# 13 Drainage and waste disposal

## 13.1 Introduction

This chapter describes Part H of Schedule 1 to the Building Regulations 2000 (as amended) and the associated Approved Document H. Together, these documents cover:

- Foul water drainage (H1);
- Wastewater treatment systems and cesspools (H2);
- Rainwater drainage (H3);
- Building over existing sewers (H4);
- Separate systems of drainage (H5); and
- Solid waste storage (H6).

Part H was substantially revised in 2002 and the current edition of Approved Document H draws together not only guidance on the drainage items listed above but also a certain amount of information on legislation related to drainage and waste disposal under the following headings:

- Repairs, alterations and discontinued use of drains and sewers (Appendix H1-B)
- Adoption of sewers and connection to public sewers (Appendix H1-C)
- Maintenance of wastewater treatment systems and cesspools (Appendix H2-A)
- Relevant waste collection legislation (Appendix H6-A).

## 13.2 Repairs, alterations and discontinued use of drains and sewers

Reconstruction and alteration to existing drains and sewers is deemed to constitute a material alteration of a controlled service under the Building Regulations and should be carried out to the same standards as new drains and sewers. Therefore, where new drainage is connected to existing pipework, the following points should be considered.

- Existing pipework should not be damaged, (e.g. use proper cutting equipment when breaking into existing drain runs).
- The resulting joint should be watertight, (e.g. by making use of purpose made repair couplings).

- Care should be taken to avoid differential settlement between the existing and new pipework, (e.g. by providing proper bedding of the pipework).

Even though the Building Regulations do not cover requirements for ongoing maintenance or repair of drains or sewers, sewerage undertakers and local authorities have a variety of powers under other legislation to make sure that drains, sewers, cesspools, septic tanks and settlement tanks do not deteriorate to the extent that they become a risk to public health and safety. This includes powers to ensure that:

- adequate maintenance is carried out
- repairs and alterations are properly carried out
- disused drains and sewers are sealed.

#### *Requirements for inspection, maintenance, repairs and alterations*

Section 48 of the Public Health Act 1936 (*power of relevant authority to examine and test drains etc. believed to be defective*) enables a local authority to examine and test any sanitary convenience, drain, private sewer or cesspool where it feels that it has reasonable grounds for believing that the drain is in such a condition:

- as to be prejudicial to health or a nuisance; or
- is so defective as to admit subsoil water (where the drain or private sewer connects indirectly with a public sewer).

Similar powers exist to enable sewerage undertakers to examine and test drains and private sewers under section 114 of the Water Industry Act 1991 (*power to investigate defective drain or sewer*).

Section 59 of the Building Act 1984 (*drainage of building*) allows a local authority to require a building owner to carry out remedial works on soil pipes, drains, cesspools or private sewers where these are deemed to be:

- insufficient for adequately draining the building
- prejudicial to health or a nuisance
- so defective as to admit subsoil water.

Section 59 also applies to disused cesspools, septic tanks or settlement tanks where these are considered to be prejudicial to health or a nuisance. The local authority can require the owner or occupier to fill or remove the tank or otherwise render it innocuous.

Under section 60 of the of the Building Act 1984 a pipe for conveying rainwater from a roof may not be used for conveying soil or drainage from a sanitary convenience, or as a ventilating shaft to a foul drain. The practical effect of this provision is that all rainwater pipes must be trapped before entering a foul drain.

Section 61 of the Building Act 1984 (*Repair etc. of drain*), requires any person intending to repair, reconstruct or alter a drain to give 24 hours notice to the local authority of their intention to carry out the works. This does not apply in an emergency; however such work must not be subsequently covered over without giving 24 hours notice. Free access must also be given to the local authority to inspect the works.

Section 17 of the Public Health Act 1961 (*power to repair drains etc. and to remedy stopped-up drains*) provides a swift procedure whereby local authorities may repair or clear blockages on drains or private sewers which have not been properly maintained. The repairs etc. must not cost more than £250 and can only be carried out after a notice has been served on the owner from whom costs can be recovered.

Section 50 of the Public Health Act 1936 (*overflowing and leaking cesspools*) allows the local authority to take action against any person who has caused by their action, default or sufferance, a septic tank, settlement tank or cesspool to leak or overflow. The person can be required to carry out repairs or to periodically empty the tank. This does not apply to the overflow of treated effluent or flow from a septic tank into a drainage field, provided the overflow is not prejudicial to health or a nuisance. It should be noted that under this section action can be taken against a builder who had caused the problem, as well as against the owner.

### Sealing and/or removal of disused drains and sewers

Disused drains and sewers can be prejudicial to health in that they harbour rats, allow them to move between sewers and the surface, and may collapse causing possible subsidence. Therefore local authorities have a number of powers to control the sealing and removal of such drains and sewers as follows.

- Where a person carries out work which results in any part of a drain becoming permanently disused, under section 62 of the Building Act 1984 (*disconnection of drain*) a local authority may require the drain to be sealed at such points as it directs.
- Section 82 of the Building Act 1984 (*notices about demolition*), allows the local authority to require any person demolishing a building to remove or seal any sewer or drain to which the building was connected (see Chapter 1, section 1.6).
- A local authority can also use its powers under section 59 of the Building Act 1984 (see above) to require an owner of a building to remove or otherwise render innocuous any disused drain or sewer which is a health risk.

Disused drains or sewers should be disconnected from the sewer system as near as possible to the point of connection. Care should be taken not damage any pipe which is still in use and to ensure that the sewer system remains watertight. Disconnection is usually carried out by removing the pipe from a junction and placing a stopper in the branch of the junction fitting. If the connection is to a public sewer the sewerage undertaker should be consulted.

Shallow drains or sewers (i.e. less than 1.5 m deep) in open ground should, where possible, be removed. To ensure that rats cannot gain access, other pipes should be grout filled and sealed at both ends and at any point of connection. Larger pipes

(225 mm diameter or greater) should be grout filled to prevent subsidence or damage to buildings or services in the event of collapse.

### Pollution of watercourses and ground water

Under Section 85 (*offences of polluting controlled waters*) of the Water Resources Act 1991 the Environment Agency have powers to prosecute anyone causing or knowingly permitting pollution of any stream, river, lake etc. or any groundwater. They also have powers under section 161A (*notices requiring persons to carry out anti-pollution works and operations*) of the Water Resources Act 1991 (as amended by the Environment Act 1995) to take action against any person causing or knowingly permitting a situation in which pollution of a stream, river, lake etc. or groundwater, is likely. Such a person can be required to carry out works to prevent the pollution.

### Control over solid waste storage

With regard to solid waste storage, all dwellings are now required to have satisfactory means of storing solid waste and the provision of sections 23(1) and (2) of the Building Act 1984 which required satisfactory means of access for removal of refuse have been replaced by paragraph H4 of Schedule 1 to the Building Regulations 2000 (as amended). This paragraph of the regulations must be read in light of other legislative provisions in respect of refuse disposal. In particular, sections 45 to 47 of the Environmental Protection Act 1990 should be referred to (see Chapter 5) since those sections deal with the removal of refuse and allied matters. Thus, under section 45 of the 1990 Act a duty is placed on the local authority to collect all household waste in their area, while sections 46 and 47 make provision for the removal of trade and other refuse. Section 23(3) of the Building Act 1984 requires the local authority's consent to close or obstruct the means of access by which refuse is removed from a house.

## 13.3 Sanitary pipework and drainage

Paragraph H1 of Schedule 1 to the Building Regulations 2000 (as amended) requires that an adequate system of drainage must be provided to carry foul water from appliances in a building to one of the following, listed in order of priority:

- a public sewer; or
- a private sewer communicating with a public sewer; or
- a septic tank which has an appropriate form of secondary treatment or another wastewater treatment system; or
- a cesspool.

Movement to a lower level in the order of priority may only be on the grounds of reasonable practicability. For example, if no public or private sewer was available within a reasonable distance then a septic tank might be a suitable alternative.

FOUL WATER is defined as waste water which comprises or includes:

- waste from a sanitary convenience, bidet or appliance used for washing receptacles for foul waste, or
- water which has been used for food preparation, cooking or washing.

Where it is proposed to divert water that has been used for personal washing or for the washing of clothes, linen or other articles to a collection system for reuse, then the provisions of requirement H1 will not apply.

Further guidance on the meaning of SANITARY CONVENIENCE is given in the guidance to Approved Document G4 where it is defined as a closet or urinal.

FOUL WATER OUTFALL may be a foul or combined sewer, cesspool, septic tank or holding tank. This term is not specifically defined in AD H1; however the term is inferred from the description of Performance on page 6.

The requirements of Paragraph H1 may be met by any foul water drainage system which:

- conveys the flow of foul water to a suitable foul water outfall;
- reduces to a minimum the risk of leakage or blockage;
- prevents the entry of foul air from the drainage system to the building, under working conditions;
- is ventilated;
- is accessible for clearing blockages, and
- does not increase the vulnerability of the building to flooding.

AD H1 sets out detailed provisions in two sections. Section 1 deals with sanitary pipework (i.e. above ground foul drainage) and is applicable to domestic buildings and small non-domestic buildings. Section 2 deals with foul drainage (i.e. below ground foul drainage). There is also an appendix (H1-A) which contains additional guidance for large buildings. Complex systems in larger buildings should follow the guidance in BS EN 12056 *Gravity drainage systems inside buildings*.

### 13.3.1 Above-ground foul drainage

A number of terms are used throughout AD H1. These are defined below and illustrated in Fig. 13.1. It should be noted that these definitions do not appear in the AD.

DISCHARGE STACK – A ventilated vertical pipe which carries soil and waste water directly to a drain.

VENTILATING STACK – A ventilated vertical pipe which ventilates a drainage system either by connection to a drain or to a discharge stack or branch ventilating pipe.

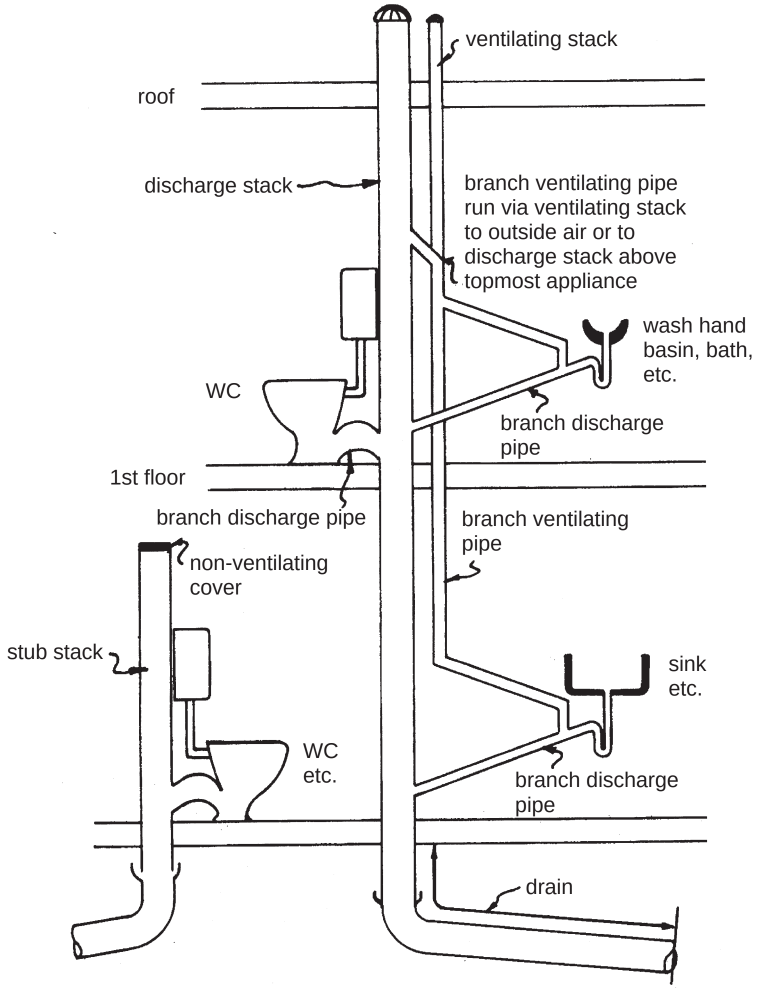



**Fig. 13.1** Definitions.

BRANCH DISCHARGE PIPE (sometimes referred to as a BRANCH PIPE) – The section of pipework which connects an appliance to another branch pipe or a discharge stack if above the ground floor, or to a gully, drain or discharge stack if on the ground floor.

BRANCH VENTILATING PIPE – The section of pipework which allows a branch discharge pipe to be separately ventilated.

STUB STACK – An unventilated discharge stack.

A drainage system, whether above or below ground, should have sufficient capacity to carry the anticipated flow at any point. The capacity of the system, therefore, will depend on the size and gradient of the pipes whereas the flow will depend on the type, number and grouping of appliances. Table 13.1 below is based on information from BS EN 12056 and Table A2 of AD HI, and gives the expected flow rates for a range of appliances.

Since sanitary appliances are seldom used simultaneously, the normal size of discharge stack or drain will be able to take the flow from quite a large number of appliances. Table A1 of AD H1 is reproduced below and is derived from BS EN 12056. It shows the approximate flow rates from dwellings and is based on an appliance grouping per household of 1 WC, 1 bath, l or 2 washbasins and 1 sink.

The guidance given in section 1 of AD H1 is applicable for WCs with major flush volumes of 5 litres or more. WCs with flush volumes of less than 5 litres may give rise to an increased risk of blockages, however BS EN 12056 contains guidance on the design of sanitary pipework suitable for WCs with flush volumes as low as 4 litres.

### 13.3.2 Pipe sizes

Since individual manufacturer's pipe sizes will vary, the sizes quoted in AD H1 are nominal and give a numerical designation in convenient round numbers. Similarly, equivalent pipe sizes for individual pipe standards are given in the standards listed in AD H Tables 4, 7 and 14 reproduced below.

**Table 13.1** Appliance flow rates.

| Appliance | Flow rate (litres/sec) |
|---|---|
| WC (9 litre washdown) | 2.3 |
| Washbasin | 0.6 |
| Sink | 0.9 |
| Bath | 1.1 |
| Shower | 0.1 |
| Washing machine | 0.7 |
| Urinal (per person unit) | 0.15 |
| Spray tap basin | 0.06 |
| Dishwashing machine | 0.25 |

## AD H1, section 1

**Table 1** Flow rates from dwellings

| Number of dwellings | Flow rate (litres/sec) |
|---|---|
| 1 | 2.5 |
| 5 | 3.5 |
| 10 | 4.1 |
| 15 | 4.6 |
| 20 | 5.1 |
| 25 | 5.4 |
| 30 | 5.8 |

### 13.3.3 Trap water seals

Trap water seals are provided in drainage systems to prevent foul air from the system entering the building. All discharge points into the system should be fitted with traps and these should retain a minimum seal of 25 mm or equivalent under test and working conditions.

Traditionally the 'one pipe' and 'two pipe' systems of plumbing have required the provision of branch ventilating pipes and ventilating stacks unless special forms of trap are used. The 'single-stack' system of plumbing obviates the need for these ventilating pipes and is illustrated in Fig. 13.2. Table 13.2 below, which is based on Table 1 and Table A3 of AD H1, gives minimum dimensions of pipes and traps where it is proposed to use appliances other than those shown in Fig. 13.2.

It is permissible to reduce the depth of trap seal to 38mm where washing machines, dishwashers, baths or showers discharge directly to a gully. Additionally, traps used on appliances with flat bottom (trailing waste) discharge which discharge to a gully with a grating may also have a water seal of not less than 38 mm.

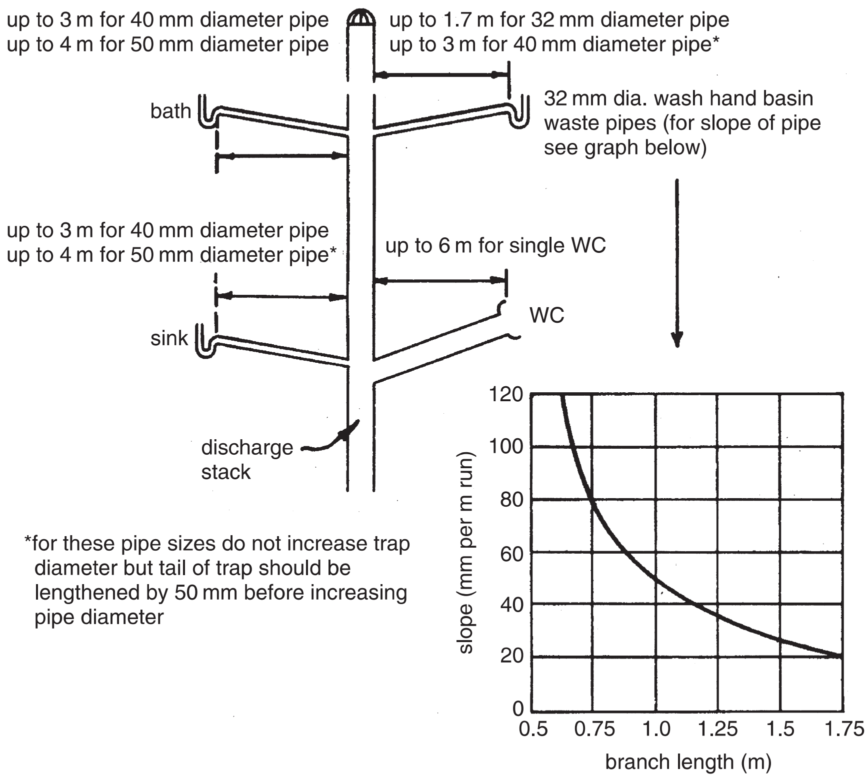
It should be stressed that the minimum pipe sizes given above relate to branch pipes serving a single appliance. Where a number of appliances are served by a single branch pipe which is unventilated, the diameter of the pipe should be at least the size given in Table 2 to section 1 of AD HI, which is reproduced below.

If it is not possible to comply with the figures given in Table 13.1, Fig. 13.2 or Table 2, then the branch discharge pipe should be ventilated in order to prevent loss of trap seals. This is facilitated by means of a *branch ventilating pipe* which is connected to the discharge pipe within 750 mm of the appliance trap. The branch ventilating pipe may be run direct to outside air, where it should finish at least 900 mm above any opening into the building which is nearer than 3m, or, it may be connected to the ventilating stack or stack vent above the 'spillover' level of the highest appliance served. In this case it should have a continuous incline from the branch discharge pipe to the point of connection with the stack (see Fig. 13.3).

Where a branch ventilating pipe serves only one appliance it should have a minimum diameter of 25 mm. This should be increased to 32 mm diameter if the branch ventilating pipe is longer than 15 m or contains more than five bends.

**Table 13.2** Minimum dimensions of branch pipes and traps.

| Appliance | Minimum diameter of pipe and trap (mm) | Depth of trap seal (mm) |
|---|---|---|
| Bidet | 32 | 75 |
| Shower<br>Food waste disposal unit<br>Urinal bowl<br>Sanitary towel macerator<br>Washing machine<br>Dishwashing machine | 40 | 75 |
| Industrial food waste disposal unit | 50 | 75 |
| Urinal stall (1 to 6 person position) | 65 | 50 |




| *Appliance* | *Minimum diameter of pipe and trap (mm)* | *Depth of trap seal* | *Slope (mm/m)* |
|---|---|---|---|
| Sink | 40 | 75 | 18–90 |
| Bath | 40 | 50 | 18–90 |
| WC – outlet < 80 mm | 75 | 50 | 18 |
| WC – outlet > 80 mm | 100 | 50 | 18 |
| washbasin | 32 | 75* | See graph above |

*Depth of seal may be reduced to 50 mm only with flush grated wastes without plugs on spray tap basins

**Fig. 13.2** Single stack system – design limits.

As appliance traps present an obstacle to the normal flow in a pipe they may be subject to periodic blockages. It is important, therefore, that they be fitted immediately after an appliance and either be removable or be fitted with a cleaning eye. Where a trap forms an integral part of an appliance (such as in a WC pan), the appliance should be removable.

## AD H1 Section 1

**Table 2** Common Branch discharge pipes (unventilated).

| Appliance | Max no. to be connected | Max length of branch pipe (m) | Min size of pipe (mm) | Gradient limits (mm fall per metre) |
|---|---|---|---|---|
| WC outlet > 80 mm | 8 | 15 | 100 | 18[2] to 90 |
| WC outlet < 80 mm | 1 | 15 | 75[3] | 18 to 90 |
| Urinal – bowl | | 3[1] | 50 | |
| Urinal – trough | | 3[1] | 65 | 18 to 90 |
| Urinal – slab[4] | | 3[1] | | |
| Washbasin or bidet | 3 | 1.7 | 30 | 18 to 22 |

**Notes:**
[1] Should be as short as possible to prevent deposition
[2] May be reduced to 9 mm on long drain runs where space is restricted, but only if more than one WC is connected
[3] Not recommended where disposal of sanitary towels may take place via the WC, as there is an increased risk of blockages
[4] Slab urinals longer than seven, persons should have more than one outlet.

### 13.3.4 Branch discharge pipes – design recommendations

In addition to size and gradient there are other design recommendations for branch discharge pipes that should be adhered to for efficient operation, and in order to prevent loss of trap seals.

Branch pipes should only discharge into another branch pipe, a discharge stack or a gully. Gullies are usually at ground floor level but may be situated in a basement and are only permitted to take wastewater. It is not permissible to discharge a branch pipe into an open hopper. Branch pipes to ground floor appliances may also discharge into a stub stack or directly to a drain.

In high buildings especially, back-pressure may build up at the foot of a discharge stack and may cause loss of trap seal in ground floor appliances. Therefore, the following recommendations should be followed.

- For multi-storey buildings up to five storeys high there should be a minimum distance of 750 mm between the point of junction of the lowest branch discharge pipe connection and the invert of the tail of the bend at the foot of the discharge stack. This is reduced to 450 mm for discharge stacks in single dwellings up to three storeys high (see Fig. 13.4).
- For appliances above ground floor level the branch pipe should only be run to a discharge stack, to another branch pipe or to a stub stack (but see also section 13.3.8 below for more information on stub stacks).
- Ground floor appliances may be run to a separate drain, gully or stub stack. (A gully connection should be restricted to pipes carrying waste water only.) They may also be run to a discharge stack in the following circumstances:
  (a) in buildings up to five storeys high – without restriction;
  (b) in buildings with six to twenty storeys – to their own separate discharge stack;

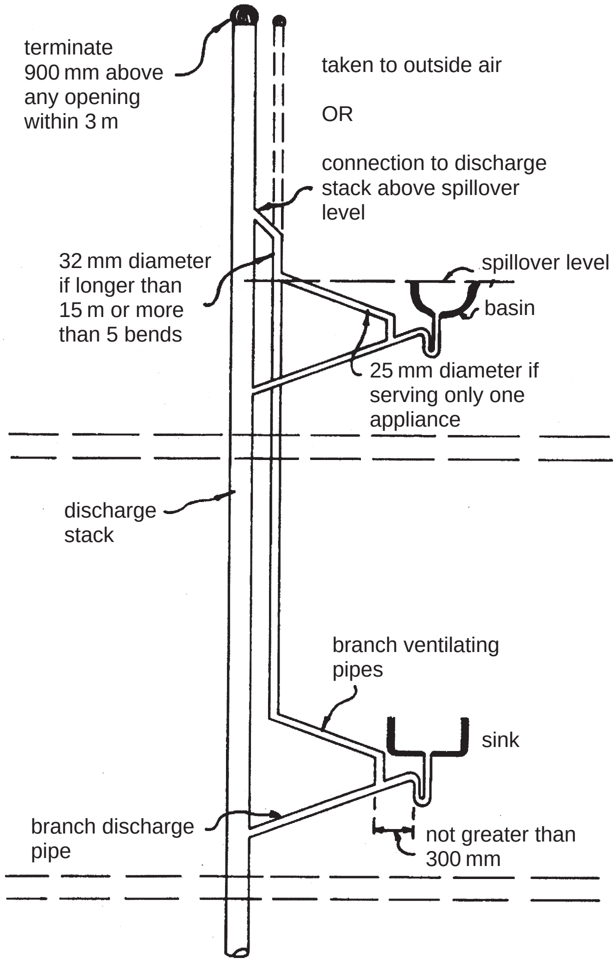



**Fig. 13.3** Branch ventilating pipes.

(c) in buildings over 20 storeys – ground and first floor appliances to their own separate discharge stack; (see Fig. 13.5).

