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**SERIES 2500**  
**SPECIAL STRUCTURES**

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# SPECIAL STRUCTURES

## 2501 Corrugated Steel Buried Structures

### General

- 1 Corrugated steel buried structures of clear span or internal diameter exceeding 900 mm shall comply with this Clause.
- 2 (11/03) The Contractor shall design the corrugated steel buried structures listed in Appendix 1/10 in accordance with Standard BD 12 (DMRB 2.2.6) and the design requirements given in Appendix 25/1.

### Earthworks

- 3 Earthworks shall comply with Series 600.

### Steel Components

- 4 All helically wound systems and all bolted segmental systems to be incorporated in the Works shall have a current Type Approval Certificate. All the individual components and materials making up the system shall comply with the properties listed in the current Type Approval Certificate.
- 5 Helically wound systems shall additionally have a current British Board of Agrément Roads and Bridges Certificate.
- 6 The lockseams of helically wound systems shall be able to withstand tensile forces across the seam, according to steel sheet thickness, as tabulated below:

Nominal Sheet Thickness (mm)	Minimum Tensile Force across Seam (kN/m)
1.00	36
1.30	51
1.60	65
2.00	88
2.80	136
3.50	182
4.20	234

For intermediate sheet thicknesses, the minimum tensile force required may be determined by linear interpolation.

- 7 After forming, the depth of the corrugations shall be within a tolerance of  $\pm 6\%$  and the pitch of the corrugations within a tolerance of  $\pm 4\%$  of the nominal dimensions. Plates shall have a minimum lip of 45 mm

beyond each end crest. Cut edges shall be free from notches, gouges, rust or burrs.

- 8 When all the plates of a bolted segmental structure have been assembled, the nuts shall be tightened by applying a torque within the range stated on the Type Approval Certificate. The tightening shall be repeated if necessary to achieve the required torque.

Bolts, nuts and washers (if provided) shall be of such a design that no damage is caused to metal coatings when the nuts are tightened as described above.

### Hot Dip Galvanizing of Steel Components

- 9 (05/01) All surfaces of steel components shall be hot dip galvanized in compliance with the standards listed in the appropriate Type Approval Certificate and British Board of Agrément Roads and Bridges Certificate. Plates for bolted segmental structures shall be galvanized after forming the corrugations and completing all necessary cutting, punching and drilling. Units in which the galvanized coating has been burned by welding or otherwise damaged in fabrication, transport, cutting or handling at site shall be made good in compliance with Clauses 1907 and 1908.
- 10 Bolts and nuts shall be hot dip galvanized in compliance with the standards listed in the appropriate Type Approval Certificate and British Board of Agrément Roads and Bridges Certificate.

### Concrete Foundations of Arch Profile Structures

- 11 Concrete foundations shall be constructed as described in Appendix 25/1 with concrete complying with Series 1700.

### Concrete Invert Pavings

- 12 (11/03) Where described in Appendix 25/1, concrete invert pavings shall be constructed in compliance with that Appendix using strength class C25/30 concrete and a maximum aggregate size of 20mm complying with Series 1700.

- 13 Concrete invert pavings shall be reinforced with a steel fabric complying with Series 1700 having mesh dimensions not greater than 150 mm x 300 mm and a nominal wire size not less than 5 mm. All laps in the mesh shall be at least 150 mm. The steel fabric shall be securely fixed to the structure by means of fixings at the bolt positions. It shall extend to within a distance not greater than 100 mm, nor less than 40 mm inside the

edges of the concrete on each side. A nominal cover of 45 mm shall be provided to all other faces, including that to the crest of the corrugations in the structural steel.

**14** Concrete invert pavings shall be cast in lengths not exceeding 10 metres with the provision of a water bar between adjacent panels and the joints sealed with a joint sealant to Clause 2303.

**15** At each end of the structure the concrete invert paving shall be either:

- (i) (11/03) terminated with a toe that returns at least 200 mm under the structural steel forming the structure. The steel fabric shall be folded under the lips of the structure to suit. The toe shall be detailed with a thickness of not less than that required for the paving, in Standard BD 12 (DMRB 2.2.6); or
- (ii) detailed to suit any headwall arrangement eg paving reinforcement lapped with headwall reinforcement.

**16** All foreign matter, (but not any secondary proprietary protective coating unless indicated otherwise in the Type Approval Certificate or British Board of Agrément Roads and Bridges Certificate referred to in sub-Clauses 4 and 5 of this Clause) and free standing water shall be removed from the steel surfaces to be paved, before commencing work.

