



Llywodraeth Cymru
Welsh Government

www.cymru.gov.uk

The Welsh Ministers standards for new gravity foul sewers and lateral drains



October 2012

Welsh Ministers' draft new build standards

Welsh Ministers' Standards Design and Construction of New Gravity Foul Sewers and Lateral Drains

Water Industry Act 1991 Sections 106B and 104(9)

Introduction

This document contains the functional standards and guidance published by the Welsh Ministers, together with industry recommendations for the design and construction of new gravity foul sewers and lateral drains.

The Welsh Ministers' standards are contained within the grey boxes (clauses prefixed by the letter S and corresponding number) are mandatory. The Welsh Ministers' guidance is given in the clear boxes beneath the standards and has clause numbers prefixed with the letter G.

The industry recommendations are given below the boxes in each section and have clause numbers prefixed with the letter R. These recommendations are not mandatory but compliance with these recommendations will normally be considered by sewerage undertakers as compliance with the requirements of the standards and guidance published by the Welsh Ministers. Other solutions may also be used if they also satisfy the requirements of the Welsh Ministers' standards. The content of these clauses are copyright of Water UK and WRc plc and may not be produced without the written consent of Water UK and WRc plc.

1 - Scope

S1. The standards give requirements for the design and construction of gravity foul sewers and lateral drains constructed in accordance with any agreement under Section 104 of the Water Industry Act 1991 in those parts of Wales and England served by water and sewerage undertakers whose areas are wholly or mainly in Wales. They are published in accordance with Section 106B (Requirement to enter into an agreement before construction) of the Water Industry Act 1991 as inserted by the Flood and Water Management Act 2010.

G.1.1. Surface water sewer systems are outside the scope of these standards and should be constructed in accordance with the requirements of the adopting authority.

G.1.2. The standards apply to sewers intended for adoption as part of the public sewerage system under Section 104 of the Water Industry Act 1991 only.

2 - Definitions

S2. In these standards -

'access point' means provision to access a sewer or drain for maintenance or inspection and includes any manhole, inspection chamber, or rodding eye.

'drain' means a pipeline, usually underground, designed to carry foul sewage or surface water from buildings and paved areas associated with buildings within the same curtilage;

'sewer' means a pipeline, usually underground, designed to carry foul sewage or surface water from buildings and paved areas associated with buildings in more than one curtilage;

'lateral drain' means that part of a drain which is between the point of demarcation, or the boundary of the property it serves, and the sewer;

'curtilage' means area of land around a building, or group of buildings, which is for the private use of the occupants of the buildings.

G.2.1. Detached semi-detached and terraced houses should each typically be considered as a separate curtilage for the purpose of these standards.

G.2.2. Where a building contains a number of flats the whole block of flats should typically be considered to be a single curtilage for the purpose of these standards.

R.1. Separate commercial properties sited on land privately owned by a single body (e.g., a shopping centre, airport terminal, retail park, etc.) will typically be considered as a single curtilage if the commercial properties share the site access and facilities.

3 - Separate systems

S3. Separate systems shall be provided for foul sewage and surface water.

G.3.1. Where foul and surface water sewer systems from the same area are to be connected to an existing combined sewer, the two systems may only be connected together immediately prior to the connection to the existing public combined sewer.

R.1. Watercourses or land drainage are not permitted to be directly or indirectly connected to the public sewer system. Satisfactory and separate arrangements should be agreed with the Local Land Drainage Authority and confirmed with the Undertaker unless it is a part of a sustainable drainage system approved by the SuDS adoption body (SAB) in accordance with Section 32 and Schedule 3 of the Flood and Water Management Act 2010.

R.2. These standards do not apply to surface water sewers and drains.

4 - Layout and Access

S4. Sewers and lateral drains shall be located so that if

- h) there is a structural failure of the drain, sewer; or
- i) excavation is carried out to repair the drain, sewer;

the integrity of adjacent buildings or other infrastructure is not impaired.

S5. Access points and any inlets to drains or sewers shall be located so as to minimise the risk of damage to buildings or other infrastructure in the event of sewer flooding.

S6. The sewer system shall be designed and constructed in order to provide access for any reasonably foreseeable maintenance activities.

S7. Access points shall be located so that they are accessible and apparent to the sewerage undertaker at all times for use.

4.1 Layout

G.4.1.1. The external face of any new sewer or lateral drain should be at least 1.2 m from any building or structure, or a distance equivalent to the depth of the sewer below the foundation, whichever is greater; except that a sewer or lateral drain with a nominal internal diameter of 150 mm or less, with an invert level at least 150 mm above the base of the foundation and no more than 1100 mm deep, should be no less than 100 mm from the foundations.

G.4.1.2. Foul sewers and lateral drains should not be constructed under any building or structure, except that they may cross under a boundary wall not greater than 1 m high.

G.4.1.3. Limiting flood risk can have an impact on the layout of a development and, therefore, can impact on the layout of drains and sewers (see G.6.2.1 and G.6.2.2).

G.4.1.4. Sewers and lateral drains, where practicable, should be laid in highways or public open space or a space where they are reasonably accessible and visible. Sewers should not be laid in enclosed private land, where there is a practicable alternative route.

G.4.1.5. Sewers should be laid in straight lines in both the vertical alignment (profile) and horizontal alignment (plan) except that bends up to 45 degrees may be laid immediately outside inspection chambers.

R.1. The location of new sewers and lateral drains in relation to any building or structure is illustrated in Figure 1 and G.4.1.1.

R.2. Where it is not possible to comply with clause G.4.1.1 above because another building/structure is in such close proximity that there are no permitted locations, new sewers or lateral drains may be located between buildings/structures provided that:

- a) there is at least 900 mm separating the buildings/structures where a single sewer or lateral drain is proposed and 1100 mm where dual systems are proposed;
- b) the depth of the invert of the sewer or lateral drain below the ground level is no greater than the distance between the buildings/structures;
- c) the sewers or lateral drains have a nominal internal diameter of 150 mm or less;
- d) the sewers or lateral drains have an invert level at least 150 mm above the base of the highest of the foundations of the two buildings;
- e) there is at least 350 mm cover above the pipe; and
- f) there is at least 100 mm between the pipe wall and the foundations (see Figure 2).

R.3. For the purposes of paragraphs 4.1.R.1 & 4.1.R.2, the foundation level of the building/structure with piled foundations should be taken from the underside of the capping beam.

Note: In paragraphs 4.1.R.1 and 4.1.R.2 the recommendations are intended to allow sufficient working space for hand excavation in proximity to the building/structure if repair is necessary in the future.

R.4. Where it is not practicable to lay sewers and lateral drains in highways or public open space or where they are reasonably accessible and visible, sewers and lateral drains with a nominal diameter of 150 mm or less may be laid:

- a) In shared rear yards or parking areas or other shared areas to which all the properties served by the sewers have right of access; or where this is not reasonably practicable,
- b) Where the drain or sewer serves ten properties or less, in unfenced gardens; or where this is not reasonably practicable,
- c) In fenced private areas, provided that the sewer is kept as far as is practicable from any point on a building where a future extension is likely.

R.5. Sewers and lateral drains may be laid through arches and other external openings through buildings/structures provided that they are laid as near to the centre of the opening as possible and:

- a) for vehicular entries with a minimum width of 4.0 m and minimum height of arch above ground level of 2.1 m, the maximum nominal internal diameter of the pipe should be 225 mm with a maximum depth to invert of the pipe of 2.0 m and the invert should be at least 150 mm above the foundation level; or,
- b) for pedestrian access with a minimum width of 0.9 m and minimum height of 2.0 m, the maximum nominal internal diameter of the pipe should be 100 mm and should comply with 4.1.R.2.

R.6. The design of landscaping should be undertaken at the same time as the design of the drains and sewers so that the impact of tree roots on sewers/drains can be considered. A sewer or lateral drain should not be located closer to trees/bushes/shrubs than the canopy width at mature height, except where special protection measures are provided in accordance with clause 7.R.6. A tree should not be planted directly over sewers or where excavation onto the sewer would require removal of the tree. The following shallow rooting shrubs are generally suitable for planting close to sewers and lateral drains:

- *Berberis candidula*; (Paleleaf barberry)
- *Berberis julianae*; (Wintergreen barberry)

- Ceanothus burkwoodii; (Californian lilac 'Burkwoodii')
- Cotoneaster dammeri; (Bearberry cotoneaster)
- Cotoneaster skogholm; (Cotoneaster x suecicus, 'Skogholm')
- Cytisus varieties or Sarothamnus; ((Common or Scotch) Broom)
- Euonymus japonica; (Japanese spindle)
- Euonymus radicans; Variety of Euonymus (Fortune's spindle or wintercreeper)
- Mahonia varieties; can be included in the genus Berberis, most common name is M. aquifolium (Oregon grape)
- Potentilla varieties; most varieties are types of cinquefoil. Also includes Common tormentil, silverweed and barren strawberry
- Skimmia japonica; (Skimmia)
- Spiraea japonica; (Japanese spirea or Japanese meadowsweet)
- Veronica varieties; (Speedwell)
- Viburnum davidii; (David viburnum)
- Viburnum tinus; (Lauristinus)

R.7. When in a highway, the outside of the sewer should be in the vehicle carriageway (not footway) and be at least 1.0 m from the kerb line. The external faces of manholes should be at least 0.5 m from the kerb line.

R.8. Where it is proposed to lay pipes in third party land, agreement should be obtained from the owner of the land surface as to the acceptable level of predicted settlement, prior to the construction. The construction techniques should be selected to ensure that the maximum settlement is within the agreed limits.

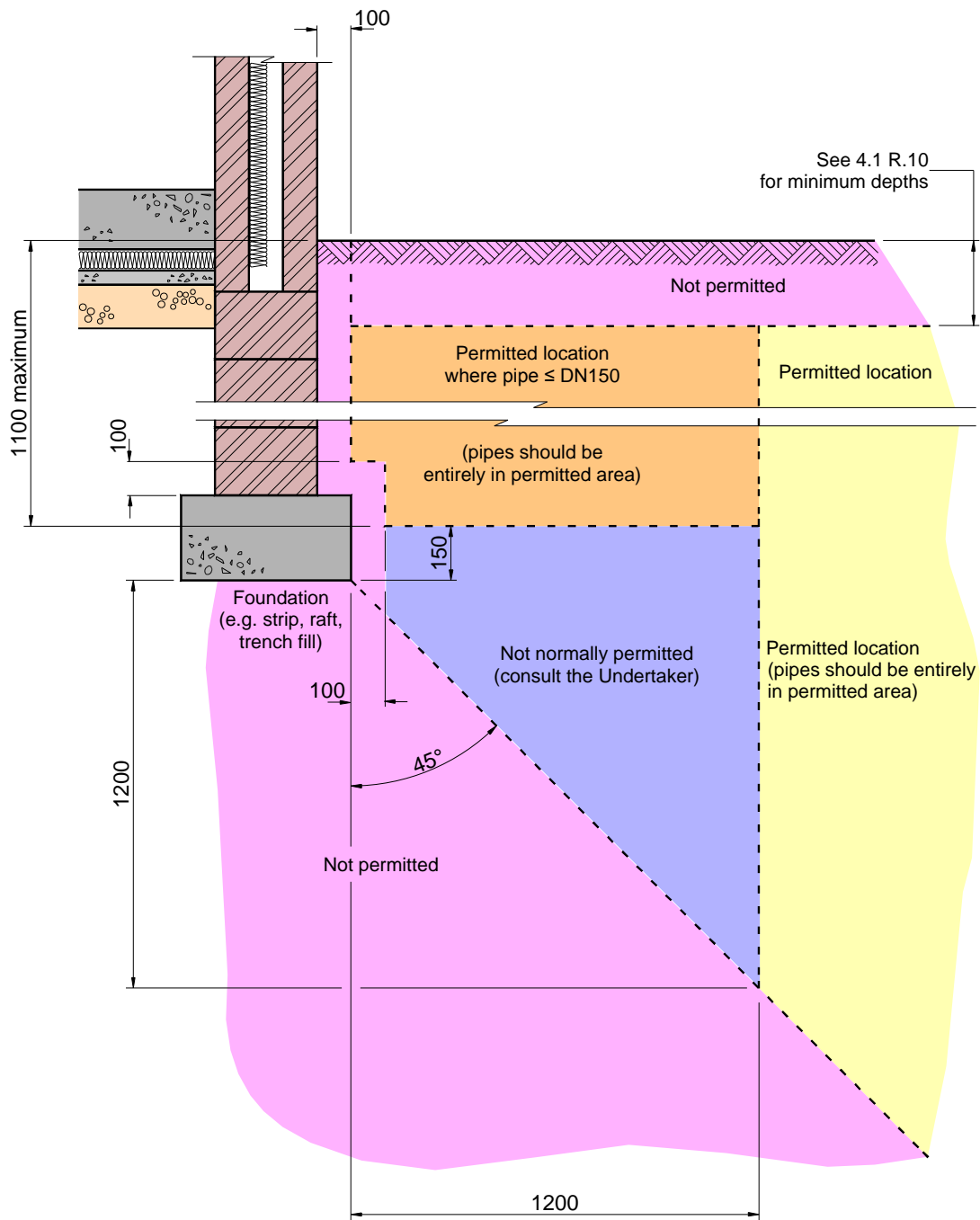
R.9 The position of access points will affect the layout; see Section 4.2 (G.4.2.1).

R.10. The minimum depth of cover to the crown of gravity pipes without protection (see G.7.1) should be as follows:

- a) Domestic gardens and pathways without any possibility of vehicular access - 0.35 m.
- b) Domestic driveways, parking areas and yards with height restrictions to prevent entry by vehicles with a gross vehicle weight in excess of 7.5 tonnes - 0.5 m.
- c) Domestic driveways, parking areas and narrow streets without footways (e.g. mews developments) with limited access for vehicles with a gross vehicle weight in excess of 7.5 tonnes - 0.9 m.
- d) Agricultural land and public open space - 0.9 m.
- e) Other highways and parking areas with unrestricted access to vehicles with a gross vehicle weight in excess of 7.5 tonnes - 1.2 m.

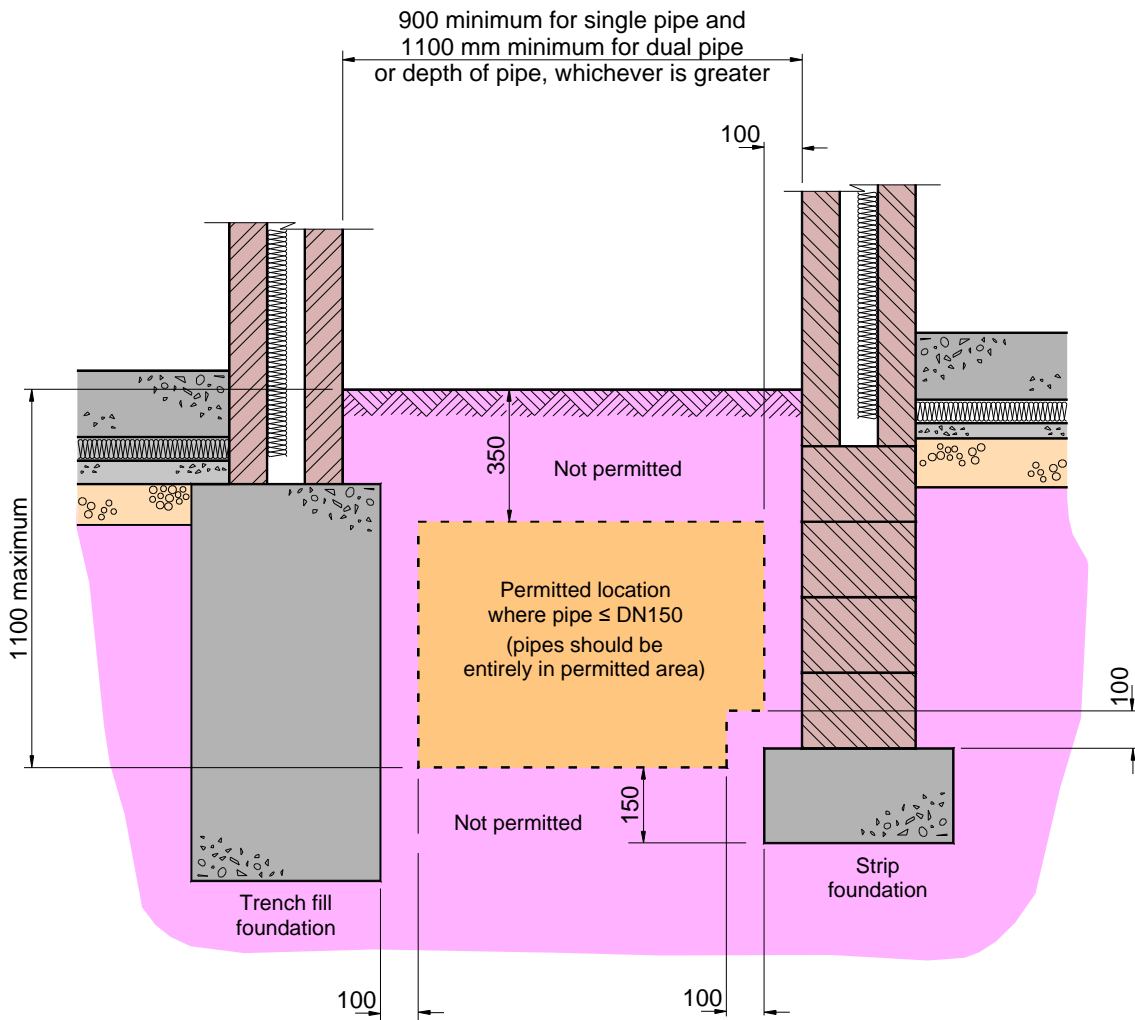
R.11. Typical layouts are shown in Figures 3 to 6.