Back-pressure and blockages may occur where branches are connected so as to be almost opposite one another. This is most likely to occur where bath and WC branch connections are at or about the same level. Figure 13.6 illustrates ways in which possible cross flows may be avoided.

Additionally, a long vertical drop from a ground floor water closet to a drain may cause self-syphonage of the WC trap. To prevent this the drop should not exceed 1.3 m from floor level to invert of drain (see Fig. 13.7).

Similarly, there is a chance of syphonage where a branch discharge pipe connects with a gully. This can be avoided by terminating the branch pipe above the water level but below the gully grating or sealing plate (see Fig. 13.7).

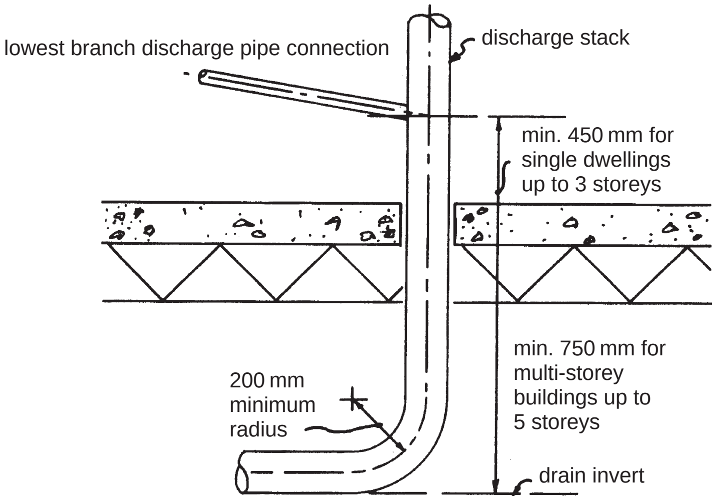



**Fig. 13.4** Connection of lowest branch to discharge stack.

Self-syphonage can also be prevented by ensuring that bends in branch discharge pipes are kept to a minimum. Where bends are unavoidable they should be made with as large a radius as possible. Junctions on branches should be swept in the direction of flow with a minimum radius of 25 mm or should make an angle of 45° with the discharge stack. Where a branch diameter is 75 mm or more the sweep radius should be increased to 50 mm (see Fig. 13.6). Branch pipes up to 40 mm diameter joining other branch pipes which are 100 mm diameter or greater should, where possible, connect to the upper part of the pipe wall of the larger branch.

Branch discharge pipes should be fully accessible for clearing blockages. Additionally rodding points should be provided so that access may be gained to any part of a branch discharge pipe which cannot be reached by removing a trap or an appliance with an integral trap.

### 13.3.5 Drainage of condensate from boilers

It is permissible to connect condensate drainage from boilers to sanitary pipework. The connecting pipework should have a minimum diameter of 22 mm and should pass through a 75 mm condensate trap. This can be by means of an additional trap provided externally to the boiler to achieve the 75 mm seal. If this is the case, an air gap should be provided between the boiler and the trap. The following recommendations should also be observed.

- For preference, the connection should be made to an internal stack with a 75 mm condensate trap.
- Any connection made to a branch discharge pipe should be downstream of any sink waste connection.
- All sanitary pipework receiving condensate should be made of materials which can resist a pH value of 6.5 and lower.

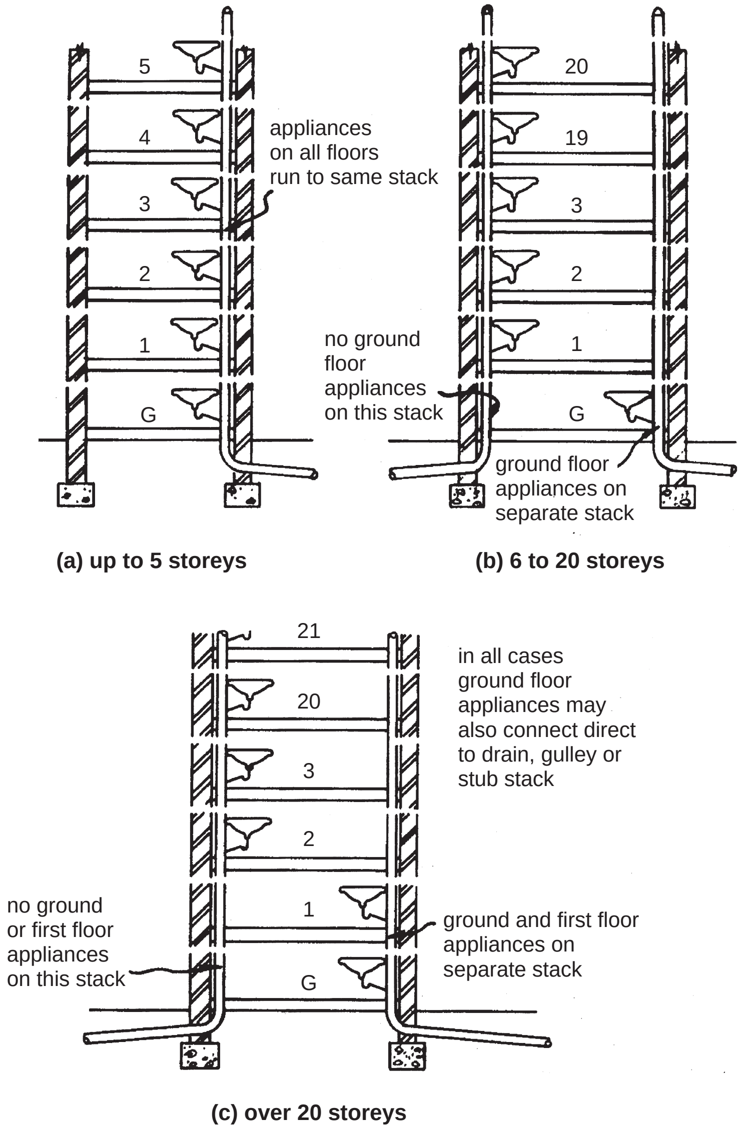



**Fig. 13.5** Provision of discharge stacks to ground floor appliances.

- The installation should follow the guidance in BS 6798 *Specification for installation of gas-fired hot water boilers of rated input not exceeding 60 kW.*

## 13.3.6 Discharge stacks – design recommendations

The satisfactory performance of a discharge stack will be ensured if it complies with the following rules.

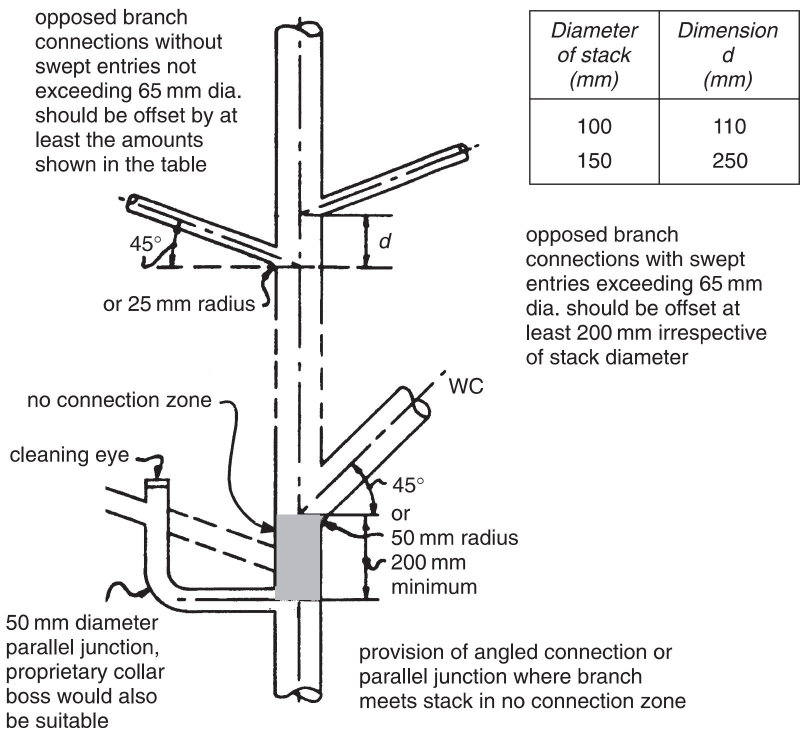



**Fig. 13.6** Avoidance of cross flows in discharge stacks.

- The foot of the stack should only connect with a drain and should have as large a radius as possible (at least 200 mm at the centreline).
- Ideally, there should be no offsets in the wet part of a stack (i.e. below the highest branch connection).
- If offsets are unavoidable then:
  - (a) buildings over three storeys should have a separate ventilation stack connected above and below the offset; and
  - (b) buildings up to three storeys should have no branch connection within 750 mm of the offset.
- The stack should be placed inside a building, unless the building has not more than three storeys. This rule is intended to prevent frost damage to discharge stacks and branch pipes.
- The stack should comply with the minimum diameters given in Table 3 to section 1 of AD Hl (see below). Additionally, the following minimum internal diameters for discharge stacks also apply:
  - (a) serving urinals – 50 mm,
  - (b) serving closets with outlets less than 80 mm – 75 mm, and
  - (c) serving closets with outlets greater than 80 mm – 100 mm.

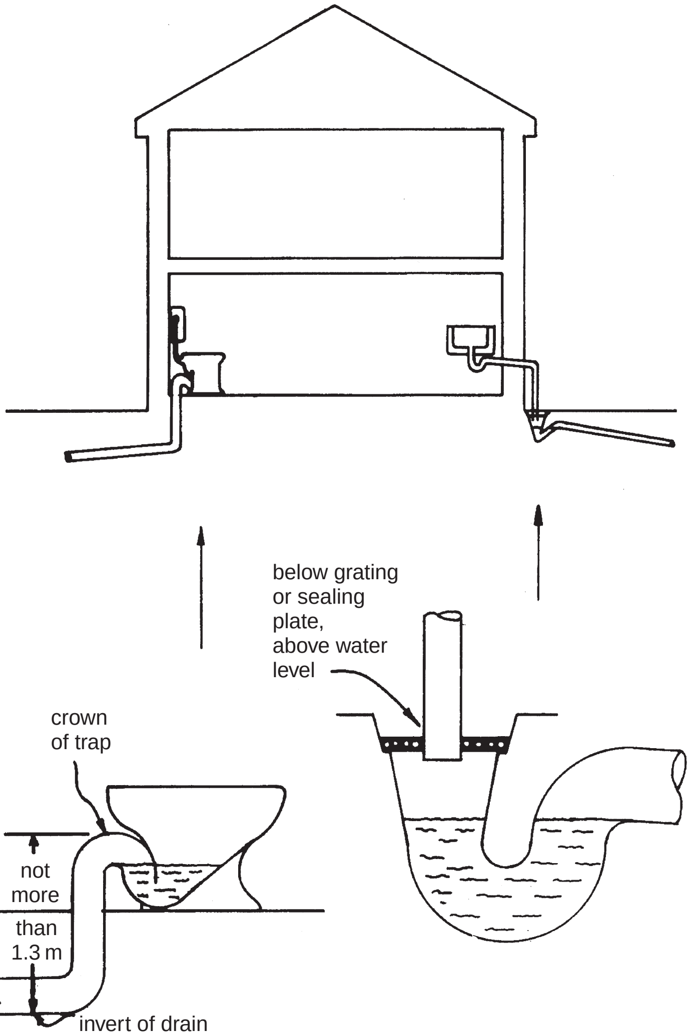



**Fig. 13.7** Ground floor connections for water closets and gullies.

- The diameter of a discharge stack should not reduce in the direction of flow and the internal diameter of the stack should not be less than that of the largest trap or branch discharge pipe.
- Adequate access points for clearing blockages should be provided and all pipes should be reasonably accessible for repairs. Rodding points in stacks should be above the spillover level of appliances.

### 13.3.7 Discharge stacks – ventilation recommendations

In order to prevent the loss of trap seals it is essential that the air pressure in a discharge stack remains reasonably constant. Therefore, the stack should be

## AD H1, section 1

**Table 3** 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 |

**Note**
* No wcs.
† Not more than 1 syphonic wc with 75 mm outlet.

ventilated to outside air. For this purpose it should be carried up to such a height that its open end will not cause danger to health or a nuisance. AD HI recommends that the pipe should finish at least 900 mm above the top of any opening into the building within 3 m. The open end should be fitted with a durable ventilating cover (see Fig. 13.8). In areas where rodent control is a problem the cover should be metallic.

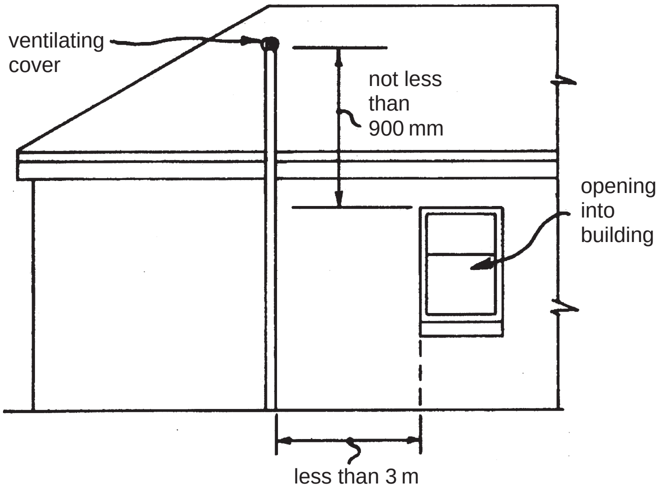



**Fig. 13.8** Termination of discharge stacks.

The dry part of a discharge stack above the topmost branch, which serves only for ventilation, may be reduced in size in one and two storey houses to 75 mm diameter.

It is permissible to terminate a discharge stack inside a building if it is fitted with an air admittance valve. This valve allows air to enter the pipe but does not allow foul air to escape. It should comply with prEN 12380 *Ventilating pipework, air* *admittance valves* and should not adversely affect the operation of the underground drainage system which normally relies on ventilation from the open stacks to the sanitary pipework.

Air admittance valves should also be:

- located in areas which have adequate ventilation
- accessible for maintenance
- removable to give access for clearing blockages.

Air admittance valves should not be used:

- in dust laden atmospheres
- outside buildings
- where there is no open ventilation on a drainage system or through connected drains – other means to relieve positive pressures should be considered.

Some underground drains are subject to surcharging. Where this is the case the discharge stack should be ventilated by a pipe of not less than 50 mm diameter connected at the base of the stack above the expected flood level. This would also apply where a discharge pipe is connected to a drain near an intercepting trap.

### 13.3.8 Stub stacks

There is one exception to the general rule that discharge stacks should be ventilated. This involves the use of an unvented stack (or *stub stack*). A stub stack should connect to a ventilated discharge stack or a ventilated drain which is not subject to surcharging and should comply with the dimensions given in Fig. 13.9. It is permissible for more than one ground floor appliance to connect to a stub stack.

### 13.3.9 Dry ventilating stacks

Where an installation requires a large number of branch ventilating pipes and the distance to a discharge stack is also large it may be necessary to use a dry ventilating stack.

It is normal to connect the lower end of a ventilating stack to a ventilated discharge stack below the lowest branch discharge pipe and above the bend at the foot of the stack or to the crown of the lowest branch discharge pipe connection provided that it is at least 75 mm diameter.

Ventilating stacks should be at least 32 mm in diameter if serving a building containing dwellings not more than ten storeys high. For all other buildings reference should be made to BS EN 12056 *Gravity drainage systems inside buildings*.

### 13.3.10 Greywater recovery systems

Greywater is defined in the Water Regulations Advisory Scheme leaflet No. 09-02-04 *Reclaimed water systems. Information about installing, modifying or maintaining*

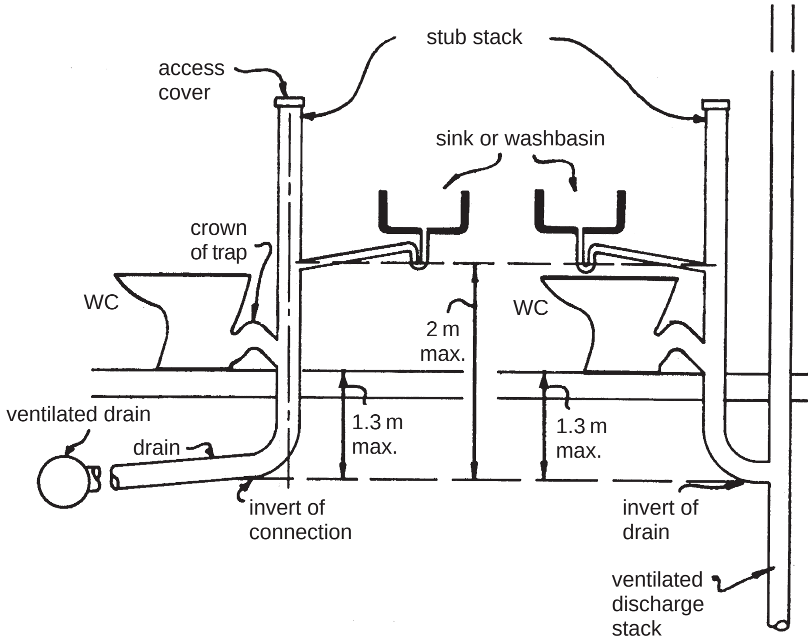



**Fig. 13.9** Stub stacks.

*reclaimed water systems* as – 'water originating from the mains potable water supply that has been used for bathing or washing, washing dishes or laundering clothes'.

Such water can be used for irrigation and for other purposes such as toilet flushing or car washing; however care must be taken to prevent contamination of potable water supplies or accidental misuse due to the greywater being mistaken for potable water.

Approved Document H1 gives very little guidance on the use of greywater other than a passing reference to the leaflet mentioned above. It is more concerned with the identification of the pipes conveying the greywater and the suitability of storage systems. Accordingly, it recommends that all sanitary pipework carrying greywater for reuse should be clearly marked with the word 'GREYWATER' in accordance with the Water Regulations Advisory Scheme leaflet No. 09-02-05 *Marking and identification of pipework for reclaimed greywater systems*.

Guidance on the provision of external tanks for the storage of greywater is given in section 13.5 below.

### 13.3.11 Materials for above-ground drainage systems

Table 4 to section 1 of AD H1, which is reproduced below, gives details of the materials that may be used for pipes, fittings and joints in above ground drainage systems. The following matters should also be addressed when considering which materials to use in a system of sanitary pipework:

## AD H1, section 1

**Table 4** Materials for sanitary pipework.

| Material | British Standard |
|---|---|
| **Pipes** | |
| Cast Iron | BS 416, BS EN 877 |
| Copper | BC EN 1254, BS EN 1057 |
| Galvanised steel | BS 3868 |
| PVC-U | BS EN 1329 |
| Polypropylene (PP) | BS EN 1451 |
| ABS | BS EN 1455 |
| Polyethylene (PE) | BS EN 1519 |
| Styrene Copolymer blends (PVC + SAN) | BS EN 1565 |
| PVC-C | BS EN 1566 |
| **Traps** | BS EN 274, BS 3943 |
| **Note:** Some of these materials may not be suitable for carrying trade effluent or condensate from boilers | |

- pipes of different metals should be separated where necessary by non-metallic material to prevent electrolytic corrosion;
- pipes should be adequately supported without restricting thermal movement;
- care should be taken to ensure continuity of any electrical earth bonding;
- care should be taken where pipes pass through fire separating elements (see Part B of Schedule 1 to the Building Regulations 2000 and Approved Document B);
- light should not be visible through the pipe wall when sanitary pipework is connected to WCs as this is believed to encourage damage by rodents.

### 13.3.12 Workmanship

Workmanship should be in accordance with BS 8000 *Workmanship on Building Sites* Part 13: *Code of practice for above ground drainage*.

### 13.3.13 Test for airtightness

In order to ensure that a completed installation is airtight it should be subjected to a pressure test of air or smoke of at least 38 mm water gauge for a maximum of three minutes. A satisfactory installation will maintain a 25 mm water seal in every trap. PVC-U pipes should not be smoke tested.

### 13.3.14 Alternative method of design

The requirements of the 2000 Regulations for above-ground drainage can also be met by following the relevant recommendations of BS EN 12056 *Gravity drainage systems inside buildings*. These are:

- in Part 1 *General and performance requirements* – clauses 3 to 6;
- in Part 2 *Sanitary pipework, layout and calculation*, clauses 3 to 6 and national annexes NA to NG (System III is traditionally in use in the UK);
- in Part 5 *Installation and testing, instructions for operation, maintenance and use*, clauses 4 to 6, 8, 9 & 11.

For vacuum drainage systems, designers should follow the guidance in BS EN 12109 *Vacuum drainage systems inside buildings*.

### 13.3.15 Below-ground foul drainage

Section 2 of AD H1 gives guidance on the construction of underground drains and sewers from buildings to the point of connection to a suitable outfall. This may be an existing sewer, a wastewater treatment system or a cesspool and includes any drains or sewers outside the curtilage of the building.

Section 2 also gives guidance in Appendix H1-B on the repair, alteration and discontinued use of drains and sewers and in Appendix H1-C on the adoption of sewers and connection to public sewers.

In most modern systems of underground drainage foul water and rainwater are carried separately. However, some public sewers are on the combined system taking foul and rainwater in the same pipe. The provisions of AD HI will apply equally to combined systems although pipe gradients and sizes may have to be adjusted to take the increased flows. In some circumstances separate drainage should still be provided on a development even though the outfall of the drainage system is to a combined sewer (see Requirement H5 in section 13.9.2 below). Combined systems should never discharge to a cesspool or septic tank.

### 13.3.16 Foul water outfalls and connections with sewers

Ideally, foul drainage from a development should connect to a public foul or combined sewer. Section 106 of the Water Industry Act 1991 gives the owner or occupier of a building the right to connect to a public sewer subject to the following conditions:

- where separate foul and surface water sewers are provided the connections must match this appropriately and proof of connectivity will be needed by the Building Control Body;
- the manner of the connection must not prejudice the public sewer system; and
- 21 days notice of intention to connect must be given to the sewerage undertaker.

Section 107 of the Water Industry Act 1991 allows the sewerage undertaker to make the connection and recover reasonable costs from the developer. Alternatively, the sewerage undertaker may allow the developer to carry out the work under its supervision.