#### Proprietary Invert Pavings

**17** Any proposed proprietary invert paving system shall have a current British Board of Agrément Roads and Bridges Certificate.

#### Proprietary Secondary Protective Coatings Applied Above Hot Dip Galvanized Coating

**18** Any proposed proprietary protective coating system shall have a current British Board of Agrément Roads and Bridges Certificate.

#### Additional Protective Coatings

**19** Where described in Appendix 25/1, exposed galvanized steel surfaces shall be prepared and protected after erection in compliance with that Appendix. The additional protective coating may be factory or site applied and shall have a service life of at least six years in aggressive conditions.

## 2502 Reinforced Soil and Anchored Earth Structures

### General

**1** (11/03) Reinforced soil or anchored earth structures shall comply with this Clause.

The Contractor shall design the reinforced soil or anchored earth structures listed in Appendix 1/10 in accordance with Standard BD 70 (DMRB 2.1.5) and the design requirements and procedures described in Appendix 25/2.

### Earthworks

**2** Earthworks for reinforced soil and anchored earth structures shall comply with Series 600.

### Reinforcing Elements for Reinforced Soil and Anchor Elements for Anchored Earth

**3** (11/05) Carbon steel strip to be hot dip galvanized shall comply with BS EN 10025-1 and BS EN 10025-2 either grade S235 JR or S355 JR or BS 1449 : Part 1.1, either quality KHR 34/20P or quality KHR 50/35P, each having a silicon content of not less than 0.25% and not more than 0.40%. The fabricated element shall be hot dip galvanized in compliance with Clause 1909 except that the average zinc coating weight for any individual test area shall be not less than 1000 g/m<sup>2</sup>.

**4** Stainless steel strip shall comply with:

- (i) (11/03) BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258, BS EN 10259 designation 1.4401 or 1.4436 except that the material shall be cold rolled to provide a 0.2% proof stress of not less than 400 N/mm<sup>2</sup> and the tensile strength shall be not less than 540 N/mm<sup>2</sup>; or
- (ii) (11/03) BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258, BS EN 10259 designation 1.4401 CR temper rolled to a minimum 0.2% proof stress of 310 N/mm<sup>2</sup>.

**5** Proprietary reinforcing elements and systems using such elements shall have a current British Board of Agrément Roads and Bridges Certificate.

**6** (11/06) Anchor elements for anchored earth shall be made of cold worked steel reinforcing bar conforming to BS EN 10080 and BS 4449 (Grade B500B) except that no bar shall contain a flash weld. Welding of steel reinforcement bars to form anchors shall comply with Clause 1717. The fabricated elements shall be hot dip galvanized in compliance with Clause 1909 except that the average zinc coating weight for any individual test area shall be not less than 1000 g/m<sup>2</sup>.

**7** Reinforcing and anchor elements shall be prefabricated and delivered to Site ready for installation into the Works. The elements shall be:

- (i) Loaded, unloaded and handled in such a manner that:
  - (a) no permanent set or other structural damage is caused;
  - (b) the protective coating is not damaged.
- (ii) Stored flat and clearly marked to identify items having different lengths and cross-sectional dimensions.

### Fasteners

**8** (05/06) Bolts, screws and nuts complying with BS EN ISO 898-1, property classes A and B, shall comply with BS EN ISO 4014, BS EN ISO 4017 and BS EN ISO 4032, and shall be made from one of the following:

- (i) (05/06) Steel property class 8.8, complying with BS EN ISO 898-1 and hot dip galvanized in compliance with Series 1900.
- (ii) (11/03) Stainless steel to BS EN 10088-1, designation 1.4401 or 1.4436 except that the 0.2% proof stress of the bolt shall be not less than 450 N/mm<sup>2</sup> and the tensile strength shall be not less than 700 N/mm<sup>2</sup>.

**9** (05/01) Bolts, screws and nuts shall comply with one of the following:

- (i) (05/06) BS EN ISO 898-1 and BS EN ISO 4016, BS EN ISO 4018 and BS EN ISO 4034, hot dip galvanized in compliance with Clause 1909. The property class of the bolts and screws shall be not less than 4.6, while the property class of the nuts shall not be less than 4.0.
- (ii) (11/03) Stainless steel to BS EN ISO 3506-1 and BS EN ISO 3506-2 grade A4-70.

**10** (05/01) Plain washers shall be of either Form A or Form E complying with BS 4320 and shall be made from one of the following:

- (i) (11/03) Cold rolled carbon steel strip CS4 complying with BS 1449 : Part 1.1 hot dip galvanized in compliance with Clause 1909.
- (ii) (11/03) Stainless steel strip designation 1.4401 or 1.4436 complying with BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259.