**FIGURE 1
PERMITTED LOCATION OF SEWERS AND
LATERAL DRAINS IN PROXIMITY TO BUILDINGS**



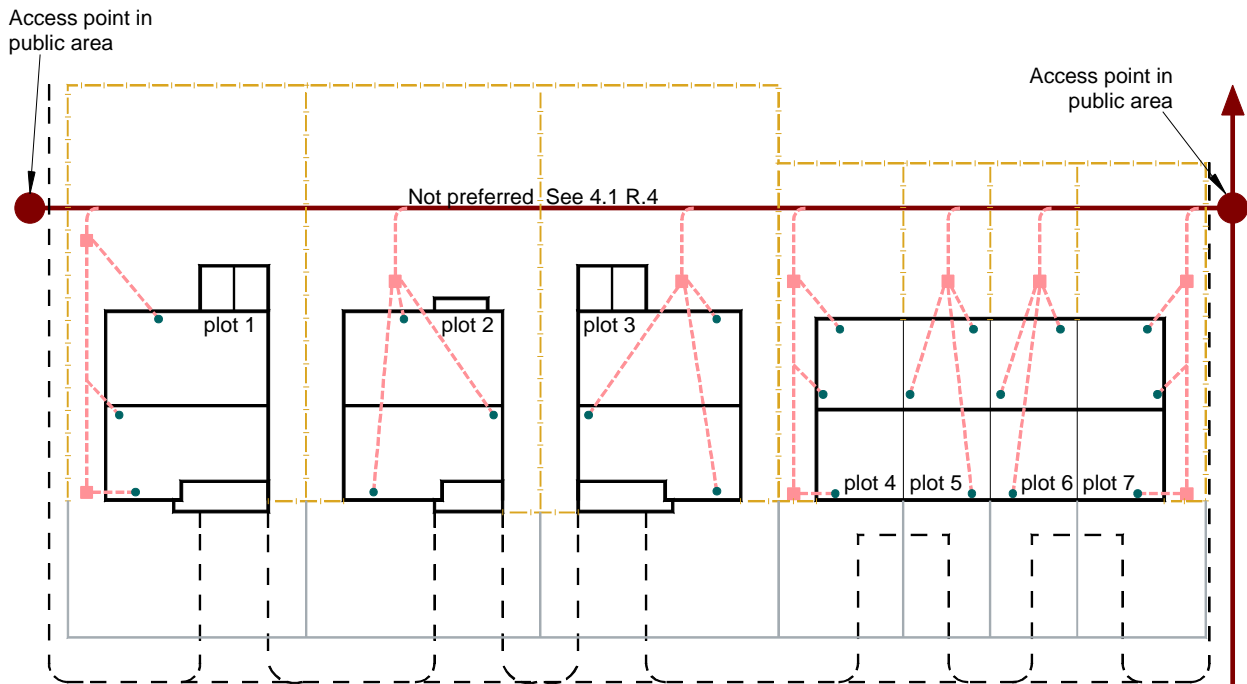
Not to scale, dimensions in millimetres

FIGURE 2
ADDITIONAL DETAIL - PERMITTED LOCATION OF SEWERS
AND LATERAL DRAINS BETWEEN BUILDINGS
(where Figure 1 is not applicable only)

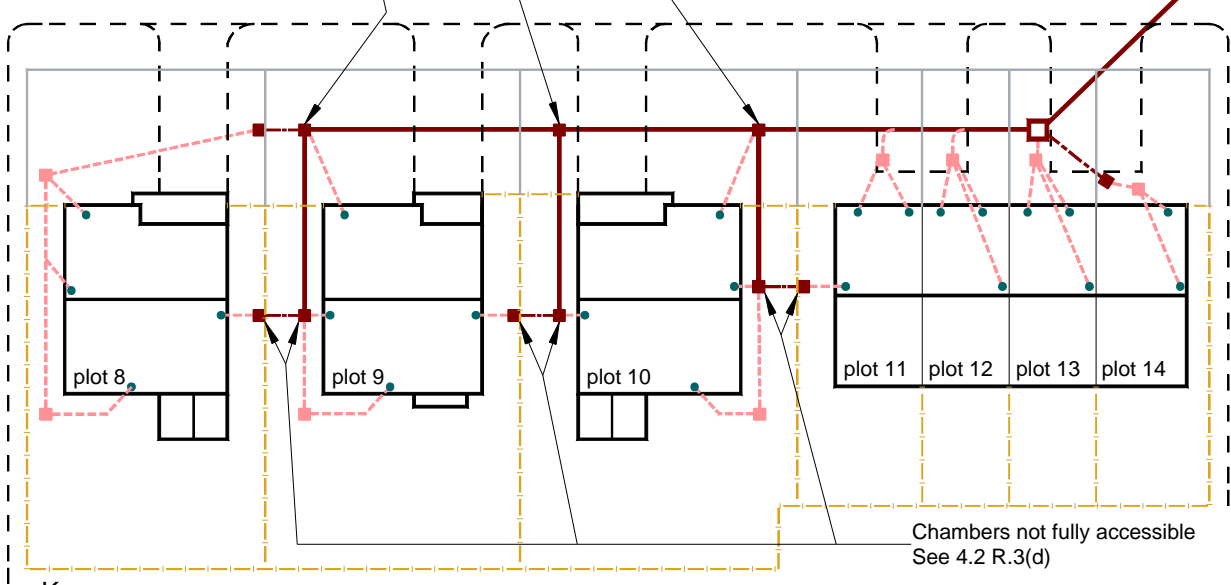


Not to scale, dimensions in millimetres

**FIGURE 3
TYPICAL LAYOUT 1**



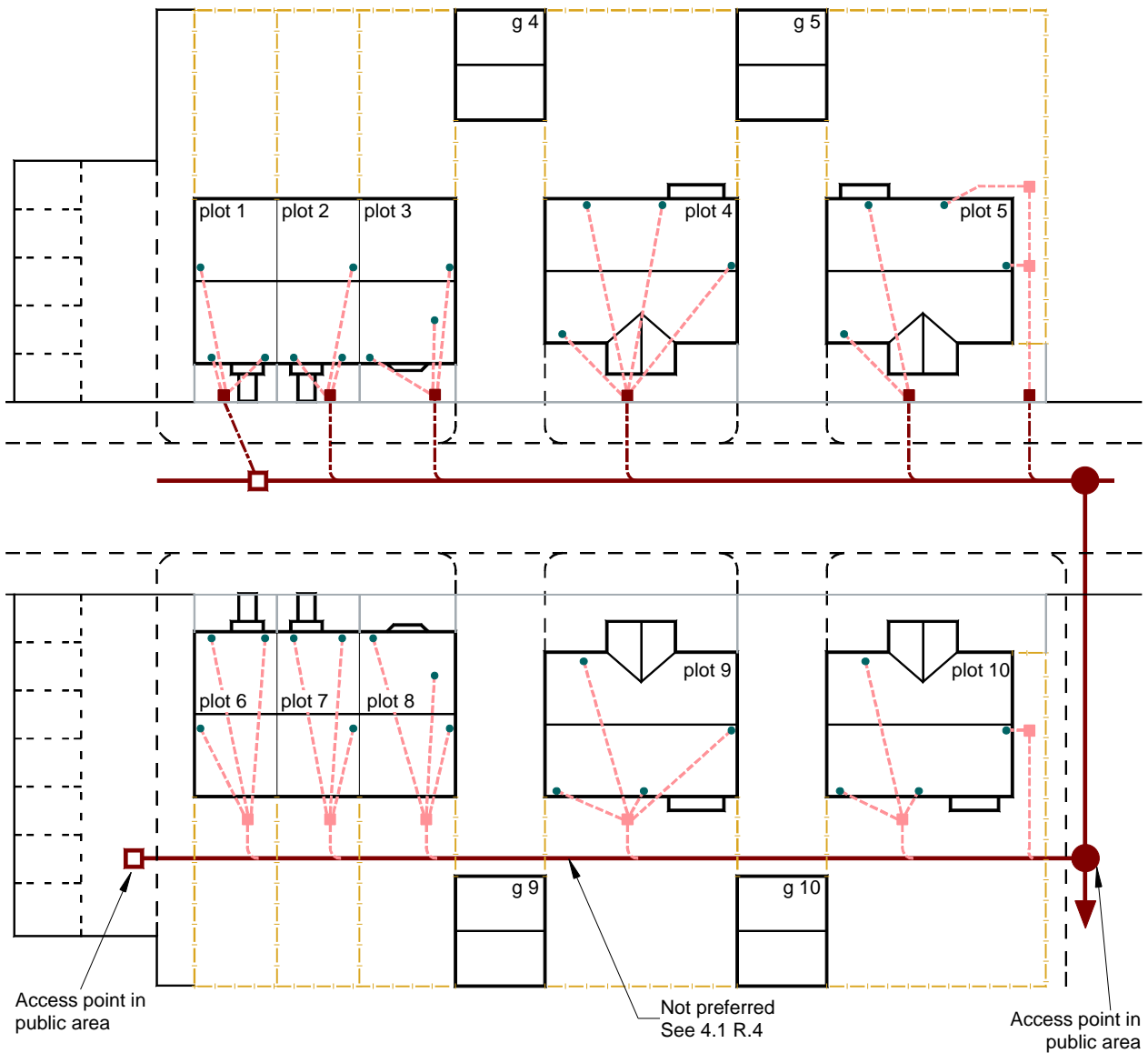
Additional inspection chambers give access to sewers in enclosed areas



- Key:
- Sewers serving more than 10 dwellings to be minimum 150 mm diameter.
 - Other sewers or lateral drains to be minimum 100 mm diameter
 - Foul sewer
 - - - Foul lateral drain
 - - - - - Foul drain (not adoptable)
 - Foul manhole
 - Type 3 foul inspection chamber
 - Type 4 foul inspection chambers - not greater than 3 properties
 - Type 4 foul inspection chambers - not greater than 1 property (not adoptable)
 - Unfenced or low fence boundary
 - - - - - High fence boundary

Note: Some inspection chambers act as demarcation chambers.

**FIGURE 4
TYPICAL LAYOUT 2**



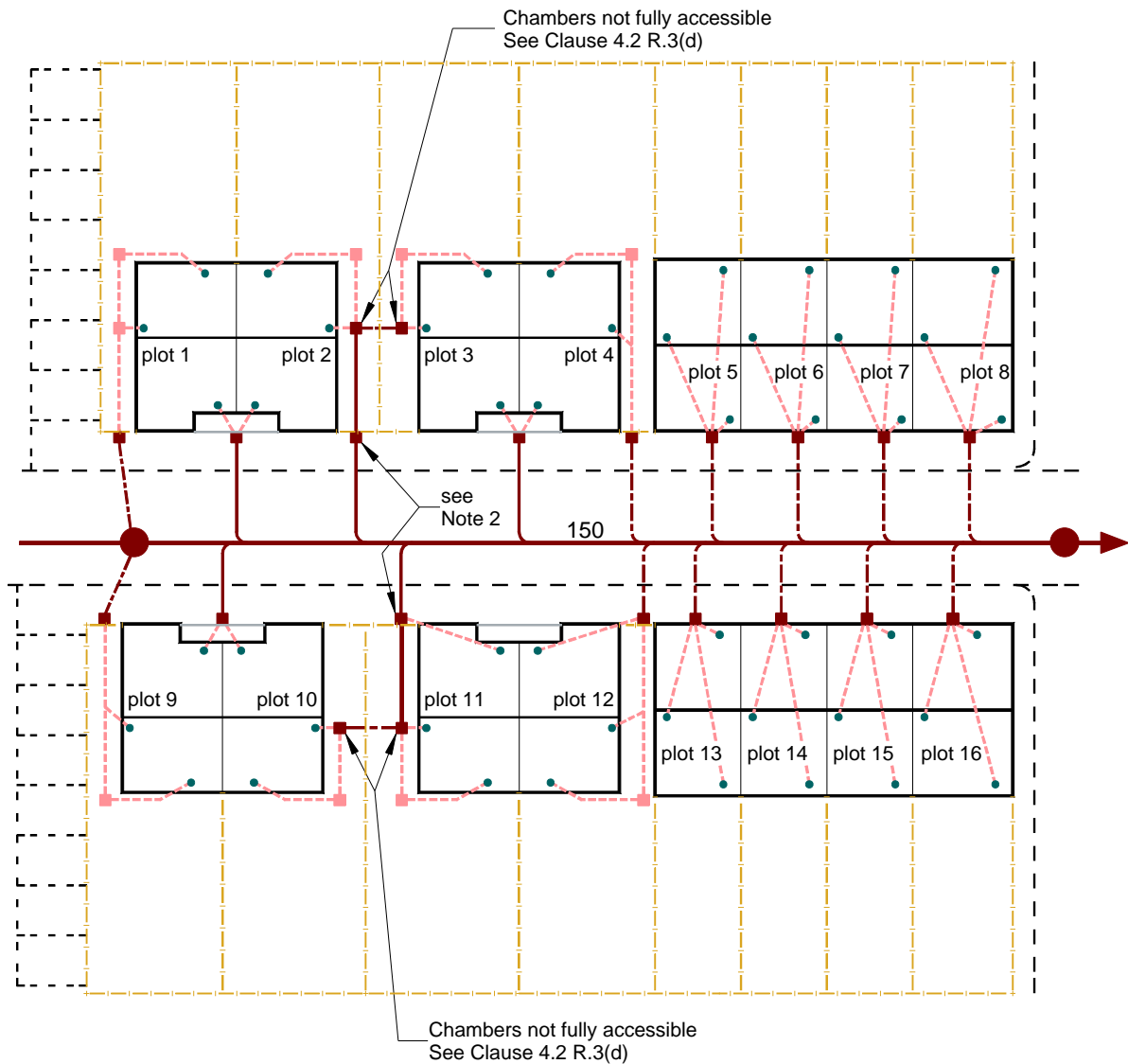
Key:

Sewers serving more than 10 dwellings to be minimum 150 mm diameter.
Other sewers or lateral drains to be minimum 100 mm diameter

- Foul sewer
- - - Foul lateral drain
- - - - - Foul drain (not adoptable)
- Foul manhole
- Type 3 foul inspection chamber
- Type 4 foul inspection chambers - not greater than 3 properties
- Type 4 foul inspection chambers - not greater than 1 property (not adoptable)
- Unfenced or low fence boundary
- - - - - High fence boundary

Note: Some inspection chambers act as demarcation chambers.

**FIGURE 5
TYPICAL LAYOUT 3**



- Notes: 1. Inspection chambers in footway are sited in zone reserved for street lighting columns
2. Additional inspection chambers give access to sewers in enclosed areas

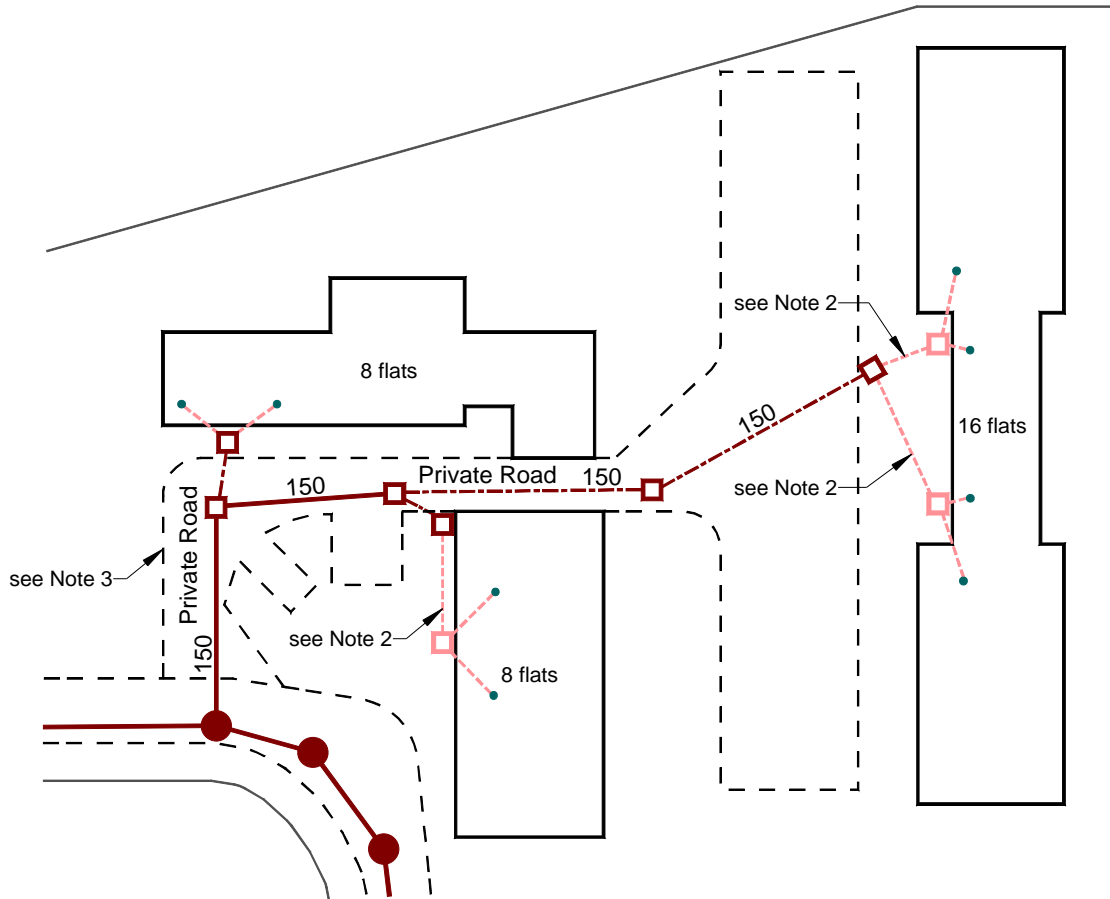
Key:

Sewers serving more than 10 dwellings to be minimum 150 mm diameter.
Other sewers or lateral drains to be minimum 100 mm diameter

- | | | | |
|--|---|--|--------------------------------|
| | Foul sewer | | Unfenced or low fence boundary |
| | Foul lateral drain | | High fence boundary |
| | Foul drain (not adoptable) | | |
| | Foul manhole | | |
| | Type 3 foul inspection chamber | | |
| | Type 4 foul inspection chambers - not greater than 3 properties | | |
| | Type 4 foul inspection chambers - not greater than 1 property (not adoptable) | | |

Note: Some inspection chambers act as demarcation chambers.