Drain connections (drains to drains, drains to public or private sewers, and private sewers to public sewers) should be made obliquely, or in the direction of flow. Connections should be made using prefabricated components and where holes are cut to make the connection, these should be drilled to avoid damaging the pipe. Sometimes, in making a connection, it is preferable to remove a section of pipe and insert a junction. Repair couplings should be used for this to ensure a watertight joint. The coupling should be carefully packed to avoid differential settlement with adjacent pipes.

Where a sewer serves more than one property it should be kept as far away as is practicable from the position where a future extension might be built.

The degree to which it is possible to connect to a public sewer may, to a certain extent, depend on the size of the development. For example, for a small development, it may be reasonable to connect to a public sewer up to 30 m from the development provided that the developer has the right to construct drainage over any intervening private land. This might necessitate the provision of a pumping installation where the levels do not permit drainage by gravity (see below section 13.3.28). The economies of larger developments may make it feasible to connect to a public sewer which is some distance away.

It is also possible, for developments which comprise more than one curtilage, for the developer to requisition a sewer from the sewerage undertaker. This may be done under section 98 of the Water Industry act 1991. In constructing the sewer, the sewerage undertaker may use its rights of access to private land, however the person requisitioning the sewer may be required to contribute towards its cost over a 12 year period.

It may be possible to connect to an existing private sewer that connects with a public sewer where it is not reasonably practicable to connect directly to a public sewer. In such a case permission will need to be granted by the owner(s) of the private sewer and it should be in a satisfactory condition and have sufficient capacity to take the increased flows.

A wastewater treatment system or cesspool should only be provided where it is not reasonably practicable to connect to a sewer as described above.

### 13.3.17 Design and performance factors

The performance of a below ground foul drainage system depends on the drainage layout, provision for ventilation, the pipe cover and bedding, the pipe sizes and gradients, the materials used and the provisions for clearing blockages.

DRAINAGE LAYOUT – The drainage layout should be kept as simple as possible with pipes laid in straight lines and to even gradients. The number of access points provided should be limited to those essential for clearing blockages. If possible, changes of gradient and direction should be combined with access points, inspection chambers or manholes.

A slight curve in a length of otherwise straight pipework is permissible provided the line can still be adequately rodded. Bends should only be used in or close to inspection chambers and manholes, or at the foot of discharge or ventilating stacks. The radius of any bend should be as large as practicable.

In commercial hot food premises, drains serving kitchens should be fitted with a grease separator in compliance with prEN 1825: *Installations for separation of grease*, Part 1: *Principles of design, performance and testing, marking and quality control* and Part 2: *Selection of nominal size, installation and maintenance*, unless other effective means of grease removal are provided.

VENTILATION – It is important to ventilate an underground foul drainage system with a flow of air. Ventilated discharge pipes may be used for this purpose and should be positioned at or near the head of each main run. An open ventilating pipe (without an air admittance valve) should be fitted on any drain run fitted with an intercepting trap (especially on sealed systems) and on drains subject to surcharge. Ventilating pipes should not finish near openings in buildings (see section 13.3.3 above).

PIPE COVER AND BEDDING – The degree of pipe cover to be provided will usually depend on:

- the invert level of the connections to the drainage system
- the slope and level of the ground
- the necessary pipe gradients
- the necessity for protection to pipes.

In order to protect pipes from damage it is essential that they are bedded and backfilled correctly. The choice of materials for this purpose will depend mainly on the depth, size and strength of the pipes used. If the limits of cover cannot be attained it may be possible to choose another pipe strength and bedding class (see also BS EN 1295-1:1998 *Structural design of buried pipelines under various conditions of loading*) or provide special protection (see section 13.3.20 below).

Pipes used for underground drainage may be classed as rigid or flexible. Flexible pipes will be subject to deformation under load and will therefore need more support than rigid pipes so that the deformation may be limited.

### 13.3.18 Rigid pipes

Tables 8 and 9 of AD HI are set out below and contain details of the limits of cover that need to be provided for rigid clay and concrete pipes in any width of trench. For details of the bedding classes referred to in the Tables, see Figs. 13.10 and 13.11.

The backfilling materials should comply with the following.

(1) Granular material for rigid pipes should conform to BS EN 1610 Annex B Table B.15. The granular material should be single sized or graded from 5 mm up to:
   - 10 mm for 100 mm pipes
   - 14 mm for 150 mm pipes
   - 20 mm for pipes from 150 mm to 600 mm diameter
   - 40 mm for pipes more than 600 mm diameter.

The compaction fraction maximum should be 0.3 for class N or B and 0.15 for class F.

(2) Selected fill should be free from stones larger than 40 mm, lumps of clay over 100 mm, timber, frozen material or vegetable matter.

(3) It is possible that groundwater may flow in trenches with granular bedding. Provisions may be required to prevent this.

(4) Socketed pipes used with class D bedding should have holes formed in the trench bottom under the sockets to give a clearance of at least 50 mm. The holes should be as short as possible.

(5) Sockets for pipes used with class F or N bedding should be at least 50 mm above the floor of the trench.

## AD H1, section 2

**Table 8** Limits of cover for class 120 Clayware pipes in any width of trench.

| Nominal size | Laid in fields | Laid in light roads | Laid in main roads |
|---|---|---|---|
| 100 mm | 0.6 m–8 + m | 1.2 m–8 + m | 1.2 m–8 m |
| 225 mm | 0.6 m–5 m | 1.2 m–5 m | 1.2 m–4.5 m |
| 400 mm | 0.6 m–4.5 m | 1.2 m–4.5 m | 1.2 m–4 m |
| 600 mm | 0.6 m–4.5 m | 1.2 m–4.5 m | 1.2 m–4 m |

**Notes:**
1. All pipes assumed to be Class 120 to BS EN 295, other strengths and sizes of pipe are available, consult manufacturers;
2. Bedding assumed to be Class B with bedding factor of 1.9, guidance is available on use of higher bedding factors with clayware pipes
3. Alternative designs using different pipe strengths and/or bedding types may offer more appropriate or economic options using the procedures set out in BS EN 1295;
4. Minimum depth in roads set to 1.2 m irrespective of pipe strength.

## AD H1, section 2

**Table 9** Limits of cover for class M Concrete pipes in any width of trench.

| Nominal size | Laid in fields | Laid in light roads | Laid in main roads |
|---|---|---|---|
| 300 mm | 0.6 mm–3 m | 1.2 m–3 m | 1.2 m–2.5 m |
| 450 mm | 0.6 m–3.5 m | 1.2 m–3.5 m | 1.2 m–2.5 m |
| 600 mm | 0.6 m–3.5 m | 1.2 m–3.5 m | 1.2 m–3 m |

**Notes:**
1. All pipes assumed to be Class M to BS 5911, other strengths and sizes of pipe are available, consult manufacturers;
2. Bedding assumed to be Class B with bedding factor of 1.9;
3. Alternative designs using different pipe strengths and/or bedding types may offer more appropriate or economic options using the procedures set out in BS EN 1295;
4. Minimum depth in roads set to 1.2 m irrespective of pipe strength.

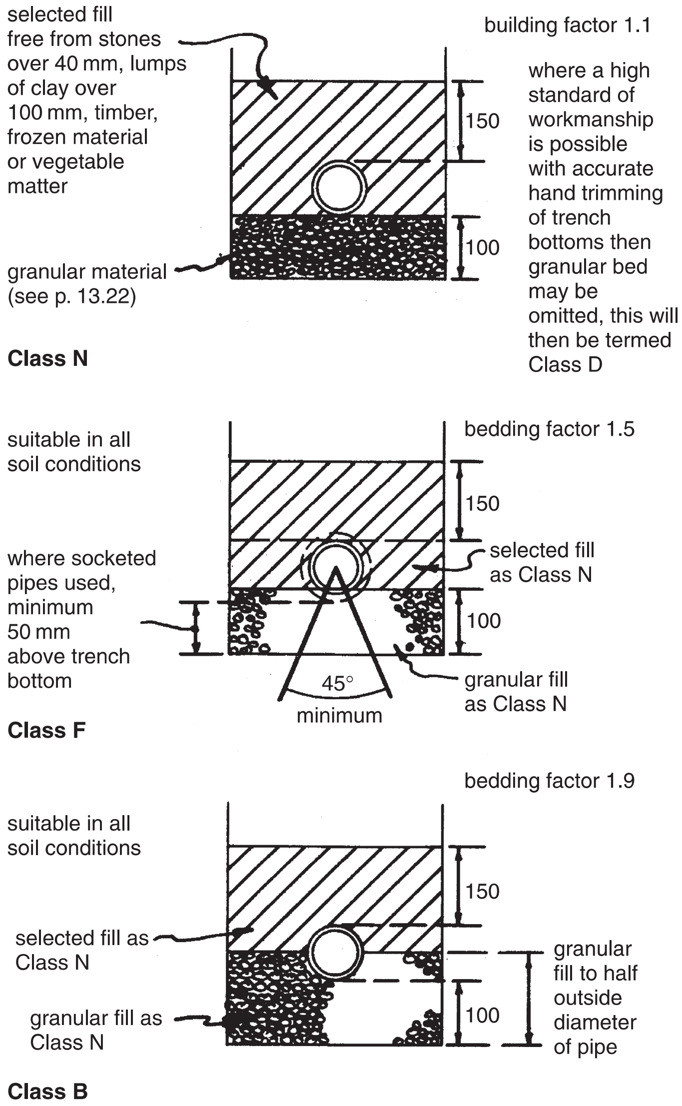



**Fig. 13.10** Bedding classes for rigid pipes.

## 13.3.19 Flexible pipes

Flexible pipes should be provided with a minimum depth of cover of 900 mm under any road. This may be reduced to 600 mm in fields and gardens. The maximum permissible depth of cover is 7 m. Figure 13.11 shows typical bedding and backfilling details for flexible pipes. Table 10 of AD H1 gives limits of cover for thermoplastics pipes in any width of trench. Where flexible pipes have less than the minimum cover depths given in the tables they should be protected where necessary, as shown in Fig. 13.12.

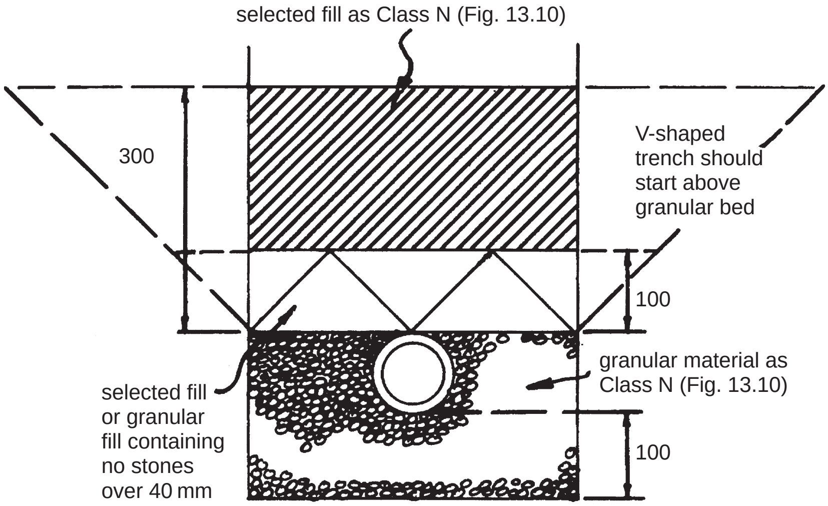



**Fig. 13.11** Bedding for flexible pipes.

### 13.3.20 Special protection to pipes

Where pipes have less than the minimum cover recommended in Tables 8, 9 or 10 they should be bridged by reinforced concrete cover slabs resting on a flexible filler with at least 75 mm of granular fill between the top of the pipe and the underside of the flexible filler (see Fig. 13.12). Where it is necessary to backfill a trench with concrete to protect adjacent foundations (see section 13.3.25 below), the pipes should be surrounded in concrete to a thickness of at least 100 mm. Expansion joints should also be provided at each socket or sleeve joint face (see Fig. 13.12).

PIPE SIZES AND GRADIENTS – Drains should be laid to falls and should be large enough to carry the expected flow. The rate of flow will depend on the type,

## AD H1, section 2

**Table 10** Limits of cover for thermoplastics (nominal ring stiffness SN4) pipes in any width of trench

| Nominal size | Laid in fields | Laid in light roads | Laid in main roads |
|---|---|---|---|
| 100 mm–300 mm | 0.6 m–7 m | 0.9 m–7 m | 0.9 m–7 m |

**Notes:**
1. For drains and sewers less than 1.5 m deep where there is a risk of excavation adjacent to the drain, a special calculation is necessary, see BS EN 1295, paragraph NA. 6.2.3
2. All pipes assumed to be in accordance with the relevant standard listed in Table 7 of AD H1 section 2 with nominal ring stiffness SN4, other strengths and sizes of pipe are available, consult manufacturers;
3. Bedding assumed to be Class S2 with 80% compaction and average soil conditions;
4. Alternative designs using different pipe strengths and/or bedding types may offer more appropriate or economic options using the procedures set out in BS EN 1295;
5. Minimum depth in roads is set to 1.5 m irrespective of pipe strength, to cover loss of side support from parallel excavations.

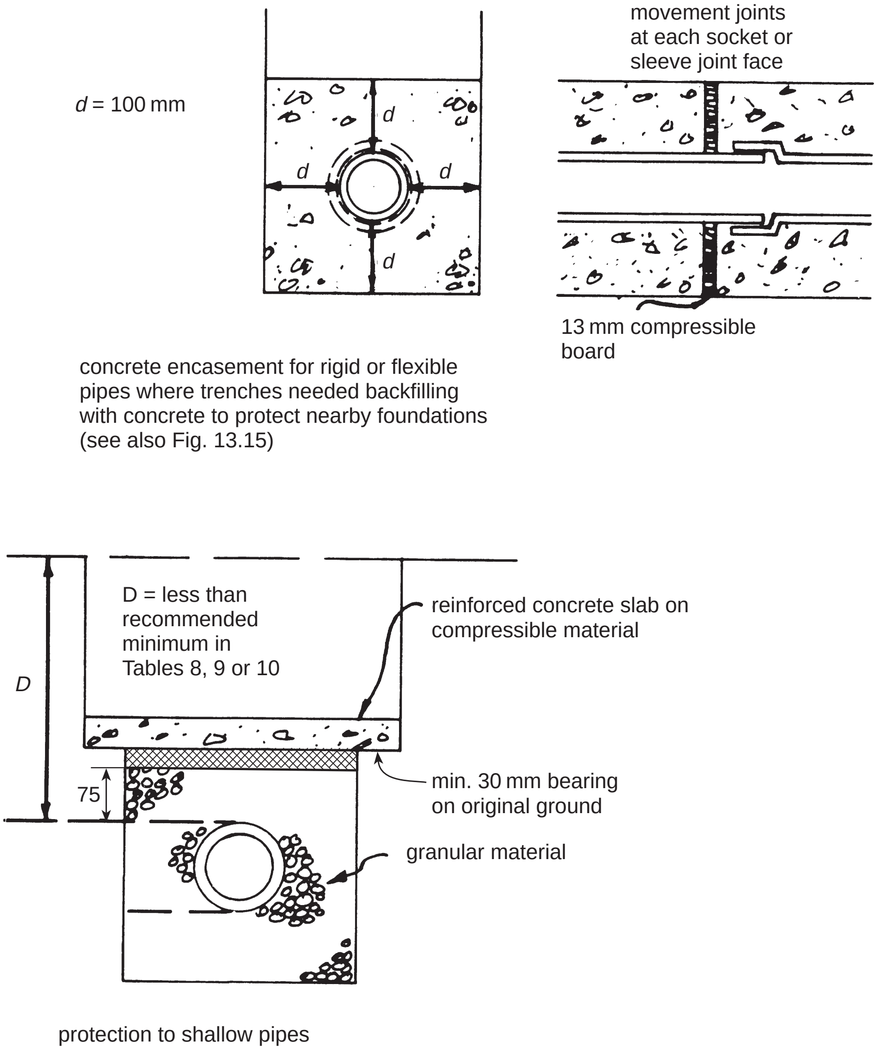



**Fig. 13.12** Special protection to pipes.

number and grouping of appliances that are connected to the drain (see Table A1, and Table 13.1, section 13.3.1). The capacity will depend on the diameter and gradient of the pipes.

Table 6 to section 2 of AD HI gives recommended minimum gradients for different sized foul drains and shows the maximum capacities they are capable of carrying. The Table is set out below.

As a further design guide Diagram 9 from AD HI is reproduced below. This gives discharge capacities for foul drains running at 0.75 proportional depth.

A drain serving more than one property (i.e. a sewer) should normally have a minimum diameter of 100 mm if serving no more than ten dwellings. Sewers serving more than ten dwellings should normally have a diameter of at least 150 mm.

## AD H1, section 2

**Table 6** Recommended minimum gradients for foul drains.

| Peak flow (litres/sec) | Pipe size (mm) | Minimum gradient (l:...) | Maximum capacity (litres/sec) |
|---|---|---|---|
| < 1 | 75 | 1:40 | 4.1 |
| | 100 | 1:40 | 9.2 |
| > 1 | 75 | 1:80 | 2.8 |
| | 100 | 1:80* | 6.3 |
| | 150 | 1:150† | 15.0 |

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

If a drain is carrying only foul water it may have a minimum diameter of 75 mm. This is increased to a minimum of 100 mm if the drain is carrying effluent from a WC or trade effluent. Where foul and rainwater drainage systems are combined, the capacity of the system should be large enough to take the combined peak flow (see Rainwater drainage, section 13.6 below).

MATERIALS – Table 7 to section 2 of AD HI, which is reproduced below, gives details of the materials that may be used for pipes, fittings and joints in below-ground foul drainage systems. Joints should remain watertight under working and test conditions and nothing in the joints, pipes or fittings should form an obstruction inside the pipeline. To avoid damage by differential settlement pipes should have flexible joints appropriate to the material of the pipes.

To prevent electrolytic corrosion, pipes of different metals should be separated where necessary by non-metallic material.

PROVISIONS FOR CLEARING BLOCKAGES – Every part of a drainage system should be accessible for clearing blockages. The type of access point chosen and its siting and spacing will depend on the layout of the drainage system and the depth and size of the drain runs. A drainage system designed in accordance with the provisions of AD H1 should be capable of being rodded by normal means (i.e. not by mechanical methods).

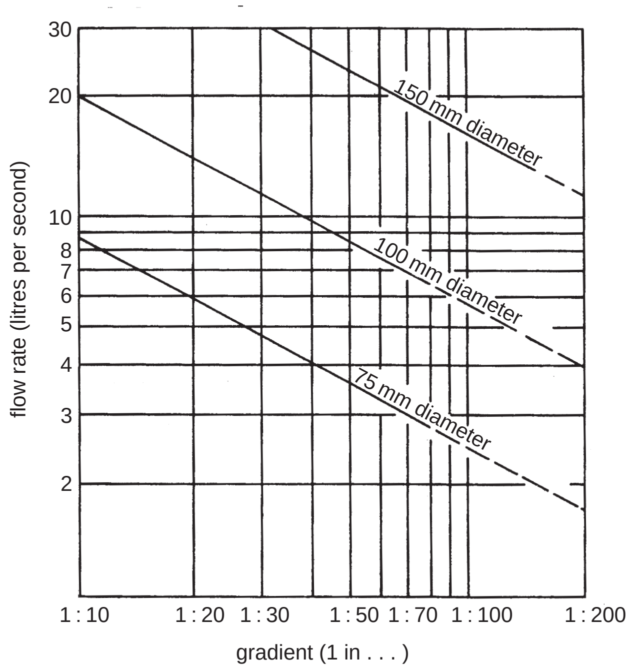
### 13.3.21 Access points

Four types of access points are described in AD H1.

- Rodding eyes (or points). These are extensions of the drainage system to ground level where the open end of the pipe is capped with a sealing plate.
- Access fittings. Small chambers situated at the invert level of a pipe and without any real area of open channel.
- Inspection chambers. Chambers having working space at ground level.
- Manholes. Chambers large enough to admit persons to work at drain level.

## AD HI, section 2

**Diagram 9** Discharge capacities of foul drains running 0.75 proportional depth.




## AD H1, section 2

**Table 7** Materials for below ground gravity drainage.

| Material | British Standard |
|---|---|
| **Rigid pipes** | |
| Vitrified clay | BS 65, BS EN 295 |
| concrete | BS 5911 |
| grey iron | BS 437 |
| ductile iron | BS EN 598 |
| **Flexible pipes** | |
| UPVC | BS EN 1401$^{+}$ |
| PP | BS EN 1852$^{+}$ |
| Structure Walled Plastic pipes | BS EN 13476 |
| $^{+}$ Application area code UD should normally be specified | |
| Note: Some of these materials may not be suitable for conveying trade effluent | |

Some typical access point details are illustrated in Fig. 13.13.

Whatever form of access point is used it should be of sufficient size to enable the drain run to be adequately rodded. Tables 11 and 12 to section 2 of AD HI set out the maximum depths and minimum internal dimensions for

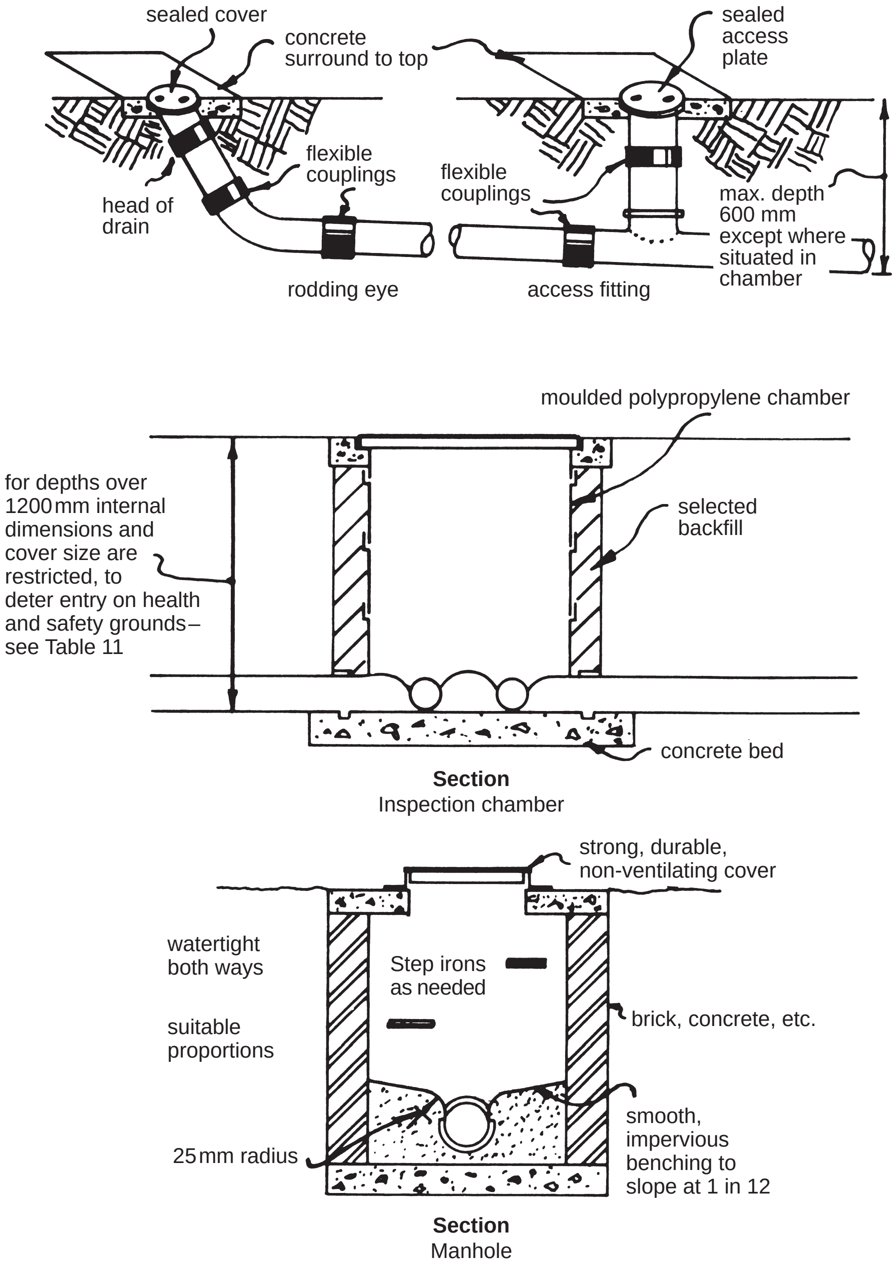



**Fig. 13.13** Access points.

each type of access point. Where a large number of branches enter an inspection chamber or manhole the sizes given in Tables 11 and 12 may need to be increased. It is usual to allow 300mm for each branch connection (thus a 1200 mm long manhole could cater for up to four branch connections on each side). The Tables are set out below.