**11** (05/01) Dowels and rods shall be made from one of the following:

- (i) (11/06) Steel bar conforming to BS EN 10080 and BS 4449 (Grade B500B), hot dip galvanized in compliance with Clause 1909.
- (ii) Steel of grade S 355 JR complying with BS EN 10 025 hot dip galvanized in compliance with Clause 1909.
- (iii) (11/03) Stainless steel to BS EN 10088-1, designation 1.4401 or 1.4436 except that the 0.2% proof stress shall be not less than 450 N/mm<sup>2</sup> and the tensile strength shall be not less than 700 N/mm<sup>2</sup>.

### Prefabricated and Precast Facing and Capping Units

**12** (11/03) Carbon steel strip or sheet to be hot dip galvanized shall comply with BS 1449 : Part 1.1, either quality KHR 34/20P or quality KHR 50/35P each having a silicon content of not less than 0.25% and not more than 0.40%. Following fabrication, the units shall be hot dip galvanized in compliance with Clause 1909 except that the average zinc coating weight for any individual test area shall be not less than 1000 g/m<sup>2</sup>.

**13** (11/03) Stainless steel strip or sheet shall comply with BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10258 and BS EN 10259 designation 1.4401 or 1.4436.

**14** Reinforced concrete shall comply with Series 1700.

**15** Proprietary facing units and systems using such units shall have a current British Board of Agrément Roads and Bridges Certificate.

### Metal Components - Material Compatibility

**16** All metallic components buried in the soil, ie reinforcing elements, connections, facing lugs and facing units, shall be of electrolytically compatible material. Where this is not possible, effective insulation shall be provided between different materials.

## 2503 Reinforced Clay Brickwork Retaining Walls of Pocket-type and Grouted-Cavity Construction

### Materials

**1** Cement, aggregates, water and mortars for reinforced brickwork retaining wall structures shall comply with the relevant Clauses of Series 2400, except where different requirements are given in this Clause.

Masonry cement or high alumina cement shall not be used.



**2** (05/05) Unless otherwise described in Appendix 25/3, masonry units (bricks) shall be HD type Class B clay engineering bricks conforming to the particular requirements of BS EN 771-1 and the performance characteristics given in Table 25/3. The equivalent strength grades of BS EN 771-1 as compared to BS 3921, see BD 91 (DMRB 2.2.14), shall be given in Appendix 25/3. The determination of sulfate content for the soluble salt content test shall be in accordance with Test No. 2 in TRL Report 447.

Selection of bricks shall follow the recommendations contained in BS 5628-3 in respect of durability and other considerations. Second hand masonry units shall not be used.

**3** (11/03) Unless otherwise described in Appendix 25/3, concrete shall be a designed concrete and shall be either ordinary structural concrete or special structural concrete. It shall comply with the requirements of Series 1700.

**4** (11/03) Reinforcement types shall comply with Series 1700 and 2400 Clauses, except that all stainless steel shall be designation 1.4401. Bed-joint reinforcement shall not exceed 6 mm diameter.

No bi-metallic contact is permitted.

**5** Wall ties shall be as described in Appendix 25/3. Dove-tail wall ties shall not be used.

**6** Damp proof courses shall be as described in Appendix 25/3.

### Storage of Materials

**7** (05/05) The handling, storage and mixture of materials shall follow the recommendations of BS 5628-3.

**8** Bricks shall be unloaded with due care to minimize damage, placed on site in different stacks according to strength and type and be marked clearly. They shall be stacked on prepared level areas avoiding ground contamination and be protected from rain or snow.

**9** Cement, lime and lime/sand mix shall be stored off the ground in dry areas and used in the sequence of delivery. Different types of cements shall be stored separately and clearly identified. Lime and lime/sand mix shall be protected from drying out.

**10** Reinforcement shall be stored on site in a safe manner and be free from loose rust, scale, dirt, paint, oil, grease or any other harmful material, prior to fixing.

### Laying of Bricks

**11** Brickwork shall be laid in accordance with Clause 2412. Jointing is preferable to pointing and shall be used unless there is a specific need for pointing.

Joints shall be tooled as the work progresses to either a flush or bucket handle profile. Bricks shall not be used within 14 days of firing.

**12** The maximum height of brickwork to be built in a day shall be limited to 1.0 m and 12 hours shall elapse before recommencing bricklaying.