**FIGURE 6
TYPICAL LAYOUT 4**



Notes: 1. Designation of individual pipes will depend on curtilage. See G.2.2

2. Designation assumes drain is in private land

3. Designation of pipe assumes road is private

Key:

Sewers serving more than 10 dwellings to be minimum 150 mm diameter.

Other sewers or lateral drains to be minimum 100 mm diameter

— Foul sewer

- - - Foul lateral drain

- - - Foul drain (not adoptable)

● Foul manhole

■ Type 3 foul inspection chamber

□ Type 3 foul inspection chamber (not adoptable)

■ Type 4 foul inspection chambers - not greater than 3 properties

■ Type 4 foul inspection chambers - not greater than 1 property (not adoptable)

Note: Some inspection chambers act as demarcation chambers.

4.2 Access

G.4.2.1. Access points should be located so that they are accessible and apparent to the Undertaker at all times for use. They should avoid rear gardens or enclosed locations. Additional access points may be provided in other locations, as long as access is provided to the system from other access points.

G.4.2.2. Where the adoptable sewer is within the property curtilage an access point may be constructed on the sewer at the point of connection to provide access to the individual property drains. Where property drains converge into a prior access point, and a single drain connects from this access point to the sewer, the connection to sewer may be by a saddle connection or other preformed junction.

G.4.2.3. Manholes should be provided as the means of access to a pipe where;

- a) the depth from the surface to the crown of the pipe is greater than 3 m,
- b) there are two or more upstream pipes each serving more than ten properties, or
- c) the distance between manholes would otherwise be greater than 150 m.

G.4.2.4. Where access to a pipe is provided through an inspection chamber, no part of the pipe should be more than 22.5 m from the adjacent inspection chamber (i.e., the distance between adjacent inspection chambers should be no more than 45 m). Where access to a pipe is provided through a manhole, no part of the pipe should be more than 75 m from the adjacent manhole.

G.4.2.5. Manholes should be designed for safe access and egress. The minimum clear opening into any manhole should be 600 mm x 600 mm.

G.4.2.6. Inspection chambers should be designed to afford reasonable access for equipment to carry out maintenance activities. Inspection chambers should be designed to deter personnel access.

R.1. Access points and sewers should be sited with due regard to public utility services. An access point should be built:

- a) at every change of alignment, gradient or pipe material;
- b) at the head of all sewers;
- c) at every junction of two or more public sewers;
- d) wherever there is a change in the size of the sewer; and
- e) at every junction of a public sewer with another sewer serving:
 - i) three or more properties where the access point is an inspection chamber; or
 - ii) more than ten properties where the access point is a manhole;
- f) at or within 1 m of the property boundary at the upstream end of each lateral drain (preferably inside the property boundary).

R.2. Further access points, in addition to these recommended in 4.2 R.1 may be provided.

R.3. Access points on sewers and lateral drains should not be laid in enclosed private land. Where this is not practicable, access points of sewers and laterals may be constructed:

- a) in shared rear yards or parking areas, provided there is free access at all times;
- b) in enclosed shared private areas provided that all those properties served by the sewers have right of access to the area at all times. Access control systems should include provision for access by the sewerage undertaker;
- c) where the drain or sewer serves ten properties or less, in unfenced gardens; or
- d) on sewers serving no more than two properties provided that access is also possible from the other property by another access point.

R.4. Four types of access point may be used (see Table 1). These are identified in the flow diagram in Figure 7, which, used in conjunction with the access structure standard details and the recommended layouts (Figure 3 to 6), will ensure that the sewerage system meets the required safety, operational and sustainability standards. Each junction, change of direction, change of status, or after a continuous sewer length greater than 150 m, is described here as a node. No access is required at a node if it connects less than three properties and there already is, or will be, sufficient access to carry out sewer maintenance.

R.5. Any pipe and associated access upstream of the point of demarcation is a private drain and should be constructed in accordance with the Building Regulations.

R.6. Figures 8 to 14 show typical details of manholes with depths from cover level to soffit of pipe not exceeding 6 m, including backdrops. No significant departure from these dimensions should be made without approval by the Undertaker.

R.7. In exceptional cases, where access is required at a greater depth than 6 m, the details should be agreed in advance with the Undertaker.

R.8. The diameter of manholes access types 1 and 2 should be in accordance with Table 2.

Table 1 Access types

Access Type	Application
Type 1	Man entry, depth 3-6 m
Type 2	Man entry, depth <3 m
Type 3	Non-entry, depth <3 m
Type 4	Non-entry, depth <2 m

Table 2 Manhole diameters

Nominal diameter of largest pipe in manhole (mm)	Minimum nominal internal dimension of manhole (mm)
Less than 375	1200
375 - 450	1350
500 - 700	1500
750 - 900	1800
Greater than 900	Pipe diameter + 900

R.9. The height of a Type 1 manhole (benching to slab soffit) should normally be in excess of 2000 mm. When this is impracticable, Type 2 manholes are preferred, subject to an absolute minimum height (benching to slab soffit) of 900 mm.

R.10. The internal dimensions quoted above are considered to be the minimum. Where two or more pipes enter the manhole, the internal dimensions should be increased where necessary to accommodate the minimum width of benching. Pipes of different diameters entering manholes should be installed with soffits at the same level.

R.11. Figures 16 to 23 show typical details of Type 3 and Type 4 inspection chambers. No significant departure from these should be made without approval by the Undertaker.

R.12. The design of special manholes and other structures should be agreed with the Undertaker.

R.13. 'In—fill' type covers should not be used. Where a cover is located in an area of block paving the bottom of the frame should be 150 mm deep.

R.14. Covers for manholes and inspection chambers should comply with the requirements of BS EN 124¹ and BS 7903².

R.15. Where covers are sited in NRSWA Road Categories I, II or III, the frames of manhole covers should be bedded using a mortar complying with the requirements of the Design Manual for Roads and Bridges 4.2 Part 5 HA/104/09 (e.g., a suitable polyester resin bedding mortar).

R.16 In situations where traffic loading is anticipated to be heavier (e.g., in industrial developments where large numbers of HGV vehicles with a gross vehicle weight in excess of 7.5 tonnes movements are expected) than would occur on a typical residential estate distributor road, a cover with a higher specification than the standard BS EN 124 D400³ cover should be used.

R.17. Unless the chamber is designed to withstand the vertical load acting on it, a precast concrete slab or in-situ concrete slab, should be provided, to act as a collar to support the cover and frame. The collar should be separate from the chamber to ensure the loading from the cover and frame is not transferred to the chamber.

R.18. The first manhole upstream from the connection to the (existing) public sewer should, when constructed, be fitted with a screen in order to prevent debris entering the public sewer. The screen should not be removed until immediately prior to the occupation of premises to be served by the sewer.

¹ "BS EN 124; Gully tops and manhole tops for vehicular and pedestrian areas — Design requirements, type testing, marking, quality control", July 2004: British Standards Institution, London

² "BS 7903; Guide to selection and use of gully tops and manhole covers for installation within the highway", 1997: British Standards Institution, London

³ "BS EN 124; Gully tops and manhole tops for vehicular and pedestrian areas — Design requirements, type testing, marking, quality control", July 2004: British Standards Institution, London

R.19. Rocker pipes should be provided at entry to, and exits from, manholes when rigid pipes are used. Their length should be as shown in Table 3.

Table 3

Nominal diameter (mm)	Effective length (m)
150 to 600	0.6
601 to 750	1.00
over 750	1.25

R.20. Where pipes serving a total of three properties or less connect on a pipe that has a nominal internal diameter less than or equal to 150 mm, the branch connections should be set so that the soffits of all the pipes are at the same level. In all other cases, branch connections should be set with the soffit levels no lower than that of the main pipe and with the invert level of the branch connection at least 50 mm above the invert of the main pipe.

R.21. The main channel should extend the whole length of the chamber, comprising a half-round section plus vertical benching from the top edge of the half round section to a height of not less than that of the soffit of the outlet, where it should be rounded off and sloped upwards to meet the wall of the chamber.

R.22. Steeper gradients are preferred to the use of backdrops. Where steeper gradients are impractical, backdrops should be constructed as shown in Figure 15. Ramped backdrops should be used for manholes rather than vertical backdrops.

R.23. Where step rungs and ladders are to be used, the distance from the top rung to the surface should be a maximum of 675 mm with a minimum of two courses of brickwork. Where ladders are to be used, they should be positioned relative to the access so that the minimum clear opening is not obstructed.

R.24. Type 4 inspection chambers should allow for a minimum vertical radius for the entry of rods, jetting equipment or CCTV inspection equipment into the pipe (see Figures 21 & 22). Where the pipe has a nominal internal diameter of 100 mm, the vertical radius should be 500 mm and where the pipe has a nominal internal diameter of 150 mm, the vertical radius should be 600 mm.

FIGURE.7
ACCESS TYPE SELECTION

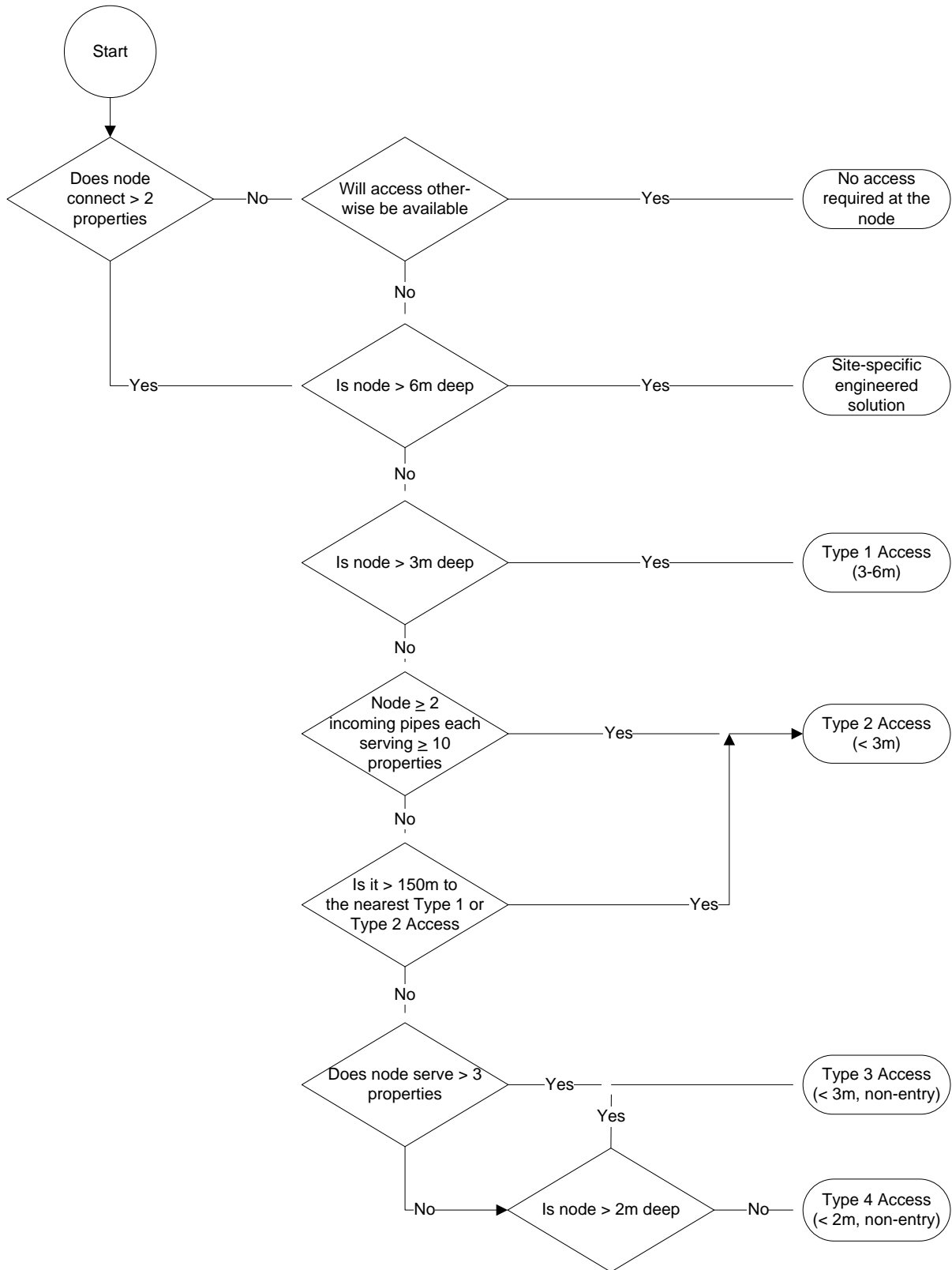


FIGURE 8
TYPICAL MANHOLE DETAIL - TYPE 1A
 Depth from cover level to soffit of pipe 3 m to 6 m

Mortar bedding and haunching to cover and frame in accordance with DfT Specification, 'Reinstatement of Openings in Highways', or M12 mortar as appropriate

Minimum 2 courses of Class B engineering bricks or precast concrete cover frame seating rings
 675 mm maximum to first ladder rung from cover level

On manholes less than 1.5 m diameter reducing slab not to be used and PC rings to continue up to cover slab

In-situ concrete to be GEN3 (designed to BRE Special Digest 1 Concrete in Aggressive Ground)

Lifting eyes in concrete rings to be pointed

High-strength concrete topping to be brought up to a dense, smooth face, neatly shaped and finished to all branch connections (minimum thickness 20 mm)

Self-cleaning toe holes to be provided where channel exceeds 600 mm wide

Inverts to be formed using channel pieces

Joint to be as close as possible to face of manhole to permit satisfactory joint and subsequent movement

Minimum width of benching for landing area to be 500 mm from the edge of the ladder to the edge of the channel

Ladder complying with BS EN 14396

Note: Opening to be located centrally over 900 mm shaft and offset approximately 200 mm for 1200 mm diameter shaft with ladder

600 mm x 600 mm clear opening cover complying with BS EN 124 and BS 7903

Minimum clear access 600 mm

900 mm minimum clear access behind ladder

Shaft diameter 1200 mm

Precast concrete manhole sections and cover slab to be bedded with mortar, plastomeric or elastomeric seal conforming to BS EN 1917 and BS 5911-3
 Chamber wall to be minimum 125 mm

Concrete surround 150 mm thick

Refer to 4.2 R.6 for PC ring diameter

The bottom precast section to be built into base concrete minimum 75 mm

Benching slope to be 1:10 to 1:30

Construction joint

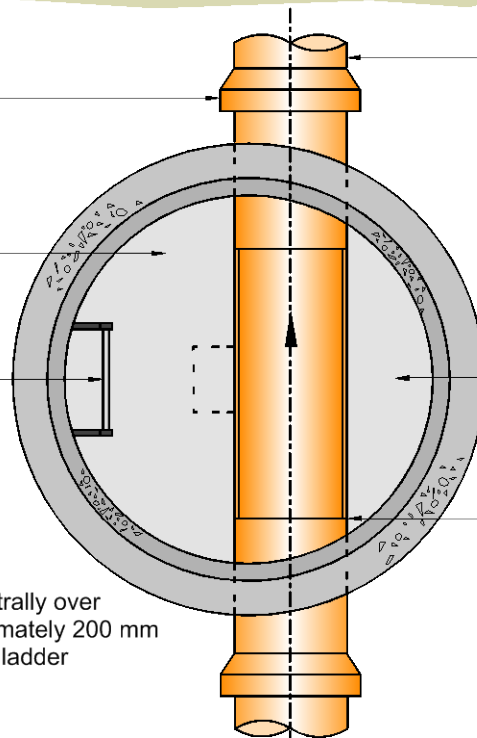
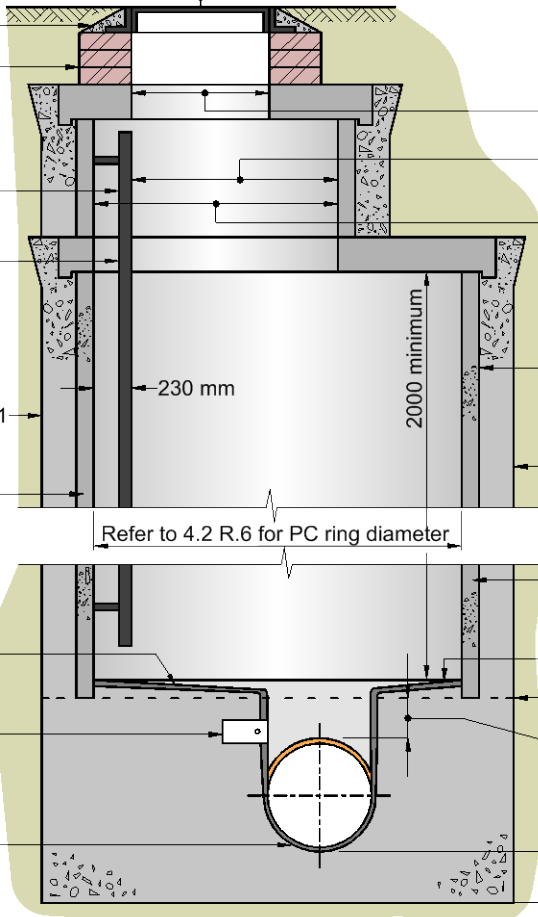
Distance between top of pipe and underside of precast section to be minimum 50 mm to maximum 300 mm