### 13.3.22 Access points – siting and spacing

Access points should be provided:

- at or near the head of any drain run
- at any change of direction or gradient
- at a junction, unless each drain run can be rodded separately from another access point
- at a change of pipe size, unless this occurs at a junction where each drain run can be rodded separately from another access point
- at regular intervals on long drain runs.

The spacing of access points will depend on the type of access used. Table 13 to section 2 of AD HI gives details of the maximum distances that should be allowed for drains up to 300 mm in diameter and is set out below.

## AD H1, section 2

**Table 11** Minimum dimensions for access fittings and chambers.

| Type | | Depth to invert from cover level (m) | Internal sizes | | Cover sizes | |
|---|---|---|---|---|---|---|
| | | | **Length × width (mm × mm)** | **Circular (mm)** | **Length × width (mm × mm)** | **Circular (mm)** |
| Rodding eye | | | As drain but min 100 | | | Same size as pipework[1] |
| Access fitting | | | | | | |
| small | 150 diam<br>150 × 100 | 0.6 or less, except where situated in a chamber | 150 × 100 | 150 | 150 × 100[1] | Same size as access fitting |
| large | 225 × 100 | | 225 × 100 | 225 | 225 × 100[1] | |
| Inspection chamber | | | | | | |
| | shallow | 0.6 or less | 225 × 100 | 190[2] | – | 190[1] |
| | | 1.2 or less | 450 × 450 | 450 | Min 430 × 430 | 430 |
| | deep | > 1.2 | 450 × 450 | 450 | max 300 × 300[3] | Access restricted to max 350[3] |

**Notes:**
[1] The clear opening may be reduced by 20 mm in order to provide proper support for the cover and frame.
[2] Drains up to 150 mm.
[3] A larger clear opening cover may be used in conjunction with a restricted access. The size is restricted for health and safety reasons to deter entry.

## AD H1, section 2

**Table 12** Minimum dimensions for manholes.

| Type | Size of largest pipe (DN) | Min internal dimensions[1] Rectangular length and width | Min internal dimensions[1] Circular diameter | Min clear opening size[1] Rectangular length and width | Min clear opening size[1] Circular diameter |
|---|---|---|---|---|---|
| Manhole | | | | | |
| < 1.5 m deep to soffit | 150 | 750 × 675[7] | 1000[7] | 750 × 675[2] | na[3] |
| | 225 | 1200 × 675 | 1200 | 1200 × 675[2] | |
| | 300 | 1200 × 750 | 1200 | | |
| | > 300 | 1800 × (DN + 450) | The larger of 1800 or (DN + 450) | | |
| > 1.5 m deep to soffit | 225 | 1200 × 1000 | 1200 | 600 × 600 | 600 |
| | 300 | 1200 × 1075 | 1200 | | |
| | 375–450 | 1350 × 1225 | 1200 | | |
| | > 450 | 1800 × (DN + 775) | The larger of 1800 or (DN + 775) | | |
| Manhole shaft[4] > 3.0 m deep to soffit of pipe | Steps[5] | 1050 × 800 | 1050 | 600 × 600 | 600 |
| | Ladder[5] | 1200 × 800 | 1200 | | |
| | Winch[6] | 900 × 800 | 900 | 600 × 600 | 600 |

**Notes:**
[1] Larger sizes may be required for manholes on bends or where there are junctions.
[2] May be reduced to 600 by 600 where required by highway loading considerations, subject to a safe system of work being specified.
[3] Not applicable due to working space needed.
[4] Minimum height of chamber in shafted manhole 2 m from benching to underside of reducing slab.
[5] Min clear space between ladder or steps and the opposite face of the shaft should be approximately 900 mm.
[6] Winch only – no steps or ladders, permanent or removable.
[7] The minimum size of any manhole serving a sewer (i.e. any drain serving more than one property) should be 1200 mm × 675 mm rectangular or 1200 mm diameter.

Where an access point is provided to a sewer (i.e. serving more than one property) it should be positioned so that it is both accessible and apparent for use in emergencies. Typically, it could be positioned in a highway, public open space, unfenced front garden or shared and unfenced driveway.

### 13.3.23 Access points – construction

Generally, access points should:

- be constructed of suitable and durable materials
- exclude subsoil or rainwater
- be watertight under working and test conditions.

Table 14 to section 2 of AD HI is shown below and lists materials which are suitable for the construction of access points.

## AD H1, section 2

**Table 13** Maximum spacing of access points in metres.

| From | To | Access Fitting Small | Access Fitting Large | Junction | Inspection chamber | Manhole |
|---|---|---|---|---|---|---|
| Start of external drain[1] | | 12 | 12 | — | 22 | 45 |
| Rodding eye | | 22 | 22 | 22 | 45 | 45 |
| Access fitting small 150 diam 150 × 100 | | — | — | 12 | 22 | 22 |
| large 225 × 100 | | — | — | 45 | 22 | 45 |
| Inspection chamber | | 22 | 45 | 22 | 45 | 45 |
| Manhole | | — | — | — | 45 | 90[2] |

**Note**
[1] Stack or ground floor appliance
[2] May be up to 200 for man-entry size drains and sewers

## AD H1, section 2

**Table 14** Materials for access points.

| Material | British Standard |
|---|---|
| **1** Inspection chambers and manholes | |
| Clay | |
| bricks and blocks | **BS 3921** |
| Vitrified clay | BS EN 295, BS 65 |
| Concrete | |
| precast | BS 5911 |
| in situ | BS 8110 |
| Plastics | BS 7158 |
| **2** Rodding eyes and access fittings (excluding frames and covers) | as pipes see Table 7 ETA Certificates |

Inspection chambers and manholes should fulfil the following.

- Have smooth impervious surface benching up to at least the top of the outgoing pipe to all channels and branches. The purpose of benching is to direct the flow into the main channel and to provide a safe foothold. For this reason the benching should fall towards the channel at a slope of 1 in 12 and should be rounded at the channel with a minimum radius of 25 mm (see Fig. 13.13 above).
- Be constructed so that branches up to and including 150 mm diameter discharge into the main channel at or above the horizontal diameter where half-round open

channels are used. Branches greater than 150mm diameter should be set with the soffit level with that of the main drain. Branches which make an angle of more than 45° with the channel should be formed using a three-quarter section branch bend.

- Have strong, removable, non-ventilating covers of suitable durable material (e.g. cast iron, cast or pressed steel or pre-cast concrete or plastics).
- Be fitted with step irons, ladders, etc., if over 1.0 m deep.
- Small lightweight access covers should be secured to deter unauthorised access (e.g. by children). Commonly, such covers are screwed down.
- A manhole or inspection chamber which is situated *within* a building should have an airtight cover that is mechanically fixed (e.g. screwed down with corrosion resistant bolts). This requirement does not apply if the inspection chamber or manhole gives access to part of a drain which itself has inspection fittings and these are provided with watertight covers.

### 13.3.24 Test for watertightness

After laying and backfilling, gravity below-ground drains and private sewers not exceeding 300 mm in diameter should be pressure tested using air or water.

For the air test, the pipe should be pressurised up to 110 mm water gauge and held for about five minutes prior to testing. Subsequently, a head loss of up to 25 mm at 100 mm water gauge is permitted in a period of seven minutes during the test.

For the water test, the section of drain to be tested should be filled with water up to a depth of 500 mm above the lowest invert and at least 100 mm above the highest invert in the test section and left to stand for about one hour to condition the pipe. Over the next 30 minutes the test pressure should be maintained by topping up the water level so that it is within 10mm of the levels given above. The leakage rate per square metre of surface area should not exceed:

- 0.15 litres for pipelines only, or
- 0.20 litres for test lengths which include pipelines and manholes, and
- 0.40 litres for tests on manholes and inspection chambers alone (i.e. no pipelines).

Using this method it is easy to check the leakage rate simply by measuring the quantity of water used to top up during the test and dividing by the surface area of the manhole or inspection chamber.

For tests on pipelines exceeding 300mm diameter, reference should be made to BS 8000: Part 14:1989 *Workmanship on building sites. Code of practice for below ground drainage*, or BS EN 1610:1998 *Construction and testing of drains and sewers. Code of practice for design and construction.*

### 13.3.25 Special protection for drains adjacent to or under buildings

Where drains pass under buildings or through foundations and walls there is a risk that settlement of the building may cause pipes to fracture, with consequential blockages and leakage. In the past it was common practice to require pipes (which were rigid jointed) to be encased in concrete. Since the development of flexible pipe systems it has become essential to maintain this flexibility in order that any slight settlement of the building will not cause pipe fracture.

Therefore, drain runs under buildings should be surrounded with at least 100 mm of granular or other flexible filling. On some sites unusual ground conditions may lead to excessive subsidence. To protect drain runs from fracture it may be necessary to have additional flexible joints or use other solutions such as suspended drainage especially where the pipe is adjacent to structures or where there is a change in soil conditions in the length of the pipe run. Shallow drain runs under concrete floor slabs should be protected as described in section 13.3.20 above and as shown in Fig. 13.12 where the crown of the pipe is less than 300 mm from the underside of the slab.

Where a drain is built into a structure (e.g. a wall, foundation, ground beam, inspection chamber, manhole etc.) suitable measures should be taken to prevent damage or misalignment. The following solutions are possible.

- The wall may be supported on lintels over the pipe. A clearance of 50 mm should be provided round the pipe perimeter and this gap be masked on both sides of the wall with rigid sheet material to prevent the ingress of fill or vermin. The void should be filled with a compressible sealant to prevent ingress of gas.
- A length of pipe may be built in to the wall with its joints not more than 150 mm from each face. Rocker pipes not exceeding 600 mm in length should then be connected to each end of the pipe using flexible joints (see Fig. 13.14).

Where a drain or private sewer is laid close to a load-bearing part of a building, precautions should be taken to ensure that the drain or sewer trench does not impair the stability of the building.

Where any drain or sewer trench is within 1 m of the foundation of a wall, and the bottom of the trench is lower than the wall foundation, the trench should be filled with concrete up to the level of the underside of the foundation.

Where a drain or sewer trench is 1 m or more from a wall foundation, and the trench bottom is lower than the foundation, the trench should be filled with concrete to within a vertical distance below the underside of the foundation of not more than the horizontal distance from the foundation to the trench less 150 mm (see Fig. 13.15).

Where it is necessary to adopt unusual design solutions for buried pipelines due to special ground conditions (e.g. pipes are to be laid on piles or beams, ground may prove to be unstable, there may be a high water table etc.) or where pipes are to be laid in a common trench, guidance may be found in the Department of Transport publication: *Guide to design loadings for buried rigid pipes*.

Additionally, local authorities may be able to provide information regarding subsoil conditions on many sites.

### 13.3.26 Special protection – drain surcharging

Under conditions of heavy rainfall, combined and rainwater sewers are designed to surcharge, whereby the water level in the manhole rises above the top of the pipe. This may also happen to some foul sewers if they receive rainwater. Therefore, on

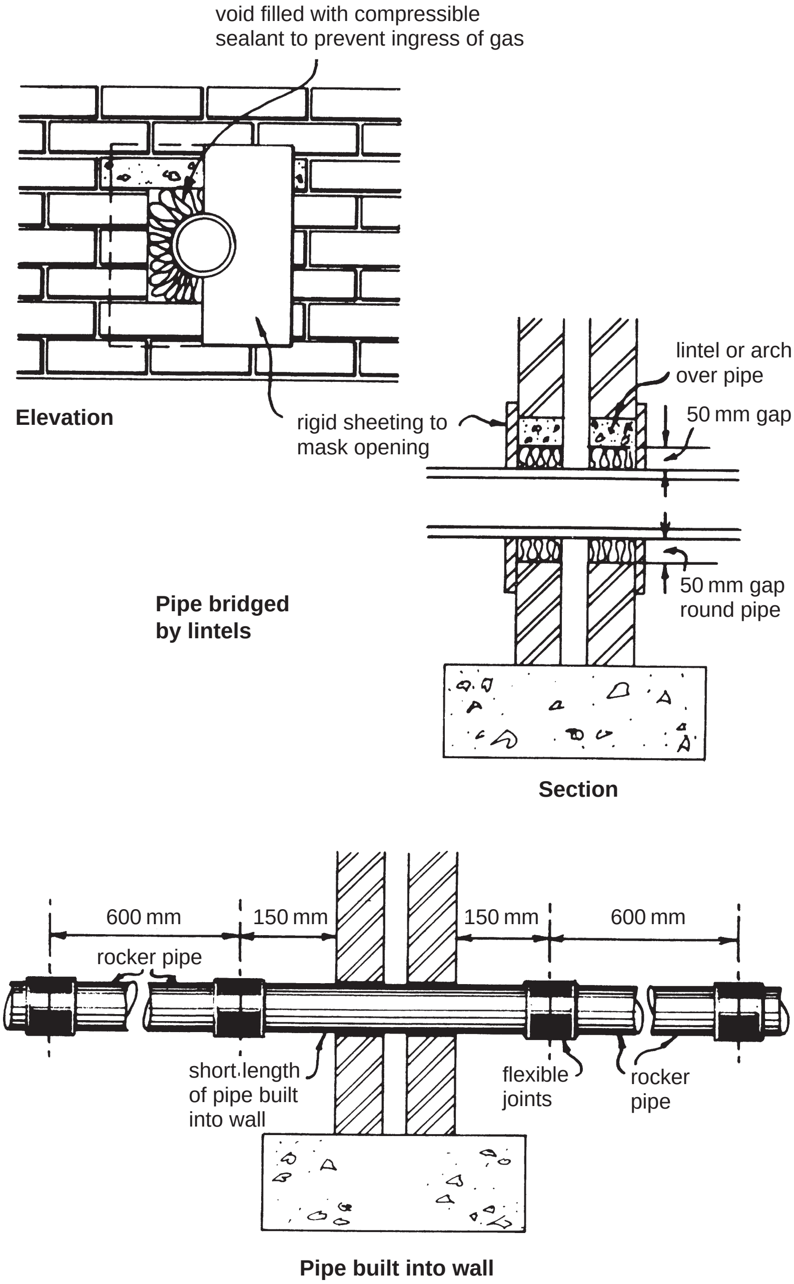



**Fig. 13.14** Drains passing through foundations.

some low lying sites properties may be at increased risk of flooding if the ground level of the site (or the level of a basement) is below the level at which the drainage connects to the public sewer. The sewerage undertaker should consulted in such cases to determine the extent and frequency of the likely surcharge.

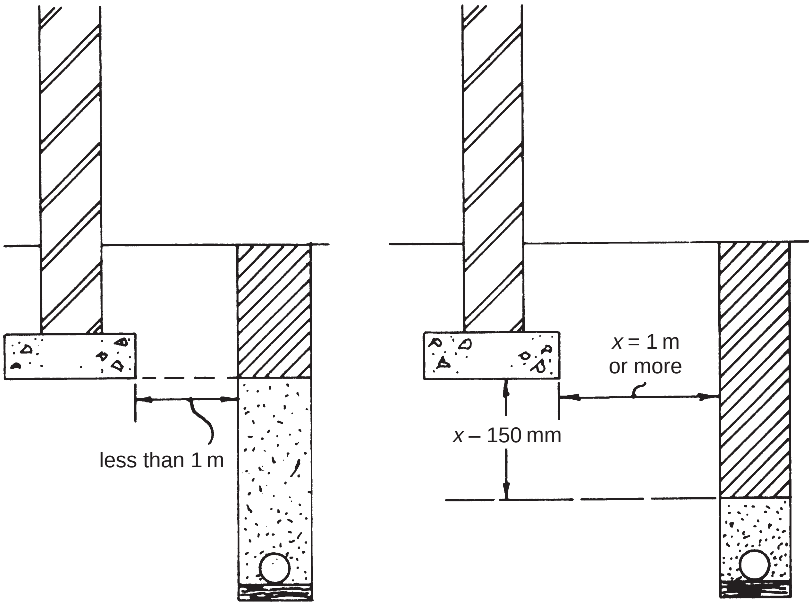



**Fig. 13.15** Drain trenches.

Where a basement contains sanitary appliances and the sewerage undertaker considers that the risk of flooding due to surcharging is high, the drainage from the basement should be pumped (see section 13.3.28 below). For low risks, an anti-flooding valve should be installed on the drainage from the basement.

For low lying sites (i.e. those not containing basements) where the risk is low, protection for the building may be achieved by the provision of an external gully sited at least 75 mm below floor level in a position so that any flooding from the gully will not damage any buildings. Higher risk areas should have anti-flooding valves or pumped drainage systems (see section 13.3.28 below).

Anti-flooding valves should:

- be of the double valve type
- be suitable for foul water
- have a manual closure device
- comply with prEN 13564 *Anti flooding devices for buildings*.

Normally, a single valve should serve only one building and information about the valve should be provided on a notice inside the building. The notice should indicate the location of any manual override and include necessary maintenance information.

Some parts of the drainage system may be unaffected by surcharging. These parts should by-pass any protective measures and should discharge by gravity.

### 13.3.27 Special protection – rodent control

Generally, rodent infestation (especially by rats) is on the increase. Since rats use drains and sewers as effective communication routes, on previously developed sites the local authority should be consulted to ascertain if any special rodent control precautions are thought necessary.

Special precautions could include the following.

- By providing inspection chambers with screwed access covers on the pipework instead of open channels. These should only be used in inspection chambers where maintenance can be carried out from the surface without personnel entry.
- Intercepting traps may also be provided as in the past, although they do increase the incidence of blockages unless adequately maintained. Trap stoppers should be of the locking type and should be easy to remove and replace after clearing any blockage. They should always be replaced after maintenance operations and should only be used in inspection chambers where maintenance can be carried out from the surface without personnel entry.
- A number of different kinds of rodent barriers might be considered. These include enlarged sections of discharge stacks which prevent rats climbing, flexible downward facing fins in discharge stacks and one way valves in underground drainage.
- The provision of metal cages on ventilator stack terminals and fixed plastic covers or metal gratings on gullies to discourage rats from leaving the drainage system.

### 13.3.28 Pumping installations

Reference has been made above to the use of pumping installations where gravity drainage is impracticable or where protection is required against flooding due to surcharge in downstream sewers.

AD H1 gives details of packaged pumping systems for use both inside and outside buildings as follows.

#### *Inside buildings*

Floor mounted units available for use in basements should comply with BS EN 12050 *Wastewater lifting plants for buildings and sites – principles of construction and testing*. The pumping installation itself should be designed in accordance with BS EN 12056:2000 *Gravity drainage systems inside buildings*: Part 4: *Effluent lifting plants, layout and calculation*.

#### *Outside buildings*

Package pumping installations for use outside buildings are also available. The pumping installation should be designed in accordance with BS EN 752 *Drain and sewer systems outside buildings*: Part 6: 1998 *Pumping installations*.

Foul water drainage pumping installations should comply with the following.

- To allow for disruption in service, the effluent receiving chamber should be sized to contain 24-hour inflow.
- For domestic use the minimum daily discharge of foul drainage should be taken as 150 litres per person per day.
- For non-domestic uses the capacity of the receiving chamber should be based on the calculated daily demand of the water intake for the building (and should be assessed on a pro-rata basis where only a proportion of the foul sewage is pumped).
- For all pumped systems the controls should be arranged to optimise pump operation.

### 13.3.29 Workmanship

In general, workmanship should be in accordance with BS 8000 *Workmanship on building sites* Part 14: *Code of practice for below ground drainage*.

In particular, drains and sewers which are left open during construction should be covered when work is not in progress to prevent entry by rats.

A number of measures are necessary to protect drains during construction work. For example, drains can be damaged by construction traffic and heavy machinery. Barriers should be provided where necessary to keep traffic away from the line of the sewer and heavy materials should not be stored over drains or sewers. Additionally, piling works can cause damage to drains and sewers unless certain precautions are taken. This would include carrying out a survey to establish the exact location of any drain runs and connections before piling commences. Piling should not be carried out where the distance from the outside of the sewer to the outside of the pile is less than two times the diameter of the pile.

### 13.3.30 Altemative method of design

Additional information on the design and construction of building drainage which meets the requirements of the 2000 Regulations may be found in the relevant parts of:

- BS EN 12056: *Gravity drainage systems inside buildings*. This standard also describes the discharge unit method of calculating flows;
- BS EN 752 *Drain and sewer systems outside buildings*: Part 3:1997 *Planning*, Part 4:1997 *Hydraulic design and environmental aspects* and Part 6:1998 *Pumping installations*;
- BS EN 1610:1998 *Construction and testing of drains and sewers*;
- BS EN 1295: Part 1:1998 *Structural design of buried pipelines under various conditions of loading*;
- BS EN 1091:1997 *Vacuum sewerage systems outside buildings*; and
- BS EN 1671:1997 *Pressure sewerage systems outside buildings*.

BS EN 752 together with BS EN 1610 and BS EN 1295 contain additional information about design and construction.

## 13.4 Wastewater treatment systems and cesspools

Any septic tank and its form of secondary treatment, other wastewater treatment system or cesspool must be sited and constructed so that:

- it is not prejudicial to health;
- it will not contaminate any watercourse, underground water or water supply;
- it is accessible for emptying and maintenance;
- it will continue to function in the event of a power failure to a standard sufficient for the protection of health, where this is relevant (i.e. where a power supply is needed for normal operation of the system).

Furthermore, any septic tank, holding tank which is part of a wastewater treatment system or cesspool must be:

- adequately ventilated
- of adequate capacity
- constructed to be impermeable to liquids.

Since all wastewater treatment systems and cesspools rely on adequate maintenance in order to continue to operate in a safe and healthy manner the Regulations require that maintenance instructions be provided in the form of a durable notice which must be affixed in a suitable place in the building. Examples of a typical notices are given in the text below.

It should be noted that the use of non-mains foul drainage should only be considered where connection to mains drainage is not practicable and any discharge from a wastewater treatment system is likely to require consent from the Environment Agency. Contact with the Environment Agency should be made as early as possible in the design process (usually when the planning process is being initiated and before a Building Regulation application is made for non-mains drainage). This will determine whether a consent to discharge is required and what parameters apply, which in turn can have an impact on the type of system that may be installed. Further guidance may be obtained from Pollution Prevention Guideline No 4 *Disposal of sewage where no mains drainage is available*: Environment Agency 1999.

