IMPLEMENTATION SPECIFICATION FOR ROAD

WORKS

SERIES IM/600

EARTHWORKS



This Specification Series implements the requirements in Subsidiary Legislation 499.57, Part II (New Roads and Road Works Regulations) in accordance with the Agency for Infrastructure Malta ACT XXV111, CAP. 588, Part I

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600 EARTHWORKS

601 Classification, Definitions and Uses of Earthworks Materials

1 This IM Series is part of the Specification for Road Works (Implementation). Whilst this Series is particularly relevant to the subject matter in its title it must be read in conjunction with the general requirements in IM Series 000 and 100 and with all other Series relevant to the specification for the particular works to be undertaken.

General Classification

- 2 Earthworks materials shall fall into one or other of the following general classifications:
 - Acceptable material: material excavated from within the site or imported on to the site which meets the requirements of Table 600-6 and contract specific IM Appendix 6/1 for acceptability for use in the permanent works;
 - b) Unacceptable material Class U1A as defined in sub-Clauses 3 of this Clause: material excavated from within the site which, unless processed so that it meets the requirements of Table 600-6 and contract specific IM Appendix 6/1, shall not be used in the permanent works;
 - c) Unacceptable material Class U1B as defined in sub-Clause 3 of this Clause: material excavated from within the site which, unless processed so that it meets the requirements of Table 600-6 and contract specific IM Appendix 6/1, shall not be used in the permanent works; and
 - d) Unacceptable material Class U2 as defined in sub-Clause 3 of this Clause: material excavated from within the site which shall not be used in the permanent works.

Recycled Content and Green Public Procurement

3 Recycled content is permitted in Earthworks materials as described in *Table 600-6* **Table 600-7** and **Table 600-9** and in Series IM/660.

Unacceptable Materials

- 4 Unacceptable material Classes U1A and U1B:
 - a) Unacceptable material Class U1A shall be:
 - Material which does not comply with the permitted constituents and material properties of Table 600-6 and contract specific IM Appendix 6/1 for acceptable material; and
 - Material, or constituents of materials, composed of organic material, and/or perishable material unless otherwise described in contract specific IM Appendix 6/1.

- b) Unacceptable material Class U1B shall be:
 - i) Contaminated materials, including controlled wastes (as defined in Legislation under the Environment Protection Act (CAP 549) whose level of contamination is above that given either in contract specific IM Appendix 6/14 or in contract specific IM Appendix 6/15, but excluding all hazardous wastes (as defined in the Legislation under Environment Protection Act (CAP 549).
 - i) Blue clay as found in Malta geology.
- 5 Unacceptable material Class U2 shall be:
 - a) Hazardous waste (as defined in the Legislation under Environment Protection Act (CAP 549).
- 6 Where required in contract specific IM Appendix 6/1, unacceptable material (other than Class U2) shall be processed by mechanical, chemical or other means to render the material acceptable for use in the permanent works in accordance with the requirements of Table 600-6, Table 600-7, Table 600-8 and
- 8 Table *600-9* and contract specific IM Appendix 6/1.

Definitions

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- 9 Where source codes are referred to these shall be for materials from the sources listed in Table 600-7.
- 10 Formation shall be the top surface of capping. Where no capping is required formation shall be the top surface of earthworks at the underside of sub-base, unless otherwise shown on the drawings.
- 11 Sub-formation shall be the top surface of earthworks at the underside of capping.



Figure 1 Pavement layer identification scheme

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Stabilisation shall mean the spreading of cement or lime or both on a layer of deposited or intact granular or cohesive material, and the subsequent process of pulverising and mixing followed by appropriate compaction to form the whole or a constituent layer of a capping.

- 13 Where 'recycled aggregate' is used in this Series, the material shall be aggregate resulting from the processing of inorganic or mineral material previously used in construction and shall have been tested in accordance with Clause 709. It shall not contain more than 1% other materials (Class X), not more than 50% in Class Ra (bituminous materials) and not more than 25% in Class Rg (crushed glass). Where 'recycled aggregate' is imported onto the site, it shall be aggregate complying with MSA EN 13242 from source code A (construction and demolition recycling industries).
- 14 Where 'recycled aggregate except recycled asphalt' is used in this Series, the aggregate shall have been tested in accordance with Clause 709. It shall not contain more than 1% other materials (Class X), not more than 1% in Class Ra (bituminous materials) and not more than 5% in Class Rg (crushed glass). Where 'recycled aggregate except recycled asphalt' is imported onto the site, it shall be aggregate complying with MSA EN 13242 from source codes A2 (crushed concrete).
- 15 'As dug' shall mean material that has been excavated, transported and placed without any processing. Where imported material undergoes any processing, including cleaning and sorting, it will not be deemed 'as dug' and thus shall be aggregate complying with MSA EN 13242.