225 mm to underside of channel

See Figure 14 for rocker pipe details

Minimum width of benching to be 225 mm

Pipe joint with channel to be located minimum 100 mm inside face of manhole



Not to scale

FIGURE 9
TYPICAL MANHOLE DETAIL - TYPE 1A (Alternative construction detail)
 Depth from cover level to soffit of pipe 3 m to 6 m

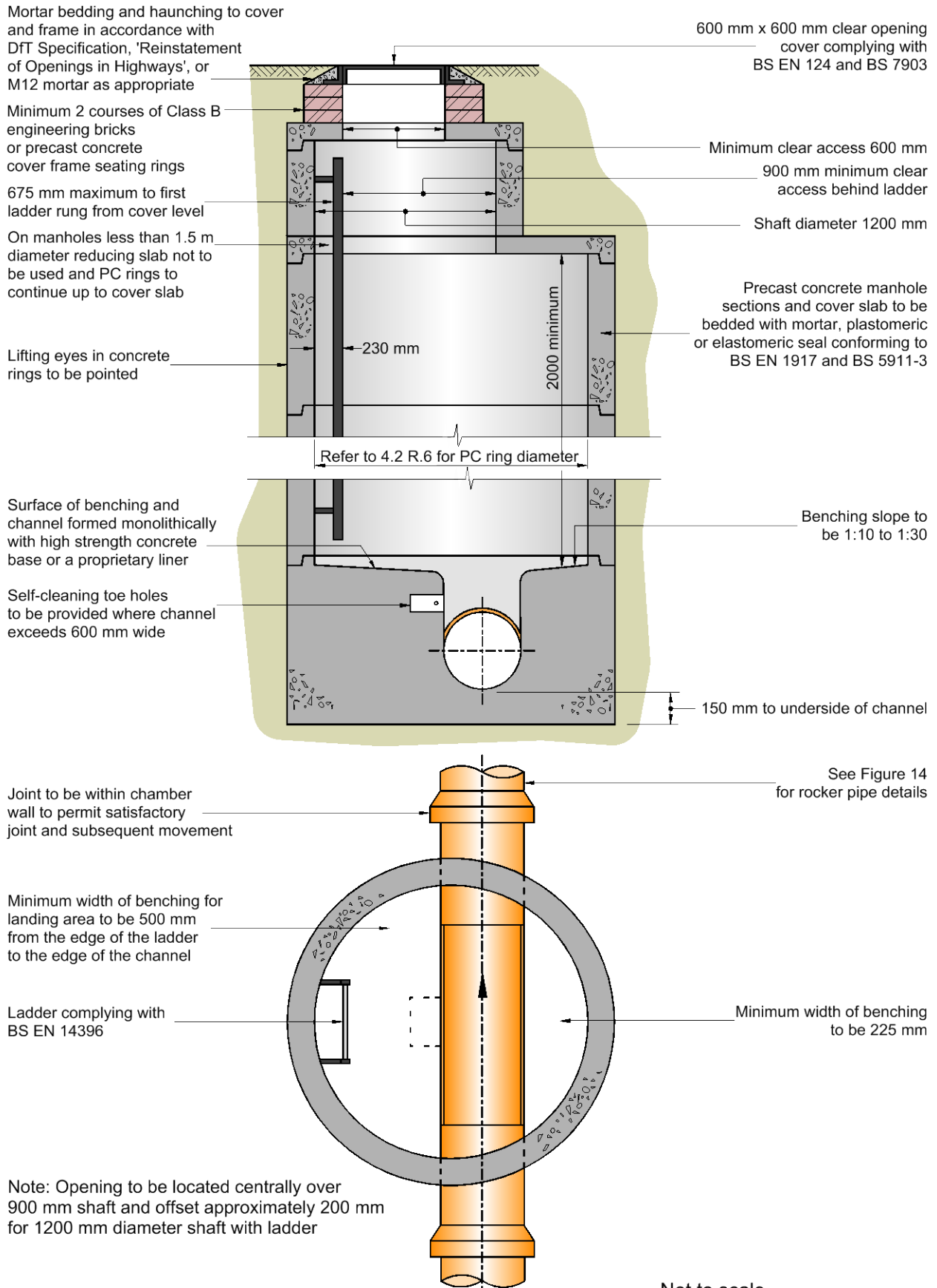


FIGURE 10
TYPICAL MANHOLE DETAIL - TYPE 1B
 Depth from cover level to soffit of pipe 3 m to 6 m

Mortar bedding and haunching to cover and frame in accordance with DfT Specification, 'Reinstatement of Openings in Highways', or M12 mortar as appropriate

Minimum 2 courses of Class B engineering bricks or precast concrete cover frame seating rings

675 mm maximum to first ladder rung from cover level

In-situ concrete to be GEN3 (designed to BRE Special Digest 1 Concrete in Aggressive Ground)

Lifting eyes in concrete rings to be pointed

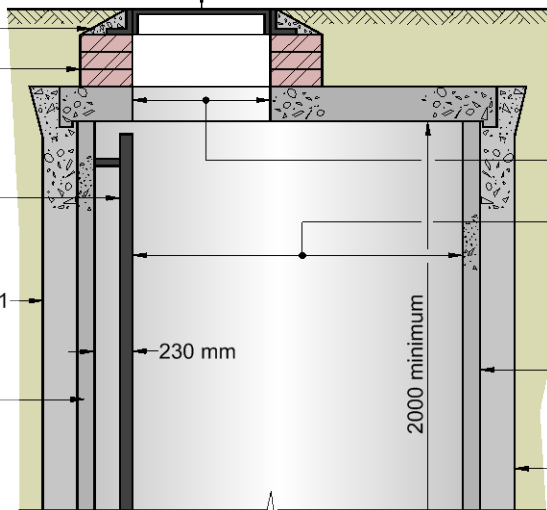
600 mm x 600 mm clear opening cover complying with BS EN 124 and BS 7903

Minimum clear access 600 mm

900 mm minimum clear access behind ladder

Precast concrete manhole sections and cover slab to be bedded with mortar, plastomeric or elastomeric seal conforming to BS EN 1917 and BS 5911-3

Concrete surround 150 mm thick



Refer to 4.2 R.6 for PC ring diameter

High-strength concrete topping to be brought up to a dense, smooth face, neatly shaped and finished to all branch connections (minimum thickness 20 mm)

Self-cleaning toe holes to be provided where channel exceeds 600 mm wide

Inverts to be formed using channel pieces

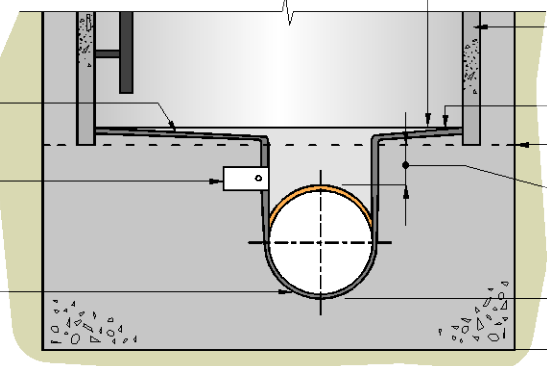
The bottom precast section to be built into base concrete minimum 75 mm

Benching slope to be 1:10 to 1:30

Construction joint

Distance between top of pipe and underside of precast section to be minimum 50 mm to maximum 300 mm

225 mm to underside of channel



Joint to be as close as possible to face of manhole to permit satisfactory joint and subsequent movement

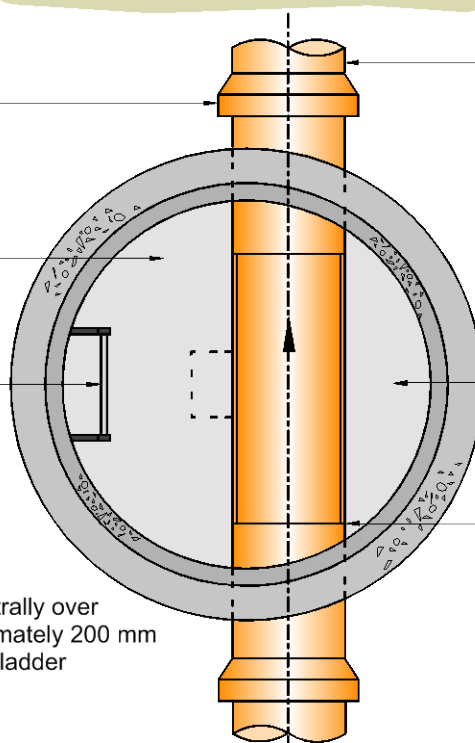
Minimum width of benching for landing area to be 500 mm from the edge of the ladder to the edge of the channel

Ladder complying with BS EN 14396

See Figure 14 for rocker pipe details

Minimum width of benching to be 225 mm

Pipe joint with channel to be located minimum 100 mm inside face of manhole



Note: Opening to be located centrally over 900 mm shaft and offset approximately 200 mm for 1200 mm diameter shaft with ladder

Not to scale

FIGURE 11
TYPICAL MANHOLE DETAIL - TYPE 1B (Alternative construction detail)
 Depth from cover level to soffit of pipe 3 m to 6 m

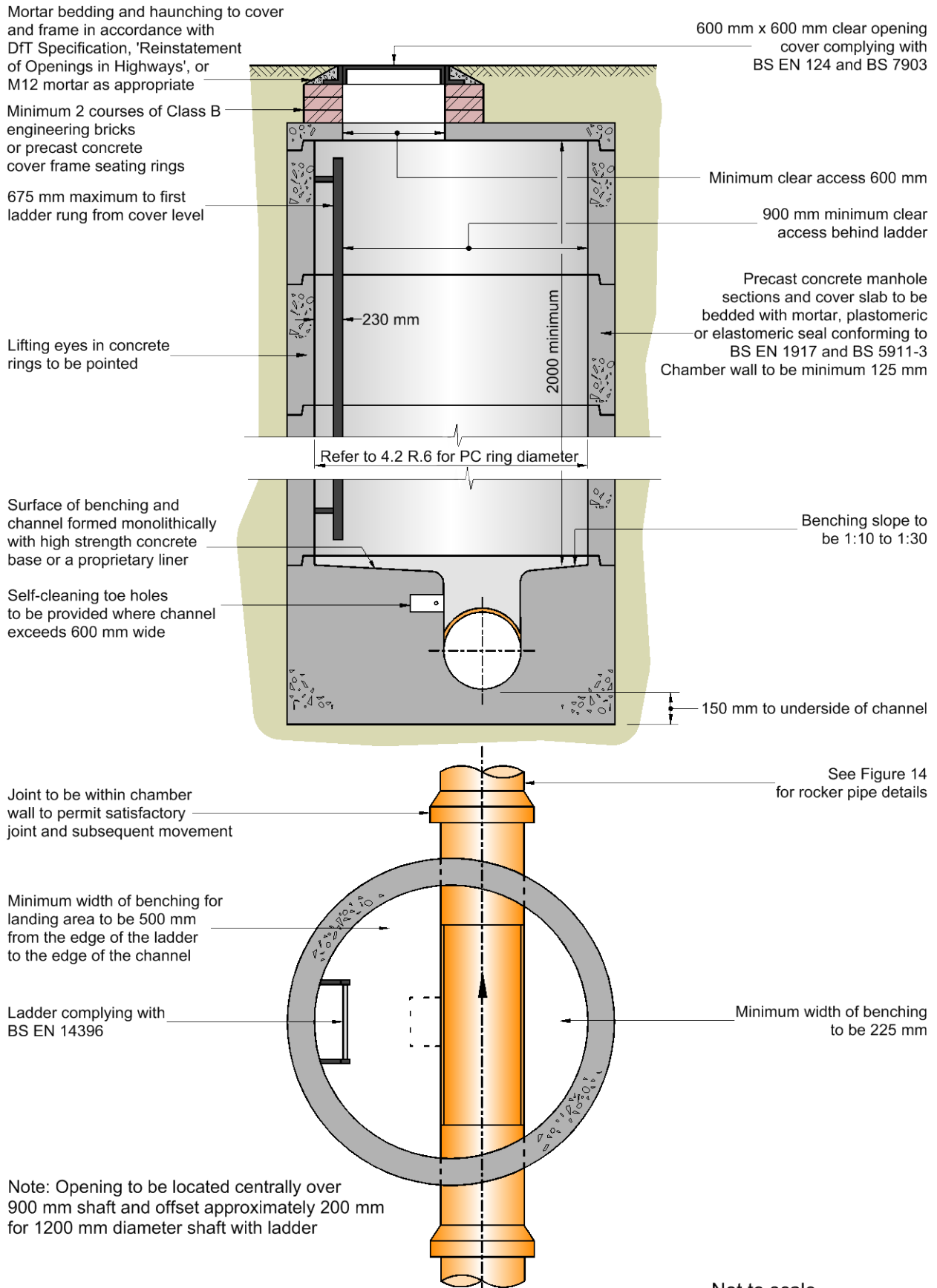


FIGURE 12
TYPICAL MANHOLE DETAIL - TYPE 2
 Maximum depth from cover level to soffit of pipe 3.0 m

Mortar bedding and haunching to cover and frame in accordance with DfT Specification, 'Reinstatement of Openings in Highways', or M12 mortar as appropriate

Minimum 2 courses of Class B engineering bricks or precast concrete cover frame seating rings
 675 mm maximum to first step rung from cover level

Lifting eyes in concrete rings to be pointed

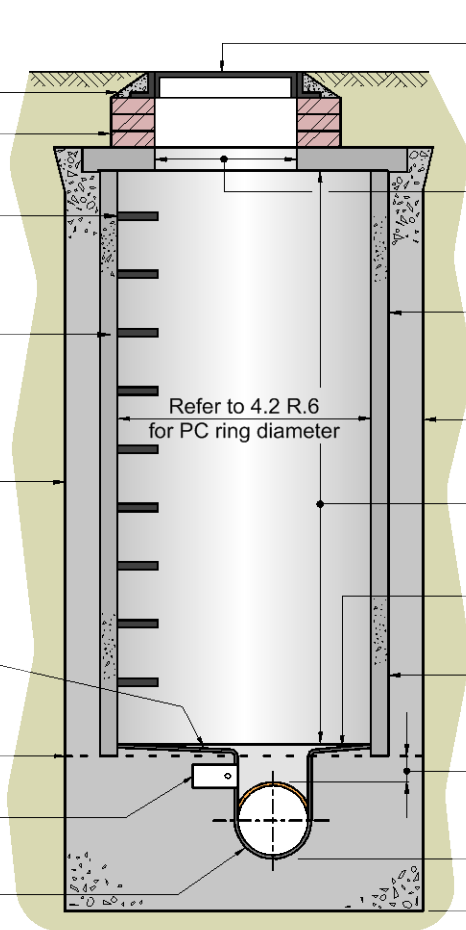
In-situ concrete to be GEN3 (designed to BRE Special Digest 1 Concrete in Aggressive Ground)

High-strength concrete topping to be brought up to a dense, smooth face, neatly shaped and finished to all branch connections (minimum thickness 20 mm)

Construction joint

Self-cleaning toe holes to be provided where channel exceeds 600 mm wide

Inverts to be formed using channel pipes



600 mm x 600 mm clear opening cover complying with BS EN 124 and BS 7903

Minimum clear access 600 mm

Precast concrete manhole sections and cover slab to be bedded with mortar, plastomeric or elastomeric seal conforming to BS EN 1917 and BS 5911-3

150 mm concrete surround

Chamber height (not less than 900 mm)

Benching slope to be 1:10 to 1:30

The bottom precast manhole ring to be built into base concrete minimum 75 mm

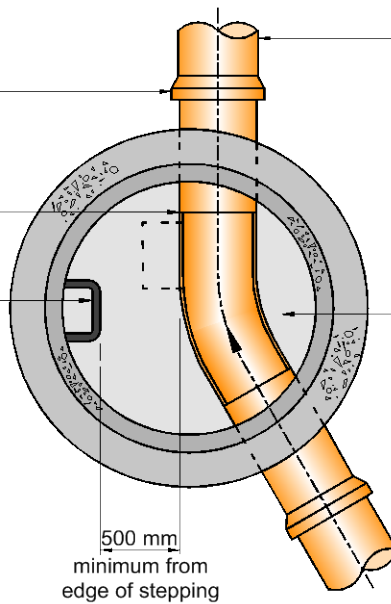
Distance between top of pipe and underside of precast section to be minimum 50 mm to maximum 300 mm