### 13.4.1 Wastewater treatment systems

A wastewater treatment system typically includes a septic or settlement tank which provides primary treatment to the effluent from a building. This is likely to be the most economic form of treating wastewater for one to three dwellings. The discharge from the tank can, however, still be harmful, therefore there is a need for a system of drainage which completes the treatment process after the effluent has passed through the tank, thus providing a means of secondary treatment. The term 'wastewater treatment system' can also include small sewage treatment works (see section 13.4.3 below).

In the past, the Regulations have tended to concentrate on the design and construction of the means of primary treatment but have failed to provide guidance on the ultimate means of disposal of the effluent. This is an area where considerable research and development has taken place in recent years and guidance is now given on the design and construction of drainage fields and mounds, and on constructed wetlands and reedbeds. The performance of a wastewater treatment system will depend on the capacity, siting, design and construction of both the septic or settlement tank and the drainage field or other means of secondary treatment.

## 13.4.2 Primary treatment systems – septic tanks and settlement tanks

### *Capacity*

The primary treatment system should have sufficient capacity and should provide suitable conditions for the settlement, storage and partial decomposition of solid matter in the wastewater from the building. It should also be sited and constructed so as to prevent overloading of the receiving water.

For up to four users, a minimum capacity of 2.7 $m^3$ (2700 litres) below the level of the inlet is set for septic tanks and settlement tanks in order to reduce danger of overflowing and malfunctioning. This size should be increased by 0.18 $m^3$ (180 litres) for each additional user.

### *Siting and construction*

Septic tanks should be designed and constructed to prevent leakage of contents and the ingress of subsoil water. They should also be provided with adequate ventilation, which should be kept away from buildings. Therefore, they should be kept at least 7 m from any habitable parts of buildings, preferably on a downslope.

Septic tanks must be periodically desludged and cleaned. This is usually carried out mechanically using a tanker. Because of the length of piping involved it is necessary that the cesspool or tank be sited within 30 m of a vehicular access; however, where the invert level of the tank is more than 3 m below the vehicle access level the 30 m distance will need to be reduced accordingly. Emptying and cleaning should not involve the contents being taken through a dwelling or place of work, and there should be a clear route for the hose so that the emptying and cleaning can be carried out without creating a hazard for the building's occupants. Access covers for emptying and cleaning should be sufficiently durable to resist the corrosive nature of the tank contents and should be designed to prevent unauthorised access (by being lockable or otherwise engineered to prevent personnel entry).

Tanks should also be constructed of materials which are impervious to the contents and to ground water. This would include engineering brickwork in 1:3 cement mortar at least 220 mm thick and concrete at least 150 mm thick (C/25/P mix to BS 5328), roofed with heavy concrete slabs. Prefabricated cesspools and tanks are available made of glass reinforced plastic, polyethylene or steel. These should follow the guidance in BS EN 12566 *Small wastewater treatment plants less than 50 PE*: Part 1: 2000 *Prefabricated septic tanks*. Care should be exercised over the stability of these tanks.

The inlet and outlet of the tank should be provided with access for sampling and inspection of the contents, and be designed to avoid excessive disturbance of the surface scum or settled contents by incorporating at least two chambers operating in sequence. The velocity of flow into the tank can be limited by laying the last 12 m of the incoming drain at a gradient of 1 in 50 or flatter for all pipes up to 150 mm in diameter. Alternatively, a dip pipe inlet may be provided (see Fig. 13.16) where the tank width does not exceed 1200 mm.

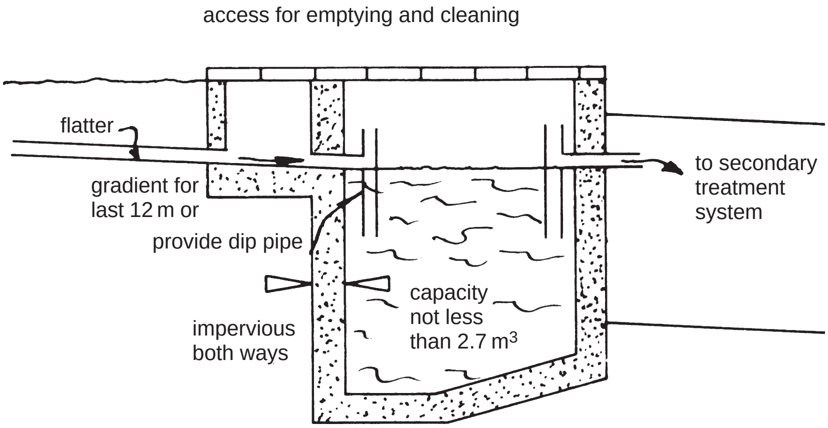



**Fig. 13.16** Septic tank.

### *Septic tank maintenance*

It is essential that building owners are kept informed about the maintenance requirements of septic tanks. Septic tanks need to be inspected monthly to make sure that they are working properly. This involves an inspection of the inlet chamber and the outlet from the tank to ensure that the effluent is flowing freely. Additionally, the effluent at the outlet should be clear.

If these conditions are not met the tank should be emptied by a licensed contractor who will make a charge. It may be more economical to take out an annual maintenance contract with a suitable contractor. Septic tanks should be emptied annually and it is usual to leave a small amount of sludge to act as an anaerobic seed.

Failure to adequately maintain the tank may result in solids being carried into the drainage field or mound. The sediments deposited may block the pores in the soil necessitating early replacement of the field or mound and in exceptional circumstances this can even render the site unsuitable for future use as a drainage field or mound.

A durable notice should be fixed within the building describing the necessary maintenance. Fig. 13 .17 below is an example of a typical notice.

**Wastewater Treatment System**

**Details of Necessary Maintenance**

Address of Property _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Location of treatment system _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

The foul drainage system from this property discharges to a septic tank and a [*insert type of secondary treatment*]

The tank requires monthly inspections of the outlet chamber or distribution box to observe that the effluent is free-flowing and clear.

The septic tank requires emptying at least every 12 months by a licensed contractor.
The [*insert type of secondary treatment*] should be [*insert details of maintenance of secondary treatment*].

The owner is legally responsible to ensure that the system does not cause pollution, a health hazard or a nuisance.

**Fig. 13.17** Septic tank – typical maintenance notice.

## 13.4.3 Primary treatment systems – packaged treatment works

Packaged treatment works, which are engineered to treat a given hydraulic and organic load to a higher standard than septic tanks, use prefabricated components which can be installed with a minimum amount of site work. They are normally more economic than septic tanks for larger developments and can also discharge direct to a suitable watercourse. They should be considered where there are space limitations or where other options are not possible. AD H2 does not really deal with such installations in any detail since specialist knowledge is needed in their detailed design and installation. However, it does recommend that the discharge from the treatment plant should be sited at least 10 m from watercourses or any other buildings. Furthermore, since many of these systems are powered by electricity it is important that the system should be able to adequately function for up to six hours without power or have an uninterruptible power supply.

Guidance on packaged treatment works may be obtained from BS 6297: 1983 *Code of practice for design and installation of small sewage treatment works and cesspools*. Additionally, packaged treatment works should be type-tested in accordance with BS 7781 or otherwise tested by a notified body.

The guidance regarding maintenance requirements mentioned above in connection with septic tanks also applies generally to packaged treatment works; however there will be variations in maintenance needs depending on the type of plant installed. The manufacturer's instructions regarding maintenance and inspection should always be adhered to. A durable notice should be fixed within the building describing the necessary maintenance. Fig. 13.18 below is an example of a typical notice.

**Wastewater Treatment System**

**Details of Necessary Maintenance**

Address of Property _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Location of treatment system _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

The foul drainage system from this property discharges to a packaged treatment works.

Maintenance is required [insert frequency] and should be carried out by the owner in accordance with the manufacturer's instructions.

The owner is legally responsible to ensure that the system does not cause pollution, a health hazard or a nuisance.

**Fig. 13.18** Septic tank – typical maintenance notice.

### 13.4.3 Secondary treatment systems – drainage fields and drainage mounds

Drainage fields and drainage mounds are used to provide secondary treatment to the discharge from a septic tank or packaged treatment plant. Drainage fields normally consist of below ground irrigation pipes which allow the partially treated effluent from the septic tank to percolate into the surrounding soil. Further biological treatment takes place naturally in the aerated soil layers. They may be used in subsoils with good percolation characteristics on sites which are not prone to flooding or waterlogging at any time of the year. Drainage mounds consist of drainage fields placed above the ground surface thus providing an aerated soil layer to treat the discharge. On sites where there is a high water table or impervious ground where occasional waterlogging is possible, drainage mounds could be used.

It should be noted that drainage fields and mounds are not permitted by the Environment Agency in prescribed Zone 1 groundwater source protection zones.

#### *Siting*

Care has to be taken with siting in order to protect underground water sources and watercourses and to ensure that the system will operate effectively. Therefore, a drainage field or mound serving a wastewater treatment system or septic tank should be sited:

- not less than 10 m from any permeable drain or watercourse;
- not less than 50 m from the abstraction point of any groundwater supply;
- away from any Zone 1 groundwater protection zone;
- not less than 15 m from any building;
- far enough away from other drainage fields, mounds or soakaways so that the overall soakage capacity of the ground is not exceeded;
- on the downslope side of any groundwater sources.

The disposal area should be isolated and should not contain any access roads, driveways or paved areas. Additionally, no water supply pipes or other underground services should be located within the disposal area other than those required by the disposal system itself.

### *Ground conditions and percolation*

Some indication of the likely percolation characteristics of a site may be gained by taking a sample and observing the nature of the subsoil. Table 13.3 below gives an indication of the likely percolation characteristics of different subsoil colours and types. Percolation characteristics should be ascertained under both summer and winter conditions. This usually takes the form of a preliminary assessment followed by a percolation test.

**Table 13.3** Likely percolation characteristics of different soil types.

| Likely percolation characteristics | Soil colour | Likely soil type |
|---|---|---|
| Well drained and well aerated | Brown, yellow or reddish | Sand, gravel, chalk, sandy loam, clay loam |
| Poorly drained or saturated | Grey, blue | Sandy clay, silty clay, clay |
| Indicative of periodic saturation | Grey or brown mottling | Sandy clay, silty clay, clay |

The preliminary assessment should involve:

- consultation with the Environment Agency and the local authority to determine the possible suitability of the site;
- an assessment of the on-site natural vegetation (most plants generally grow best on well drained land, the presence of certain plants may indicate wet or boggy conditions etc.);
- a determination of the position of the standing ground water table.

The standing ground water table is determined by excavating a trial hole. This should be at least 1 $m^2$ in area and should be at least 2 m deep or 1.5 m below the invert of the proposed drainage field pipework. The ground water table should be at least 1m below the invert level of the proposed effluent distribution pipes in both summer and winter.

The preliminary assessment should be followed by a percolation test of the proposed disposal area. Fig. 13.19 below illustrates the three stages of the percolation test. Where deep drains are needed the 300 mm hole should be excavated at the base of a wider excavation to allow room for working. Alternatively a modified test procedure can be adopted using a 300 mm earth auger bored vertically into the ground. All debris should be removed from the hole before the test is carried out.

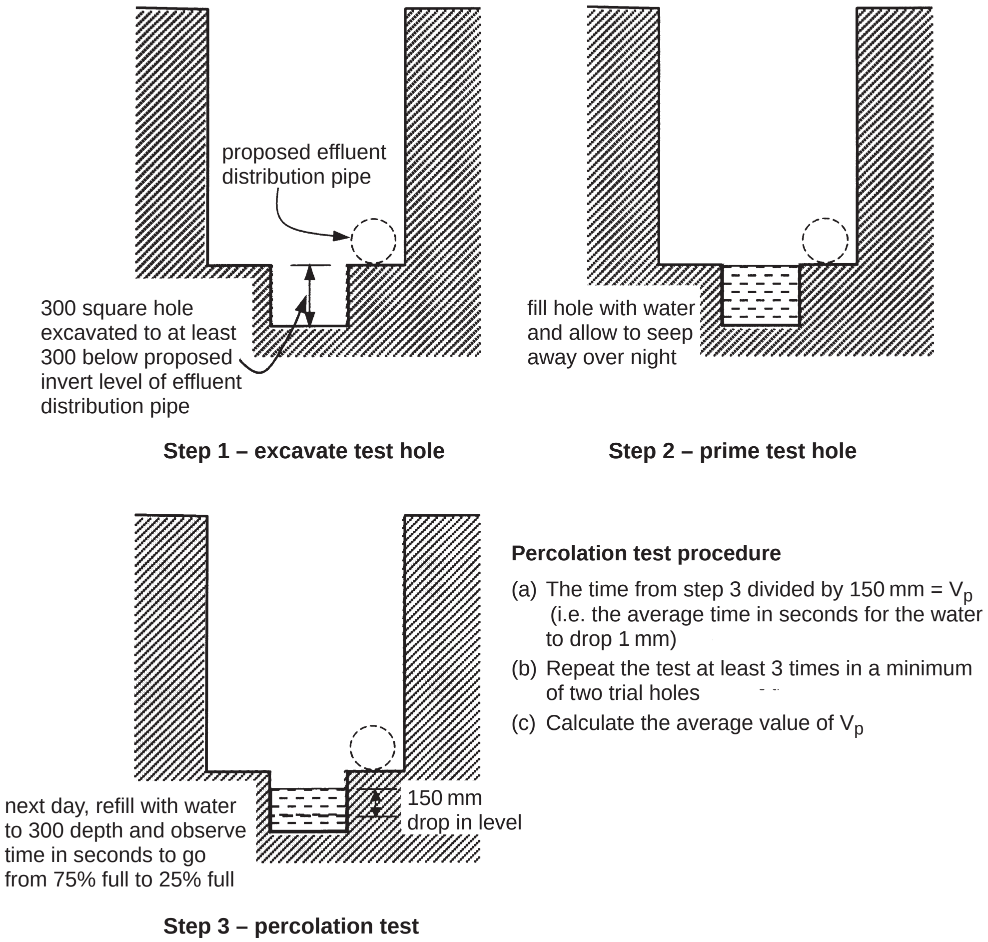



**Fig. 13.19** Percolation test method.

The test should only be carried out when weather conditions are suitable (i.e. not during heavy rain, severe frost or drought).

Disposal via a drainage field should only be considered when:

- the percolation tests give values of $V_p$ between 12 and 100 sec/mm; and
- the preliminary site assessment report is favourable; and
- the trial hole tests give acceptable results.

The values of $V_p$ given above ensure that untreated effluent cannot percolate too rapidly into the ground water. Where $V_p$ is outside the quoted range, treatment via a drainage field is unlikely to be successful. In these circumstances it may still be possible to use a septic tank provided that an alternative method of secondary treatment can be used to treat the effluent from the septic tank. It might then be possible to take the final discharge to a soakaway.

### *Design and construction*

The main features of a typical drainage field are illustrated in Fig. 13.20, whilst Fig. 13.21 shows the main features of a drainage mound. Both are designed to ensure aerobic contact between the liquid effluent and the subsoil.

Pipes for drainage fields should be:

- perforated and laid in trenches of uniform gradient not exceeding 1 in 200;
- laid on a 300 mm layer of clean shingle or broken stone graded between 20 mm and 50 mm;
- laid at a minimum depth of 500 mm below the surface of the ground;
- laid in a continuous loop fed from an inspection chamber sited between the septic tank and the drainage field.

Pipe trenches for drainage fields should be:

- filled to a level of 50 mm above the pipe with the shingle or broken stone and covered with a layer of geotextile to prevent entry of silt;
- topped up with soil to ground level;
- between 300 mm and 900 mm wide;
- at least 2 m from other trenches in the same drainage field.

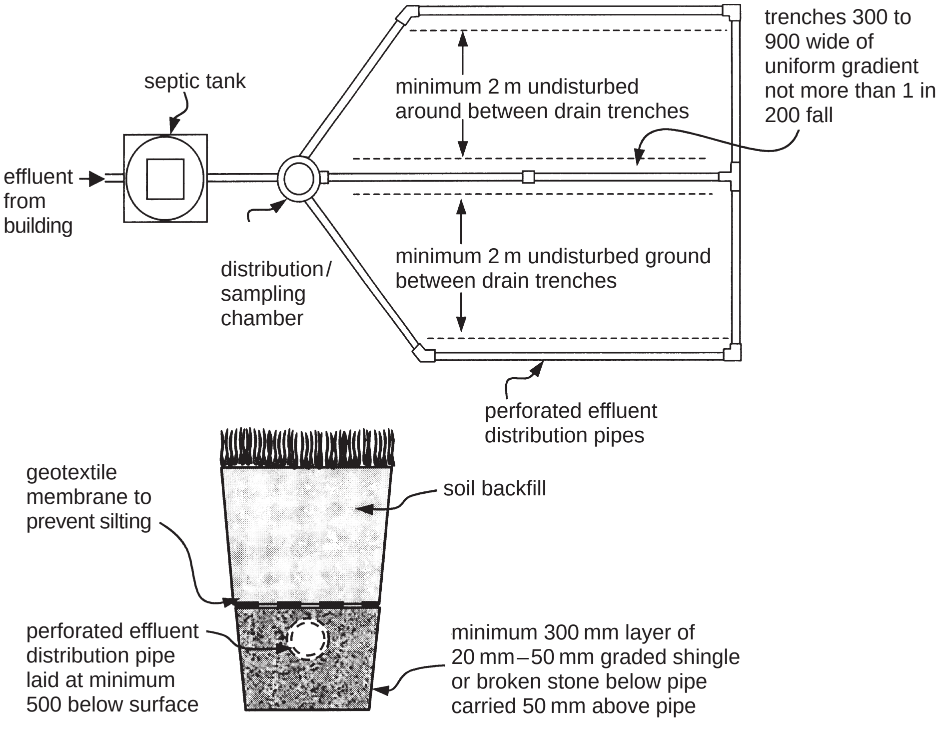



**Fig. 13.20** Drainage field.

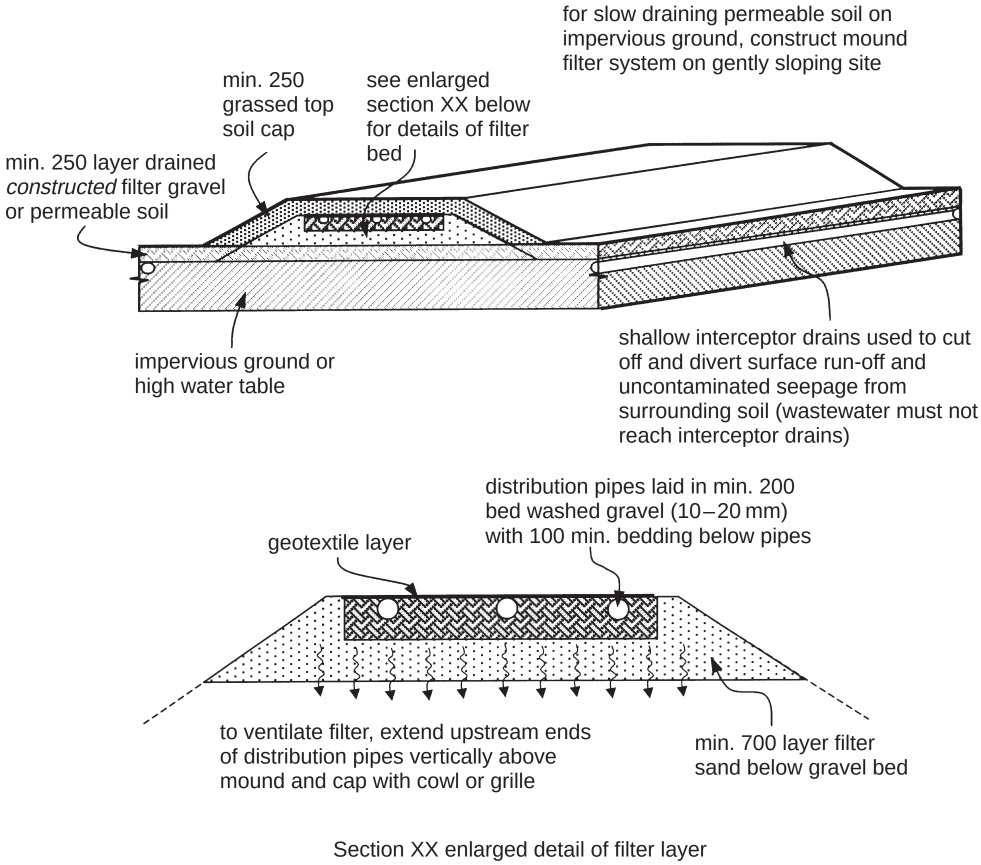



**Fig. 13.21** Drainage mound details.

The area needed to be covered by the drainage field (the floor area, $A_t$ $m^2$) can be calculated from the formula $\mathbf{A_t = p \times V_p \times 0.25}$
where p = number of persons served by the septic tank and $V_p$ = the percolation value in sec/mm obtained as described above.

Drainage mounds should contain the features shown in Fig. 13.21.

### 13.4.4 Secondary treatment systems – constructed wetlands/reed beds

Where drainage fields or mounds are not a practical solution, it may be possible to treat septic tank effluent by means of constructed wetlands discharging to a suitable watercourse. Constructed wetlands (e.g. consisting of reed beds) are man-made systems which exploit the natural treatment capacity of certain wetland plants such as the common reed (*Phragmites communis*). The Environment Agency's consent may be required for this.

### *Constructed wetlands – general comments*

Constructed wetland treatment systems purify wastewater by a combination of filtration, bacterial oxidation, sedimentation and chemical precipitation as the effluent moves through a gravel bed and around the rhizomes and roots of the wetland plants. In this way the biological oxygen demand (BOD) and suspended solids of the effluent are reduced, ammonia is oxidised, nitrates are reduced and a small amount of phosphorous is removed.

Plants used for reed beds and in constructed wetlands include:

- common reed (*Phragmites communis*);
- reed maces (*Typha latifolia*);
- rushes (*Juncus effusus*);
- bulrush (*Schoenoplectus lacustris*);
- members of the sedge family (*Carex*); and
- yellow flag (*Iris pseudocorus*).

In general, shaded areas (under trees or close to buildings) should not be used as the site for a constructed wetland as this will lead to poor and patchy growth. Additionally, the likely winter performance of the wetland should be taken into account during the design stage, as the lower temperatures tend to lead to poorer removal of ammonia although the other functions mentioned above are not affected.

### *Constructed wetlands – design*

There are two principal designs for constructed wetland systems, horizontal flow and vertical flow. These can be used separately or can be combined to give superior treatment. The reed bed systems that produce good quality effluents with nitrification use vertical flow reed beds followed by a horizontal flow bed. Whether such a high level of treatment is appropriate depends on the quality and dilution of the receiving water body.

### *Vertical flow systems*

In a vertical flow system, the top surface of the reed bed is intermittently flooded with wastewater. There are usually two or more beds provided side by side allowing a regime of rest and loading so that the surface, which might become clogged in use, can recover its permeability. The flow of wastewater passes down through layers of free-draining sand and gravel to an outlet at the bottom where it is collected by a system of drains at the base. In practice, depth is limited by available falls and construction techniques, however, a bed depth of about 1 m is typical and good results should be achieved with a single bed between 1 and 2 m deep.

In general, vertical flow systems are able to achieve more complete treatment of the effluent (particularly of ammonia) than horizontal flow systems because they can deliver much better oxygen transfer. Unfortunately, they do require more maintenance.

