

Precast concrete pipes and ancillary concrete products —

Part 200: Specification for unreinforced and reinforced manholes and soakaways of circular cross-section

ICS 23.040.50; 91.140.80; 93.030

Committees responsible for this British Standard

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- Association of Consulting Engineers
- British Precast Concrete Federation Ltd.
- Concrete Pipe Association
- Concrete Society
- County Surveyors' Society
- Department of the Environment (Property Services Agency)
- Department of Transport
- Federation of Civil Engineering Contractors
- Institution of Civil Engineers
- Institution of Highways and Transportation
- Institution of Water and Environmental Management
- Pipe Jacking Association
- Water Services Association of England and Wales

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Foreword

This part of BS 5911 has been prepared under the direction of Technical Committee B/505, Waste water engineering. This edition is a reissue of the 1989 edition, incorporating editorial corrections, and is not a technical revision of the standard.

As part of the new approach to harmonization of standards in Europe, work on a specification for manholes is being undertaken in CEN/TC 165, Waste water engineering, and the requirements for manholes specified in the 1989 edition are now subject to a standstill agreement. Standstill is an obligation accepted by the members of CEN/CENELEC not to take any action, during the preparation of a European Standard (EN), which could prejudice the harmonization process.

The opportunity was taken, when part 1 was revised and replaced by part 100, to rationalize the BS 5911 part numbering system whereby part 100, part 101, etc. would cover various types of concrete pipes and part 200, etc. would cover manholes and other ancillary concrete products.

As regards performance of units in the ground, it should be noted that this part of BS 5911 is a specification based principally on testing units in the manufacturer's works or in testing stations. The criteria are, however, intended to ensure that the units will be capable of withstanding earth and traffic loading without suffering structural damage, provided that the method of installation and the general conditions under which the units are operating are suited to a proper design concept. Units in contact with sea water, industrial waste, etc., and those to be installed in an environment aggressive to concrete, should be the subject of special consideration.

BS EN 752-3, BS EN 1295-1 and BS EN 1610 deal with design, installation and testing of manholes on drains and sewers. The original National Annex NB of BS EN 752-3:1997 gave information about traditional UK practice as described in BS 8301 and BS 8005-1, both of which are now withdrawn. The national annex was amended on 15 November 2000 to take account of *Safe Work in Confined Spaces — Approved Code of practice, Regulations and Guidance*, issued by the Health and Safety Commission under the provisions of the *Confined Spaces Regulations 1997 (SI 1997 No. 1713)* [1]. Members of CEN/CENELEC are permitted under the duty of care owed by the publisher of documents having a recognized national status to amend their existing national standards accordingly in such circumstances. Therefore, Amendments Nos. 1 and 2 to this standard together reflect the revised information in National Annex NB of BS EN 752-3:1997, as amended by Amendments Nos. 1 and 2 to that standard, as regards safe working in manholes.

In order to allow users and specifiers time to amend specifications and the orderly disposal of stock by the manufacturers, Amendment No. 2 comes into effect on 01 November 2001.

For an enquiry or order to be fully understood it is essential that the manufacturer be given the information set out in Annex A.

Product certification/inspection/testing. Users of this British Standard are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this British Standard. Appropriate conformity attestation arrangements are described in BS EN ISO 9002:1994. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 48, an inside back cover and a back cover.

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Section 1. General

1.1 Scope

This part of BS 5911 specifies requirements for precast concrete components for manholes of circular cross-section, either unreinforced or reinforced with steel, intended to be used in pipelines for the conveyance, under atmospheric pressure, of sewage or surface water. Requirements for soakaways are also specified. Requirements are given for materials, finish, dimensions and inspection procedures. Dimensions are specified for ogee, rebated and tongued and grooved type joints.

1.2 References

1.2.1 Normative references

This part of BS 5911 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on page 47. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this part of BS 5911 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

1.2.2 Informative references

This part of BS 5911 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

1.3 Definitions

For the purposes of this Part of BS 5911, the following definitions apply.