**13** Cutting of bricks shall be kept to a minimum. When cutting is necessary, cutting discs shall be used.

**14** Where sleeves, chases or holes are required, they shall be provided during the erection of brickwork.

### Mixing of Mortar

**15** Mortar shall be mixed mechanically until its colour and consistency are uniform. The constituent material shall be accurately measured.

**16** (11/05) Where ready mixed mortars are specified, their use shall be in accordance with the manufacturer's instructions and BS EN 998-1 and BS EN 998-2.

**17** Mortar shall be made in small quantities only as and when required. Mortar which has begun to set or which has been mixed for a period of more than one hour shall be discarded.

**18** When additives or admixtures are specified in Appendix 25/3, their use shall strictly follow the manufacturer's instructions and shall be demonstrated in the trial panel.

**19** (05/06) Mortars shall be tested in accordance with Annex A of BS 5628-1.

### Concrete - General

**20** Batching and mixing of concrete shall comply with Clause 1706.

**21** (11/03) Concrete compliance shall be in accordance with Clauses 1701 to 1705 and 1707.

**22** Transporting, placing, compacting and finishing of concrete shall be in accordance with Clauses 1708 and 1710. The rate of placing of concrete with respect to the rate of brickwork construction shall be as required by Appendix 25/3. The placing and compaction of concrete shall not disrupt either the masonry or the reinforcement.

### Cold Weather Working

**23** (05/01) Cold weather working shall be in accordance with Clauses 1710 and 2414.

### Hot Weather Working

**24** During hot weather, the Contractor shall ensure that the constituent materials of mortar and concrete are sufficiently cool to prevent stiffening before placement in

their final position. Cement shall not be allowed to come into contact with water at a temperature greater than 60°C.

### Protection of New Work

**25** Protection of newly laid brickwork shall be in accordance with Clause 2415.

**26** In addition, during freezing conditions, brickwork shall be covered with an insulating layer followed by a waterproofing material. Covers shall be held clear of the brickwork and be well secured.

**27** Side protection shall be provided in exposed site conditions.

### Weatherproofing, Backfill and Drainage

**28** The retaining face of the wall shall be flush-jointed and tooled and shall be subsequently painted with a waterproofing material in accordance with Clauses 2001, 2004 and 2006.

**29** Backfilling shall be in accordance with Clause 610. Before commencing backfilling, a period of 14 days or longer if required by Appendix 25/3 shall elapse after the completion of the wall.

**30** Permeable backing to the retaining wall shall be in accordance with Clause 513.

**31** When used, weep-holes shall not be allowed to drain freely across footways or carriageways.

### Trial Panel

**32** The Contractor shall construct a trial panel of pocket type or grouted-cavity reinforced brickwork retaining wall of dimensions specified in Appendix 25/3 prior to commencement of permanent work. The trial panel shall be used to demonstrate the colour of mortar, workability of mortar, formation of pockets and infilling of concrete. Where required in Appendix 25/3, the panel shall be dismantled in such a manner that the effectiveness of each element can be examined.

**33** Where required in Appendix 25/3, the Contractor shall construct additional panels to comply with the appearance requirements of BS 3921.

## 2504 Environmental Barriers

### General

**1** (05/01) Environmental barriers shall be constructed from the quality of materials and be erected to standards described in the following sub-Clauses, unless otherwise specified in Appendix 25/4.

**2** Where an environmental barrier is erected on ground or any other surface which follows the longitudinal profile of the adjacent road or on existing ground or earthwork environmental bund which has a

gradient of not greater than 1 in 50 along the line of the barrier, the top of the barrier shall follow a flowing vertical alignment. Where the earthwork environmental bund or original ground has a slope exceeding 1 in 50, the top of the barrier may be stepped, where permitted in Appendix 25/4. The minimum height of the barrier and the maximum step increments where steps are permitted, shall be as specified in Appendix 25/4. Where necessary the ground shall be excavated or filled and compacted in compliance with the appropriate Clauses in Series 600. Any excavation required shall not affect the minimum height of the barrier as shown in Appendix 25/4. The gravel board or bottom edge of the barrier shall be buried to a depth of at least 50 mm.

**3** (05/04) Where the environmental barrier is combined with a safety barrier, the safety barrier shall comply with the current standards issued by the Overseeing Organisation.

**4** (05/01) Where the environmental barrier is to be erected on an earthwork environmental bund, the bund shall comply with Clause 619.