Use of Fill Materials

- 16 In addition to any grading requirements the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness.
- 17 Materials placed within 500 mm, or any other distances described in the contract specific IM Appendix 6/3, of concrete, cement bound materials, other cementitious mixtures or stabilised capping forming part of the permanent works shall conform to, as appropriate, the following requirements:
 - a) Materials shall conform to the following criteria:
 - Water-soluble sulfate (WS) content determined in accordance with MSA EN 1744-1 clause 10 shall not exceed 1500 mg of sulfate (as SO₄) per litre;
 - ii) Total sulfur (TS) content determined in accordance with MSA EN 1744-1 clause 11 expressed as (S) shall not exceed 1% for aggregates.
 - b) Materials shall conform to at least one of the following options:
 - i) When described in accordance with MSA EN 932-3 and MSA EN 13242 Annex A, limestone, dolomite, or crushed concrete are predominant.
 - ii) The sulfide content of the material determined in accordance with MSA EN 1744-1 Clause 13 is less than 0.5% (as SO₄).
- 18 When determining WS, TS or sulfide content, at least five samples of each material shall be tested. The mean of the highest two values shall be used for comparison with the limiting values. This shall also apply if six to nine results are available. If ten or more results are available, the mean of the highest 20% of the results shall be used for comparison with the limiting values.
- 19 Material placed within 500mm, or any other distances described in the contract specific IM Appendix 6/3, of metallic structural elements forming part of the permanent works shall conform, as appropriate, to the following requirements:
 - a) Materials shall conform to the following criteria:
 - Water-soluble sulfate (WS) content determined in accordance with MSA EN 1744-1 clause 10 shall not exceed 300 mg of sulfate (as SO₄) per litre; and
 - ii) Total sulfur (TS) content determined in accordance with MSA EN 1744-1 clause 11 expressed as (S) shall not exceed 1% for aggregates.
 - b) Materials shall conform to at least one of the following options:
 - i) When described in accordance with MSA EN 932-3 and MSA EN 13242 Annex A, limestone, dolomite, or crushed concrete are predominant.
 - ii) The sulfide content of the material determined in accordance with MSA EN 1744-1 Clause 13 is less than 0.06% (as SO₄).
- 20 When determining WS, TS or sulfide content, at least five samples of each material shall be tested. The mean of the highest two values shall be used for comparison with the limiting

values. This shall also apply if six to nine results are available. If ten or more results are available, the mean of the highest 20% of the results shall be used for comparison with the limiting values.

21 The requirements in (a) and (b) above shall not apply to metallic items protected by concrete or ancillary metallic items such as the tops of chambers and gullies.

602 General Requirements

- 1 The requirements of BS 6031 Code of Practice for Earthworks and BS 5975 Code of practice for temporary works procedures and the permissible stress design of falsework shall apply as required.
- 2 The Contractor shall employ only plant and working methods which are suited to the materials to be handled and traversed. They shall be responsible for maintaining the nature of the acceptable material so that when it is placed and compacted it remains acceptable in accordance with the contract. Acceptability shall be determined in accordance with Table 600-6 and any special contract specific requirements in IM Appendix 6/1.
- 3 Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition to ensure compliance with Clause 610.
- 4 No excavated acceptable material or unacceptable material required to be processed, other than surplus to the requirements of the contract, shall be removed from the site unless indicated otherwise in contract specific IM Appendix 6/1. Where the Contractor is permitted to remove acceptable material, or unacceptable material required to be processed, from the site to suit his operational procedure, then they shall make good any consequent deficit of material arising therefrom. Environmental requirements for processing of Class U1B material, in terms of limiting values of contaminants or other requirements, shall be set out in contract specific IM Appendix 6/1 in the earthworks Class for which the processed material is to be used.
- 5 If any acceptable material or unacceptable material required to be processed is, where permitted by contract specific IM Appendix 6/1, used by the Contractor for purposes other than for general fill, sufficient acceptable fill material to occupy, after full compaction, a volume corresponding to that which the excavated material occupied shall be provided by the Contractor.
- 6 Acceptable material (other than Class 5A or any Class 5B material replacing Class 5A material in accordance with sub-Clause 3 of this Clause) surplus to the total requirements of the permanent works and all unacceptable material Class U1A not required to be processed shall, unless indicated otherwise in contract specific IM Appendix 6/1, be run to spoil in tips provided by the Contractor. In the case of unacceptable material, Class U1B and Class U2, the Contractor shall comply with any specific requirements for disposal described in contract specific IM Appendix 6/2.
- 7