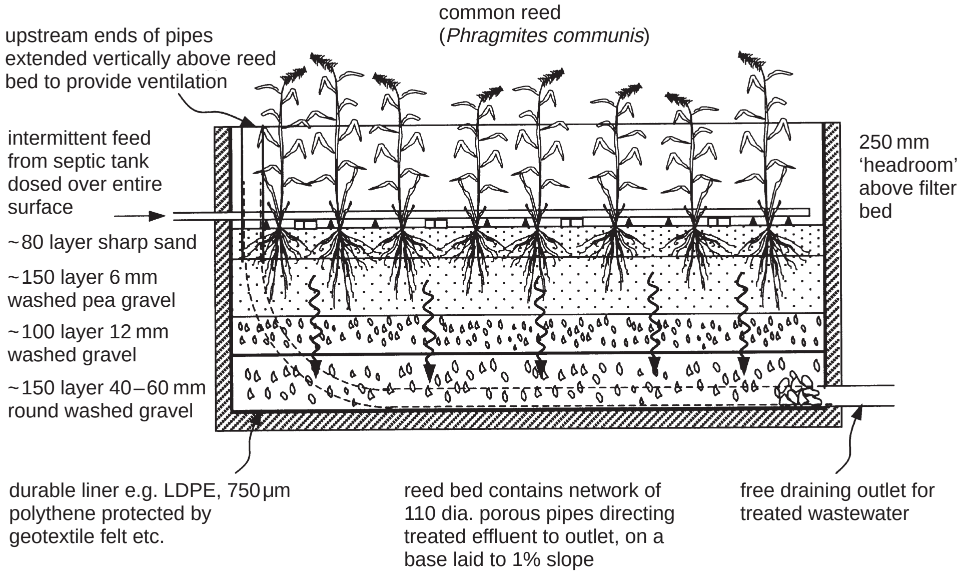



**Fig. 13.22** Typical vertical flow reed bed treatment system.

A typical vertical flow reed bed treatment system is shown in Fig. 13.22.

### *Horizontal flow systems*

In a horizontal flow system, wastewater is continuously fed in from the upstream end and passes over the full width of a gravel bed to an outlet at the downstream end. Horizontal flow systems have the disadvantage of being oxygen-limited and therefore incapable of fully treating concentrated effluents, especially those containing high levels of ammonia. They also require a relatively level site but have lower maintenance needs than vertical flow systems since only one bed is needed. A typical horizontal flow reed bed system is illustrated in Fig. 13.23.

The guidance provided in AD H2 on vertical and horizontal flow reed bed systems is extremely limited and has been enhanced in the above notes and illustrations by reference to BRE Good Building Guide 42 (GBG 42) to which reference should be made. There are many other forms of constructed wetland treatment systems available and being developed both nationally and internationally. GBG 42 contains a number of references to such systems which will normally require specialist advice.

### *Maintenance of constructed wetlands*

It is essential that building owners are kept informed about the maintenance requirements where constructed wetlands are provided. The main maintenance

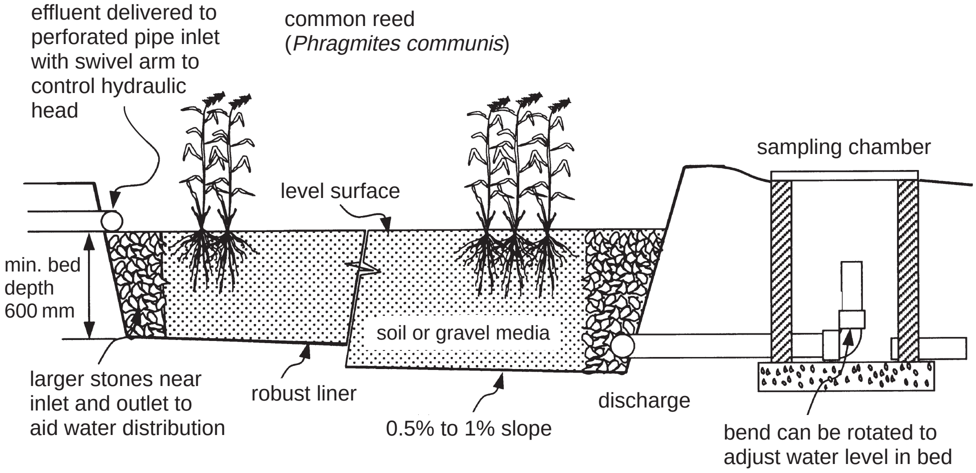



**Fig. 13.23** Typical horizontal flow reed bed.

requirements are weeding, annual reed cutting and general grounds-care around the system. There will also be the need for periodic resting where multiple beds are provided in horizontal flow systems. Horizontal flow reed beds require less routine maintenance than vertical flow beds and where weeds are a problem the bed can be flooded to kill off the weeds. Full details of guidance on maintenance of reedbeds can be found in GBG 42 Part 2. A durable notice should be fixed within the building describing the necessary maintenance. Fig. 13.24 below is an example of a typical notice.

**Wastewater Treatment System**

**Details of Necessary Maintenance**

Address of Property _________________________________________

Location of treatment system _________________________________________

The foul drainage system from this property discharges to a [*insert type of primary treatment*] and a constructed wetland.

The [*insert type of primary treatment*] requires [*insert details of maintenance of the primary* treatment].

The constructed wetland system requires [*insert details of maintenance of the constructed wetland*].

**Fig. 13.24** Constructed wetland – typical maintenance notice.

### 13.4.5 Cesspools

Where no other drainage disposal option is available it may be acceptable to provide a cesspool. Quite simply, a cesspool is a watertight underground tank provided for the storage of raw sewage. No treatment is involved.

#### *Siting*

Cesspools should be sited:

- on sloping ground away from and lower than nearby buildings;
- below, and at least 7 m from, the habitable parts of buildings;
- within 30 m of a vehicle access;
- at such levels that emptying and cleaning can be carried out without creating a hazard for the building's occupants and without the contents being taken through a dwelling or place of work.

Access for emptying and cleaning may be through a covered space which may be lockable.

#### *Design and construction*

The minimum capacity of the cesspool measured below the level of the inlet should be 18 $m^3$ (18,000 litres) based on two users. This capacity should be increased by 6.8 $m^3$ (6800 litres) for each additional user.

Additionally, cesspools should:

- have no openings except for the inlet from the drain, access for emptying and cleaning and ventilation;
- prevent leakage of the contents and ingress of subsoil water;
- be ventilated;
- be provided with access for emptying, cleaning, and inspection at the inlet.

Access covers for emptying and cleaning should be sufficiently durable to resist the corrosive nature of the tank contents and should be designed to prevent unauthorised access (by being lockable or otherwise engineered to prevent personnel entry).

Cesspools should also be constructed of materials which are impervious to the contents and to ground water. This would include engineering brickwork in 1:3 cement mortar at least 220 mm thick and concrete at least 150 mm thick (C/25/P mix to BS 5328), roofed with heavy concrete slabs. Prefabricated cesspools are available made of glass reinforced plastics, polyethylene or steel. These should follow the guidance in BS EN 12566 *Small wastewater treatment plants less than 50 PE:* Part 1: 2000 *Prefabricated septic tanks*. Care should be exercised over the stability of these tanks. Fig. 13.25 illustrates a typical cesspool designed for two users.

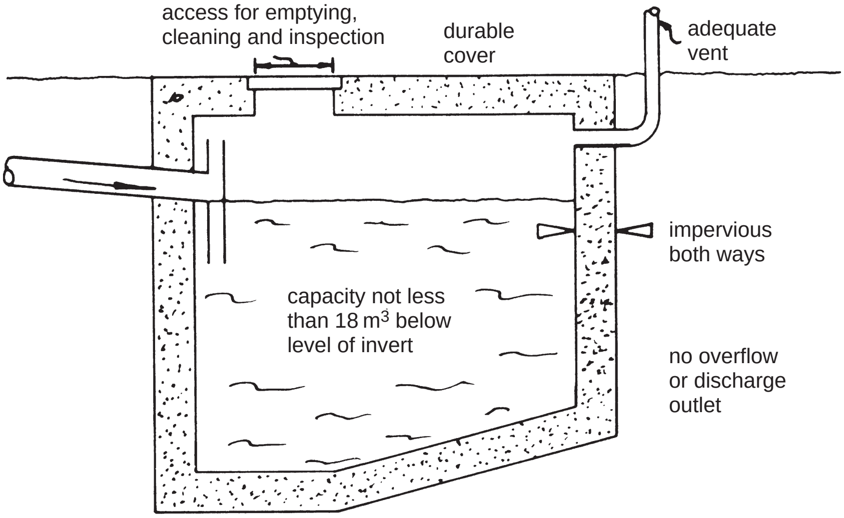



**Fig. 13.25** Cesspools.

### *Maintenance of cesspools*

It is essential that building owners are kept informed about the maintenance requirements where cesspools are provided. Cesspools should be inspected every two weeks for overflow and emptied as necessary. A typical emptying frequency is once per month and this can be estimated by assuming a filling rate of 150 litres per person per day. Cesspools which do not fill within the expected period may be leaking and should be checked out. A durable notice should be fixed within the building describing the necessary maintenance. Fig. 13.26 below is an example of a typical notice.

**Cesspool foul drainage system**

**Details of Necessary Maintenance**

Address of Property _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Location of treatment system _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

The foul drainage system from this property is served by a cesspool

The system should be emptied approximately every *[insert design emptying frequency*] by a licensed contractor and inspected fortnightly for overflow.

The owner is legally responsible to ensure that the system does not cause pollution, a health hazard or a nuisance.

**Fig. 13.26** Cesspool – typical maintenance notice.

## 13.5 Greywater and rainwater storage tanks

AD H2 concludes with limited guidance information on tanks for storage of greywater or rainwater for reuse within the building. The guidance does not apply to water butts used for storing rainwater for use in gardens.

Reclaimed water systems aid water conservation by reducing the amount of mains supply water used in houses and commercial buildings. Clearly there is a potential for reclaimed water systems to contaminate potable mains water supplies by inadvertent cross connection or backflow. Therefore, it is essential that water installations comply with the Water Supply (Water Fittings) Regulations 1999 in England and Wales, the Water Byelaws 1999 in Scotland or the Water Regulations in Northern Ireland.

Greywater should only be used for irrigation purposes and even then, certain precautions should be taken to prevent possible health problems occurring. Section 9 of the Water Regulations Advisory Scheme leaflet 09-02-04 *Reclaimed Water Systems. Information about installing, modifying or maintaining reclaimed water systems* gives general tips on reclaimed water uses and treatment. It also includes a great deal more information than can be found in AD H2, including a definition of greywater. This means water originating from the mains potable water supply that has been used for bathing or washing, washing dishes or laundering clothes.

Therefore, greywater and rainwater tanks should be:

- ventilated and prevent ingress of subsoil water or leakage of the contents;
- fitted with an anti-backflow device on any overflow connected to a drain or sewer to prevent contamination should a surcharge occur in the drain or sewer;
- provided with access for emptying and cleaning.

Access covers for emptying and cleaning should be sufficiently durable to resist the corrosive nature of the tank contents and should be designed to prevent unauthorised access (by being lockable or otherwise engineered to prevent personnel entry).

### 13.5.1 Alternative approach

Requirement H2 of Schedule 1 to the Building Regulations 2000 may also be met by complying with the relevant recommendations of BS 6297: 1983 *Code of practice for the design and installation of small sewage treatment works and cesspools*. These are – sections one, two, four and the appendices and clauses 6 – 11 of section three.

## 13.6 Rainwater drainage

Paragraph H3 of Schedule 1 to the Building Regulations 2000 requires that:

- any system carrying rainwater from the roof of a building is adequate; and
- paved areas around the building are so constructed as to be adequately drained.

It should be noted that only the following paved areas are covered by the Regulations:

- those which provide access for disabled people in accordance with requirement M2 (see Chapter 17 below);
- those which provide access to or from a place used for the storage of solid waste (see requirement H6(2) below); and
- those which give access to the building where this is intended to be used in common by the occupiers of one or more other buildings.

Rainwater from the roof of the building and any relevant paved areas must be taken to one of the following, listed in order of priority:

- an adequate soakaway or some other adequate infiltration system; or
- a watercourse; or
- a sewer.

Movement to a lower level in the order of priority may only be on the grounds of reasonable practicability since it is the purpose of the Regulation to encourage drainage connections to other than surface water sewers where this is technically feasible. This is an attempt to lessen the effect of flash flooding occurring in times of exceptionally heavy rainfall. This requirement does not apply to the gathering of rainwater for re-use.

The requirements of Paragraph H3 will be met if the following are fulfilled.

- Rainwater from paved areas and roofs is carried away from the relevant surface by a drainage system or some other appropriate means.
- Any rainwater drainage system:
  (a) conveys the flow of rainwater to a suitable outfall (soakaway, watercourse, surface water or combined sewer);
  (b) reduces to a minimum the risk of leakage or blockage;
  (c) is accessible for clearing blockages.
- Rainwater soaking into the ground (to a soakaway etc.) is sufficiently distributed so as not to damage the foundations of the building or any adjacent structure.

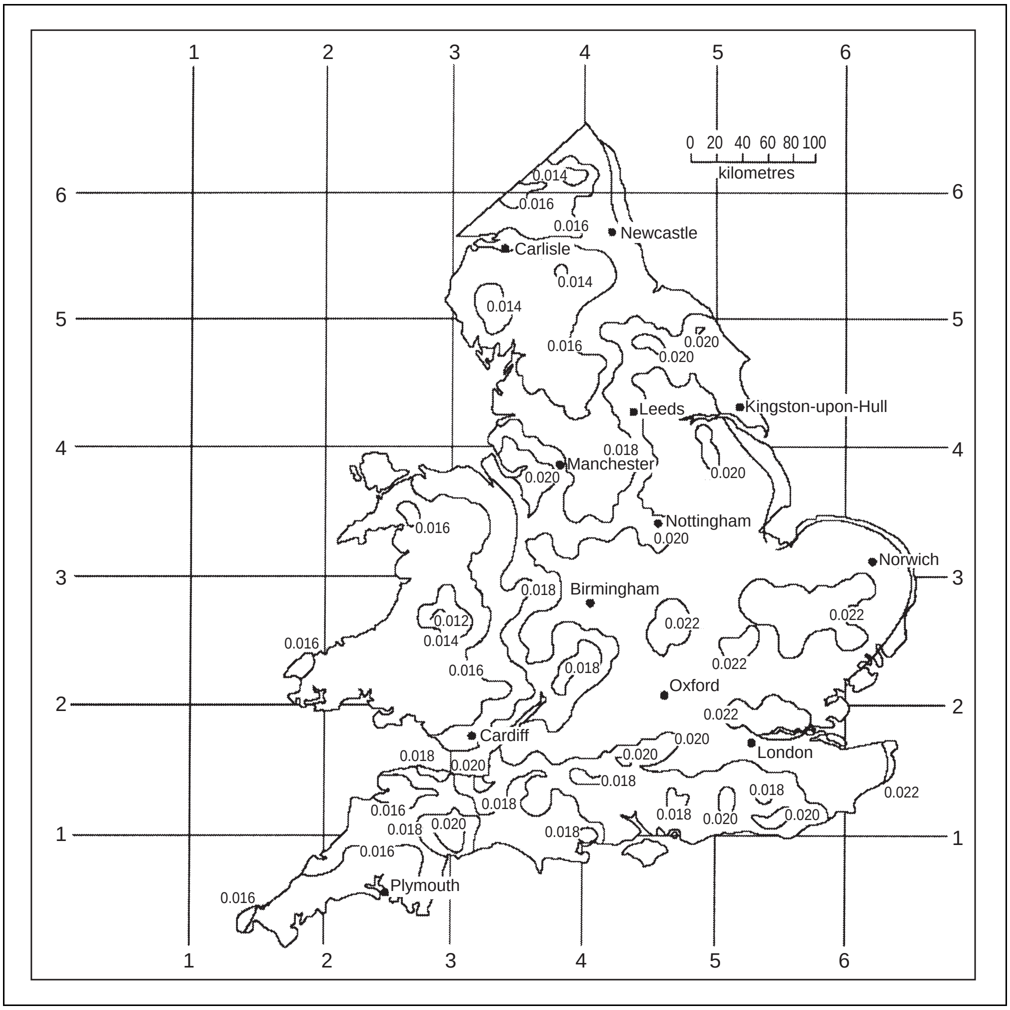
The emphasis in H3 on infiltration systems to dispose of rainwater means that it is essential to ensure adequate distribution of rainwater where it will not harm the structure of the building. Rainwater or surface water should never be discharged to a cesspool or septic tank.

### 13.6.1 Gutters and rainwater pipes

A rainwater drainage system should be capable of carrying the anticipated flow at any point in the system. The flow will depend on the area of roofs to be drained and on the intensity of the rainfall. For eaves gutters, a design rainfall intensity of 0.021 litres/second/m$^2$ (i.e. 75 mm of rainfall in any one hour) should be assumed in design

## AD H3, Section 1

**Diagram 1** Rainfall intensities for design of gutters and rainfall pipes (litres per second per square metre)




calculations. For valley gutters, parapet gutters, siphonic systems and other rain gathering systems the rainfall intensity should be obtained from Diagram 1 of AD H3 which is reproduced above.

For some roof designs incorporating valley gutters, parapet gutters or drainage from flat roofs it is possible that intense rainfall could cause overtopping of the construction resulting in water entering the building causing damage, wetting of insulation etc. The design of such systems should be carried out in accordance with BS EN 12056 *Gravity drainage systems inside buildings*.

The ultimate capacity of gutters and rainwater pipes depends on their length, shape, size and gradient and on the number, disposition and design of outlets. AD

## AD H3, section 1

**Table 2** Gutter sizes and outlet sizes.

| Max effective roof area ($m^2$) | Gutter size (mm dia) | Outlet size (mm dia) | Flow capacity (litres/sec) |
|---|---|---|---|
| 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 nominal half round eaves gutters laid level with outlet at one end sharp edged.
Round edged outlets allow smaller downpipe sizes.

H3 contains design data for half-round gutters up to 150 mm in diameter. They are assumed to be laid level and to have a sharp-edged outlet at one end only. Table 2 to section 1 of AD H3 is reproduced above and gives gutter and outlet sizes for the drainage of different roof areas for lengths of gutter up to 50 times the water depth. The gutter capacity should be reduced for greater lengths.

The maximum roof areas given in Table 2 are the largest effective areas which should be drained into the gutters given in the table. The effective area of a roof will depend on whether the surface is flat or pitched. Table 1 to section 1 of AD H3 shows how the effective area may be calculated for different roof pitches.

## AD H3, section 1

**Table 1** Calculation of area drained.

| Type of surface | Effective design area ($m^2$) |
|---|---|
| **1** flat roof | plan area of relevant portion |
| **2** pitched roof at 30°<br>pitched roof at 45°<br>pitched roof at 60° | plan area of portion × 1.29<br>plan area of portion × 1.50<br>plan area of portion × 1.87 |
| **3** pitched roof over 70°<br>or any wall | elevational area × 0.5 |

Gutters should also be fitted so that any overflow caused by abnormal rainfall will be discharged clear of the building. Additional outlets may be necessary on flat roofs, valley gutters and parapet gutters to avoid over-topping.

Where it is not possible to comply with the conditions assumed in Table 2, further guidance is given in AD H3.

- Where an end outlet is not practicable the gutter should be sized to take the larger of the roof areas draining into it.
- If two end outlets are provided they may be 100 times the depth of flow apart.
- It may be possible to reduce pipe and gutter sizes if:
  (a) the gutter is laid to fall towards the nearest outlet; or
  (b) a different shaped gutter is used with a larger capacity than the half round gutter; or
  (c) a rounded outlet is used.

In these cases reference should be made to the following parts of BS EN 12056:

- Part 3: *Roof drainage layout and calculation*, clauses 3 to 7
- Annex A and National Annexes
- Part 5: *Installation, testing instructions for operation and maintenance and use*, clauses 3, 4, 6 & 11.

Rainwater pipes should comply with the following rules.

- Discharge should be to a drain, gully, other gutter or surface which is drained.
- Any discharge into a combined system of drainage should be through a trap (e.g. into a trapped gully).
- Rainwater pipes should not be smaller than the size of the gutter outlet. Where more than one gutter serves a rainwater pipe the pipe should have an area at least as large as the combined areas of the gutter outlets and be large enough to take the flow from the whole contributing area.
- Discharge from a rainwater pipe onto a lower roof or paved area should be via a pipe shoe to divert water away from the building.
- Where a single downpipe serves a roof with an effective area greater than 25 $m^2$ and discharges onto a lower roof, a distributor pipe should be fitted to the shoe to ensure that the width of flow at the receiving gutter is great enough to prevent overtopping of the gutter.

### 13.6.2 Siphonic roof drainage systems

Using siphonic action to accelerate the flow of water from the gutters to the below ground drainage system enables small-diameter pipes to achieve high rates of discharge. This permits a reduction in the number of downpipes that need to be provided when compared with traditional systems of roof drainage, and this is particularly useful in large single-storey commercial buildings with restricted numbers of columns.

For the siphonic action to start, the pipework must be airtight. This requires special rainwater outlets with baffle plates, correctly dimensioned pipes and fully sealed joints. Additionally, care should be taken that other trades do not connect their internal drainage pipes into a siphonic system, and thus break the vacuum.

The following considerations should also be taken into account.

- Possible surcharging in the downstream drainage system as this can cause reductions in flow rates in downpipes.
- The time taken to prime the siphonic action may be excessive where long gutters are specified. In this case, overflow arrangements to prevent gutters from overtopping, should be provided.

More information on the design of siphonic systems of roof drainage may be obtained from Report SR 463 *Performance of syphonic drainage systems for roof gutters* published by Hydraulics Research Ltd. Reference should also be made to BS EN 12056: Part 3.

### 13.6.3 Eaves drop systems

In modern buildings it is normal for rainwater from roofs to be collected by a system of guttering and downpipes to be transmitted to a system of below-ground drainage. In fact, the requirement of H3 for adequacy or rainwater systems means that an eaves drop system (where rainwater is allowed to fall from the roof freely to the ground) can be a perfectly acceptable solution provided that the following design considerations are taken into account.

- The fabric of the building should be protected against ingress of water caused by splashing against the external walls.
- The entry of water into doorways and windows should be prevented.
- Persons should be protected from falling water in doorways etc.
- Splashback caused by water hitting the ground should be prevented from affecting people and the fabric of the building (e.g. by providing a gravel layer or angled concrete apron to deflect water away).
- Foundations should be protected from concentrated discharges which occur at valleys, valley gutters or from excessive flows caused by large roofs (where the area of roof per unit length of eaves is high).

### 13.6.4 Rainwater recovery systems

In order to conserve water supplies, it is possible to collect rainwater for re-use within the building provided that the following considerations are taken into account.

- Storage tanks should follow the guidance given in section 13.5 above.
- Pipework, valves and washouts used for recovered water should be clearly identified on marker plates in accordance with the recommendations the Water Regulations Advisory Scheme leaflet 09-02-04 *Reclaimed Water Systems. Information about installing, modifying or maintaining reclaimed water systems* where further guidance on the use of rainwater recovery systems will be also be found.

