

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 The Contractor shall design the corrugated steel buried structures listed in Appendix 1/10 in accordance with UK Department of Transport Standard BD 12/88, the design requirements given in Appendix 25/1 and subject to the approval of the Engineer.

Earthworks

- 3 Earthworks shall comply with the 600 Series.

Structural Components

- 4 All helically wound systems and all bolted segmental systems, including the galvanizing of their plates, bolts and nuts, to be incorporated in the Works shall have a current Irish Agrément Board Roads and Bridges Certificate.
- 5 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.
- 6 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 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.

Metal Coating of Plates, Bolts and Nuts

- 7 Plates for bolted segmental structures shall be galvanized after forming the corrugations and completing all necessary cutting, punching and drilling. Units in which the metal coating has been burned by welding or otherwise damaged in fabrication, transport or handling at Site

shall be made good in compliance with Clauses 1905 and 1906.

Concrete Paved Inverts

- 8 Concrete paved inverts shall be constructed as described in Appendix 25/1 with concrete complying with the 1700 Series.

Proprietary Paved Invert Systems

- 9 Proprietary paved invert systems shall have a current Irish Agrément Board Roads and Bridges Certificate.

Proprietary Applied Protective Coatings (Additional to Metal Coatings)

- 10 Proprietary protective coating systems shall have a current Irish Agrément Board Roads and Bridges Certificate.

Protective Coatings

- 11 Where described in Appendix 25/1, exposed surfaces shall be prepared and protected after erection in compliance with that Appendix.

2502 Reinforced Earth and Anchored Earth Structures

General

- 1 Reinforced earth or anchored earth structures shall comply with this Clause.

The Contractor shall design the reinforced earth or anchored earth structures listed in Appendix 1/10 in accordance with the design requirements and procedures described in Appendix 25/2.

Earthworks

- 2 Earthworks for reinforced earth and anchored earth structures shall comply with the 600 Series.

Reinforcing Elements for Reinforced Earth and Anchor Elements for Anchored Earth

- 3 Aluminium alloy strip shall comply with BS 1470 quality 5454 in the H24 condition.

- 4 Copper strip shall comply with BS 2870 quality C101 or C102 in the 1/2H condition and shall have a 0.2% proof stress of not less than 180 N/mm².
- 5 Carbon steel strip to be galvanized shall comply with BS 1449 : Part 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 galvanized in compliance with Clause 1911 except that the average zinc coating weight for any individual test area shall be not less than 1000 g/m².
- 6 Stainless steel strip shall comply with BS 1449 : Part 2 quality 316 S 31 or 316 S 33 except that the material shall be cold rolled to provide a 0.2% proof stress of not less than 400 N/mm² and the tensile strength shall be not less than 540 N/mm².
- 7 Proprietary reinforcing elements and systems using such elements shall have a current Irish Agrément Board Roads and Bridges Certificate.
- 8 Anchor elements for anchored earth shall be made of cold worked steel reinforcing bar Type 2, Grade 460 complying with BS 4449 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 galvanized in compliance with Clause 1911 except that the average zinc coating weight for any individual test area shall be not less than 1000 g/m².
- 9 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**
- 10 Precision hexagon bolts, screws and nuts shall comply with the dimensional requirements of BS 3692 and shall be made from one of the following:
- (i) Aluminium alloy bar either HE 30 in the TF condition complying with BS 1474 or NB6 in the H4 condition complying with BS 1473.
 - (ii) Copper alloy PB 102 complying with BS 2874.
 - (iii) Steel alloy Grade 8.8 complying with BS 3692 galvanized in compliance with the 1900 Series.
 - (iv) Stainless steel quality 316 S 31 or 316 S 33 complying with BS 970 : Part 1 except that the 0.2% proof stress of the bolt shall be not less than 450 N/mm² and the tensile strength shall be not less than 700 N/mm².
- 11 Black hexagon bolts, screws and nuts shall comply with BS 4190 : 1967 and shall be galvanized in compliance with Clause 1911. The strength grade designation of bolts and screws shall be not less than 4.6 and of nuts not less than 4.0.
- 12 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) Aluminium alloy strip quality 5454 in the H24 condition complying with BS 1470.
 - (ii) Copper strip C101 or C102 in the 1/2H condition complying with BS 2870.
 - (iii) Cold rolled carbon steel strip CS4 complying with BS 1449 : Part 1 galvanized in compliance with Clause 1911.
 - (iv) Stainless steel strip quality 316 S 31 or 316 S 33 complying with BS 1449 : Part 2.
- 13 Dowels and rods shall be made from one of the following:
- (i) Aluminium alloy either HE 30 in the TF condition complying with BS 1474 or NB6 in the H4 condition complying with BS 1473.
 - (ii) Copper alloy PB 102 complying with BS 2874.
 - (iii) Steel bar complying with BS 4449 grade 460, galvanized in compliance with Clause 1911.
 - (iv) Steel of grade Fe 510 B complying with BS EN 10 025 galvanized in compliance with Clause 1911.
 - (v) Stainless steel quality 316 S 31 or 316 S 33 complying with BS 970 : Part 1 except that the 0.2% proof stress shall be not less than 450 N/mm² and the tensile strength shall be not less than 700 N/mm².

