SERIES NG 2500
SPECIAL STRUCTURES

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SPECIAL STRUCTURES

NG 2501 Corrugated Steel Buried Structures

1 Any special drainage requirements associated with corrugated steel buried structures such as the need for watertight jointing or lining of trenches with impervious membranes should be shown on the Drawings or given in Appendix 25/1.

2 A check should be made that bolts and nuts are tightened to a torque within the range stated on the Type Approval Certificate.

NG 2502 Reinforced Soil and Anchored Earth Structures

1 Where special requirements are proposed which would limit the Contractor's choice of the full range of alternative systems for reinforcing elements, anchor elements, facing units or capping units, the Overseeing Organisation should be consulted.

2 (11/03) Further details and guidance on the requirements for materials associated with reinforced soil and anchored earth structures are given in Standard BD 70 (DMRB 2.1.5).

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

1 The choice of DPC must not affect the bending moment and shear capacity of the wall.

2 The rate of concrete infill will be determined by the designer and be related to the strength of the masonry.

3 The rate of backfilling to the wall will be determined by the designer and be related to the strength of the wall.

4 The choice of material and minimum width of backfilling will be determined by the requirements for good compaction as well as the need to satisfy the principles used in the calculation of the earth pressure.

NG 2504 Environmental Barriers

1 It is recommended that environmental barriers are designed in accordance with Advice Note HA 65. The Drawings should show methods of fixing barriers to structures, which ensure that gaps below the bottom edge of the barrier are avoided. Where it is proposed to attach an environmental barrier to a highway bridge parapet, only those combinations which have been satisfactorily tested under vehicle impact should be used.

2 The Drawings should show the position and height of the barrier and where applicable the position of gates, the fittings required and the proposals for treatment at gaps to maintain the acoustic attenuation. The length and position of barriers behind any gap should ensure that there is adequate deviation of the noise path from the carriageway to any property being protected by the barrier. It should be noted that additional width may be required on embankments to install panels behind the general fence line where gaps are required.

3 Gates or gaps should be provided at about 200 m intervals to provide access for the maintenance of both the barrier and any planting behind the barrier. Where possible these access points should be located to provide access to any traffic control and communications equipment.

4 Whenever there is a likelihood of an environmental barrier being struck by an errant vehicle, safety fencing should be installed between it and the hard shoulder or carriageway on roads where speeds of 80 km/h (50 mph) or more are permitted. The criteria for the provision of safety fencing and clearance required behind it for the various categories of safety fence are contained in the current Standard on safety fences. Alternatively, where space is limited safety fencing can be integrated with the environmental barrier as shown in HCD : Section 2.

5 If the Contractor is required to design the environmental barriers listed in Appendix 1/10, full requirements should be specified in Appendix 25/4. In particular it should clearly define whether he is required to design the foundations, posts and/or other supports.

6 Where the design of environmental barriers is to be provided to the Contractor, the details of the complete installation, including foundations, should be shown on the Drawings.

7 Guidance on the suitability of materials can be obtained from the Overseeing Organisation and the advice of the Regional Landscape Architect should also

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be obtained to ensure that acceptable materials are specified in the design or stated as acceptable in Appendix 25/4.

8 Where the Contractor is required to design environmental barriers, an outline Approval in Principle form for each barrier containing, inter alia, the following information should be included in Appendix 25/4.

(i) Criteria for Design. These should be based on Advice Note HA 66.

(ii) Materials. Materials and finishes that will be acceptable in the barrier:

(a) In addition to aesthetic considerations, materials should be suitable for the location eg where stubble burning is likely, combustible materials should not be used.

(b) It is recommended that a galvanized coating and paint system is used for steel members. Improved atmospheric corrosion resistant steel should be excluded where the barrier is adjacent to the carriageway and likely to be affected by salt spray. Standard BD7 should be referred to for specific requirements regarding its use.

(iii) Design Features. Specific design features required, eg:

(a) Where steps between panels are permitted, what limitations in size or regularity are needed to ensure that the visual impact of the aesthetic design is not disrupted?