### 13.6.5 Materials

Materials used should be adequately strong and durable. Additionally:

- Gutters should have watertight joints under working conditions.
- Downpipes placed inside a building should be capable of withstanding the test for airtightness described in section 13.3.13 above.
- Gutters and rainwater pipes should be adequately supported with no restraint on thermal movement.
- Pipes and gutters of different metals should be separated by non-metallic material to prevent electrolytic corrosion.
- Siphonic roof drainage pipework should be designed to resist negative pressures.

### 13.6.6 Alternative method of design

The requirements of the 2000 Regulations for rainwater drainage can also be met by following the relevant recommendations of BS EN 12056 *Gravity drainage systems inside buildings*. These are:

- In Part 3 *Rainwater drainage, layout and calculation*, clauses 3 to 7.
- Annex A and National Annexes.
- In Part 5 *Installation and testing, instructions for operation, maintenance and use*, clauses 3, 4, 6, & 11.

### 13.6.7 Drainage of paved areas

Section 2 of AD H3 contains information on the design of rainwater drainage systems for paved areas around buildings and small car parks up to 4000 $m^2$. For the design of systems serving larger catchment areas the guidance in BS EN 752 *Drain and sewer systems outside buildings* Part 4: 1998 *Hydraulic design and environmental aspects* should be followed. Rainfall intensities of 0.014 litres/sec/$m^2$ (i.e. 50 mm of rainfall in any one hour) are assumed for normal situations. More accurate local figures can be obtained from Diagram 2 of Section 2 to AD H3 which is reproduced below. In very high risk areas where ponding could lead to flooding of buildings, drainage of paved areas should be designed in accordance with BS EN 752: Part 4.

AD H3 describes three methods for draining paved areas:

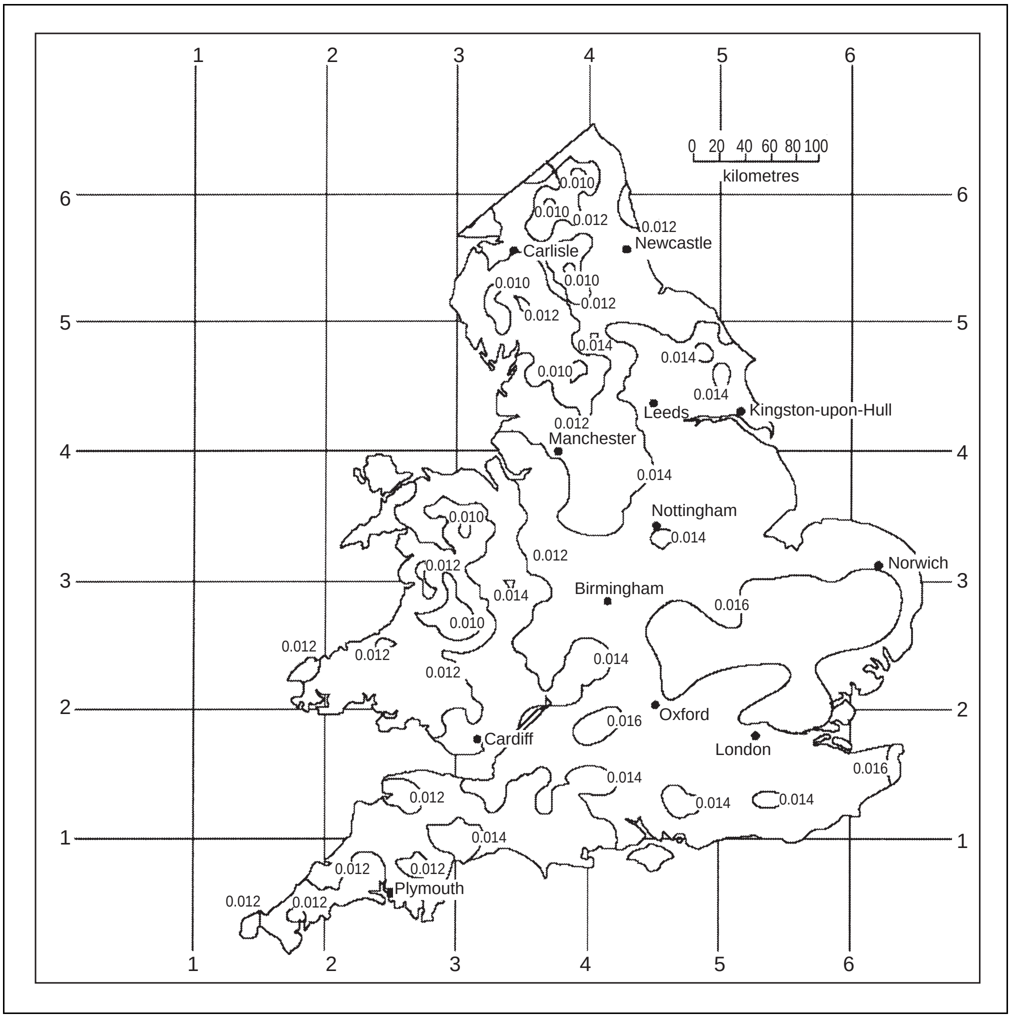
- Allow pavings to drain freely onto adjacent pervious surfaces
- Use pervious paving
- Use impervious paving discharging to gullies or channels connected to a drainage system.

### 13.6.8 Design of freedraining surfaces

Surface water should not be allowed to soak into ground where the conditions are not suitable; however, paved areas do not always have to be served by underground

# AD H3, Section 2

**Diagram 2** Rainfall intensities for design of drainage from paved areas and underground rainwater drainage (litres per second per square metre)




drainage systems. It is acceptable for paths, driveways and other narrow areas of paving to be freedraining to pervious areas (e.g. grassland) if the following conditions are met.

- Water should be directed away from buildings where foundations could be damaged. This can be achieved by suitable surface gradients (e.g. where ground levels would cause water to collect along the wall of a building a reverse gradient could be created at least 500 mm wide to divert water away).
- Impervious surfaces should have a cross fall of at least 1 in 60 to permit rapid draining. The fall across a path should not exceed 1 in 40.

- Where paving drains onto adjacent ground it should be finished flush with, or above the level of the surrounding ground to permit the water to run off.
- The soakage capacity of the ground should not be overloaded and where the adjacent ground is not sufficiently permeable to take the flow it may be necessary to provide filter drains (see section 13.7.4 below).

### 13.6.9 Pervious paving

As an alternative, and where it is not possible to drain large paved areas to adjacent pervious surfaces, it may be possible to construct pervious paving to deal with surface drainage. Pervious paving is made up of a porous or permeable surface material placed onto a granular layer which acts as a storage reservoir, retaining peak water flows until soakage into the underlying subsoil takes place. The storage layer should be designed on a similar basis to the design of the storage volume in a soakaway (see section 13.7.4 below).

On steeply sloping surfaces it will be necessary to check that the water level can rise sufficiently in the storage reservoir to enable its full capacity to be used. It will also be necessary to check that water is not inadvertently accumulating around the building foundations.

Pervious paving, on flat or sloping sites, may even be used where infiltration drainage is not possible (see section 13.7.4). In this case an impermeable barrier is placed below the storage layer to act as a detention tank or pond prior to discharge of the stored water to a drainage system (see section 13.6.10 below).

Pervious paving should not be used:

- where excessive amounts of sediment are present since these can enter the pavement and block the pores;
- in oil contaminated areas or where run-off may be contaminated with pollutants.

More information on the design of pervious paving can be found on pages 64 to 66 of CIRIA report C522: *Sustainable urban drainage systems – design manual for England and Wales*.

### 13.6.10 Paving connected to drainage system

Where it is not possible for the paving to be freedraining or for pervious paving to be used, impervious paving should be used in conjunction with gullies or channels connected to a drainage system. Gullies should comply with the following guidance.

- Be provided as necessary at low points to ensure that ponding does not occur.
- Be provided at intermediate positions so that individual gullies are not overloaded and channels do not have excessive depths of flow.
- Have their gratings set about 5 mm below the surrounding paving to allow for settlement of the paving.

Since it is possible that drainage from pavings may encourage silt and grit to enter the drainage system this should be intercepted by providing suitably sized gully pots or catchpits.

### 13.6.11 Alternative method of design

The requirements of the 2000 Regulations for drainage of pavings can also be met by following the relevant recommendations of BS EN 752 *Drain and sewer systems outside buildings*. These are:

- in Part 4, *Hydraulic design and environmental considerations*, clause 11.
- National Annexes ND and NE.

## 13.7 Rainwater drainage below ground

### 13.7.1 Connections and outlets

Section 3 of AD H3 deals specifically with drainage systems carrying only rainwater. Where practicable, surface water drainage should discharge to a soakaway or other infiltration system. Discharge to a watercourse is the next best option but the consent of the Environment Agency may be required and they may put a limit on the rate of discharge, although this can be attenuated by the use of detention ponds or basins. Where these forms of outlet are not practicable, discharge should be made to a suitable sewer.

Combined systems (those carrying both foul and rainwater) are permitted by some drainage authorities where allowance is made for the additional capacity. Where a combined system does not have sufficient capacity, rainwater will need to be taken via a separate system to its own outfall. Even where a sewer is operated as a combined system and has sufficient capacity it may still be necessary to provide separate systems of drainage to the building in accordance with the provisions of Requirement H5 (see below section 13.9.2). Surface water drainage connected to a combined system should have traps on all inlets.

Pumped systems of surface water drainage may be needed where there is a tendency to surcharging or gravity connections are impracticable (see also section 13.3.28 above).

The design information contained below is suitable for the drainage of small impervious catchment areas up to 2 hectares with an assumed design rainfall intensity of 0.014 litres/sec/$m^2$ for normal situations. Rainfall intensity may also be obtained from Diagram 2 of AD H3 illustrated in section 13.6.7 above. Where it is intended to drain larger areas than 2 hectares or where low levels of surface flooding could cause flooding of buildings, reference should be made to BS EN 742: Part 4.

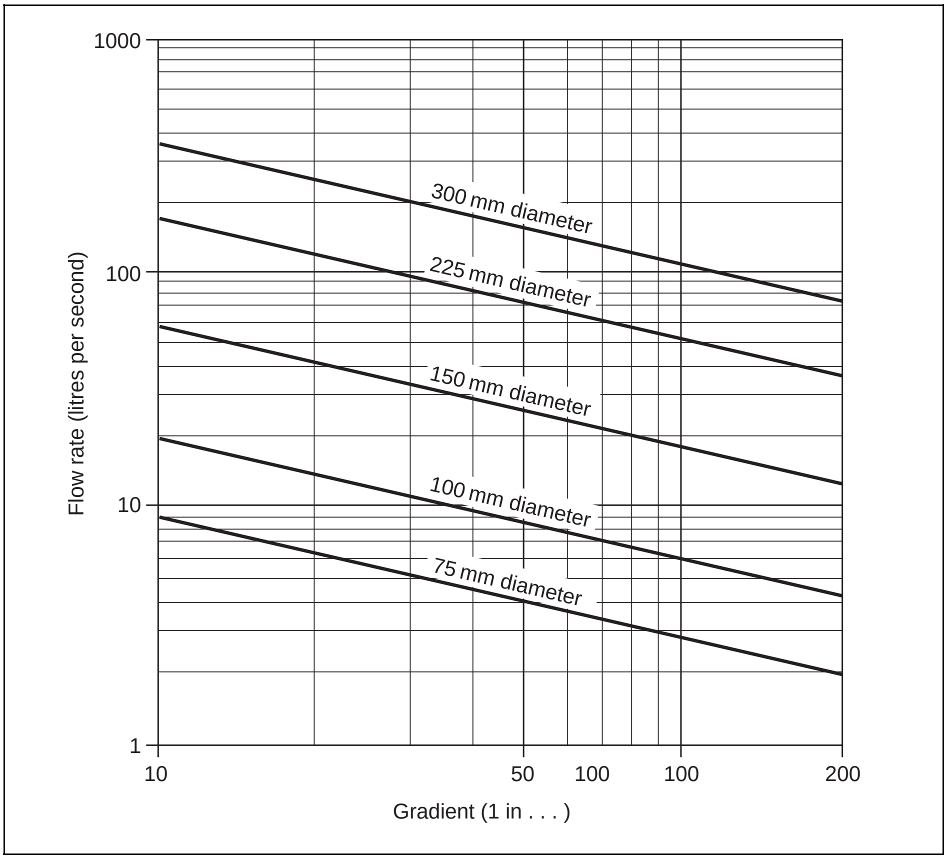
With the exception of pipe gradients and sizes, the recommendations given above for below ground foul drainage (materials, bedding and backfilling, clearance of blockages, workmanship and testing and inspection) apply equally to rainwater drainage below ground.

### 13.7.2 Pipe sizes and gradients

Drains should be laid to falls and should be large enough to carry the expected flow. The rate of flow will depend on the area of the surfaces (including paved or other hard surfaces) being drained. The capacity will depend on the diameter and gradient of the pipes. The minimum permitted diameter of any rainwater drain is 75 mm. Surface water sewers (i.e. drains serving more than one building) should have a minimum diameter of 100 mm. Diagram 3 to Section 3 of AD H3 is reproduced below and gives discharge capacities for rainwater drains running full where it will be seen that the capacity increases proportionately with the pipe diameter and gradient.

## AD H3, Section 3

**Diagram 3** Discharge capacities of rainwater drains running full.




In general, the minimum permitted gradient of a pipe is related to its diameter as shown in Table 13.4 below.

**Table 13.4** Pipe sizes and minimum gradients.

| Pipe diameter mm | Minimum gradient |
|---|---|
| 75 | 1 in 100 |
| 100 | 1 in 100 |
| 150 | 1 in 150 |
| 225 | 1 in 225 |
| Over 225 | See BS EN 752: Part 4 |

## 13.7.3 Contaminated runoff

It is an offence under section 85 (*offences of polluting controlled waters*) of the Water Resources Act 1991 to discharge any polluting or noxious material into coastal or underground water, or a watercourse. Since most surface water sewers discharge to watercourses, separate drainage systems should be provided where materials are stored or used which could cause pollution. The drainage system should include:

- an appropriate form of separator (see oil separators below); or
- an appropriate treatment system; or
- discharge of the flow into a system suitable for receiving polluted effluent.

Certain areas, such as petrol filling stations and car parks suffer from leakage or spillage of oil and the surface water runoff from these areas can find its way via the drainage system to a watercourse where pollution can occur. Since it is an offence under section 111 (*restrictions on the use of public sewers*) of the Water Industry Act 1991 to discharge petrol into any drain connected to a public sewer, oil separators should be provided in risk situations.

There are, of course, other controls over the storage of petrol, due to its combustible nature. Premises used for keeping petrol must be licensed under the Petroleum (Consolidation) Act 1928. A licence can be granted with or without conditions. Guidance on the storage of oil may be obtained from the Health and Safety Executive.

### *Oil separators*

The type of oil separator that should be provided will depend on the risk of contamination represented by the site.

For comparatively low risk areas, such as paved areas around buildings and car parks, a bypass separator should be provided with a nominal size (NSB) of 0.0018 times the contributing area and a silt storage volume in litres equal to 100 $\times$ NSB. Bypass separators treat all flows generated by rainfall rates of up to 5 mm/hr, thus accounting for 99% of all rainfall events. Flows above this rate are allowed to bypass the separator.

For fuel storage and other high risk areas, full retention separators should be provided with nominal size (NS) equal to 0.018 times the contributing area and a silt storage volume in litres equal to 100 $\times$ NS. Full retention separators treat the full flow that can be delivered by the drainage system which is normally equivalent to the flow generated by a rainfall intensity of 50 mm/hr.

Separators should:

- be Class 1 when discharging to infiltration devices or surface water sewers (i.e. designed to achieve a concentration of less than 5mg/litre of oil under standard test conditions);
- be leaktight and adequately ventilated;
- have inlet arrangements that avoid directing the inflow to the surface of the water already in the separator;
- comply with the requirements of the Environment Agency and prEN 858 *Installations for separation of light liquids (e.g. petrol or oil)*;
- comply with the requirements of the licensing authority where the Petroleum Act applies;
- be regularly maintained to ensure continued effectiveness. It is normal for routine inspections to be carried out every six months including the completion of a log which details the inspection date, depth of oil and any cleaning undertaken; and
- be provided with sufficient access points to allow for inspection and cleaning of all internal chambers.

More information on the provision of oil separators may be found in the Environment Agency publication – Pollution Prevention Guidelines 3 (PPG 3) *Use and design of oil separators in surface water drainage systems.*

### 13.7.4 Infiltration drainage systems

Infiltration drainage systems are designed to return rainwater from roofs and pavings to the ground in the vicinity of the building, without involving connection to sewers or watercourses. They include such devices as soakaways, swales, infiltration basins, filter drains and detention ponds (but see the comments on these below). AD H3 gives a very brief summary of the various infiltration devices which are available; however the information provided is too brief to be of any real use for the designer. The notes which follow have been enhanced using the various documents referred to in the text. These reference sources are essential for anyone seriously interested in infiltration drainage systems.

It is not always possible to provide infiltration drainage to a building. For example, infiltration devices should not be provided in the following situations.

- Within 5 m of a road or building.
- In areas of unstable land. (Annex 1 of Planning Policy Guidance Note 14 warns against the use of infiltration systems in areas subject to landslip).
- In ground with a high water table (i.e. where the water table reaches the base of the device at any time of the year.
- Where ground water source or resource might be polluted by the presence of contamination in the runoff.

- At such a distance from drainage fields, drainage mounds or other soakaways so that the overall soakage capacity of the ground would be exceeded and the effectiveness of any drainage field would be impaired.

### *Soakaways*

Soakaways should be designed to store the immediate surface water runoff and allow for its efficient infiltration into the surrounding soil. Stored water must be discharged sufficiently quickly to provide the necessary capacity to receive runoff from a subsequent rainfall event. The time taken for discharge depends upon the soakaway shape and size, and the infiltration characteristics of the surrounding soil.

Soakaways serving catchment areas of less than 100 $m^2$ are usually built as square or circular pits filled with rubble or lined with dry-jointed masonry or pre-cast perforated concrete ring units surrounded by suitable granular backfill. For drained areas above 100 $m^2$, soakaways can be lined pits or of trench type and usually a depth of 3 to 4 m is adequate if ground conditions allow. Trench soakaways are cheaper to dig with readily available excavating equipment.

Although the design of soakaways should be carried out by considering storms of different durations over a ten year period in order to determine the maximum storage volume, for small soakaways serving 25 $m^2$ or less, a design rainfall of 10 mm in five minutes can be taken to represent the worst case. For soakaways serving larger areas reference should be made to BRE Digest 365 *Soakaway design* or BS EN 752: Part 4. Where the percolation characteristics of the ground are marginal it may still be possible to use soakaways in conjunction with overflow drains.

The percolation test described in AD H2 (see Fig. 13.19 above) may be carried out to determine the capacity of the soil to receive infiltration. The value of $V_p$ from the percolation test may be used in the equation below to determine the soil infiltration rate:

$$f = 10^{-3}/2V_p$$

where $f$ = the soil infiltration rate

Therefore, assuming a value of $V_p$ of 20,

$$f = 1/1000 \times 2 \times 20 = 0.000025\ \text{m/sec}$$

The storage volume of the soakaway should be able, during storm conditions, to accommodate the difference between the inflow volume and the outflow volume.

The inflow volume is simply calculated by considering the design rainfall depth during a storm multiplied by the drainage area. Therefore, if a rainfall depth of 10mm is considered over an area of 25 $m^2$ in a five minute period:

$$\text{the inflow volume} = 0.01 \times 25 = 0.25\ \text{m}^3$$

The outflow volume (O) is calculated from the equation:

$$O = a_{s50} \times f \times D$$

Where:
$a_{s50}$ is the area of the side of the storage volume when filled to 50% of its effective depth, and $D$ is the duration of the storm in minutes.

Using the figures from the example given above and assuming a soakaway 2m deep and 2m x 1m in area with the inlet 1m below ground:

$$O = 4 \times 0.000025 \times 5 \times 60 = 0.03\,m^3$$

Therefore the difference between the inflow volume and the outflow volume equals the storage volume $= 0.25 - 0.03 = 0.22\,m^3$

The actual volume of soakaway below inlet $= 1 \times 1 \times 2 = 2\,m^3$ which is more than adequate.

### *Swales*

Swales are simply grass-lined channels with shallow side-slopes used to carry rainwater from a site. They can also control the flow and quality of surface runoff and allow a certain amount of the flow to infiltrate into the ground. To increase the infiltration and detention capacity of swales they can be provided with low check dams across their width. To prevent overtopping during wet spells, it is possible to provide an overflow at one end discharging into another form of infiltration device or watercourse. They can be used to treat runoff from small residential developments, parking areas and roads.

### *Infiltration basins*

These are dry grass-lined basins for storage of surface runoff that are free from water under dry weather flow conditions. They can be designed to manage water quantity and quality and are used to encourage surface water infiltration into the ground.

### *Filter drains*

Otherwise known as french drains, filter drains consist of geotextile-lined trenches filled with gravel, sometimes containing perforated pipes to assist drainage. They are designed so that most of the flow enters the filter drain directly from the runoff or is discharged into it through other drains from where it infiltrates into the ground.

### *Detention ponds*

The term 'detention pond' appears to be a mistake in the AD since the reference material given for this section in AD H3 (*Sustainable urban drainage systems – a design manual for England and Wales* published by CIRIA) makes reference to 'detention basins' and 'retention ponds' but not 'detention ponds'.

According to this reference source '*detention basins are vegetated depressions. They are formed below the surrounding ground, and are dry except during and immediately following storm events. Detention basins only provide flood storage to attenuate flows. Extending the detention times improves water quality by permitting the settlement of course silts*'.

On the other hand, '*retention ponds are permanently wet ponds with rooted wetland and aquatic vegetation – mainly around the edge. The retention time of several days provides better settlement conditions than offered by extended detention ponds and provides a degree of biological treatment*'. The description given in AD H3 could apply to either or both of the above.

### 13.7.5 Alternative method of design

Requirement H3 can also be met by following the relevant recommendations of BS EN 752 *Drain and sewer systems outside buildings*.

These are:

- in Part 4, *Hydraulic design and environmental considerations*, clauses 3 to 12;
- National Annexes NA, NB and ND to NI.

Additionally, detailed information about design and construction can be found in:

- BS EN 1295, *Structural design of buried pipelines under various conditions of loading:* Part 1: 1998 *General requirements*; and
- BS EN 1610: 1998 *Construction and testing of drains and sewers*.

## 13.8 Building over existing sewers

### 13.8.1 Introduction

Control of building works over or near existing sewers has long been subject to control in England and Wales. Until the coming into effect of the first amendment to the 2000 Regulations on 1 April 2002 this control was exercised by local authorities through the medium of section 18 of the Building Act 1984. The first amendment introduced a new Building Regulation requirement H4, which replaced section 18 and can be administered by both local authorities and approved inspectors, although the substance of section 18 has been little altered by the change. What has altered is the substantial amount of guidance provided by Approved Document H4.

### 13.8.2 Interpretation

The following terms apply in AD H4:

DISPOSAL MAIN – Any pipe, tunnel or conduit used for the conveyance of effluent to or from a sewage disposal works, which is not a public sewer.

MAP OF SEWERS – Any records kept by a sewerage undertaker under section 199 of the Water Industry Act 1991.

### 13.8.3 Building over sewers

H4 requires that where it is intended to:

- erect a building; or
- extend a building; or
- carry out works of underpinning to a building

near to or over a drain, sewer or disposal main, then the work must be carried out so that it is not detrimental to the building or extension or to the continued maintenance of the drain, sewer or disposal main.

