recommended.) Storm water drains, water mains, service pipes, soakaways, access roads, driveways, paved areas or land drains should not be located within or around the infiltration area.

The minimum separation distances should be in accordance with the EPA Code of Practice – Section 6.

**2.9.4** In areas of low permeability soils, shallow interceptor drains should cut off all surface run-off and seepage from the surrounding soil. The interceptor drain should be 2 m distant from the upgradient side and parallel to the side edges of the infiltration area. These drains would comprise land drainage pipes overlain to ground surface with permeable gravel or broken stone aggregate. These interceptor drains should be brought to the nearest water course or stream into which they outfall.

**2.9.5** Under the Water Pollution Act 1977 a Discharge Licence is required where the

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effluent is being discharged to a surface water course and this will dictate the final effluent quality which may require the use of specific tertiary treatment in accordance with the EPA Code of Practice - Section 10.

### **2.10 Holiday homes**

When choosing a wastewater treatment system for holiday homes consideration should be given to the selection of a system that can adequately deal with periods of inactivity (i.e. when the house is unoccupied for prolonged periods). Systems that are capable of re-circulating the effluent may be appropriate.

# Standards and publications

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## **Standards referred to:**

I.S. 6: 2004 Concrete sewer pipes

I.S. 134: 1977 Polyethylene pipe type 32

I.S. 135: 1975 Polyethylene pipe type 50

I.S. 166: 1972 Concrete surface water pipes

I.S. 262: 1984 Grey iron and ductile iron pipe fittings

I.S. 420: 2004 Pre-cast concrete manholes

I.S. EN 124: 1994 Gulley tops and manhole tops for vehicular and pedestrian areas – Design requirements, type testing, marking and quality control

I.S. EN 197-1: 2001 Cement - Part 1: Composition, specifications and conformity criteria for common cements; AMD 3 2007

I.S. EN 206-1: 2002 Concrete - Specification, performance, production and conformity

I.S. EN 274 (1-3): 2002 Specification for plastics waste traps AMD 3206; AMD 4191; AMD 4692

I.S. EN 295-1: 1992 Vitrified clay pipes and fittings and pipe joints for drains and sewers - Part 1: Requirements

I.S. EN 295-2: 1992 Vitrified clay pipes and fittings and pipe joints for drains and sewers - Part 2: Quality control and sampling

I.S. EN 295-3: 1992 Vitrified clay pipes and fittings and pipe joints for drains and sewers - Part 3: Test methods

I.S. EN 588-1: 1997 Fibre-cement pipes for sewers and drains - Part 1: Pipes, joints and fittings for gravity systems

I.S. EN 598: 2007 Ductile iron pipes, fittings, accessories and their joints for sewerage applications

I.S. EN 752: 2008 Drain and sewer systems outside buildings

I.S. EN 771-1: 2003 Specification for masonry units - Part 1: Clay masonry units

I.S. EN 771-3: 2003 Specification for masonry units - Part 3: Aggregate concrete masonry units

I.S. EN 877: 2000 Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings - Requirements, test methods and quality assurance

I.S. EN 1057: 2006/A1: 2010 Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications.

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I.S. EN 1091: 1997 Vacuum drainage and sewerage systems outside buildings

I.S. EN 1254-2: 1998 Copper and copper alloys – Plumbing fittings - Part 2: Fittings with compression ends for use with copper tubes

I.S. EN 1254-3: 1998 Copper and copper alloys – Plumbing fittings - Part 3: Fittings with compression ends for use with plastic pipes

I.S. EN 1295-1: 1998 Structural design of buried pipelines under various conditions of loading - Part 1: General requirements

I.S. EN 1329-1: 1999 Plastic piping systems for soil and waste discharge (low & high temperature) within the building structure - Unplasticized poly(vinyl Chloride) (PVC-U)

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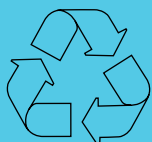
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SR 16: 2004 Guidance on the use of I.S. EN 12620 - Aggregates for concrete

I.S. EN 1085: 2007 Wastewater treatment vocabulary



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