1.3.1

unit

a manhole or soakaway component

1.3.2

manhole

a vertical chamber of circular cross-section, with or without an access shaft, constructed over a sewer or drain to permit inspection and access

1.3.3

soakaway

a vertical chamber of circular cross-section, perforated to allow the passage of water and with or without an access shaft

1.3.4

shaft

a vertical passageway of circular cross-section providing access for a person to work in a manhole or soakaway

1.3.5

nominal size (DN)

a numerical designation of the bore of a shaft or chamber section, which is a convenient round number approximately equal to the internal diameter in millimetres

1.3.6

manufacturing diameter

a diameter of a shaft or chamber section that a manufacturer seeks to achieve

1.3.7

actual diameter

a diameter found by measurement

1.3.8

effective length

the length of a shaft, chamber or taper section measured (see Figure 1)

1.3.9**characteristic strength of concrete**

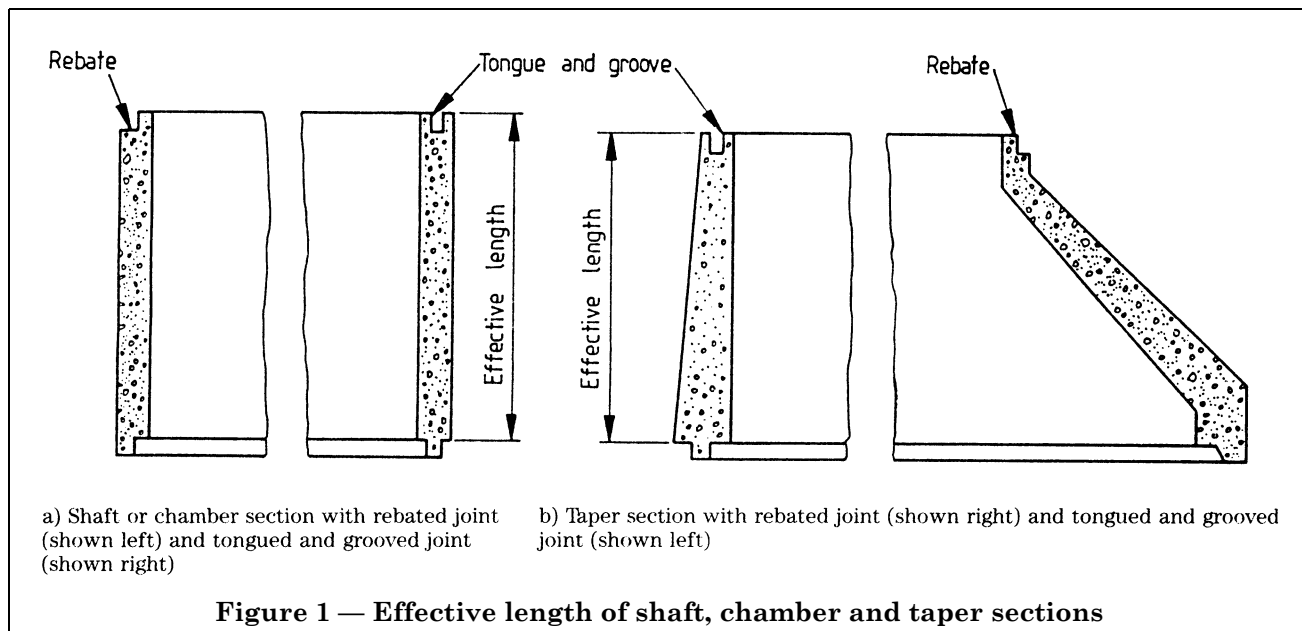
that value of cube strength below which 5 % of all possible strength measurements of the specified concrete are expected to fall

1.3.10**batch**

the number of units of a particular specification produced under uniform conditions during a given production period by one particular process

1.3.11**reinforcement**

steel, other than stainless steel, cast within a unit so as to reinforce the concrete or to locate steel for that purpose



Section 2. Materials

2.1 Cement

The cement shall either:

- a) be factory-produced by the cement manufacturer and conform to one of the following standards as appropriate:

Type of cement	Standard
ordinary and rapid-hardening Portland	BS 12
Portland blast-furnace	BS 146
Sulfate-resisting Portland	BS 4027
Portland pulverized fuel ash (p.f.a)	BS 6588

or

- b) consist of one of the following combinations of cement conforming to BS 12 and ground granulated blast-furnace slag (g.g.b.s.) or p.f.a., in accordance with the following, to be included as part of the concrete mix by simultaneously combining them with the other concrete materials at the concrete mixer:

Cementitious component other than cement	Standard	% (m/m) of total cementitious content
g.g.b.s.	BS 6699	0 % to 65 %
p.f.a.	BS 3892-1	15 % to 35 %

Where special combinations of cement conforming to BS 12 and g.g.b.s. or p.f.a. are to be used for additional resistance to sulfate attack (see note), the percentage by mass of the total cementitious content shall be in the ranges 70 % to 90 % or 25 % to 40 % respectively.