H4 is limited to work carried out:

- near to or over a drain, sewer or disposal main which is shown on any map of sewers; or
- which will result in interference with the use of, or obstruction of any person's access to, any drain, sewer or disposal main shown on any map of sewers.

In order to meet the requirements of H4 it is necessary to ensure the following.

(1) That the work of building, extending or underpinning:
   - is expedited so as not to overload or otherwise damage the drain, sewer or disposal main both during construction and after it is completed; and
   - will not prevent reasonable access to any manhole or inspection chamber situated on the drain, sewer or disposal main.

(2) That where the drain, sewer or disposal main needs to be replaced:
   - a satisfactory diversionary route can be provided; or
   - the building or extension will not unduly obstruct the replacement work if the current alignment is maintained.

(3) That if the drain, sewer or disposal main fails, the risk of damage to the building will not be excessive. To assess the risk of damage to the building it is necessary to consider:
   - the nature of the ground;
   - the location, construction and condition of the drain, sewer or disposal main;
   - the nature, volume and pressure of the flow in the drain, sewer or disposal main; and
   - the design and construction of the building's foundations.

### 13.8.4 Application

The provisions of H4 apply where it is intended to erect, extend or underpin a building that is situated over, or within 3 m of the centreline of, an existing drain, sewer or disposal main shown on the sewer records of the sewerage undertaker, even if the sewer is not a public sewer.

The public have access to copies of sewer record maps during normal office hours, these being held by both sewerage undertakers and local authorities.

### 13.8.5 Consultation

When it is proposed to carry out any work to which H4 applies, the developer should always consult the owner of the drain or sewer (for public sewers this would be the sewerage undertaker) unless, of course, the developer is also the owner. In the case of public sewers the sewerage undertaker should be able to provide useful information regarding the age, location, condition and depth to invert of the sewer. They may also be able to arrange an inspection and if a public sewer needs to be repaired or replaced, they will carry out this work. The sewerage undertaker should also be consulted where it is proposed to build or extend over a sewer that is later intended for adoption.

In order to ensure compliance with H4 it will be necessary to apply to the relevant building control body (local authority or approved inspector) so that the works can be properly controlled. This will involve the carrying out of further consultations as follows.

- If using the local authority you must deposit full plans. This enables the local authority to carry out its duties under Regulation 14A of the Building Regulations 2000 to consult the sewerage undertaker as soon as practicable after the plans have been deposited. The local authority is not permitted to pass the plans or issue a completion certificate until the consultation has taken place (the sewerage undertaker has up to 15 days to reply) and it must have regard to the views expressed by the sewerage undertaker.
- If using an approved inspector, he must consult the sewerage undertaker where an initial notice or amendment notice is to be given (or has been given). The consultation must take place at the following stages:
  - (a) before or as soon as is practicable after giving an initial notice or an amendment notice;
  - (b) before giving a plans certificate (whether or not this is combined with an initial notice); and
  - (c) before giving a final certificate.

  Additionally, he must allow the sewerage undertaker up to 15 working days to comment, and have regard to the views it expresses, before giving a plans certificate or final certificate to the local authority.

### 13.8.6 Building near drains or sewers in risk situations

Unless special measures are taken, buildings should not be constructed or extended over or within 3 m of any of the following:

- drains or sewers in poor condition (pipes which are cracked, fractured, misaligned or more than 5% deformed);

- drains or sewers constructed from brick or other masonry;
- rising mains (except those used only to drain the building);

since failure of the drain or sewer would expose the building to a high level of risk.

Additionally, certain soil types (fine sands, fine silty sands, saturated silts and peat) are easily eroded by groundwater leaking into drains or sewers. Therefore, failure of a drain or sewer could result in erosion of soil from around the foundations thereby exposing the building to undue risk. Where such soils are present, buildings should not be constructed or extended over or within 3 m of any drain or sewer to which H4 applies unless special measures are taken in the design and construction of the foundations to mitigate the effect of drain or sewer failure. Special measures are not needed if the invert of the drain or sewer is:

- above the level of the foundations; and
- above the level of the groundwater; and
- no deeper than 1 m.

### 13.8.7 Access for maintenance

Fig 13.27 below gives details of the precautions that should be taken to ensure that sewers remain accessible when buildings are constructed over or within 3m of them. The following main points should be observed.

- Do not construct a building or extension over a manhole, inspection chamber or access fitting on a sewer (i.e. a drain serving more than one property).
- Locate access points to sewers where they are accessible and apparent for use in emergency. Where this provision is already met by the existing sewer, do not construct a building or extension which would remove this provision unless a satisfactory alternative on the line of the sewer can be agreed with the sewer owner.
- Ensure that a satisfactory diversionary route is available at least 3 m from the building to allow the drain or sewer to be reconstructed without affecting the building. Where existing drains or sewers more than 1.5 m deep have access for mechanical excavators, ensure that the diversionary route also has such access.
- Unless the sewer owner agrees, the length of drain or sewer under a building should not exceed 6 m in length.
- Do not build over or near an existing sewer more than 3 m deep or more than 225 mm diameter without the sewer owner's permission.

### 13.8.8 Protection of drains and sewers

Approved Document H4 contains details of protection which should be provided both during construction of the building over the drain or sewer, and subsequently to prevent damage by settlement of the building. Details of other protection

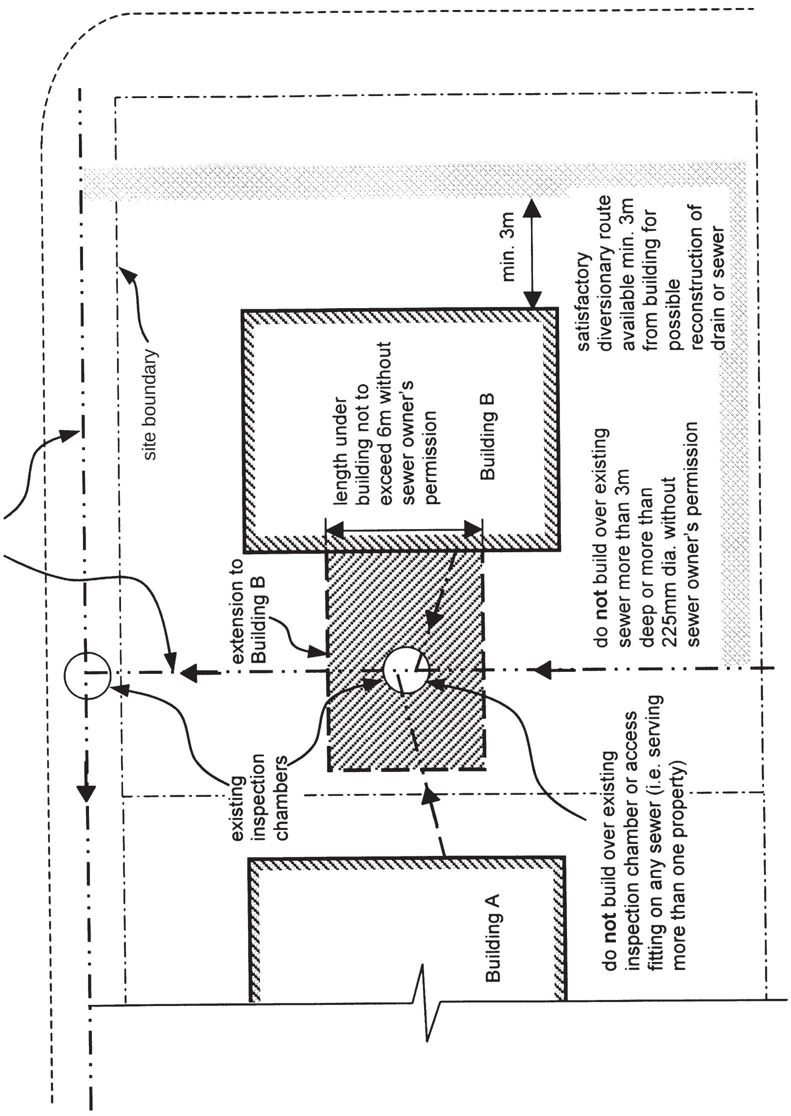



**Fig. 13.27** Building over sewers.

measures for below ground drainage also apply to drains or sewers covered by the following notes. They may be found in sections 13.3.20 (pipes); 13.3.25 (drains); 13.3.26 (surcharging); and 13.3.27 (rodent control).

### Protection during construction

During construction activities drains and sewers should be protected from damage by:

- providing barriers to keep construction traffic and heavy machinery away from the line of the sewer;
- not storing heavy materials over drains or sewers.

Piling works present a special risk and care should be taken to avoid damage to drains and sewers in the vicinity of such activities. The following precautions should be taken:

- a survey should be carried out to establish the position of the drain or sewer;
- where piling will take place within 1 m of a drain or sewer trial holes should be excavated to establish its exact position and the location of any connections;
- piling should not be carried out where the distance from the outside of the pile to the outside of the drain or sewer is less than twice the pile diameter.

### Protection from settlement

Drains or sewers passing under buildings should comply with the following guidance.

- Provide at least 100 mm of granular or other flexible filling round the pipe.
- Where excessive subsidence is possible provide additional flexible joints or adopt other solutions (e.g. suspended drainage).
- Provide special protection where the crown of the pipe is within 300 mm of the underside of the slab (see section 13.3.20 above).
- For drains or sewers less than 2 m deep, increase the depth of the foundations in the vicinity of the drain or sewer so that it may pass through the wall.
- For drains or sewers greater than 2 m deep, design the foundations as a lintel spanning the drain or sewer. The 'lintel' should extend at least 1.5 m on either side of the pipe and should be designed so that no loads are transmitted to the drain or sewer.
- Where the drain or sewer passes through a wall or foundation follow the guidance given in section 13.3.25 above and shown in Fig. 13.14.
- Trenches for drains and sewers should only be excavated below the level of the building foundations if the precautions described in section 13.3.25 and illustrated in Fig.13.15 are taken.

## 13.9 Separate systems of drainage

### 13.9.1 Introduction

Control over the provision of separate systems of drainage was first introduced into the Building Regulations with the coming into force of the first amendment to the 2000 Regulations on 1 April 2002. The provisions are aimed at helping to minimise the volume of rainwater which enters the public foul sewer system since this can lead to overloading of the capacity of sewers and treatment works, and can cause flooding. At the date of this edition, this requirement sits uncomfortably beside six local Acts of Parliament which cover broadly the same area of control and are listed in Appendix A. A consultative document published by the Office of the Deputy Prime Minister in July 2002 aims to repeal these six Acts and will probably come into force some time in 2003.

### 13.9.2 Requirement H5

Any system for discharging water to a sewer which is provided to take rainwater from roofs or from paved areas around buildings covered by the requirements of H3 (see section 13.6), must be separate from that provided for the conveyance of foul water from the building.

For H5 to apply:

- the drainage system must be provided in connection with the erection or extension of a building; and
- it must be reasonably practicable for the system to discharge directly or indirectly to a sewer for the separate conveyance of surface water.

Additionally, the sewer must be:

- shown on a map of sewers (see definition in section 13.8.2 above); or
- under construction either by the sewerage undertaker or by some other person (although in this case the sewerage undertaker must have agreed in advance to adopt the drain or sewer in accordance with section 104 of the Water Industry Act 1991).

### 13.9.3 Meeting the requirement

The requirements of H5 can be met in either of two ways:

- by connecting to separate public sewers which are already in existence; or
- by providing separate drainage systems on the site of the building which will later be connected to separate public sewers which are under construction at the time of the building works.

### 13.9.4 Provision where separate sewer systems already exist

Where the sewerage undertaker has provided separate sewer systems, the owner or occupier of a building has a right to connect to the public sewers (see section 106 of the Water Industry Act 1991) provided that the following restrictions are observed.

- The surface water drainage from the building must be connected to the appropriate public surface water sewer.
- The foul water drainage from the building must be connected to the appropriate public foul water sewer.
- The way in which the connection is made must not be prejudicial to the public sewer system.
- 21 days notice must be given to the sewerage undertaker of the intention to make the connection.

It is normal for the sewerage undertaker to carry out the work of making the connection and recover its reasonable costs from the developer (see section 107 of the Water Industry Act 1991). Alternatively the developer may be permitted to carry out the work under the supervision of the sewerage undertaker.

### 13.9.5 Provision where separate sewer systems are proposed

Separate sewer systems should still be provided to drain the building even if only a combined system exists at the time of the building works, provided that separate public sewers are under construction by the sewerage undertaker, or by some other person for later adoption by the sewerage undertaker. Depending on the respective programmes for the building works and the public sewer construction, it may be necessary initially to connect the separated site drainage to the existing combined sewer. Later reconnection to the separate sewer systems can be made when these are completed thus minimising disruption to the building occupiers.

### 13.9.6 Dealing with contaminated surface water

It should be noted that the necessity to connect to a separate surface water sewer would only apply if the surface water was uncontaminated. Drainage from areas where materials are stored could contaminate runoff and lead to pollution if discharged to a surface water sewer. The alternative of discharging such contaminated water to a foul sewer needs to be discussed with the sewerage undertaker (see section 106 of the Water Industry Act 1991 and notes above) whose consent is required. It will also be necessary to consult the sewerage undertaker when connecting such contaminated runoff via a new foul sewer to an existing combined sewer, if it is intended that this will eventually be reconnected to a foul sewer that is proposed or under construction.

## 13.10 Solid waste storage

### 13.10.1 Introduction

The efficacy of the refuse storage system is dependent on its capacity and ease of collection by the waste collection authority. Under section 46 (*Receptacles for household waste*) and section 47 (*Receptacles for commercial or industrial waste*) of the Environmental Protection Act 1990, the waste collection authority has powers to specify the type and number of receptacles which should be provided and the position where the waste should be placed for collection. Therefore it is important that consultations take place with the waste collection authority to establish its specific requirements regarding the storage and collection of waste.

The opportunity has been taken in AD H6 to give general recommendations regarding the separate storage of waste for recycling. This is interesting since the Building Regulations do not cover the recycling of household or other waste. However, there are moves afoot to amend sections 46 and 47 of the Environmental Protection Act 1990 to allow for separate storage, and of course, there are a number of national initiatives on recycling and waste reduction which the AD is attempting to support. From a legal standpoint it is unlikely that the recommendations can, in fact, be enforced.

### 13.10.2 Requirement H6

Buildings are required to have:

- adequate means of storing solid waste;
- adequate means of access for the users of the building to the place of storage; and
- adequate means of access from the place of storage to:
  - (a) a collection point where one has been specified by the waste collection authority under section 46 (for household waste) or section 47 (for commercial waste) of the Environmental Protection Act 1990; or
  - (b) to a street (in the case of no collection point being specified).

The requirements of paragraph H6 may be met by providing solid waste storage facilities which are:

- large enough, bearing in mind the requirements of the waste collection authority for the number and size of receptacles (this relates to the quantity of refuse generated and the frequency of removal, see sections 46 and 47 of the Environmental Protection Act 1990);
- designed and sited so as not to present a health risk; and
- sited so as to be accessible for filling by people in the building and for removing to the access point specified by the waste collection authority.

### 13.10.3 Domestic buildings – storage capacity

Assuming weekly collection, dwellinghouses, flats and maisonettes up to four storeys high should have, or have access to, a location large enough to accommodate at least two movable, individual or communal containers, which meet the requirements of the waste collection authority.

The location should cater for separated waste (i.e. one container taking waste for recycling and another taking all other waste). The combined capacity of the two containers should not be less than $0.25\,m^3$ per dwelling (or such other capacity as is agreed with the waste collection authority). If the waste collection authority does not provide weekly collections then larger capacity containers or more individual containers will need to be provided.

The size of the location will depend on whether this is based on the provision of communal or individual storage. Where individual storage is provided for each dwelling this should be an area with dimensions of at least 1.2 m × 1.2 m. The waste collection authority should be consulted regarding space requirements for communal storage areas.

Dwellings in buildings above the fourth storey may either:

- share a container fed by a chute for non-recyclable waste, plus be provided with separate storage for waste which is to be recycled; or
- be provided with storage compounds or rooms for both types of waste if suitable management arrangements can be assured for conveying the waste to the place of storage.

For large blocks, recyclable waste can also be dealt with by providing 'Residents Only' recycling centres (places where residents can bring their own recyclable waste for storage in large containers, such as bottle banks).

### 13.10.4 Siting of waste containers and storage areas

Waste containers should comply with the following rules with regard to siting.

- For new buildings it should be possible to take a container to a collection point without taking it through a building. (It is permissible to pass through a porch, garage, carport or other covered space.) Buildings should not be extended or converted in such a way as to remove such an access facility where it already exists.
- Waste containers and chutes should not be sited more than 25 m from the waste collection point specified by the waste collection authority.
- Householders should not be required to carry refuse more than 30 m to a storage area for a waste container or chute (excluding any vertical distance).
- For waste containers with capacities up to 250 litres:
  - (a) steps should be avoided wherever possible on the route between the container store and the waste collection point and where unavoidable they should be restricted to three in number;

(b) ideally, slopes should not be greater than 1 in 12 but where this is unavoidable they should be of restricted length and not in a series.

- For waste containers with capacities greater than 250 litres the storage area should be located so that steps are avoided altogether.
- The waste collection authority should be consulted to ensure that the collection point can be accessed by its normal size of waste collection vehicle.
- External locations for waste containers should be sited in shade or under shelter away from windows or ventilators.
- Waste storage areas should not obstruct pedestrian or vehicle access routes to buildings.

## 13.10.5 Design of waste containers and storage areas

### *Enclosures, compounds or storage rooms*

Enclosures, compounds and storage rooms should comply with the following.

- Be designed to allow room for filling and emptying.
- Have a clear space of 150 mm provided between and around containers.
- Be permanently ventilated at top and bottom.
- Have paved impervious floors.
- Be secure to prevent access by vermin (unless, in the case of compounds, the refuse is stored in secure containers with close fitting lids).
- If enclosing communal containers, have:
  (a) clear headroom of 2 m;
  (b) provision for washing down and draining the floor into a drainage system designed to receive polluted effluent;
  (c) gullies incorporating traps which maintain their seals even after prolonged periods of disuse.
- If enclosing individual containers, be sufficiently high to allow the lid to be opened for filling.
- Where storage rooms are provided these should contain separate rooms for recyclable and non-recyclable waste.

A waste storage facility which is located in a publicly accessible area or in an open area around a building (such as a front garden) should be provided with an enclosure or shelter.

### *Refuse chutes*

For high rise domestic developments where refuse chutes are provided, AD H6 recommends that they should be at least 450 mm in diameter and constructed with:

- smooth, non-absorbent inner surfaces
- close fitting access doors at each storey containing a dwelling
- ventilation at top and bottom.

Alternatively, refuse chutes may be designed in accordance with the relevant clauses in BS 5906: 1980 *Code of practice for storage and on-site treatment of solid waste from buildings*. Figure 13.28 is based on the recommendations of BS 5906: 1980 and illustrates a typical refuse chute installation.

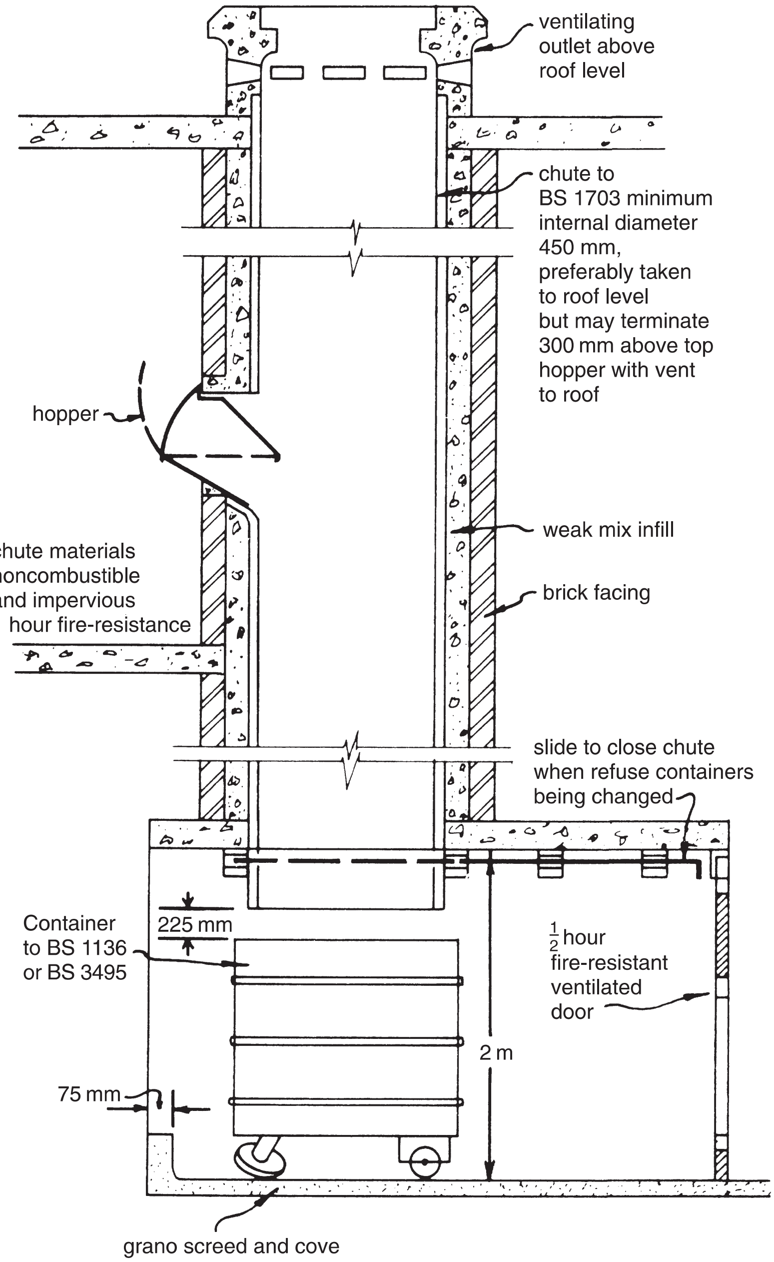



**Fig. 13.28** Refuse chutes.

### 13.10.6 Non-domestic buildings

In the development of non-domestic buildings special problems may arise. It is therefore essential to consult the refuse collection authority for their requirements with regard to the following.

- The storage capacity required for the volume and nature of the waste produced. (The collection authority will be able to give guidance as to the size and type of container they will accept and the frequency of collection).
- Storage method. This may include details of any proposed on-site treatment and should be related to the future layout of the development and the building density.
- Location of storage and treatment areas and collection points, including access for vehicles and operatives.
- Measures to ensure adequate hygiene in storage and treatment areas.
- Measures to prevent fire risks.
- Segregation of waste for recycling.

The following recommendations should also be considered.

- Rooms and compounds provided for the open storage of waste should be secure to prevent access by vermin (unless in the case of compounds, the refuse is stored in secure containers with close fitting lids).
- Waste storage areas should:
  - (a) have an impervious floor and provision for washing down and draining the floor into a drainage system designed to receive polluted effluent;
  - (b) have gullies incorporating traps which maintain their seals even after prolonged periods of disuse;
  - (c) be marked to show their use and signs should be provided to indicate their location.

### 13.10.7 Alternative approach

As an alternative to the recommendations listed above for waste disposal, it is permissible to use BS 5906: 1980 especially clauses 3 to 10, 12 to 15 and Appendix A. However, BS 5906 does not contain information on recycling. It is currently being revised and the new edition is expected to contain such information.