Where the excavation reveals a combination of acceptable and unacceptable materials the

Contractor shall, unless indicated otherwise in contract specific IM Appendix 6/3, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. Unless otherwise described in the contract classes of fill material required to be deposited separately shall be excavated separately without contamination by other Classes of material.

- 8 The Contractor shall make his own arrangements for stockpiling of acceptable material, and unacceptable material to be processed, and for the provision of sites for the purpose.
- 9 The Contractor shall ensure that they do not adversely affect the stability of excavations or fills by his methods of stockpiling materials, use of plant or siting of temporary buildings or structures.
- Existing topsoil material shall, except where it is to be left in place in the locations described in contract specific IM Appendix 6/8, be stripped to depths as described in contract specific IM Appendix 6/8 for Class 5A material from all areas of cutting and from all areas to be covered by embankment or by other areas of fill. Where stated in contract specific IM Appendix 6/8 existing topsoil shall be stripped as follows:
 - a) Grass shall be mown before lifting to no more than 35 mm high.
 - b) Turves shall be cut using plant or tools designed for the purpose.
 - c) Turves shall not be cut from soil that is waterlogged, as defined in Clause 614, or excessively dry.
 - d) Turves shall be of uniform thickness.
 - e) Turves shall be rectangular, with the shorter sides not less than 300 mm.

Topsoil shall wherever practicable be used immediately after its stripping and if not shall be stored in stockpiles of heights not exceeding 2 m or other heights stated in contract specific IM Appendix 6/8. Unless otherwise stated in contract specific IM Appendix 6/8, topsoil shall not be stockpiled for more than two years. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged, or otherwise loaded and multiple handling shall be kept to a minimum.

- 11 All Class 5A topsoil arising from the site, or any Class 5B material replacing Class 5A material in accordance with sub-Clause 3 of this Clause, in excess of the requirements for topsoiling, shall be subject to the requirements described in contract specific IM Appendix 6/8.
- 12 Excavations for foundations and trenches shall be adequately supported at all times, and except where otherwise described in contract specific IM Appendix 6/3, shall not be battered. Where excavations are permitted to be battered, they shall be benched as described in contract specific IM Appendix 6/3 prior to backfilling and compaction. The additional work and materials shall be provided by the Contractor. Sheeting and other excavation supports shall be removed as filling proceeds except where they are required in

contract specific IM Appendix 6/3 to be left in position.

- 13 Excavations requiring backfilling shall remain open only for the minimum period necessary.
- 14 Excavations requiring backfilling in existing paved or other surfaces, including those paved areas to be reconstructed or repaired, shall be carried out and reinstated in compliance with Clause 706.
- 15 The Contractor shall keep earthworks free of water including:
 - a) Arranging for the rapid removal of water by pumping out or appropriate measures:
 - i) Shed on to the earthworks including rainwater;
 - i) Entering the earthworks from any source including seawater tidal level shifts.
 - b) Lowering and maintaining by pumping out or appropriate measures, the water level in excavations, sufficiently to enable the permanent works to be constructed.
- 16 In carrying out the requirements of sub-Clause 14 of this Clause the Contractor shall:
 - Form and maintain cuttings, embankments and other areas of fill with appropriate falls and gradient and sealed surfaces;
 - b) Provide where necessary temporary watercourses, drains, pumping and the like;
 - c) Discharge accumulated water and groundwater into the permanent outfalls of the drainage system where practicable;
 - d) Provide adequate means for trapping silt on temporary systems discharging into permanent drainage systems.
- 17 The Contractor shall carry out and maintain any groundwater lowering or other treatment required in contract specific IM Appendix 6/1.
- 18 Where materials are designated in the contract as either Class U1B or Class U2, the Contractor shall carry out any special requirements for their handling described in contract specific IM Appendix 6/2. Where such materials are encountered during the progress of the works, the Contractor shall make all necessary arrangements for their safe handling and disposal after consultation with the appropriate environmental authority.