(b) Is a sawn finish for timber satisfactory or should it be planed?

(c) What are the aesthetic requirements (eg colour scheme, texture of finish)?

(d) Is acoustic testing required?

9 If sample panels are required for approval the Contractor should supply them 6 weeks prior to mass production.

10 The following are some of the points which should be considered when the Contractor's design is checked:

(i) The calculations for wind load and acoustic performance.

(ii) The quality of the materials proposed to be incorporated in the barrier, particularly those, if any, that are not included in the Specification.

(iii) That the structural grades of materials used are in accordance with those quoted in the calculations.

(iv) Workmanship, particularly the method of fixing. For timber, the nails should be of sufficient length to penetrate the rails by not less than 30 mm and in such a manner that nails do not pass through more than one board.

(v) That the acoustic properties are maintained by the avoidance of gaps, including gaps due to shrinkage or thermal movement.

(vi) Easy replacement of parts following accidental or wilful damage.

(vii) Security of components and nature of materials used to discourage wilful damage.

(viii) Acoustic screens up to 3 m high are to be treated as Category 0 structures; higher screens (barriers) are to be treated as Category 1.

Aesthetic Approval

11 Wherever possible Appendix 25/4 should include aesthetic factors which the Contractor will need to take into account when formulating his design. The Contractor's design should be submitted to the Overseeing Organisation for aesthetic approval and the Contractor notified accordingly when this has been given.

Post Foundation Test

12 Testing should be carried out at any barrier location where there is doubt about the resistance of the embedment material. The number and position of tests and the required performance criteria should be stated in Appendix 25/4. Care should be taken to ensure that design assumptions and the required frequency of tests are fully described to enable the Contractor to make adequate provision for testing. Testing should not be carried out when the ground is frozen.

13 Details of foundations should be shown on the Drawings.

Acoustic Performance

14 (05/01) The overall insulation performance of a barrier should be at least 10 dBA higher than the calculated screening attenuation. Care should be taken to prevent loss of performance through leakage at gaps and joints. It should be noted that the mass law may overpredict the insulation performance of barriers

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constructed from timber planks. Consideration should be given as to whether evidence of acoustic tests should be required to demonstrate achievement of specified requirements.

BS EN 1793-2 recommends a classification of barrier products covering ranges of performance measured as DL_R as follows:

B0 not tested
B1 < 15
B2 15 - 24
B3 >24

15 (05/01) Absorptive materials reduce reflected noise and reverberation, which may sometimes reduce the effectiveness of a barrier. Acoustic test results may exceed the theoretical maximum of $\alpha_i = 1$ at some frequencies. This is acceptable provided the overall summation is less than the sum of the weightings. For an overall efficiency of 80%, the absorption index DL_α is approximately 7; the limiting value allowed by the standard is $DL_\alpha = 20$. BS EN 1793-1 recommends a classification of barrier products covering ranges of performance measured as DL_α as follows:

A0 not tested
A1 < 4
A2 4 - 7
A3 8 - 11
A4 > 11

16 The weightings for the range of frequencies covered by the standard are representative of urban conditions; this slightly accentuates performance at lower frequencies where there is most variation between the absorptive materials used in proprietary systems.

17 (05/01) Mechanical performance and stability of complete barrier systems may be specified in accordance with BS EN 1794-1. This provides harmonised methods of indicating resistance to the following factors: wind loads, other applied (static) loads, self weight, impact of stones, impact of vehicles, snow expelled by snow ploughs.

18 (05/01) General safety and environmental protection features of complete barrier systems may be specified in accordance with BS EN 1794-2. This provides harmonised methods of describing the following aspects of performance:

resistance to brush fire, danger of falling debris, environmental advantages and disadvantages of components, dimensions and other requirements for emergency exits, light reflection and transparency.

NG 2505 (05/01) Drainage Structures

1 Pipes can be made of materials, e.g. concrete, that deflect relatively little under load before cracking (rigid pipes) or of materials that will tolerate large deflections under load, e.g. corrugated steel, before inward buckling occurs (flexible pipes). There are also materials, e.g. ductile iron, of intermediate behaviour (semi-rigid pipes) (see BS EN 1295-1 National Annex A). Flexible joints enable all three types of pipe to take up differential settlement within the ground.