In all cases where combinations of cement conforming to BS 12 and g.g.b.s. or p.f.a. are used, the relevant proportion of g.g.b.s. or p.f.a. shall be fully documented in the production records.

NOTE The requirements specified in 2.4.1 for minimum cement content and maximum water/cement ratio will ensure that any of the permitted cements or standard combinations of cement conforming to BS 12 and g.g.b.s. or p.f.a. should provide resistance to sulfate attack equivalent to classes 1 and 2 of Table 6.1 of BS 8110-1:1985. Where either class 3 or class 4 conditions as specified in Table 6.1 of BS 8110-1:1985 are required, see 2.4.1. The advice of the pipe manufacturer should be sought where class 5 conditions exist.

2.2 Aggregates

2.2.1 General

Aggregates shall consist of materials conforming to BS 882.

NOTE The manufacturer may modify the gradings to suit the manufacturing process. (See clause 0 of BS 882:1992.)

2.2.2 Mechanical properties

The limiting values on the mechanical properties of coarse aggregates shall be either:

- a) a minimum 10 % fines value of 100 kN when tested in accordance with BS 812-111; or
- b) a maximum aggregate impact value of 30 % when tested in accordance with BS 812-112.

When tested in accordance with BS 812-105.1, the flakiness index shall be not more than 35.

2.2.3 Nominal maximum size

The nominal maximum size of aggregate shall not exceed the lesser of the following:

- a) 20 mm;
- b) the size of concrete cover (see 2.5.2).

2.3 Other concrete materials

2.3.1 Water

Water shall be clean and free from harmful matter in such quantities as affect the properties of the concrete in the plastic or hardened state.

NOTE 1 See Appendix A of BS 3148:1980.

NOTE 2 As a general rule, potable water, whether treated for distribution through the public supply or untreated, is suitable for making concrete.

2.3.2 Admixtures

2.3.2.1 Admixtures shall conform to BS 5075.

NOTE Admixtures, when used (see Annex A), should not impair the durability of the concrete, nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of reinforcement.

2.3.2.2 The chloride ion content of admixtures shall not exceed 2 % (m/m) of the admixture nor 0.03 % (m/m) of the cement, when used in:

- a) any concrete containing reinforcement or other embedded metal; and
- b) any concrete made with cement conforming to BS 4027.

2.4 Concrete mix, casting and finish

2.4.1 Cement content

2.4.1.1 The fully compacted concrete shall contain not less than 360 kg/m³ of cement (inclusive of any g.g.b.s. or p.f.a.) and shall have a water/cement ratio of not greater than 0.45.

2.4.1.2 Where a special combination of cement conforming to BS 12 and g.g.b.s. or p.f.a. is used (see 2.1b), the minimum cementitious content shall be increased from 360 kg/m³ to 380 kg/m³ where class 3 sulfate resistance conditions as specified in Table 6.1 of BS 8110-1:1985 are required (see Annex A).

NOTE Class 3 resistance is also obtained by use of cement conforming to BS 4027 alone.

2.4.1.3 When making class 4 conditions, as specified in Table 6.1 of BS 8110-1:1985, as may be required by the purchaser (see Annex A), cement conforming to BS 4027 shall be used and the minimum cement content shall be increased from 330 kg/m³ to 370 kg/m³.

NOTE Where class 5 conditions exist, the pipe manufacturer's advice should be sought.

2.4.2 Chloride content

The total chloride ion content of the concrete mixes shall be as given in Table 1.