603 Forming of Cuttings and Cutting Slopes

- 1 Cuttings shall be excavated to the lines and levels described in contract specific IM Appendix 6/3.
- 2 Cutting slopes or toes of cuttings shall only be undercut when required in the contract for trench or other excavations. Such excavations shall be restricted in extent as described in contract specific IM Appendix 6/3 and where they require backfilling shall remain open only for the minimum period necessary, to prevent risk to the permanent works.
- 3 Except where otherwise described in contract specific IM Appendix 6/3, the excavation of cuttings may be halted at any stage providing at least 300 mm of material as a weather protection is left in place above the formation or above the sub-formation, subject to the

requirements of Clauses 611 and 612.

- 4 Final faces of cuttings which are not to receive topsoil shall:
 - a) wherever possible be left without scars or damage from construction plant; and
 - b) to achieve a natural appearance, when the stratum permits have the face left irregular within tolerances given in contract specific IM Appendix 6/3; and
 - c) have boulders or other rock fragments that can be moved by hand without tools, removed; and
 - where required in contract specific IM Appendix 6/3 have material that can be blown away by airline hose, having pressures no greater than those stated therein, so removed; and
 - e) have adequate access to enable inspection to be carried out to determine the extent of work required by this sub-clause.
 - Where required in contract specific IM Appendix 6/3, faces of cuttings which are not required to receive topsoil shall have one or more of the following measures carried out as appropriate:
 - a) Isolated patches of soft, fragmented and insecure material shall each be excavated to a depth of at least 200 mm unless other depths are stated in contract specific IM Appendix 6/3 and replaced as soon as practicable with ST2 concrete to Clause 2602 well rammed into the cleaned-out void.
 - b) Areas of cutting face requiring their surface to be made stable shall be trimmed back by a nominal 50 mm or other amount required in contract specific IM Appendix 6/3 and the resulting surface together with an area of any surrounding intact material as detailed in contract specific IM Appendix 6/3, shall have a suitable cement-based grout or sprayed concrete, applied by pressure to form a total nominal thickness of 40 mm unless the required thickness is stated in contract specific IM Appendix 6/3. Where required in contract specific IM Appendix 6/3, reinforcement shall be fixed to the surface before application of the concrete or grout. Weep holes using permanent formers shall be constructed to the requirements of contract specific IM Appendix 6/3 and at the locations described in contract specific IM Appendix 6/3.
 - c) Soft or insecure material interlayered with rock shall be excavated to the depth behind the face described in contract specific IM Appendix 6/3. The resulting cavity shall be filled with ST2 concrete to Clause 2602 or with masonry infill complying with the Series 2400 and provided with weep holes all in accordance with requirements in contract specific IM Appendix 6/3.
 - Netting or other sheet covering as described in contract specific IM Appendix 6/3 or rock bolts as described in contract specific IM Appendix 6/10.

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- 6 Where required in contract specific IM Appendix 6/3, faces of cuttings which are to receive topsoil shall have one or more of the following measures carried out as appropriate:
 - a) Be benched to retain topsoil as described in contract specific IM Appendix 6/3.
 - b) Be harrowed to a depth of 50 mm. Such harrowing shall be carried out immediately prior to topsoiling, diagonally, at an angle between 5° to 45° to the line of the toe, measured on the plane of the slope.
 - c) Isolated patches of soft, fragmented or insecure material shall be excavated and either:
 - i) Filled by well ramming in a Class of fill with similar characteristics as the surrounding intact material; or
 - i) Excavated and dealt with as described in sub-Clause 5(a) of this Clause.
 - d) Other areas required to be made stable shall be dealt with as stated in contract specific IM Appendix 6/3.
- 7 The concrete, referred to in sub-Clauses 5(a) and 5(c) of this Clause, permanently exposed on the face of the cutting shall have surface features as nearly as possible matching those of the adjacent intact face. Such concrete and the grout referred to in sub-Clause 5(b) of this Clause shall have a consistent colour as nearly as possible matching that of the adjacent intact face.