Prefabricated and Precast Facing and Capping Units

- 14 Carbon steel strip or sheet to be galvanized shall comply with BS 1449 : Part 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 galvanized in compliance with Clause 1911 except that the average zinc coating weight for any individual test area shall be not less than 1000 g/m².
- 15 Stainless steel strip or sheet shall comply with BS 1449 : Part 2, quality 316 S 31 or 316 S 33.
- 16 Reinforced concrete shall comply with the 1700 Series.
- 17 Proprietary facing units and systems using such units shall have a current Irish Agrément Board Roads and Bridges Certificate.

2503 Pocket Type Reinforced Brickwork Retaining Wall Structures

Materials

- 1 Cement, aggregates, water and mortars for reinforced brickwork retaining wall structures shall comply with the relevant Clauses of the 2400 Series, except where different requirements are given in this Clause.
- 2 Clay bricks shall comply with the particular requirements of IS 91. When tested in accordance with IS 91, clay bricks shall have:
 - (a) a minimum crushing strength of 40 N/mm²;
 - (b) water absorption not greater than 7% by mass;
 - (c) an initial rate of suction not exceeding 1.5 kg/m²/min;
 - (d) frost resistance, in the particular environment, in accordance with Clause 12 of IS 91.

The Contractor shall submit results of the above tests to the Engineer for his approval. Only random sampling as described in IS 91 shall be employed in selecting test samples.

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

- 4 Reinforcement shall comply with Clause 1712. Cutting, bending and fixing of reinforcement shall be in accordance with Clauses 1713, 1714, 1715 and 1716.
- 5 Wall ties shall be as described in Appendix 25/3.
- 6 Damp proof courses shall be as described in Appendix 25/3.

Storage of Materials

- 7 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.
- 8 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.
- 9 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

- 10 Brickwork shall be laid in accordance with Clause 2412.
- 11 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. No sleeves, chases or holes shall be cut without the Engineer's approval.

Mixing of Mortar

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

- 16 Where ready mixed mortars are specified, their use shall be in accordance with the manufacturer's instructions and Appendix A of BS 4721 : 1981 (AMD 5041, 1986).
- 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 Mortars shall be tested in accordance with Appendix A1 of BS 5628 : Part 1 : 1978 (AMD 5736, 1985), to the satisfaction of the Engineer.

Concrete - General

- 20 Batching and mixing of concrete shall comply with Clause 1706.
- 21 Concrete compliance shall be in accordance with Clauses 1701 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 agreed by the Engineer.

Cold Weather Working

- 23 Cold weather working shall be in accordance with Clauses 1709 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 the Engineer, shall elapse after the completion of the wall.
- 30 Permeable backing to the retaining wall shall be in accordance with Clause 513.

Trial Panel

- 31 The Contractor shall construct a trial panel of pocket type 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, to the approval of the Engineer, the colour of mortar, workability of mortar, formation of pockets and infilling of concrete. When directed by the Engineer, the panel shall be dismantled in such a manner that the effectiveness of each element can be examined.