Table 1 — Limits of chloride content of concrete

Type of concrete	Maximum total chloride content expressed as a percentage of chloride ion by mass of cement (inclusive of g.g.b.s. or p.f.a. when used) % (m/m)
Heat-cured concrete containing embedded metal	0.1
Concrete made with cement conforming to BS 4027	0.2
Concrete containing embedded metal and made with cement conforming to BS 12, BS 146, or combinations of cement conforming to BS 12 and g.g.b.s. or p.f.a.	0.4

2.4.3 Temperature of concrete and other materials

Concrete, when placed, shall have a temperature of at least 5°C, which shall be maintained until the concrete is hardened. If aggregates and water are heated before mixing, the temperature shall not exceed 60°C.

The temperature of any other materials and moulds used shall be at least 0 °C.

2.4.4 Compaction

All units shall be compacted so that, when hardened, they shall be free from honeycombing and from any individual large void as defined in 4.4.1 of BS 1881-120:1983.

NOTE Any individual void larger than 6 mm is unacceptable. Blistering should not be regarded as a void.

2.4.5 Surface finish

With the exception of the external edges of slabs and of cover frame seating rings, surfaces of units, when tested in accordance with Annex B, shall be free from voids which permit diametrically opposite points of the rim of the gauge to touch simultaneously the surface of the unit.

NOTE Voids up to and including 12 mm deep may be made good using material conforming to 2.4.6. Voids up to 12 mm deep in the external edges of slabs and of cover frame seating rings need not be made good.

2.4.6 Making good

2.4.6.1 Materials

Materials for making good shall be one of the following:

- neat cement grout, with or without the addition of styrene-butadiene rubber (SBR), the type of cement being compatible with that in the unit to be made good;
- 1 : 3 cement/sand mortar proportioned by mass with or without the addition of SBR; the cement shall be compatible with that in the unit to be made good, and the sand shall conform to the requirements for fine sand in BS 882 but have a grading such that 100 % of the material passes through a 5 mm sieve;
- a sample of the concrete mix minus the aggregate retained on the 5 mm sieve, with or without the addition of SBR;
- epoxy or polyester resin, or polymer latex mortar.

NOTE For guidance on the use of epoxy and polyester resins, see CIRIA Report 69 *Effective use of epoxy and polyester resins in civil engineering structures* [2]. See also *The repair of concrete structures* [3] published by the Cement and Concrete Association, which also deals with polymer latex mortars, and 6.10.5 of BS 8110-1:1985.

2.4.6.2 Blistering

Any blistering shall be made good using material conforming to 2.4.6.1.

NOTE Flaking of the surface of a unit does not constitute blistering.

2.4.6.3 Joint surfaces

Prior to testing, making good of joint surfaces shall only be carried out in the following circumstances.

a) If the requirements of 2.4.4 have been met, a joint profile may be reworked for conformity to 3.5 by one of the following methods:

- 1) Whilst the concrete is green, by application of material conforming to 2.4.6.1b) or c) to a depth not exceeding 5 mm;
- 2) by the application of material conforming to 2.4.6.1d);
- 3) by grinding off.

b) If the requirements of 2.4.4 have been met and the conditions given in 1) and 2) apply, any spalling of the arrises of spigots or sockets that has occurred during demoulding or handling may be made good by the application of material conforming to 2.4.6.1b) or c).

- 1) In any unit the total exposed area of broken concrete does not exceed $6 \times (\text{DN}) \text{ mm}^2$ and no individual area exceeds $3 \times (\text{DN}) \text{ mm}^2$.

NOTE For example. The total area for a DN 900 shaft unit is 5 400 mm² with no individual area exceeding 2 700 mm².

- 2) No exposed area of broken concrete is in contact with both the outer and inner surface of the spigot or socket of the unit.

c) If the requirements of 2.4.4 have been met, any spalling of the arrises of spigots or sockets that has occurred during demoulding or handling may be made good by the application of material conforming to 2.4.6.1d) provided that in any unit the total exposed area of broken concrete does not exceed $12 \times (\text{DN}) \text{ mm}^2$ and no individual area exceeds $6 \times (\text{DN}) \text{ mm}^2$.