### Tolerances

**5** Tolerances shall be as follows:

- (i) An environmental barrier shall be erected along a line or smooth curve as indicated on the contract drawings within a tolerance of  $\pm 75$  mm normal to the plane of the barrier; in addition, the horizontal deviation from the required positions at adjacent panels or posts shall not vary by more than  $\pm 15$  mm.
- (ii) The top edge of the barrier shall be at the specified height above the road surface, existing ground or finished ground level of the earthwork environmental bund within a tolerance of  $\pm 50$  mm and the deviation from the required levels at adjacent panels or posts shall not vary by more than  $\pm 15$  mm.
- (iii) Barriers shall be vertical unless otherwise stated in Appendix 25/4.

### Timber

**6** Timber shall comply with Clause 304. Non-structural timber shall be acceptable if it complies with HCD Drawing Number H37 and H38. For checking compliance, the rejection numbers shall be 3, 4, 6, 8, 11 and 15 respectively instead of 4, 6, 8, 11, 15 and 22.

**7** Timber surfaces shall be sawn unless otherwise stated in Appendix 25/4.

**8** Timber within panels shall not be butt jointed. The thickness of panel boards shall be sufficient to ensure the specified acoustic requirements and their width

shall not be more than 150 mm measured at 28% moisture content. Exposed ends of vertical boards shall be protected against weathering by a top or capping rail.

### Fittings

**9** (11/03) Fittings shall comply with Clause 305 unless otherwise stated in Appendix 25/4. Nails in timber preserved with copper/chromium/arsenic (CCA) treatment shall be austenitic stainless steel designation 1.4301 to BS EN 10088.

### Concrete

**10** (05/01) Reinforced concrete components shall comply with the requirements of Annex A of BS 1722 : Part 2.

### Combination of Timber and Concrete

**11** (05/01) Timber cladding used to screen concrete panel barriers shall comply with BS 1722 : Part 5 and Clause 304.

### Steel

**12** (05/01) Steel posts and environmental barrier members shall comply with the requirements in Series 1800 and shall:

- (i) be hot dip galvanized to comply with Clause 1909, and either be:
  - (a) (05/04) painted with the following paint system to comply with Series 1900 (Table 19/2B, system IV),
    - 1 coat of Item 155
    - 1 coat of Item 110 or Item 121
    - 1 coat of Item 112 or Item 121
    - 1 coat of Item 168 or Item 169
 to achieve a minimum total dry film thickness of the paint system of 175 microns; or
  - (b) plastic coated to comply with Clause 2604;
- (ii) have improved atmospheric corrosion resistance complying with Clauses 1801 and 1803.

### Brickwork

**13** Brickwork shall comply with Series 2400.

### Other Materials

**14** Other materials, or combination of materials, shall comply with Appendix 25/4.

### Design

**15** Where required, the Contractor shall design the environmental barriers listed in Appendix 1/10 in accordance with the design specification and procedures in Appendix 25/4. In addition, if required in Appendix 25/4 he shall design foundations, posts and/or other supports. The Contractor shall submit his design to the Overseeing Organisation for aesthetic approval. The Contractor shall also take account of the following:

- (i) (05/04) The Contractor shall, when required in Appendix 25/4, erect 2 sample panels of barrier not less than 6 weeks before starting construction. One section shall show the horizontal elevation, the other a sloping elevation. Spacing of barrier posts shall be as described in Appendix 25/4. When Appendix 25/4 requires a safety barrier to be attached to the environmental barrier, the safety barrier shall be supplied and fixed to the sample panels of the environmental barrier. The sample panels shall be used as the standard which must be maintained throughout the Contract.
- (ii) The Contractor shall provide working drawings of the design and details of fabrication.
- (iii) The Contractor shall supply the Overseeing Organisation with the following:
  - (a) Design calculations.
  - (b) Details of materials and components used in the barrier.
  - (c) Details of gates and methods of fixing where applicable.
  - (d) Details of fixing to adjoining structures and parapets where applicable.
- (iv) Fixings shall be fitted so that bolts either do not protrude on the traffic side, or only do so with a coach bolt head, a cup square head, or with a dome headed nut.
- (v) Fixings and fastenings used shall be designed to prevent wilful damage. The design and materials used shall also enable damaged components to be replaced.
- (vi) Stepping of panels shall only be permitted as specified in Appendix 25/4 to be compatible with aesthetic requirements.
- (vii) The design shall be such that movement due to change in moisture content, thermal effects or weathering will not reduce the acoustic attenuation of the barrier.