2 (11/03) The Contractor should normally be offered in Appendices 25/1 and 25/5 the full selection of pipe types and bedding combinations given in Table 25/1, but see also sub-Clause NG 5 of this Clause.

3 The pipes included in the Specification will normally be satisfactory in respect of their hydraulic flow capacity. However there may be variation between some products, such as vitrified clay and concrete pipes, and in particular corrugated pipes. The effect of a rougher pipe should be considered on the system as a whole and not just on the length in question. A pipe, which is not acceptable on a straight exchange basis, may be acceptable if diameters on adjacent lengths are adjusted. Appendices 25/1 and 25/5 should provide the basis on which the Contractor is to submit his proposals for pipe types and makes.

4 (11/03) Any tendency to deterioration by acidic ground water or sulfates present in the backfill or the ground should be taken into account when the use of concrete, steel or iron pipes is being considered for inclusion in the acceptable alternatives in Appendices 25/1 and 25/5. This matter is considered in detail in sub-Clause NG 501.3. Useful information is also available in the 'Materials selection manual for sewers, pumping mains and manholes' (Foundation for Water Research, 1993). Where concrete pipes are used in extreme conditions there is merit in using oversized pipes to allow space for subsequent lining. The thaumasite form of sulfate attack may also have to be taken into account (refer to BRE Special Report SD1) as well as the use of limestone aggregates as bedding materials (refer to Advice Note HA 40 - DMRB 4.2.5).

5 Pipes of more than one type within any individual drain or service duct between consecutive chambers will be exceptional. Whatever the circumstance giving rise to the proposal, consideration should be given to whether the joint between the two pipes will provide an appropriately watertight joint and smooth inner transition for cleaning purposes.

6 Plastics pipes in excess of 900 mm internal diameter pose problems associated with unauthorised access which may result in vandalism or the lighting of fires. For these reasons they have not been included in Table 25/1.

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7 (11/03) Guidance is given on the spacing, types, detailed design of chambers and on safety during rehabilitation, including the minimum entry size of sewers in the National Annexes NA and NB and Tables NB 2 and 3 of BS EN 752-3.

8 Safety considerations also dictate that where personnel access is required, chamber covers should have a 600 mm x 600 mm clear opening with a minimum diagonal dimension of 700 mm. In carriageways, hard shoulders and verges, chamber covers, frames and gratings should be at least Class D400. Where, exceptionally, covers have to be located in areas subjected to large numbers of high speed heavy goods vehicles, Class E600 chamber covers, frames and gratings should be considered. Advice may be sought from the Overseeing Organisation. It will normally be expected that the minimum frame depth is 150 mm.

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

1 Where differential movements are expected to be significant, then bearing in mind that the magnitude of angular deflection of the joints of larger diameter pipes is usually less than that of the smaller sizes, the maximum length of pipe between flexible joints may well have to be limited. The limits of such restrictions should be shown in Appendix 25/5. Where movements are large, pipe laying should be delayed until as much as possible of the settlement has taken place.

2 The loading on rigid pipes is governed by the conditions under which they are installed and these can be affected by the construction methods used. In the deeper trenches, for example, the load on the pipe is often proportional to the width of the trench. It is imperative, therefore, in such situations that the trench widths used to determine the loading on pipes are not exceeded on site. At the same time adequate working space must be provided and the minimum trench widths for various pipe sizes are given in Table 1 of BS EN 1610. Construction traffic, unless controlled, can also apply heavy loads on pipes and there will be many situations where such loading may determine the strength of pipe required.

3 The matters considered in Clause NG 502 concerning excavation for pipes and chambers and in Clause NG 503 on the bedding, laying and surrounding of pipes are also germane to these activities for pipes exceeding 900 mm diameter.