2.4.6.4 Exposed steel

Where, on de-moulding, bar steel not forming part of the reinforcement of a unit is visible, or is found to be within the concrete cover and a manufacturer wishes to make good rather than discard the unit, a maximum of two such pieces shall be removed, each having a length not exceeding half the thickness of the unit, and the void(s) shall be made good with material conforming to 2.4.6.1d) before the unit is assessed for conformity.

2.5 Reinforcement

2.5.1 Materials and arrangement

Reinforcement and steel lifting facilities shall conform to one of the following standards as appropriate.

Type of reinforcement	Standard
carbon steel bars for the reinforcement of concrete	BS 4449
cold reduced steel wire for the reinforcement of concrete	BS 4482
steel fabric for the reinforcement of concrete	BS 4483

NOTE It is permissible to use main reinforcement in the form of loose rings, either hooked, butt welded or lap welded, or in the form of a continuous helix or fabric, suitably welded.

Longitudinal bars or wires or any other effective method shall be used to control spacing and shape and to ensure safe handling.

The clear space between bars shall be not less than the nominal maximum size of the coarse aggregate plus 5 mm.

2.5.2 Protection for reinforcement

The concrete cover over all reinforcement shall be such that, in any finished unit, it is nowhere less than 12 mm in depth and in slabs or cover frame seating rings nowhere less than 20 mm in depth (see 4.2.5 and Annex F).

An effective means shall be provided for maintaining the reinforcement in position and for ensuring correct cover during manufacture of the unit. Spacers for this purpose shall be of grade 316S31 austenitic stainless steel conforming to BS 970-1, or other rustproof material.

NOTE Units exhibiting rust marks that originate from steel within the unit are not acceptable.

Except for the exposed section of steel lifting facilities to slabs there shall be no steel, other than stainless steel, within the concrete cover.

Reinforcement and steel lifting facilities shall be free from mud, oil, paint, retarders, loose rust, loose mill scale, snow, ice, grease or any other substance which can be shown to affect adversely the steel or concrete chemically, or to reduce the bond between steel and concrete.

Section 3. Dimensions and tolerances

3.1 Nominal size (DN)

The nominal sizes (see 1.3.5) of shaft and chamber sections shall be as specified in Table 2.

3.2 Internal manufacturing diameter and actual diameter

The maximum and minimum internal manufacturing diameters of a shaft or chamber section (see 1.3.6), shall be as specified in Table 2.

The actual internal diameter shall not deviate from the manufacturing diameter by an amount greater than that specified in column 3 of Table 2.

NOTE The external manufacturing diameter of the barrel of a shaft or chamber section should be stated by the manufacturer if so required (see Annex A).

3.3 Variation in the thickness of wall

The variation in radial thickness of the wall of a shaft or chamber section shall not exceed the amount specified in Table 2.

3.4 Squareness of ends

Sections shall be capable of being jointed in any orientation with their axes coincident.

NOTE Squareness of ends of shaft, chamber and taper is significant only as it relates to the jointing of units and to the verticality of the chamber or shaft.

3.5 Joints

Joints shall be of the ogee, rebated or tongued and grooved type.

The axial length of each ogee or rebated end of a section shall be not less than $(0.03 \text{ DN} + 7)$ mm, where DN is the nominal size of the section.

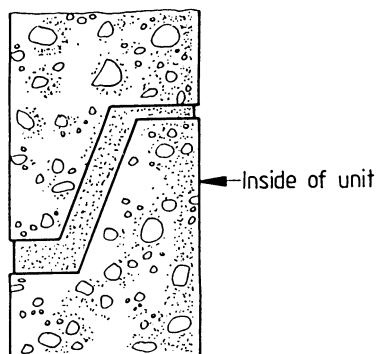
NOTE 1 For example, for a section of DN 1 200, the axial length should be not less than $(0.03 \times 1\,200 + 7)$ mm = 43 mm.

The profile of a joint shall be in accordance with the design dimensions and tolerances of mating surfaces (spigot and socket) as recorded by the manufacturer.

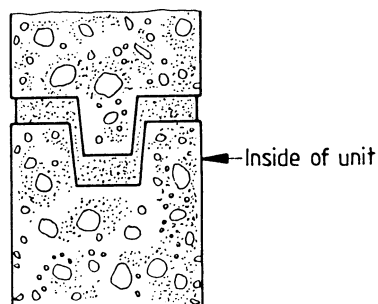
NOTE 2 Typical joints are shown in Figure 2.