225 mm to underside of channel

Joint to be as close as possible to face of manhole to permit satisfactory joint and subsequent movement

Pipe joint with channel to be located minimum 100 mm inside face of manhole

Double step rungs in accordance with BS EN 13101



See Figure 14 for rocker pipe details

Minimum width of benching to be 225 mm

Not to scale

FIGURE 13
TYPICAL MANHOLE DETAIL - TYPE 2 (Alternative construction detail)
 Maximum depth from cover level to soffit of pipe 3.0 m

Mortar bedding and haunching to cover and frame in accordance with DfT Specification, 'Reinstatement of Openings in Highways', or M12 mortar as appropriate

Minimum 2 courses of Class B engineering bricks or precast concrete cover frame seating rings
 675 mm maximum to first step rung from cover level

Lifting eyes in concrete rings to be pointed

Surface of benching and channel formed monolithically with high strength concrete base or a proprietary liner

Self-cleaning toe holes to be provided where channel exceeds 600 mm wide

600 mm x 600 mm clear opening cover complying with BS EN 124 and BS 7903

Minimum clear access 600 mm

Precast concrete manhole sections and cover slab to be bedded with mortar, plastomeric or elastomeric seal conforming to BS EN 1917 and BS 5911-3

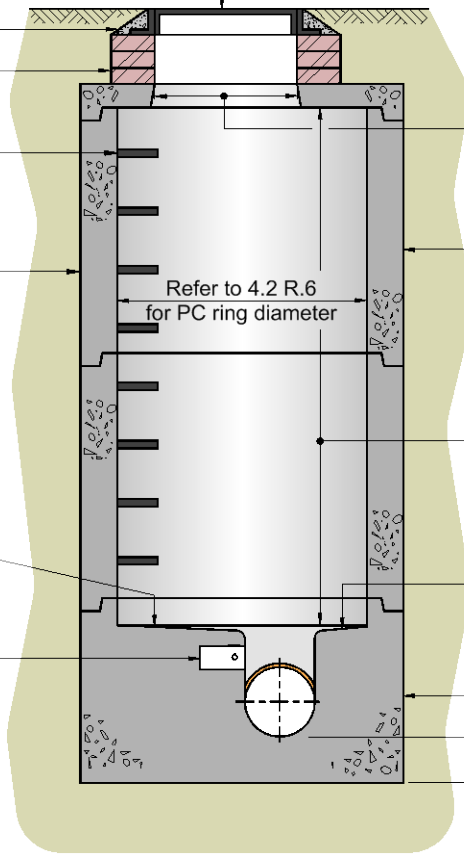
Chamber height (not less than 900 mm)

Benching slope to be 1:10 to 1:30

Precast base unit

150 mm to underside of channel

Refer to 4.2 R.6 for PC ring diameter



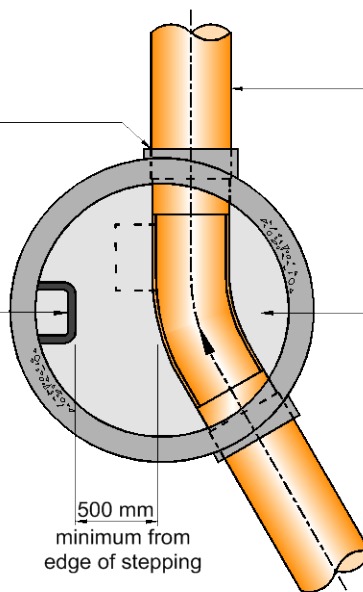
Joint to be within chamber wall to permit satisfactory joint and subsequent movement

Double step rungs in accordance with BS EN 13101

500 mm minimum from edge of stepping

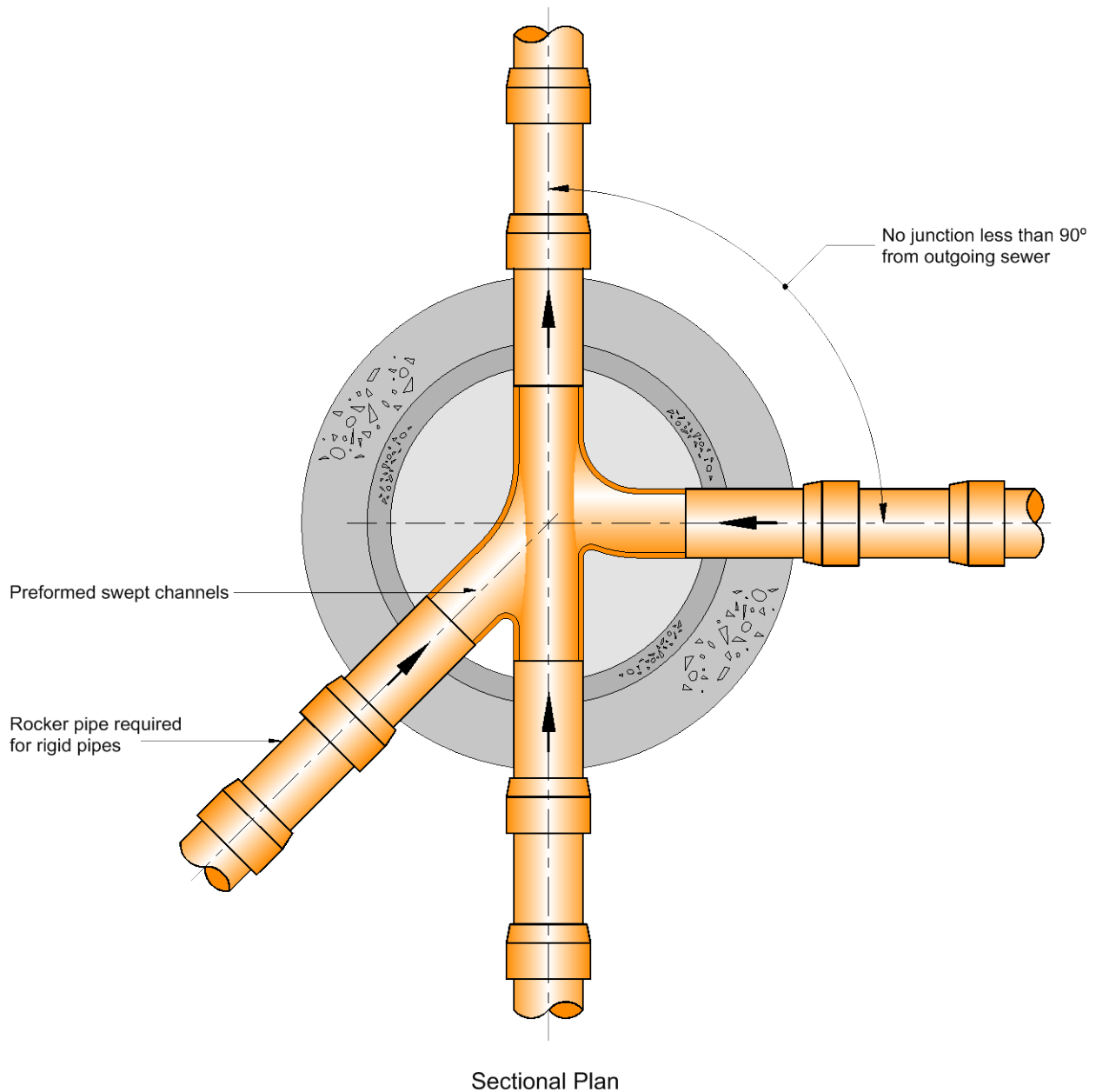
See Figure 14 for rocker pipe details

Minimum width of benching to be 225 mm



Not to scale

FIGURE 14
TYPICAL ARRANGEMENT OF PIPE JUNCTIONS WITHIN MANHOLES

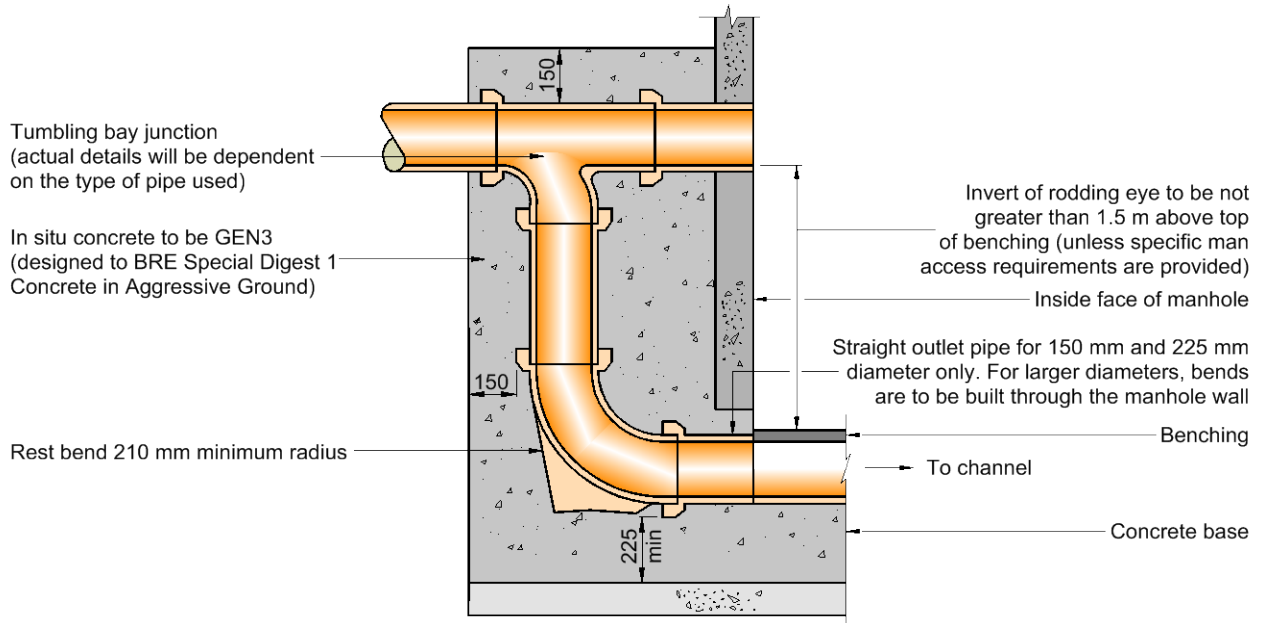


Rigid pipes built into manhole should have a flexible joint as close as feasible to the external face of the structure and the length of the next rocker pipe should be as shown.

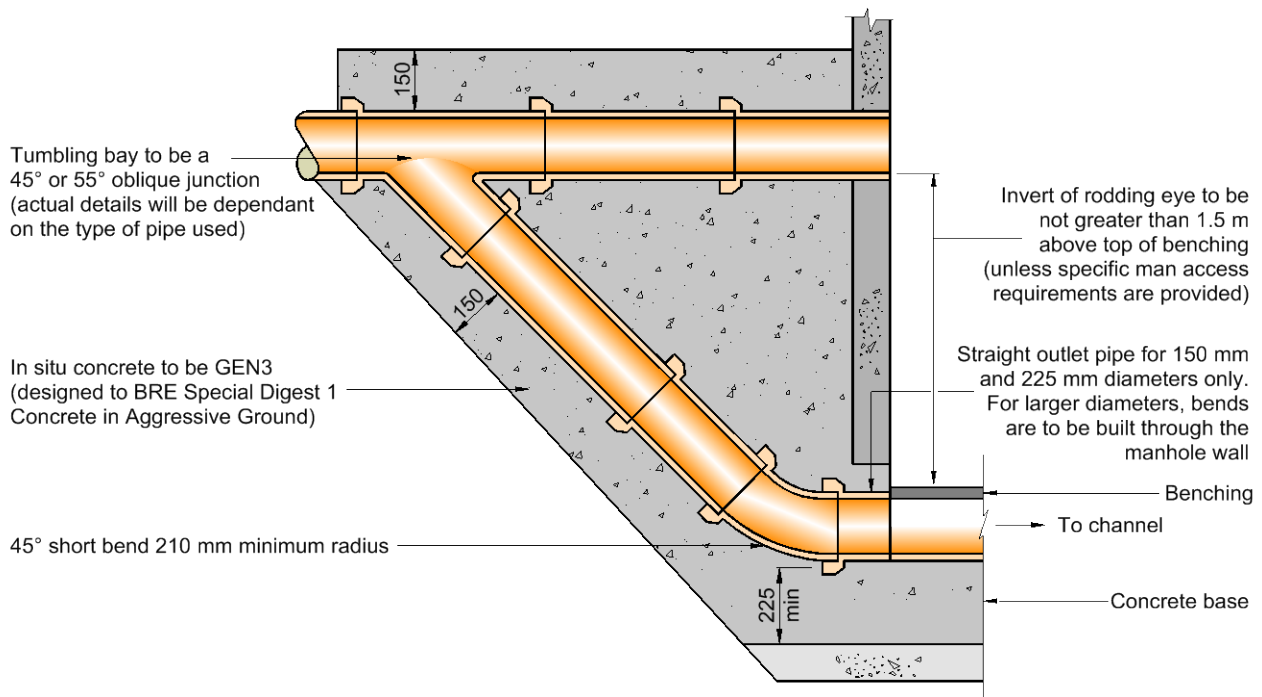
Nominal diameter (mm)	Maximum effective length (m)
150 - 600	0.6
601 - 750	1.00
over 750	1.25

All pipes entering the bottom of the manhole to have soffits level.

FIGURE 15
TYPICAL VERTICAL AND RAMPED BACKDROP DETAIL
 Note: Steeper gradients are preferred to the use of backdrops.
 Type of backdrop to be used to be agreed with Undertaker.



External Vertical Backdrop



External Ramped Backdrop

Not to scale, dimensions in millimetres

FIGURE 16
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 3 (Flexible material detail)
 Maximum depth from cover level to soffit of pipe
 in areas subject to vehicle loading 3 m, non entry

Plastic chambers and rings shall comply with BS EN 13598-1 and BS EN 13598-2 or have equivalent independent approval

Mortar bedding and haunching to cover and frame in accordance with DfT Specification, 'Reinstatement of Openings in Highways', or M12 mortar as appropriate

Surface course
 Binder course
 Base course

Precast concrete slab or in-situ concrete slab to support cover and frame

Flexible seal

Temporarily cap shaft during construction

Joints between base and shaft and between shaft components to be fitted with watertight seals

Joint to be as close as possible to face of chamber to permit satisfactory joint and subsequent movement

Manhole cover to suit BS EN 124 loading Highways - Class D400 600 mm clear opening

Access opening restricted to 350 mm diameter or 300 mm x 300 mm if depth of chamber to invert is > 1 m

Class B engineering brickwork or precast concrete cover frame seating rings

DOT Type 1 sub base (thickness varies)

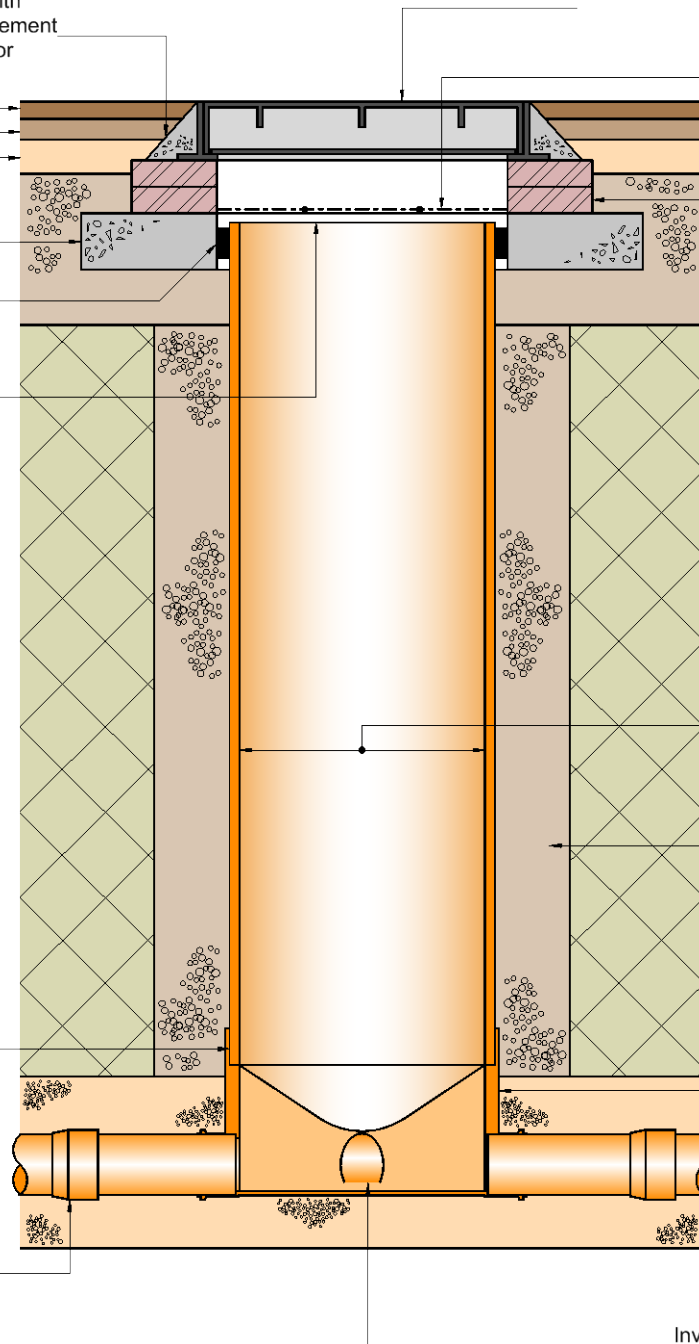
Minimum internal dimensions 450 mm diameter or 450 mm x 450 mm