4 Most joints will be flexible, but rigid joints are occasionally used with clay pipes. Flexible joints should be specified for pipelines in and under embankments, or where differential settlement is expected, such as in compressible soils subject to non-uniform loading.

5 Reference has already been made in sub-Clauses NG 2505.7 and NG 2505.8 on the design of chambers and on the means of access to them.

6 The matters considered in sub-Clause NG 507.1, concerning brick and precast or cast in situ concrete chambers, are also relevant to such access facilities on larger diameter pipes.

7 It may be necessary, due to constraints in pipe lengths, to vary the lengths of the articulated section described in sub-Clause 2506.24. However, the principle of having the joint nearest the chamber as close as possible to the chamber and the next joint positioned so as to give an effective length of intervening articulated pipe, free from constraint by the trench bottom, should be maintained. Where considerable differential movement is anticipated several ‘rocker’ pipes should be laid and the gradient should, if necessary, be adjusted locally to reduce the likelihood of a back fall developing.

8 Where it is not necessary for a pipe to be built into a structure, the effects of differential movement may be overcome by the provision of a relieving arch, lintel or sleeve leaving a gap of not less than 50 mm around the pipe. Effective means should be adopted to prevent the entry of backfill, rodents or gas from whatever source. The designer should take due note of the proximity of underground gas services as indicated by the Department of Energy report into serious gas explosions (Department of Energy, 1977).

9 Where connections have to be made other than at chambers the use of purpose manufactured junction pipes is recommended; indeed the use of saddles should only be permitted where there is no alternative.

NG SAMPLE APPENDIX 25/1: REQUIREMENTS FOR CORRUGATED STEEL BURIED STRUCTURES

1 Design Requirements

[Note to compiler: This should include the outline Approval in Principle form and any other information required to enable the Contractor to complete a detailed design using any bolted or helically wound segmental structure system, having a current Materials for Corrugated Steel Buried Structures Certificate and a British Board of Agrément Certificate for helically wound systems.]

2 Other Information

[To be included as required]

(i) Roughness coefficient.

(ii) Special needs for watertight jointing.

(iii) Special needs for lining of trenches with impervious linings.

(iv) Need for invert pavings.

(v) Need for concrete foundations.

(vi) Need for additional protective coatings.

[Acceptability limits for MCV, if required, for Class 6K and 6M fills should be stated in Appendix 6/1.]

NG SAMPLE APPENDIX 25/2: REQUIREMENTS FOR REINFORCED SOIL AND ANCHORED EARTH STRUCTURES

[Note to compiler: Include here:]

1 Design requirements.

(11/03) *[Where the design retained height exceeds 1.5 m, or in Northern Ireland 1.0 m, include the requirement for the design to comply with Standard BD 2 (DMRB 1.1.1) and the outline Approval in Principle form or in Northern Ireland, include the requirement for the design to comply with the Technical Approval System of the Overseeing Organisation.]*

2 References to drawings showing locations and outlines.

3 Other information.

[Contract-specific earthworks requirements should be included in Appendix 6/1; see NG 622.]

NG SAMPLE APPENDIX 25/3: REQUIREMENTS FOR POCKET-TYPE AND GROUTED-CAVITY REINFORCED BRICKWORK RETAINING WALL STRUCTURES

[Note to compiler: Include here:]

1 Requirements for concrete if different from the requirements of sub-Clause 2503.3.

2 Requirements for wall ties *[2503.5]*.

3 Requirements for damp proof courses *[2503.6]*.

4 Requirements for additives or admixtures *[2503.18]*. *[See sub-Clause 1703.4.]*

5 Requirements for rate of placing of concrete with respect to the rate of brickwork construction *[2503.22]*.

6 Requirements for a time in excess of 14 days before commencement of backfilling *[2503.29]*.

7 Requirements for trial panels *[2503.32, 33]*.

NG SAMPLE APPENDIX 25/4 : ENVIRONMENTAL BARRIERS

[Note to compiler: Include here:]

1 (i) Whether it is satisfactory for timber to be sawn *[2504.7]*.

(ii) The treatment required for post and barrier members *[2504.12]*.