Table 2 — Nominal sizes and tolerances for shaft and chamber sections

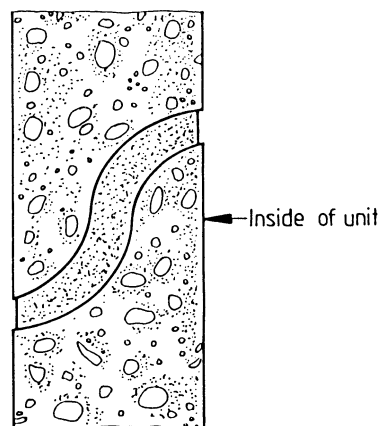
Nominal size of sections		Limits of internal manufacturing diameter		Deviation of actual internal diameter from manufacturing diameter	Variation of wall thickness
Chambers	Shafts	Maximum diameter	Minimum diameter		
DN	DN	mm	mm	mm	mm
	900	920	880	6	6
1 050	1 050	1 070	1 030	6	6
1 200	1 200	1 220	1 180	10	10
1 350		1 380	1 330	10	10
1 500		1 530	1 480	10	10
1 800		1 830	1 780	10	10
2 100		2 135	2 075	16	16
2 400		2 435	2 375	16	16
2 700		2 740	2 675	16	16
3 000		3 040	2 975	16	16



a) Rebated units



b) Tongued and grooved units



c) Ogee units

Figure 2 — Typical joint designs

3.6 Components

3.6.1 General

A manhole or soakaway shall consist of two or more of the following precast components:

- a) cover frame seating ring;
- b) shaft cover slab;
- c) shaft section;
- d) reducing slab;
- e) taper;
- f) chamber cover slab;
- g) chamber section (perforated for soakaways);
- h) landing slab.

Tapers, shaft and chamber sections shall be jointed by means of one of the joints specified in 3.5.

NOTE Typical manhole arrangements are shown in Figure 3.

3.6.2 Dimensions

The dimensions of components shall be as specified in Table 2, Table 3, Table 4, Table 5 and Table 6, and 3.6.8. For cover frame seating rings, shaft and chamber cover slabs, reducing slabs and landing slabs, it is permissible for the vertical face(s) of an opening to be cast with a nominal release angle away from the opening.

NOTE All sections within a given manhole or soakaway should be of the same 150 mm or 125 mm module.

Soakaway chamber sections shall have holes not less than 45 mm and not greater than 80 mm in diameter, or slits 15 mm or 25 mm wide, arranged in one or more rows spaced around the circumference. The number and area of holes or slits shall be such that there is a minimum aperture area in each unit of 50 000 mm² per metre of depth per metre of nominal size of chamber.

3.6.3 Tapers

Tapers shall be of the straight-back type, to facilitate access, and of the dimensions given in Table 3.

3.6.4 Lifting facilities

Arrangements for lifting shall be incorporated in all units.

3.6.5 Steps

Steps conforming to BS 1247, which are installed by the manufacturer of the unit, shall be fitted unless required otherwise by the purchaser (see Annex A). Steps shall be fitted with the tail always within the wall thickness.

The nominal vertical interval between all steps within a given manhole [dimension *K* in Figure 3a)] or soakaway shall be 300 mm or 250 mm (see Table 3) and, with the exception of sections immediately below a cover slab, there shall be a step at a distance equal to half this vertical interval below the top of each unit [dimension *L* in Figure 3a)].

3.6.6 Cover slabs for shafts and chambers

3.6.6.1 External dimensions

The external dimensions of cover slabs shall be as specified in Table 4.

NOTE Typical cover slabs are shown in Figure 4.

3.6.6.2 Cover slabs for shafts

DN 900 shaft cover slabs shall be provided with a central access hole 600^{+20}_0 mm square located in accordance with Figure 4f). Access holes in cover slabs for DN 1 050 units shall be 600^{+20}_0 mm square and for DN 1 200 units shall be 750^{+20}_0 mm $\times$ 600^{+20}_0 mm located eccentrically in accordance with Figure 4e). All access holes shall be provided with corners radiused or chamfered at least 75 mm as shown in Figure 4c).