DOT Type 1 sub base (thickness varies) or concrete surround

Base unit to have all connections with soffit levels set no lower than that of the main pipe

Granular bedding material

Invert of connecting pipe at least 50 mm above that of the main pipe



Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

**FIGURE 17
ALTERNATIVE TOP DETAILS FOR LIGHT VEHICLE LOADING
AND LANDSCAPED AREAS- TYPE 3**

Plastic chambers and rings shall comply with BS EN 13598-1 and BS EN 13598-2 or have equivalent independent approval

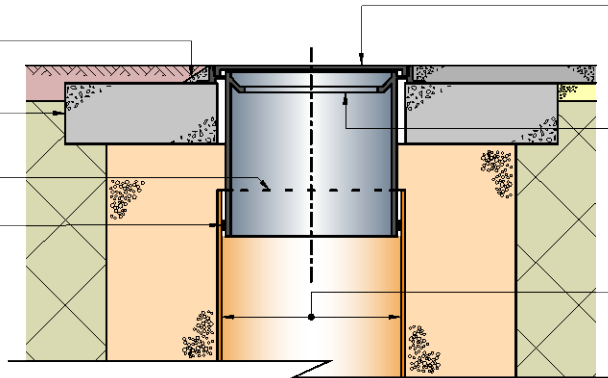
Sited in domestic driveways or footways

Mortar bedding and haunching to cover and frame to be M12 mortar

150 mm deep concrete collar

Temporarily cap shaft during construction

Flexible seal



Cover complying with BS EN 124 and BS 7903 for driveways, footways and landscaped areas - Class B125

Access opening restricted to 350 mm diameter or 300 mm x 300 mm if depth of chamber to invert is > 1 m

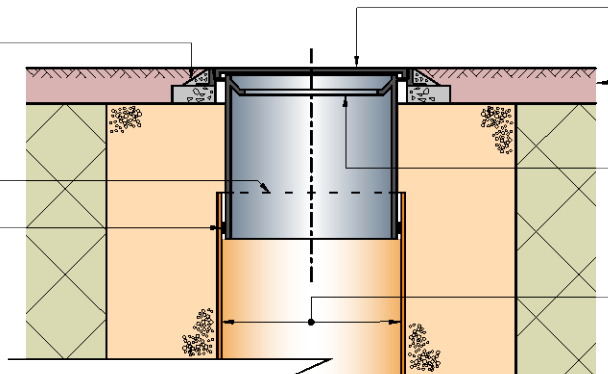
Minimum internal dimensions 450 mm diameter or 450 mm x 450 mm

Sited in domestic gardens

Mortar bedding and haunching to cover and frame to be M12 mortar

Temporarily cap shaft during construction

Flexible seal



Cover complying with BS EN 124 and BS 7903 for gardens - Class A15

Topsoil

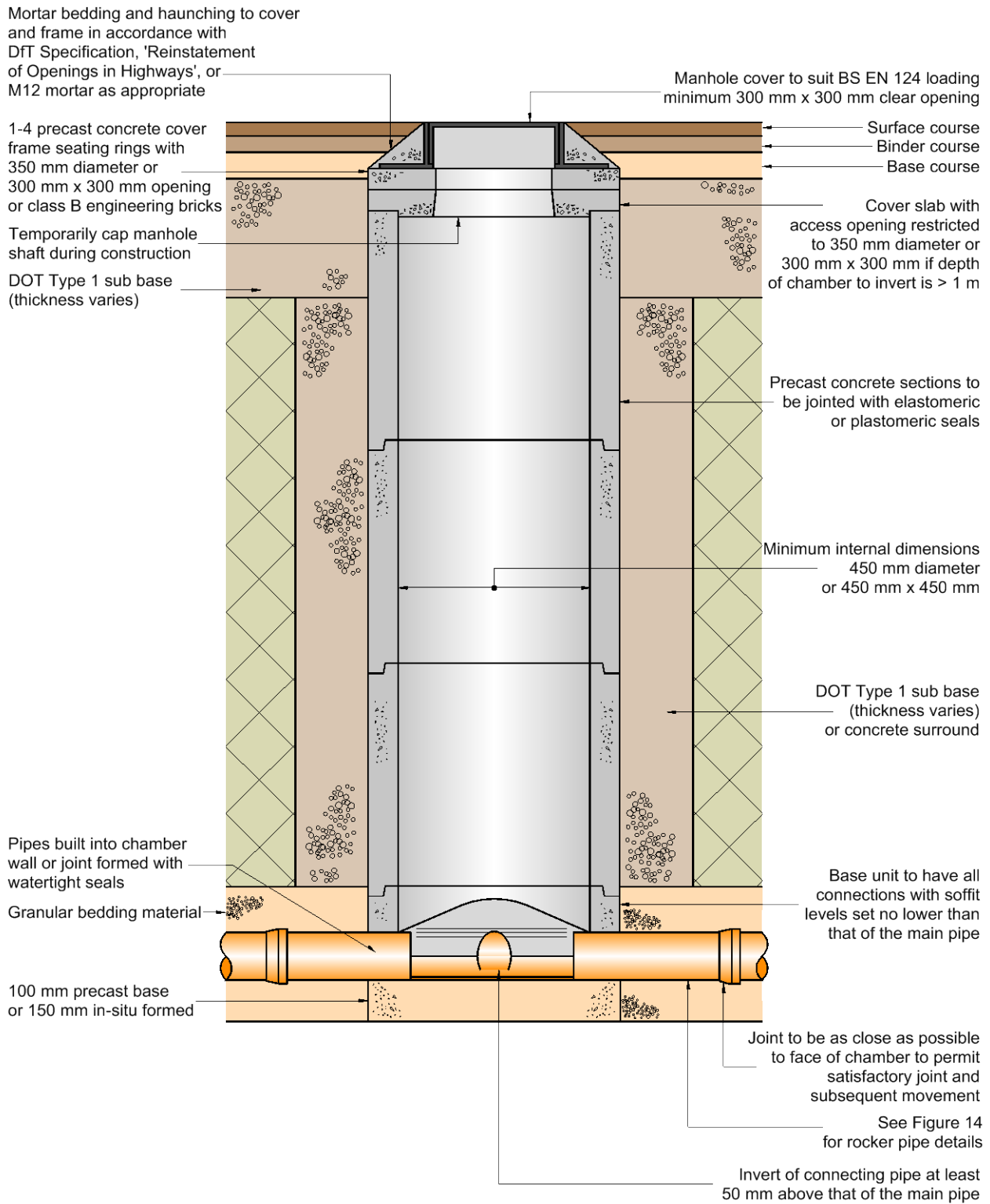
Access opening restricted to 350 mm diameter or 300 mm x 300 mm if depth of chamber to invert is > 1 m

Minimum internal dimensions 450 mm diameter or 450 mm x 450 mm

Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

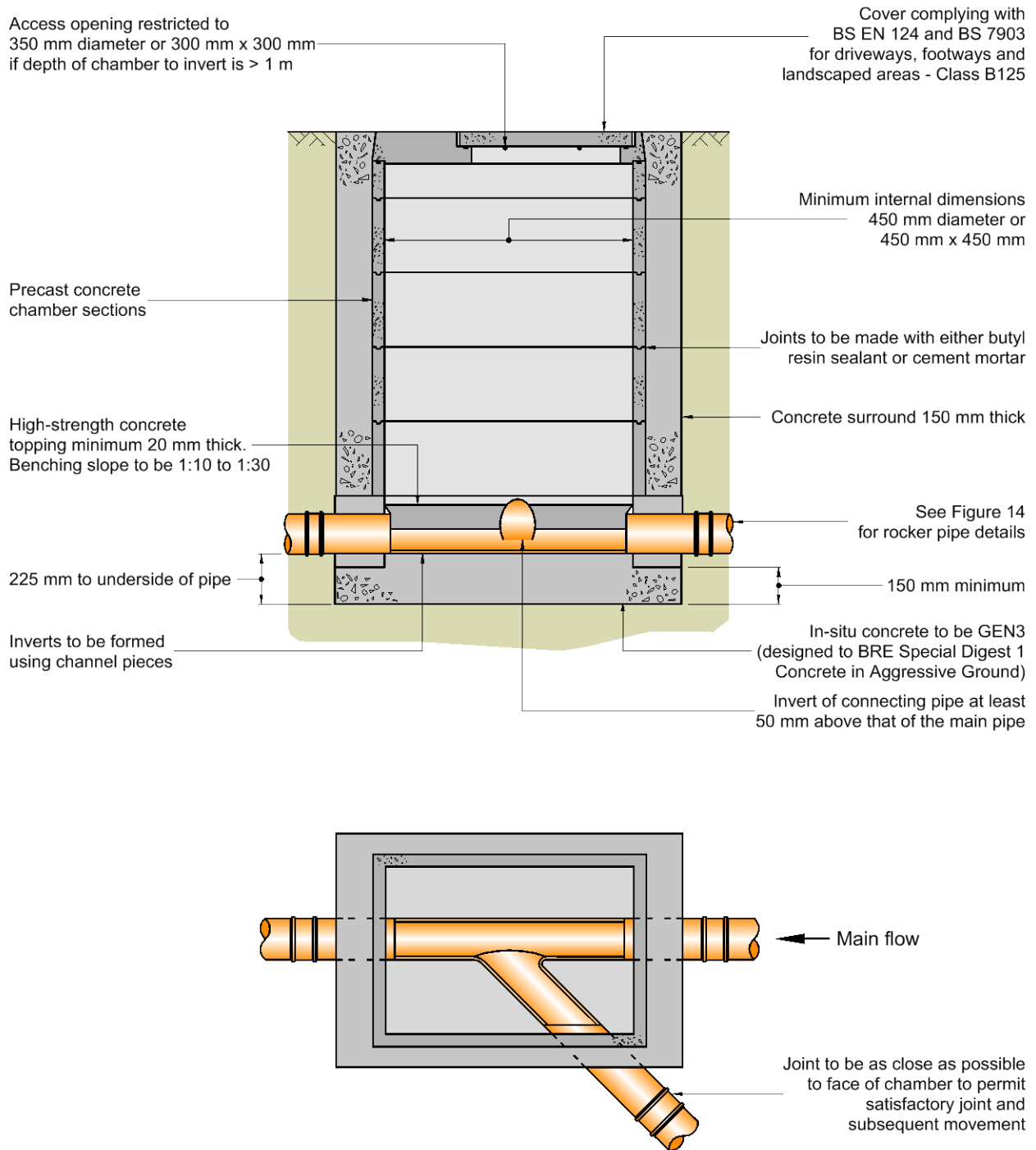
FIGURE 18
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 3 (Rigid material detail)
 Maximum depth from cover level to soffit of pipe
 in areas subject to vehicle loading 3 m, non entry



Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

FIGURE 19
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 3 (Rigid material detail)
 Alternative maximum depth from cover level to soffit of pipe 3 m for areas not subject to vehicle loading or areas subject to light vehicle loading, non entry

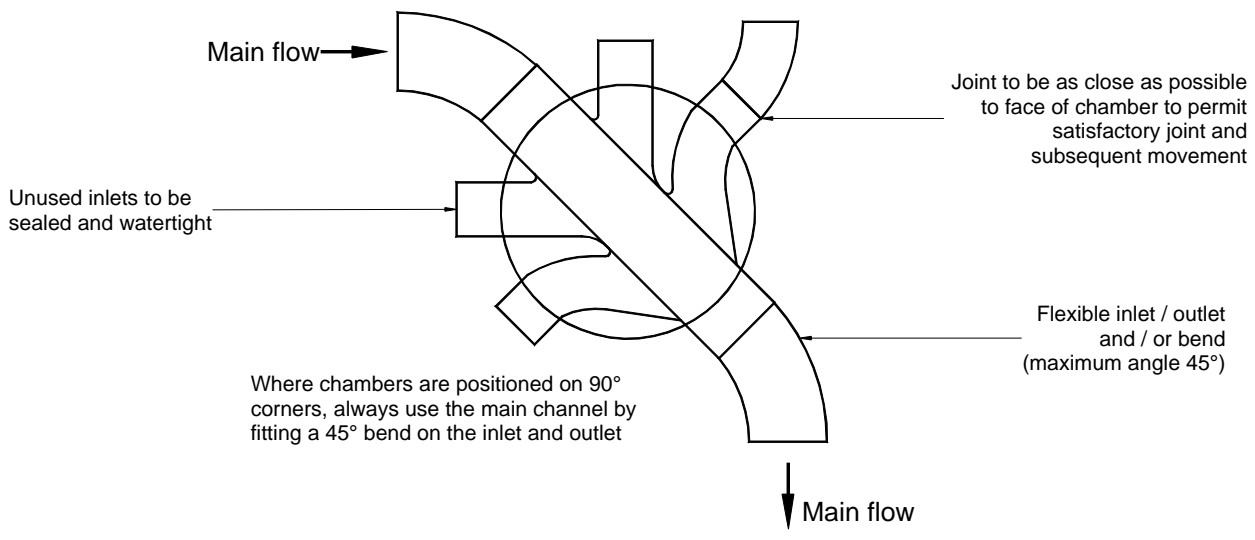
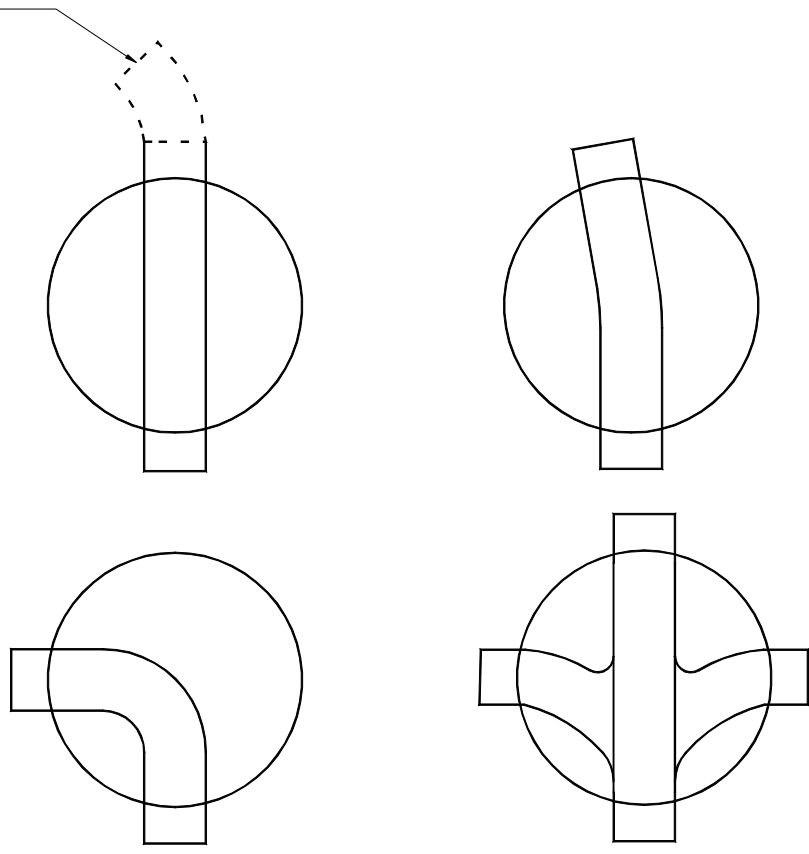


Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

**FIGURE 20
ALTERNATIVE BASE LAYOUTS FOR TYPE 3 CHAMBERS**

Flexible inlet / outlet
and / or bend
(maximum angle 45°)
to facilitate connection



Note: Where a bend is used immediately outside the manhole, this may be used as the rocker pipe

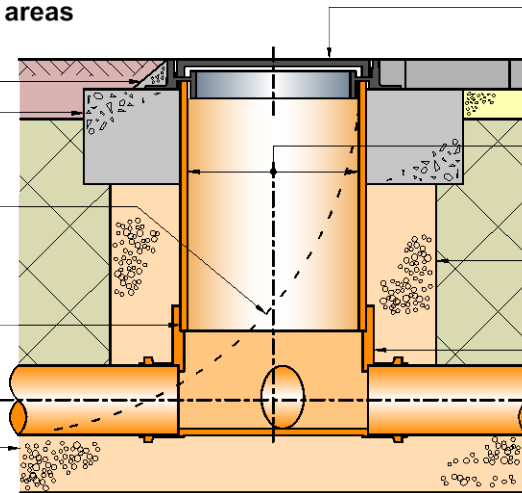
Not to scale

FIGURE 21
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 4 (Flexible material detail)
 Maximum depth from cover level to soffit of pipe 2 m, non entry

Plastic chambers and rings shall comply with BS EN 13598-1 and BS EN 13598-2 or have equivalent independent approval

Sited in driveways / paved areas

Mortar bedding and haunching to cover and frame to be M12 mortar
 150 mm deep concrete collar
 Minimum radius to be 500 mm for a 100 mm diameter pipe and 600 mm for a 150 mm diameter pipe to allow entry of maintenance equipment
 Joints between base and shaft and shaft components to be fitted with watertight seals