604 Excavation for Foundations

1 The bottom of all foundation excavations shall be formed to the lines and levels shown on the drawings. Pockets of soft soil or loose rock shall be removed, and the resulting voids and any natural voids shall be filled with ST1 concrete to Clause 2602 (or other material as required by contract specific IM Appendix 6/3) except in excavations for corrugated steel buried structures when Class 6K lower bedding fill material complying with

- 2 Table 600-11 shall be used.
- 3 After placing of any blinding concrete shown on the drawings, no trimming of the side faces of the excavation shall be carried out for 24 hours.
- 4 The Contractor shall make good:
 - a) Any lateral overbreak of the excavation above the bottom of the foundation greater than the net volume required for the permanent works with material of the same Class as used for fill above structural concrete foundations to comply with Clause 609 (except that for corrugated steel buried structures Class 6K lower bedding material shall be used) or, where the excavation is too narrow to allow the compaction of earthworks materials, with ST1 concrete to Clause 2602;
 - b) Any additional excavation at or below the bottom of foundations, including that resulting from removal of material which the Contractor has allowed to deteriorate, with ST1 concrete to Clause 2602 (or other material required by contract specific IM Appendix 6/3) except that under corrugated steel buried structures Class 6K lower bedding material shall be used.
- 5 Class 6K lower bedding material referred to in this Clause shall be deposited and compacted in compliance with Clauses 606 and 610 and

6 Table *600-11*.

605 Watercourses

- 1 The clearance and modification of existing, or the construction of new watercourses, including ditches, canals, streams (including seasonal streams), wetlands and ponds, shall be as described in contract specific IM Appendix 6/3 including any protection, lining, revetment or other works and shall comply with sub-Clauses 2 to 4 of this Clause.
- 2 Clearance of existing watercourses shall include the removal of vegetation, vegetable matter and all other deposits within the watercourse profile. Materials resulting from this clearance shall be dealt with as unacceptable material.
- 3 New watercourses and cleared existing watercourses shall be maintained in a clear condition.
- 4 Redundant watercourses shall, where required in contract specific IM Appendix 6/3, be drained and cleared in accordance with sub-Clause 2 of this Clause and material outside the watercourse profile excavated and dealt with as unacceptable material. The excavations shall be to the dimensions stated in the contract and the whole filled with general or selected fills of the Class described in contract specific IM Appendix 6/3 complying with Table 600-6 deposited and compacted in compliance with Clause 606 and 610. Where the surface is to remain exposed it shall be topsoiled and seeded, or receive other treatment, all as described in contract specific IM Appendix 6/3.

606 Construction of Fills

- 1 All fills, including embankments, shall be constructed:
 - a) In the locations described in contract specific IM Appendix 6/3 to the lines and levels stated therein;
 - b) Of classes of materials required or permitted in contract specific IM Appendix 6/1, complying with Table 600-6 with, unless otherwise described in the contract, only Class 6A material deposited into open water;
 - c) By depositing, as soon as practicable after excavation, in layers to meet the compaction requirements of Clause 610 as required for each Class of material in Table 600-6 except that:
 - Material requiring end product compaction shall be deposited in layers not exceeding 250 mm uncompacted thickness;
 - i) Material placed into open water shall be deposited by end tipping without compaction;
 - iii) Material deposited in areas to receive dynamic compaction complying with clause 626 shall be deposited and compacted to the requirements therein.