- (viii) All joints shall be sufficiently masked by cover strips or rebated to ensure acoustic integrity.
- (ix) The design shall ensure that all members of the barrier can drain freely and do not allow water to stand on their surfaces or within joints.
- (x) Where access gates are required in Appendix 25/4, their design shall be such that they blend unobtrusively into the barrier. They shall open away from the nearest carriageway and leave no gap when closed. The gates shall be self-closing by the provision of a heavy duty spring and be secured as described in Appendix 25/4. In barriers up to and including 2.00 m high the top edge of the gate shall be at the specified height of the barrier. Gates in barriers over 2.00 m high shall be 2.00 m high and provided with a header panel to align with the top of the barrier. Where a gate is not to be provided, but a gap is to be left for access as described in Appendix 25/4, a length of barrier shall be erected behind the gap or an overlap provided sufficient to maintain the acoustic properties of the barrier.
- (xi) When timber is used in the barrier the following shall apply:
  - (a) One or two gravel boards not less than 150 mm deep shall be provided having a total thickness of not less than 50 mm. Concrete gravel boards or edging will be acceptable.
  - (b) Fixings shall be such as to allow timber movement due to change in moisture content to be accommodated without inducing splitting.

### Testing of Acoustic Performance

**16** (11/03) Where required in Appendix 25/4 the complete form of construction proposed for an environment barrier shall have been tested, by an appropriate organisation accredited in accordance with sub-Clauses 105.3 and 105.4, for acoustic testing in accordance with BS EN 1793.

### Insulation Requirements

**17** The overall performance characteristic  $DL_R$  determined in accordance with BS EN 1793 Part 2 shall meet the requirements stated in Appendix 25/4.

### Absorption Requirements

**18** The performance characteristic  $DL_\alpha$  determined in accordance with BS EN 1793 Part 1 shall meet the requirements stated in Appendix 25/4.

### Post Foundation Test

- 19** (i) Where stated in Appendix 25/4 the Contractor shall provide test equipment and carry out loading tests on post foundations as described in Appendix 25/4. The results shall be available at least one week prior to installation of the relevant length of fence, unless otherwise stated in Appendix 25/4.
- (ii) The Contractor shall install foundations for testing after completion of the finished ground.
- (iii) On completion of loading tests the Contractor shall remove the test posts and foundations and make good the finished ground, unless the posts and foundations have not exhibited failure and can be incorporated into the Permanent Works.
- (iv) The Contractor shall establish and maintain appropriate traffic safety and management measures complying with Clause 117 during installation, loading and removal of the test posts and foundations.

## 2505 (05/01) Drainage Structures

### General

**1** All drains, piped and box culverts, sewers and drainage structures, other than bridges, that have a diameter or clear span exceeding 900 mm shall comply with this Clause and any additional requirements described in Appendices 25/1 and 25/5. Where the term drain is used in this Series it shall be deemed to include the terms sewer and piped culvert.

**2** The Contractor shall design the piped and box culverts and other drainage structures listed in Appendix 1/10 in accordance with the requirements of Clause 106. Unless otherwise described in Appendices 25/1 and 25/5 only one type of pipe shall be used within any individual drain between consecutive chambers.

**3** Pipes for drains shall be selected from the alternatives in Table 25/1 and shall comply with the standards and particular requirements therein. The Contractor shall show that the pipes which have been selected have an hydraulic flow capacity equal to that adopted in the hydraulic design of the system as



described in Appendices 25/1 and 25/5. On completion of the whole of the drainage works the Contractor shall provide the Overseeing Organisation with a schedule showing details of all pipe types used, including quality, joints and name of manufacturer.

**TABLE 25/1: (05/05) Pipes for Drains and Culverts having Diameter or Clear Span Exceeding 900 mm**

Material	Usage	Standard	Particular requirements
Vitrified clay	Surface & foul water drains	BS EN 295	Shall comply with Clause 2506
Concrete (With cement types CEM I or SRPC, as defined in Table A.17 of BS 8500-1, when required in Appendix 25/5. Supersulfated cement shall not be used)	Surface & foul water drains	BS 5911-1 and BS EN 1916 or BS 5911-5	Pipes having a concrete mix meeting the following requirement. (Testing in accordance with the relevant BS and sampling in accordance with sub-Clause 28 of Clause 2506):  A total chloride content not exceeding the values in Table 17/1  Shall comply with Clause 2506
Iron	Surface & foul water drains	BS EN 598 (Ductile iron)	
Corrugated steel	Surface water drains	BD 12 (DMRB 2.2.6)	Type approval certificate and BBA Roads and Bridges Certificate  Shall comply with Clause 2501

## 2506 (05/01) Buried Rigid Pipes for Drainage Structures

### Scope

**1** For the purposes of this Clause, rigid pipes include vitrified clay pipes and plain, reinforced and prestressed concrete pipes as set out in Table 25/1. The maximum length of pipe between flexible joints shall comply with the requirements of Appendix 25/1.