Cover complying with BS EN 124 and BS 7903 for driveways, footways and landscaped areas - Class B125

Minimum internal dimensions 180 mm diameter or 225 mm x 100 mm

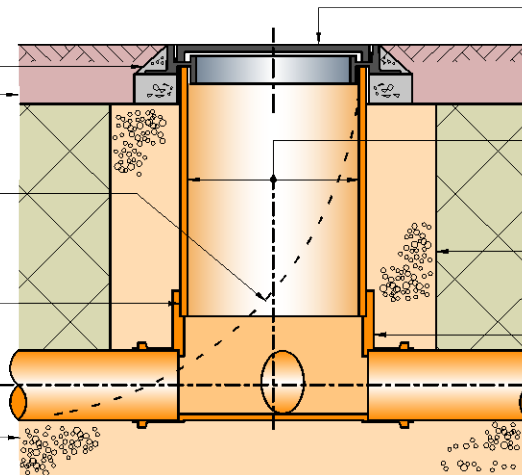
DOT Type 1 sub base (thickness varies) or concrete surround

Base unit to have all connections with a diameter greater than 150 mm set at soffits level

Granular bedding material

Sited in domestic gardens

Mortar bedding and haunching to cover and frame to be M12 mortar
 Topsoil
 Minimum radius to be 500 mm for a 100 mm diameter pipe and 600 mm for a 150 mm diameter pipe to allow entry of maintenance equipment
 Joints between base and shaft and shaft components to be fitted with watertight seals



Cover complying with BS EN 124 and BS 7903 for gardens - Class A15

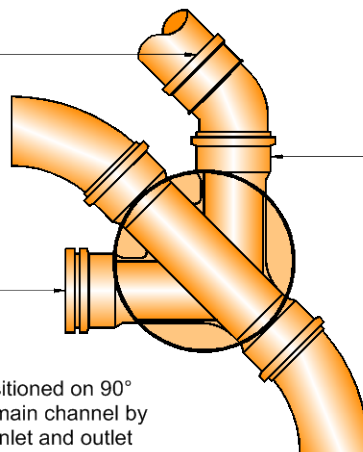
Minimum internal dimensions 180 mm diameter or 225 mm x 100 mm

DOT Type 1 sub base (thickness varies) or concrete surround

Base unit to have all connections with soffit levels set no lower than that of the main pipe

Granular bedding material

Flexible inlet / outlet and / or bend (maximum angle 45°)



Joint to be as close as possible to face of chamber to permit satisfactory joint and subsequent movement

Unused inlet to be sealed and watertight

Where chambers are positioned on 90° corners, always use the main channel by fitting a 45° bend on the inlet and outlet

Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

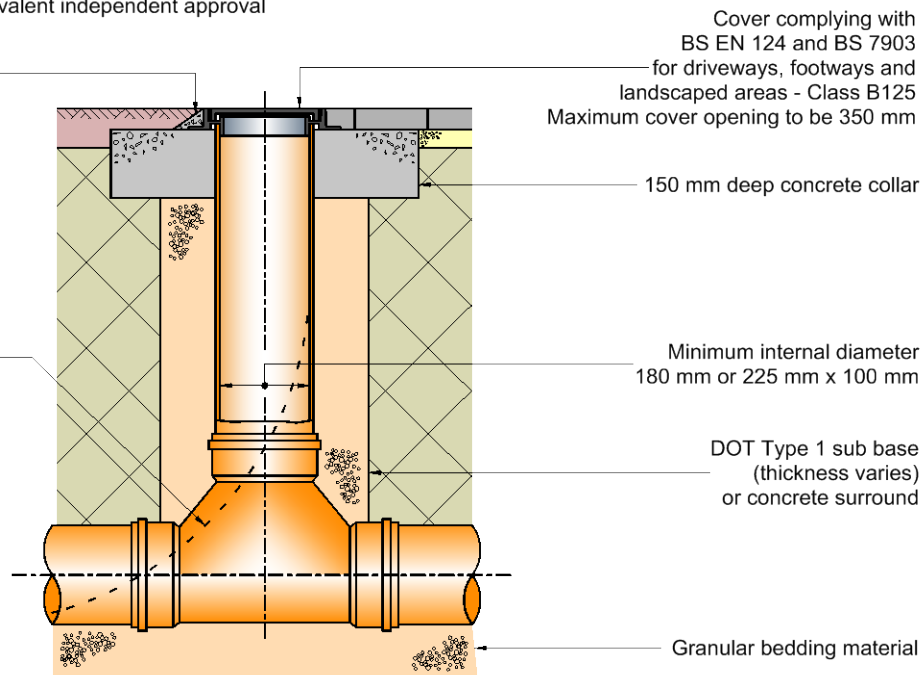
Not to scale

FIGURE 22
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 4 (Alternative construction detail)
 Maximum depth from cover level to soffit of pipe 2 m, non entry

Plastic chambers and rings shall comply with BS EN 13598-1 and BS EN 13598-2 or have equivalent independent approval

Mortar bedding and haunching to cover and frame to be M12 mortar

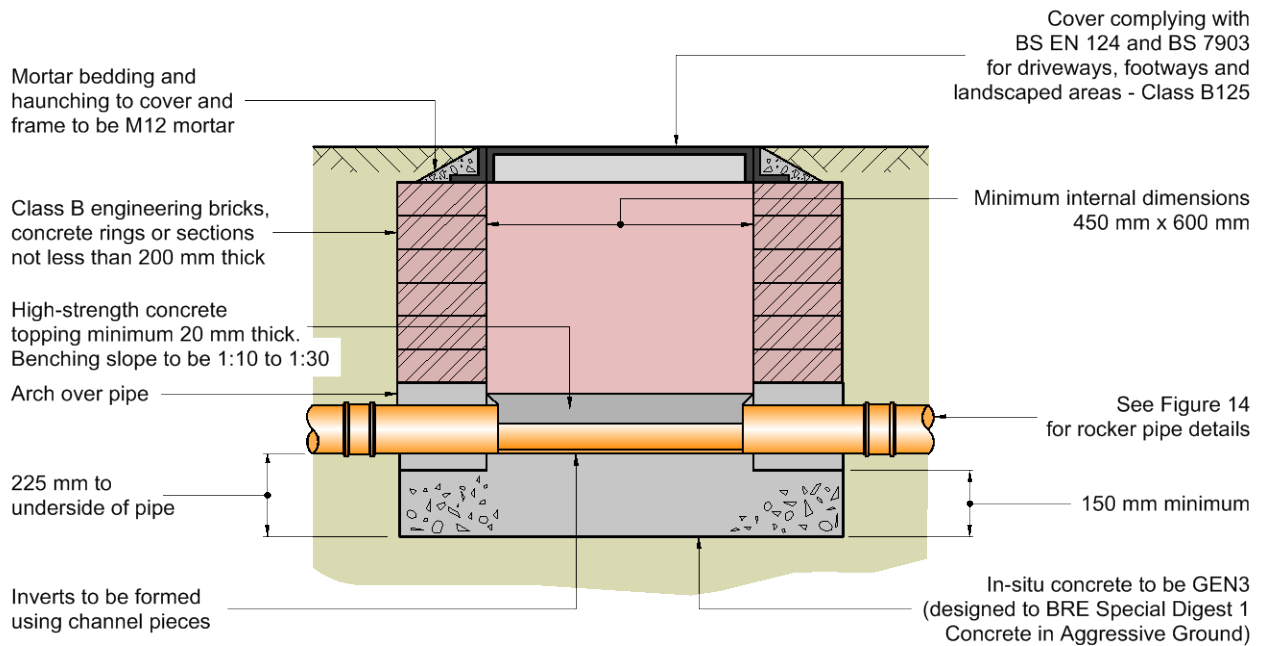
Minimum radius to be 500 mm for a 100 mm diameter pipe and 600 mm for a 150 mm diameter pipe to allow entry of maintenance equipment



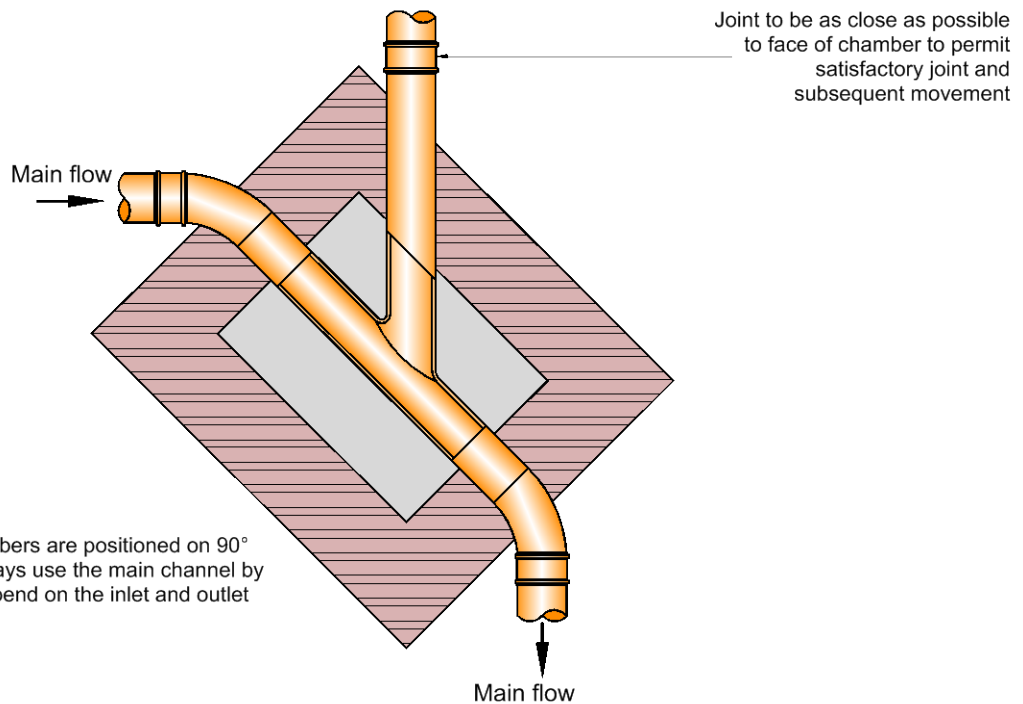
Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

FIGURE 23
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 4 (Rigid material detail)
 Maximum depth from cover level to soffit of pipe 1 m, non entry



Note: The use of precast rectangular concrete manhole units with 150 mm grade GEN3 concrete surround (designed to BRE Special Digest 1 Concrete in Aggressive Ground) is permitted.



Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

5 - Reliability

S8. The system shall be designed and constructed to reliably convey the flows that can be legally discharged into the system.

G.5.1. Pipes should be free from defects or other features that might cause blockage or otherwise impede the design flow.

G.5.2. Gravity drains and sewers should have adequate gradient to maintain self-cleansing conditions.

G.5.3. The minimum size for a gravity foul sewer should be:

- a) 100mm nominal diameter for ten properties or less,
- b) 150mm nominal diameter for more than ten properties.

The minimum size for a gravity foul lateral drain should be 100 mm.

G.5.4. Sewers and laterals drains, and all ancillary structures close to existing or proposed trees, bushes or shrubs should be constructed from materials that resist tree root intrusion.

G.5.5. The mode of connection and layout of any junctions or connections between pipes, whether at manholes, inspection chambers, access points or otherwise should be designed to minimise the risk of blockage.

R.1. As far as practicable, junctions should be built in for all planned connections when sewers are constructed to avoid damage to the sewer by installing connections at a later date. Where it is necessary to make a post- construction connection to a sewer clauses 5.R.3 to 5.R.7 will apply. The upstream end of any unused connection should be sealed until required.

R.2. The vertical angle between the connecting pipe and the horizontal should be greater than 0 degrees and not more than 60° (see Figure 24).

R.3. Where the connection is being made to a sewer with a nominal internal diameter of 300 mm diameter or less, connections should be made using 45° angle or 90° angle curved square junctions (see Figure 24).

R.4. Connections made with junction fittings should be made by cutting the existing pipe, inserting the junction fitting, and jointing with flexible repair couplings or slip couplers.

R.5. Where the connection is being made to a sewer with a nominal internal diameter greater than 300 mm:

- a) where the diameter of the connecting pipe is greater than half the diameter of the sewer, the connection of an access point should be constructed; or,
- b) where the diameter of the connecting pipe is less than or equal to half the diameter of the sewer, then the connection should be made using a preformed saddle fitting.

R.6. Connections made with saddle fittings should be made by cutting and safely removing a core from the pipe and jointing the saddle fitting to the pipe in accordance with the manufacturer's instructions to ensure a watertight joint. The connecting pipe should not protrude into the sewer.

R.7. To provide a self-cleansing regime within gravity foul sewers, the minimum flow velocity should be 0.75 m per second at one-third design flow. Where this requirement cannot be met, then this criterion would be considered to be satisfied if:

- a) a 150 mm nominal internal diameter gravity sewer is laid to a gradient not flatter than 1:150 where there are at least ten dwelling units connected; or,
- b) a sewer or lateral drain with a nominal internal diameter of 100 mm, or lateral drain serving ten or less properties is laid to a gradient not flatter than 1:80, where there is at least one WC connected and 1:40 if there is no WC connected.

R.8. These parameters should not be taken as a norm when the topography permits steeper gradients. Hydraulic studies indicate that these requirements may not necessarily achieve a self-cleansing regime. When a choice has to be made between gravity sewerage and pumped sewerage, these criteria should not be regarded as inflexible and the Developer should consult the Undertaker.

R.9. The roughness value (k_s) for foul gravity sewer design should be 1.5 mm.

6 - Hydraulic Design

S9. The hydraulic design of sewers and lateral drains shall include an allowance for increased flows that might be reasonably foreseeable within the development.

S10. Flows that cannot be contained within the drain and sewer system as a result of failure of all or part of the drainage system shall be managed in flood conveyance routes in order to minimise the damage to people and property.

6.1 Gravity Foul Sewers and Lateral Drains

G.6.1.1. Gravity foul sewers and lateral drains should be designed to convey the projected flows together with an allowance for:

- a) variations in foul flows resulting from increased occupancy or intensification of the development commensurate with the introduction of water saving measures,
- b) increased trade effluent flows resulting from reasonable changes in use or intensification of development of an any industrial or commercial development,
- c) levels of groundwater infiltration that might reasonably be expected over the life of the drain or sewer system,
- d) inflow of surface water that might reasonably be expected due to leakage or accidental connection.

G.6.1.2. In accordance with paragraph G.6.1.1 above, design flow rates for dwellings should be 4000 litres per dwelling per day.

Note: This is a design peak flow rate not a daily average water usage, and represents the peak flow rate from a number of appliances. Reducing daily water usage does not necessarily reduce the peak flow rate.

G.6.1.3. Foul drain and sewer systems should be watertight to minimise the ingress of groundwater and surface water.

R.1. The following design flows for industrial developments should be used where the actual details of flows are unknown:

- a) Domestic flow element - calculated in accordance with BS EN 752 or in the absence of appropriate information, 0.6 litres per second per hectare of developable land.
- b) Trade effluent flow should be based on a metered water supply to premises similar to that proposed, or should assume 0.5 litres per second per hectare for normal industry and 1 litre per second per hectare for wet industry. Where the proportion of wet industry is unknown, an average flow of 0.7 litres per second per hectare should be used.
- c) To obtain the total design flow the domestic design flow should be added to the trade effluent design flow.

6.2 Protection Against Flooding

G.6.2.1. The layout of the system and the development should minimise the risk of damage to property from flooding in the event of excessive flows, blockage, or failure of pumping stations on the system.

G.6.2.2. Flooding caused by blockages of foul sewers should have identified flow paths and should not cause internal property flooding.

R.1. In designing the site layout and sewerage, developers should also demonstrate flow paths and the potential effects of flooding resulting from blockages, pumping station failure or surcharging in downstream combined sewers, by checking the ground levels around the likely points that flow would flood from the system, to identify the flood routes.

R.2. The designer should carry out checks to ensure that an adequate level of protection against the flooding of properties is achieved. The layout of the sewer system and/or the development should be adjusted to minimise the risk of flooding of properties.

7 - Structural Design and Integrity

S11. Sewers, lateral drains and associated structures shall be designed and constructed to ensure structural integrity over the design life.

S12. Connections to existing sewers shall be carried out in a manner that does not compromise the structural integrity of the existing sewer.

G.7.1. Buried pipes should have sufficient cover to afford adequate protection from anticipated loading, low temperatures and damage from normal use of the land. Where this cannot be achieved there should be suitable alternative protection measures provided.

G.7.2. Structural design should take account of imposed loads, support and protection.

G.7.3. As far as practicable junctions should be built in for planned future connections.

G.7.4. The manner of connection should not damage the structural integrity of the existing pipe.

R.1. Buried pipes should be designed in accordance with BS EN 1295-1⁴.

Note: BS 9295⁵ gives information and guidance for the use of EN 1295-1 Annex A, the UK established method for the structural design of buried pipelines under various conditions of loading. The procedures are explained and, where general assumptions can be made, loading tables are given. Application details for pipelines laid in various trench conditions and in poor ground are shown.

R.2. The design of the pipeline should take account of loading from the passage of construction plant as well as normal design loading.

R.3. The minimum depths of pipeline to afford adequate protection from anticipated loading, low temperatures and damage from normal use of land are specified in 4.1 R.10.