- iv) To the requirements of this Clause and any other requirements for fill in this Series.
- 2 Starter layers of Classes 6B, 6C or 6D materials as described in contract specific IM Appendix 6/3 shall be deposited as the first layer or layers of fill above existing ground level or, if appropriate, above any ground improvement required by contract specific IM Appendix 6/13. Plant movement across starter layer material shall be restricted to that plant which is necessary for its deposition, spreading and compaction in compliance with this Clause and Clause 610 and any plant required to carry out any ground improvement beneath it if required by Clause 626. The Contractor shall take all reasonable measures to prevent damage to the underlying strata, which may include use of lighter spreading plant or a reduction of the number of passes of compaction plant.
- 3 Coarse granular material Classes 1C and 6B shall, before compaction, be spread in layers by a crawler tractor of not less than 15 tonnes total mass. After compaction each layer shall, if voids remain, be blinded with an approved Class of granular material complying with Table 600-6 and Table 600-8 so that all surface voids are filled before the next layer and before any capping or sub-base is constructed.
- 4 Embankments and other areas of fill shall, unless otherwise required in the contract, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct constructional plant and other vehicular traffic uniformly over them. Damage by constructional plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.
- 5 Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those described in contract specific IM Appendix 6/3, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material. However, any oversteepening or increase in width shall not exceed any limits described in contract specific IM Appendix 6/3 and shall remain only for the minimum periods necessary consistent with the safety of the permanent works.
- 6 Staged construction of fills and any controlled rates of filling shall be carried out, in accordance with any requirements described in contract specific IM Appendix 6/3 including installation of instrumentation and its monitoring, in compliance with Clause 624.
- 7 Where required in contract specific IM Appendix 6/3 the Contractor shall surcharge embankments or other areas of fill, as described therein for the periods stated. If settlement of surcharged fill results in any surcharging material, which is unacceptable for use in the fill being surcharged, lying below the formation or, where there is a capping, the sub- formation, the Contractor shall remove this unacceptable material and dispose of it in accordance with Clause 602. They shall then bring the resultant level up to formation or sub-formation, as appropriate, with acceptable material.
- 8

Where pipes in embankments or in other areas of fill are permitted in contract specific IM

Appendix 5/1 to be constructed other than in a trench, the fill shall be brought up to and over them equally on both sides. The fill shall be deposited in even layers and shall not be heaped above the pipe. Spreading and compaction shall be carried out evenly without dislodging, distorting or damaging the pipe. Power rammers are not to be used within 300 mm of any part of the pipe or joint.

- The last 600 mm depth of fill up to sub-formation level, or formation level as appropriate, shall, unless otherwise required in the Contract, be carried out for the full width of embankments, or between the outer extremities of the verges in other areas of fill, in a continuous operation. The Contractor shall then continue without delay to carry out either (a) or (b) below:
 - a) Form the sub-formation or formation, all in accordance with Clauses 611 and 612, following immediately either by:
 - i) The construction of the full thickness of capping or sub-base as appropriate; or
 - i) If permitted in contract specific IM Appendix 6/3, the construction of a lesser thickness of capping or sub-base as described therein laid as a weather protection layer;
 - b) Place an additional 300mm minimum compacted thickness of material above subformation level or formation level as appropriate for the full width of the filling to form a weather protection. This weather protection shall be composed of the same material as the sub-formation or formation and compacted in compliance with Table 600-8. The material shall be provided from the contractor's own resources and the protection layer shall be constructed in a continuous operation. For stabilised capping, the protective layer shall consist of un-stabilised material.
- 10 Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations, such faces shall be benched or otherwise shaped as required in contract specific IM Appendix 6/3 immediately before placing the subsequent fill.

607 Geotextiles, Geotextile-related Products and Geogrids Used to Separate or Reinforce Earthworks

- 1 Geotextiles and geotextile-related products (Eg. GeoGrids) shall conform to the requirements of the product standards MSA EN 13249 (Roads and Traffic Areas), 13251 (Eartworks, Foundations, Retaining Structures), 13252 (Drainage Systems), 13253 (Erosion Control), 13256 (Tunnels) and other characteristics and locations as set out in contract specific IM Appendix 6/5 or as described in the Bills of Quantities. A Declaration of Performance DoP) for each product stating compliance with the relevant standard and the required levels of performance stated in contract specific IM Appendix 6/5 shall be submitted to the Overseeing Organisation prior to their placement in the works.
- 2 The requirements in **Table 600-1** and **Table 600-2** shall apply:

Table 600-1: Geotextiles (PET)

		400 g/m2	600 g/m2
Characteristic	Test Method	Nominal Value	Nominal Value
Mass per unit area (g/m2)	EN ISO 9864	400 (-60)	600 (-60)
Tensile strength (kN/M)	EN ISO 10319		
	MD		
	CMD		
Elongation (%)	EN ISO 10319		
	MD		
	CMD		
Static puncture resistance (N)	EN ISO 12236		
Dynamic perforation test	EN ISO 13433		
(mm)			
Supported pyramidal	EN 14574		
puncture resistance (N)			

Table 600-2: Geotextiles (PP)