### Excavation for Pipes and Chambers

**2** Excavation shall comply with Clause 602, and with sub-Clause 502.1. Trenches shall not exceed the maximum widths scheduled in Appendix 25/5.

**3** Unless otherwise described in Appendix 25/5, all pipes in or under new embankments shall be laid only when the embankment has been formed and compacted to formation level under paved areas, to finished earthworks level in other areas, or to a level which will give a minimum cover of 1.2 m to the pipes, whichever is the lowest.

### Bedding, Laying and Surrounding of Pipes

**4** Immediately following the excavation of the trench, the pipes shall be laid and jointed on the pipe bed in accordance with sub-Clause 503.1. Where described in Appendix 25/5, limestone aggregates shall not be used as bedding.

**5** Drainage pipe and bedding combinations shall be selected from the alternatives described in Appendix 25/5. Pipe bedding, haunching and surrounding material shall be as shown on HCD Drawing Numbers F1 and F2, and shall comply with sub-Clause 503.3(i), (ii), (iii), (iv) and (vi).

**6** Completion of the bedding, haunching and surrounding of the pipes shall be carried out immediately after jointing in accordance with sub-Clause 503.4.

**7** Precautions shall be taken to minimise water flows through the granular beddings surrounding rigid pipes as required in Appendix 25/5.

### Jointing of Pipes

**8** Rigid joints shall mean joints made solid by caulking the sockets, or bolting together flanges integral with the pipes. Flexible joints shall mean joints made with deformable rings or gaskets held between pipe spigots and sockets, sleeves or collars.

**9** Joints in surface water drains and foul sewers shall be watertight and comply with the appropriate British Standards and the manufacturer's instructions. Rigid joints shall be used only where permitted in Appendix 25/5. Spigots and sockets of rigid joints may be caulked with tarred rope yarn or equivalent and the socket completely filled with mortar designation (i) complying with Clause 2404, but excluding lime; a fillet of mortar shall be worked around the socket extending for a length of not less than 50 mm from the face of the socket.

**10** Where a concrete bed, cradle, arch or surround is used with rigid pipes having flexible joints, joint filler board complying with Clause 1015 shall be placed in contact with the end of the socket at all pipe joints and shall extend through the full thickness of the concrete bed, haunch and surround in contact with the pipe.

## Backfilling of Trenches

**11** Backfilling shall be undertaken immediately after the required operations preceding it have been completed.

**12** Except where otherwise described in Appendix 25/5, trenches shall be backfilled above the pipe surround material described in Clause 503, with Class 1, 2 or 3 general fill material complying with Series 600.

**13** Backfilling shall be deposited and compacted in compliance with Clause 612. The material used for backfilling shall be deposited in even layers and shall not be heaped in the trench before being spread. Spreading and compaction shall be carried out evenly without dislodging, distorting or damaging the pipe. Power rammers shall not be used within 300 mm of any part of the pipe or joint.

**14** Except in carriageways and other paved areas and locations described in Appendix 25/5, backfill of trenches shall be brought up to ground level. Where topsoil is at the surface on the line of the trench, the upper section of the backfill shall be topsoil of the thickness described in Appendix 6/8, or of the same thickness and quality of topsoil as on the surrounding ground where no thickness is specified. For trenches in carriageways or other paved areas the backfill shall be brought up to formation level, or sub-formation level where capping is required, unless a lower level is described in Appendix 25/5. Sheet piling and other excavation supports shall be removed as the filling proceeds unless otherwise described in Appendix 6/3.

## Connecting to Existing Drains, Chambers and Channels

**15** Connections to existing drains, chambers and channels shall be carried out in accordance with Clause 506 with the exception that where Appendix 5/1 is mentioned in sub-Clauses 506.1 and 506.3 it shall be altered to read Appendix 25/5.

## Chambers

**16** Chambers, other than those used in motorway communications installations, shall include manholes, catchpits, inspection chambers, draw pits and walled soakaways. Chambers shall be one of the types specified in Appendix 25/5.

**17** (11/03) Foundations to chambers shall be of ST4 concrete complying with Clause 2602. Channels for chambers shall be formed and finished smooth in the foundation concrete or constructed of preformed half circle channels, with sides benched in the same mix of concrete, or mortar designation (i) complying with Clause 2404, but excluding lime.