R.3. If the depth of cover to the crown of the pipe is less than the values recommended in clause 4.1. R.10, (unless it can be demonstrated by structural calculations or other suitable means) one of the following protection measures should be provided:

- a) A concrete slab in accordance with Figure 25; or
- b) A concrete surround with flexible joints in accordance with Figure 26; or

⁴ "BS EN 1295-1:1998 Structural design of buried pipelines under various conditions of loading. General requirements", Published June 1998, British Standards Institution, London

⁵ "BS 9295:210 Guide to the structural design of buried pipelines", Published March 2010, British Standards Institution, London

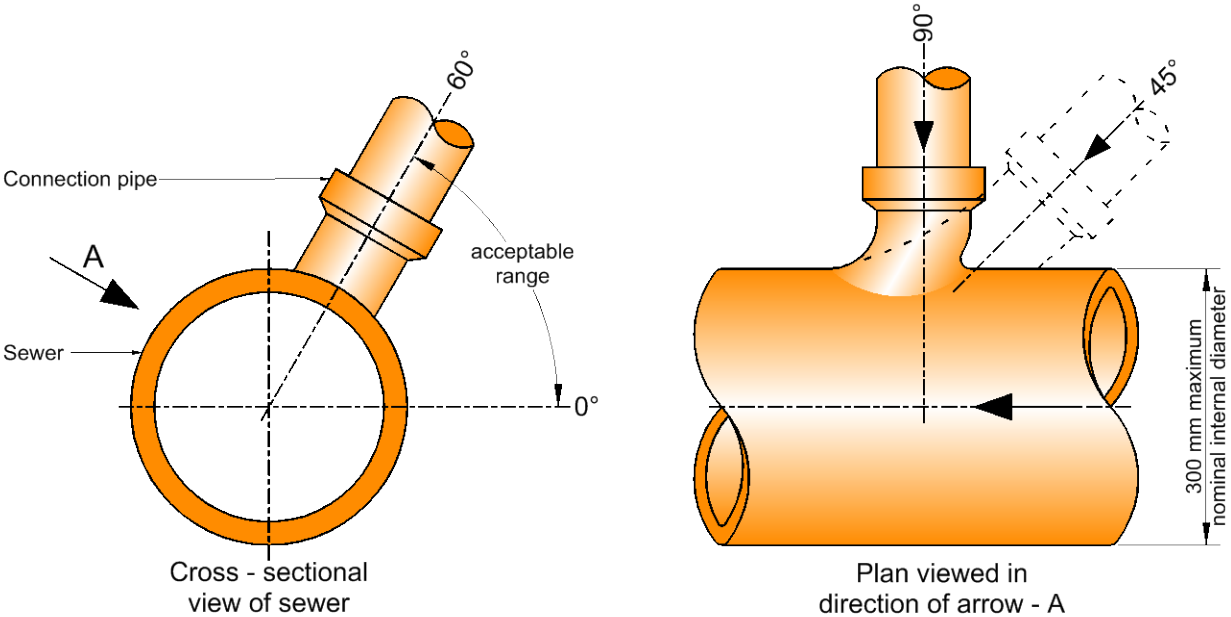
c) A ductile iron pipe should be used.

R.4 Sewers or lateral drain may pass through an opening in a property boundary wall provided that there is an arch or lintelled opening to give at least 50 mm space all around the pipe, see clause G.4.1.2.

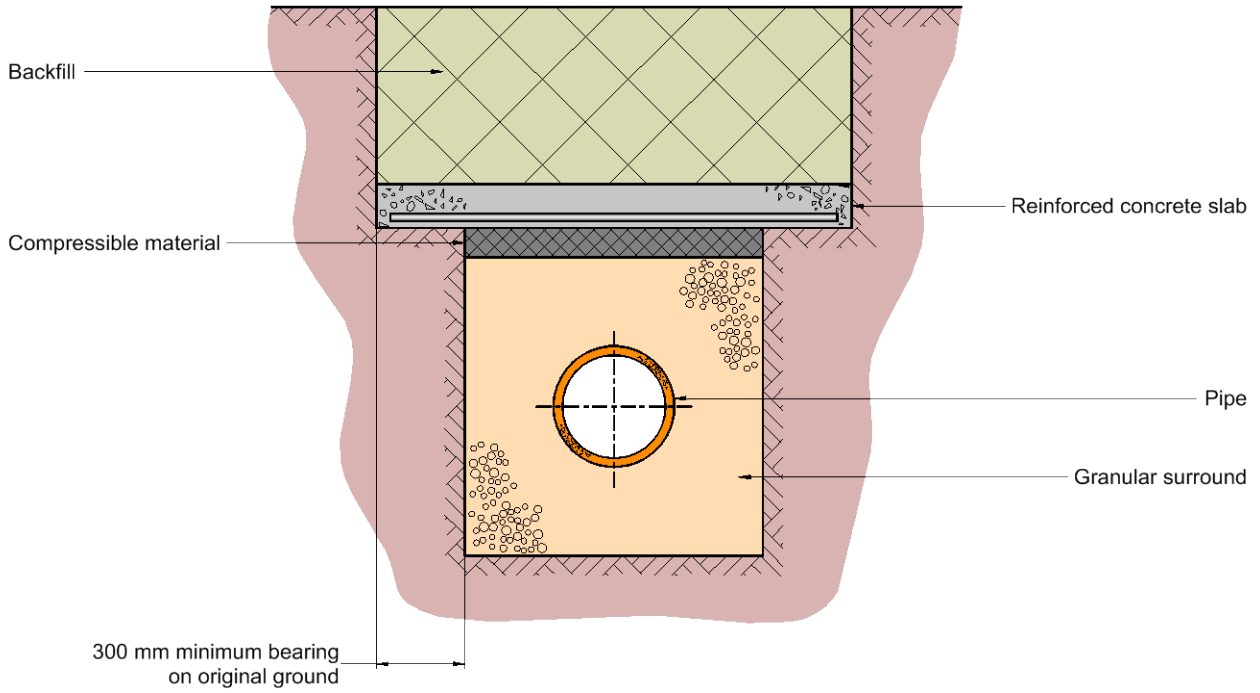
R.5. The structural design of all pipes should take into account the possible incidence of punching shear. The design should ensure that no vertical load is imposed by structures such as shafts onto non-load bearing components such as the pipes.

R.6. Where there is a risk of tree root intrusion (see clause 4.1.R.3) the sewer system should be resistant to tree root ingress (e.g. by use of appropriate barriers or constructed from polyethylene with welded joints).

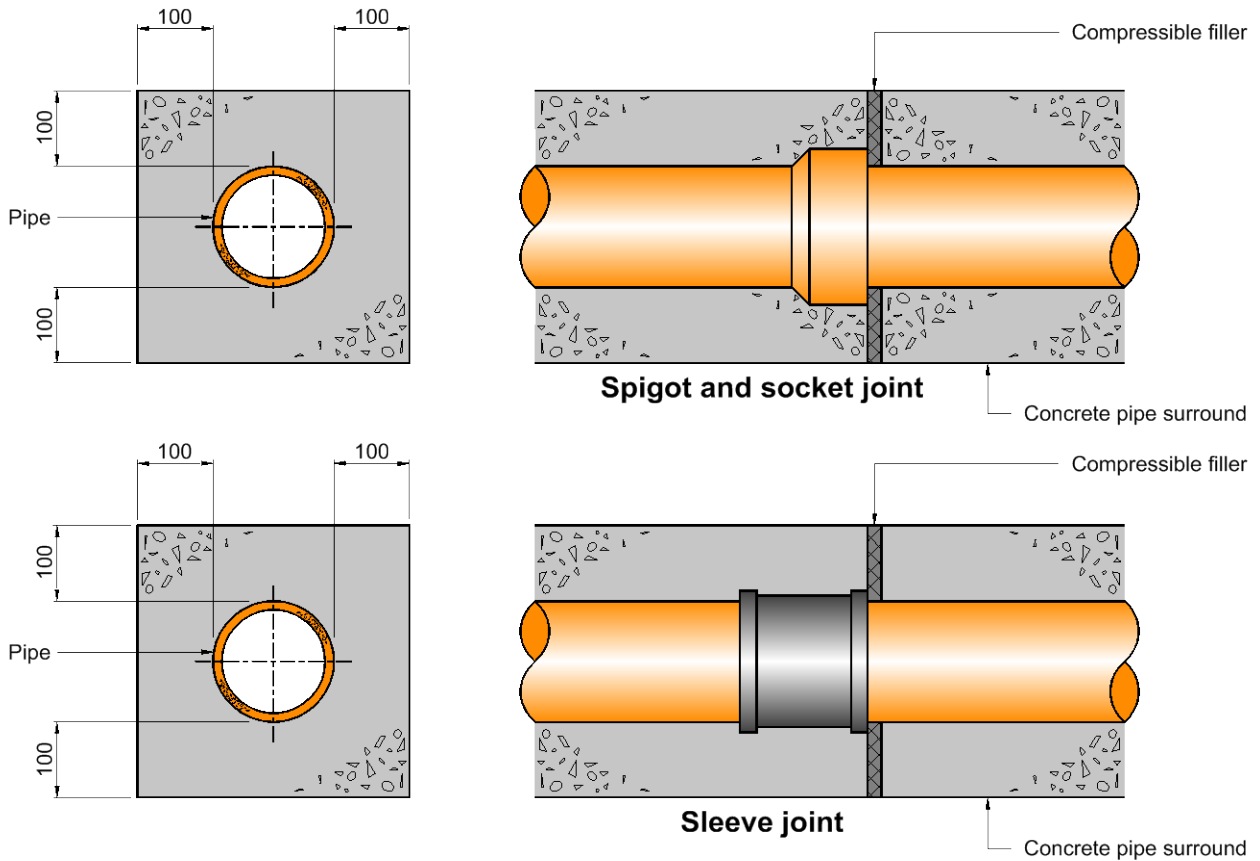
**FIGURE 24
CONNECTIONS TO SEWER**



**FIGURE 25
PROTECTION OF PIPES LAID AT SHALLOW DEPTHS**

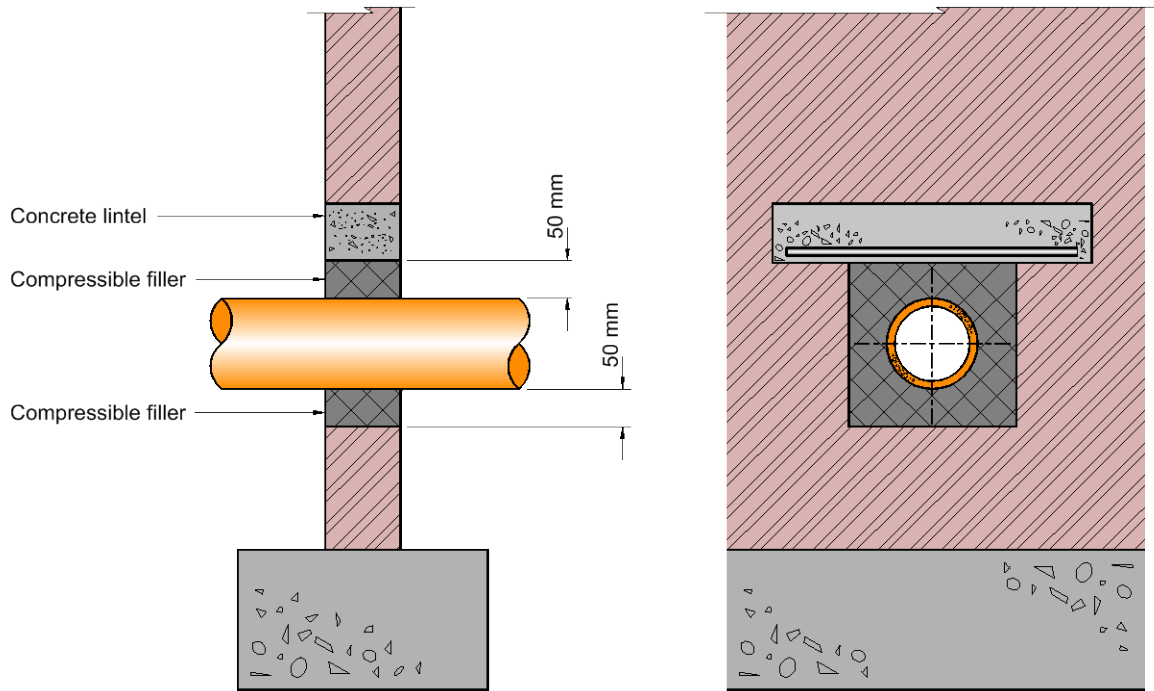


**FIGURE 26
JOINTS FOR CONCRETE ENCASED PIPES**



Not to scale, dimensions in millimetres
(all dimensions are minimum sizes)

FIGURE 27
PROTECTION OF PIPES PENETRATING SINGLE LEAF BOUNDARY WALLS



Not to scale
(all dimensions are minimum sizes)

8 - Materials

S13. Materials including products, components, fittings or naturally occurring materials which are specified by the designer shall be of suitable nature and quality for their intended use.

S14. The environmental impact shall be minimised by the careful selection of materials, and where appropriate by the use of recycled and recyclable materials. The materials specified shall not have any adverse implications of health and safety of the completed drainage systems.

S15. Products, materials, and their construction methods shall be selected that minimise depletion of the finite resources having regard to the design life of the component and the potential for re-use or recycling.

S16. Sewers and lateral drains shall be designed and constructed so that:

- a) pollution of surface receiving waters and groundwater is prevented;
- b) for all practicable purposes, they are watertight;
- c) to avoid odour nuisance or creation of toxic explosive or corrosive substances;
- d) to minimise noise and vibration.

G.8.1. The suitability of materials and products can be demonstrated by appropriate use of a product bearing CE marking in accordance with the Construction Products Directive (89/106/EEC) and any other relevant Directives as amended by the CE Marking Directive (93/68/EeC) or;

- a) a product complying with an appropriate technical specification (as defined in those Directives),
- b) a British Standard or an alternative national technical specification of any state which is a contracting party to the European Economic Area which in use is equivalent,
- c) or a product covered by a national or European certificate issued by a European Technical Approval Issuing body, and the conditions of use are in accordance with the terms of the certificate.

G.8.2. Pipes should have sufficient ring stiffness to prevent deformation during storage, embedment and backfilling.

R.1. Materials should comply with the requirements of provisions in G.8.2, with the Civil Engineering Specification for the Water Industry, 7th Edition, March 2011.

R.2. Materials and components should comply with the following:

- a) the manufacturing process should minimise the use of solvent-based substances that emit volatile organic compounds or ozone-depleting substances;
- b) products should be made from recycled material, where reasonably practicable; and

c) the use and/or creation of substances included in the UK Red List (DoE, 1988) of toxic substances should be avoided during the manufacturing process.

9 - Construction

S17. Sewers and lateral drains shall be constructed in a manner such that:

- a) where relevant, materials are:
 - i) adequately mixed or prepared; and
 - ii) applied, used, or fixed so as to perform adequately the functions for which they are intended.
- b) no part of the drainage system is damaged or its function impaired by:
 - i) the method of construction; or
 - ii) runoff from the construction site entering the sewer system;
- c) damage to existing ecosystems and major trees in the development site is prevented;
- d) soil erosion is minimised.

G.9.1. The drainage system should be constructed in accordance with the approved design.

G.9.2. Run-off from the construction site should not be allowed to enter the drainage system unless the design has specifically provided for this.

G.9.3. All necessary precautions should be undertaken to avoid causing damage to, or interference with flow in, existing public sewers, and should ensure that debris, silt and mud etc. do not enter the sewer.

G.9.4. All necessary precautions should be taken to avoid misconnection of foul drainage to surface water drains or sewers, or surface water drainage to foul drains or sewers.

G.9.5. On completion of construction all internal surfaces of sewers and access points should be thoroughly cleansed of all deleterious matter to prevent it passing into existing sewers or water courses.

G.9.6. Operations should be carried out in such a manner as to avoid damage to or deterioration of the integrity to adjacent buildings or other infrastructure.

G.9.7. Excavations in roads and streets should be carried out in accordance with the relevant highway authority requirements.

R.1. Construction of the drainage system should comply with the requirements of The Civil Engineering Specification for the Water Industry, 7th Edition, March 2011.10 - Testing

S18. Sewers and lateral drains shall be tested and inspected to ensure that:

- a) the systems is for all practical purpose, leaktight;
- b) that no surface water drainage has been connected to a foul sewer system and foul drainage has not been connected to a surface water system;
- c) pipes have not been damaged, deformed or subject to settlements during construction.

G.10.1. Gravity sewers, pressure pipelines, manholes and inspection chambers should be leak tight when tested after backfilling.

G.10.2. Pipelines should be inspected by means of a visual or closed circuit television (CCTV) examination to record condition and deformation.

G.10.3. Drains and sewers should be tested to check that there have been no misconnections of foul and surface water.

G.10.4 The standards do not specify who should undertake the testing. This should be agreed between the developer and the adopting undertaker.

R.1. Testing of the drainage system should comply with the requirements of the Civil Engineering Specification for the Water Industry, 7th Edition, March 2011.

11 - Pumping Stations

S19. The design of the system shall, so far as is reasonable practicable, minimise the use of energy over the life of the system.

G.11.1. Foul sewage pumping stations or pumped systems should only be used where their whole life cost is less than conventional gravity systems over a period of 40 years.