(iii) Testing requirements for foundations, including location, frequency and performance criteria, e.g. allowable angular rotation under load, recovery on removal of load etc. *[2504.19].[Cross referenced in Appendix 1/5]*.

(iv) (05/01) Requirements for moisture content determination *[311]*

(v) (11/02) List of Standards acceptable in verifying sustainable timber sources set by the Forest Stewardship Council or equivalent bodies *[304.5]*

[Where the environmental barrier is to be designed by the Contractor include here:]

2 (i) (11/03) The requirement for the design to comply with Standard BD2 (DMRB 1.1.1) and the outline Approval in Principle form, or in Northern Ireland with the Technical Approval System of the Overseeing Organisation.

(ii) Whether sample panels are required *[2504.15(i)]*.

(iii) Whether posts need to be at 2.4m centres in order to combine with OBB safety fences.

(iv) Whether stepping of panels is permitted and if so what limitations on steps apply *[2504.2, 2504.15(vi)]*

(v) Whether the Contractor is required to design the foundations, posts and/or other supports.

(vi) If applicable, particular requirements for foundations, eg. class of concrete.

(vii) If applicable, particular requirements for any other supports.

(viii) Factors influencing aesthetic approval *[agreed with the Overseeing Organisation]*.

(ix) (05/01) Requirements for materials other than timber, concrete, steel and brickwork *[2504.1, 2504.14]*.

(x) Whether access gates are required *[2504.15]*.

(xi) If applicable, requirements for padlocks to access gates *[2504.15]*.

(xii) If applicable, details of the barrier to be erected to shield a gap provided for access *[2405.15]*.

(xiii) Minimum height of the barrier above road or other reference level *[2504.2]*.

(xiv) If applicable, inclination of barrier *[2504.5(iii)]*.

(xv) (05/01) If applicable, sound reduction index requirements specified in accordance with BS EN 1793-2 *[2504.17]*.

(xvi) (05/01) If applicable, sound absorption coefficient requirements specified in accordance with BS EN 1793-1 *[2504.18]*.

(xvii) (05/01) If applicable, requirements for mechanical performance and stability specified in accordance with BS EN 1794-1.

(xviii) (05/01) If applicable, requirements for general safety and environmental protection specified in accordance with BS EN 1794-2.

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NG SAMPLE APPENDIX 25/5: (05/01) REQUIREMENTS FOR BURIED RIGID PIPES FOR DRAINAGE STRUCTURES

[Note to compiler: Include here:]

1 The requirements, including hydraulic ones, of all drainage structures *[2505.1, 2505.2, 2505.3]*.

2 Schedule of locations where pipe lengths are limited *[2506.1]*.

3 (11/03) A schedule of the maximum trench widths used in the structural design of drainage structures using rigid pipes: these widths should not be exceeded on site *[2506.2]*.

4 A schedule of permitted alternative pipe bedding combinations and aggregate types *[2506.4 and 2506.5]* and list of pipelines to be constructed other than in a trench *[608.8]*.

5 The requirements for minimising water flows along the granular beddings surrounding rigid pipes *[2506.7]*.

6 Where rigid joints are permitted, if at all *[2506.9]*.

7 Backfilling requirements differing from sub-Clauses 2506.12 and 2506.21: references to drawings giving locations where backfilling is required to a level other than that specified in sub-Clauses 2506.3 and 2506.14.

8 (a) drains to new drainage structures and details of special connecting pipes *[2506.15]*.

(b) requirements for sealing, removal or grouting of existing drains occasioned by the construction of new drainage structures *[2506.15]*.

9 References to drawings showing details of chambers for drainage structures *[2506.16 and 2506.19]*.

10 Requirements for testing the watertightness of chambers on drainage structures carrying foul water *[2506.22]*.

11 Details of chamber covers, gratings and frames including special duty covers for use in carriageways *[2506.23]*.

12 Requirements for setting existing covers and gratings to level if different from the requirements of sub-Clause 2506.25.

13 Where saddles may be used, if at all *[2506.27]*.