**18** Brickwork shall comply with Series 2400 and be built with mortar designation (i) in English bond. The joints of brickwork where exposed shall be finished as specified for unpointed joints in Clause 2412. The ends of all pipes shall be neatly built into the brickwork and finished flush with mortar designation (i) complying with Clause 2404.

**19** (11/04) Precast concrete chambers shall comply with BS 5911-3 and BS EN 1917. Cast in situ concrete chambers shall be constructed of ST4 concrete complying with Clause 2602 unless otherwise described in Appendix 25/5.

**20** (11/04) Manhole steps complying with BS EN 13101 shall be built in accordance with relevant Series F HCD Drawings. Steelwork used for ladders, handholds and other fittings shall comply with BS 970 : Part 1 and be galvanized in compliance with Clause 1909 after fabrication. Threaded components shall be galvanized in compliance with Clause 1909.

**21** (11/03) Excavation around chambers shall be backfilled with Class 2A wet cohesive fill material (Table 6/1) with the plasticity and grading requirements set out in Appendix 25/5; this material shall be compacted in accordance with Clause 612. Where mechanical compaction is impracticable, the excavation shall be backfilled with ST2 concrete complying with Clause 2602. Where there are precast concrete access shafts to precast concrete chambers, the shafts shall be surrounded by a minimum thickness of 150 mm of ST4 concrete complying with Clause 2602, and the remaining excavation backfilled with general fill material as described in Table 6/1 compacted in accordance with Clause 612.

**22** Chambers for foul drains shall be tested for watertightness as scheduled in Appendix 25/5.

**23** Chamber covers, gratings and frames shall be as described in Appendix 25/5, and shall comply with BS EN 124 and sub-Clauses 10, 11, 12, 13 and 15 of Clause 507; they shall be set in cement mortar or quick setting mortar complying with sub-Clause 507.16.

**24** For rigid pipelines the nearest joint to any chamber shall be not more than 500 mm from the inner face of the wall and shall not be restricted by any concrete surround. Between this and the next joint, the length of the articulated pipe (rocker pipe) shall be not less than 1250 mm.

**25** Where the adjustment or replacement of existing frames and covers or gratings is required, the units shall be taken up and refixed or replaced with new units in accordance with sub-Clause 23 of this Clause, or such other specification as agreed with the Overseeing Organisation. The finished thickness of the mortar bed shall be between 10 mm and 25 mm. Unless otherwise

described in Appendix 25/5, adjusted or replaced chamber frames and covers or gratings shall be set flush with the new surface. Any additional adjustments shall be by modifying the brickwork in compliance with sub-Clause 18 of this Clause or by using a frame of a suitable depth.

### Pipe Juncions

**26** Junction pipes shall be manufactured of the same type and class of material as the remainder of the pipes in the run. Junction pipes, which are laid but not immediately connected, shall be fitted with temporary stoppers or seals and the position of all such junctions shall be clearly defined by means of stakes or tracing wires properly marked or labelled.

**27** (11/03) Saddles may be used to form junctions only where permitted in Appendix 25/5. No internal projections greater than 5 mm shall be permitted. Saddles for rigid pipes shall be jointed with mortar designation (i) complying with Clause 2404, but excluding lime. Saddles and pipes shall be surrounded with ST2 concrete complying with Clause 2602.

### Pipe Quality

**28** For rigid pipes the Contractor shall obtain test certificates provided by the manufacturer, based on the following sampling rates:

- (i) For the hydraulic or hydrostatic test and for the works proof load test, samples shall be taken at random from each batch of consecutively manufactured pipes of each diameter, joint type and strength class as described in Table 25/2.
- (ii) For the maximum load test, one pipe shall be taken at random from those which have been selected for, and have passed, the proof load test. If this pipe fails, a further two pipes taken from those which have been selected for, and have passed, the proof load test shall be tested and if either pipe then fails, the whole batch shall be rejected.

### Testing and Cleaning

**29** Drainage structures shall be visually examined before backfilling is commenced and after backfilling is completed. Where such installations are subsequently subjected to heavy construction plant loads they shall be inspected again when the construction work has finished and before handover of the completed works.

**30** Drainage structures shall at all times be left clean and free from silt and obstruction.

**TABLE 25/2: Sampling Rates**

Number of pipes in batch	Sample size	If all pass	If 2 or more fail	If 1 fails take a further sample of	If 1 or more of the further sample fails
40 or less	2	ACCEPT	REJECT or test ALL remaining pipes in batch, failing pipes to be rejected	2	REJECT or test ALL remaining pipes in batch, failing pipes to be rejected
41-60	3			3	
61-80	4			4	
81-100	5			5	
More than 100	5 per batch of 100			5	