		400 g/m2	600 g/m2
Characteristic	Test Method	Nominal Value	Nominal Value
Mass per unit area (g/m2)	EN ISO 9864		
Tensile strength (kN/M)	EN ISO 10319		
	MD		
	CMD		
Elongation (%)	EN ISO 10319		
	MD		
	CMD		
Static puncture resistance (N)	EN ISO 12236		
Dynamic perforation test	EN ISO 13433		
(mm)			
Supported pyramidal	EN 14574		
puncture resistance (N)			

Table 600-3: Geogrids

Characteristic	Test Method	
Mass per unit area (g/m2)	EN ISO 9864	
Tensile strength (kN/M)	EN ISO 10319	
	MD	
	CMD	
Elongation (%)	EN ISO 10319	
	MD	
	CMD	
Static puncture resistance (N)	EN ISO 12236	
Dynamic perforation test	EN ISO 13433	
(mm)		
Supported pyramidal	EN 14574	
puncture resistance (N)		

608 Fill to Structures

1 This Clause shall apply to fill to structures other than:

- a) Fill for reinforced earth structures, including associated drainage layers;
- b) Fill for anchored earth structures including associated drainage layers;
- c) Fill for surround and bedding of steel buried structures (including corrugated steel buried structures);
- d) Fill above structural concrete foundations unless otherwise required in contract specific IM Appendix 6/6.
- 2 Materials, as required or permitted in contract specific IM Appendix 6/6 of Classes 6N and 6P complying with Table 600-8 shall be used as fill to structures, in the locations described in contract specific IM Appendix 6/6.
- 3 The Contractor shall compact, in compliance with Clause 610, end-product compaction, Class 6N and 6P material to satisfy the compaction requirements for those Classes as listed in Table 600-8, but subject to the restrictions in sub-Clauses 4 and 5 of this Clause.
- Where fill to structures is required to the same level on more than one side of a structural element or buried structure (except where Clause 619 applies) it shall be maintained at heights not differing by more than 250 mm after compaction on opposing sides of the structural element as filling proceeds.
- 5 The Contractor shall restrict compaction plant used on fill to structures, within 2 m of a

structure, to the following items as described in sub-Clause 610.11 and listed in Table 600-8.

- a) Vibratory roller having a mass per metre width of roll, as determined by sub-Clause
 610.11, not exceeding 1,300 kg with a total mass not exceeding 1,000 kg;
- b) Vibrating plate compactor having a mass not exceeding 1,000 kg;
- c) Vibro-tamper having a mass not exceeding 75 kg.
- 6 The compacted level of the fill within this zone shall not differ during construction from the compacted level of the remainder of the adjoining fill to structures by more than 250 mm.
- 7 Where required in contract specific IM Appendix 6/6, Class 6N and 6P material shall be shown, by means of a trial utilising not less than 20 m³ of the material, deposited and compacted in accordance with this Clause, to be stable, when it is trimmed to a slope of 1 vertical to 1¹/₂ horizontal, or other slope described in contract specific IM Appendix 6/6.

609 Fill Above Structural Concrete Foundations

- 1 Fill deposited above structural concrete foundations shall be, as shown on the drawings:
 - a) Class 6N and 6P selected fill material complying with Clause 608 including compaction requirements;
 - b) Another class of selected fill or general fill complying with Table 600-8 deposited and compacted in compliance with clauses 606 and 610 and in addition be subject to subclauses 608.4 and 5.

610 Compaction of Fills

- 1 Except for dynamic compaction, which shall comply with Clause 626, and unless otherwise described in contract specific IM Appendix 6/3, the Contractor shall carry out compaction in compliance with this Clause, as soon as practicable after deposition, on all those Classes of fill in
- 2
- 3 *Table 600-9* which require to be compacted.
- 4 Compaction shall be either method or end-product as required for the Class of fill in

Table 600-9, using plant appropriate to the Class of fill and the site conditions.

5 The Contractor shall obtain permission from the Overseeing Organisation before carrying out compaction outside normal working hours.

Method Compaction

6

This sub-clause details four methods for types of compaction plant. Each method states the number of passes required for a compacted layer thickness. Method compaction shall comply with methods 2, 3, 5 and 6 depending on material type. Table 600-4 provides examples of cohesive and granular material types. Table 600-5 defines which compaction method should be used for different materials.

Table 600-4: Material Types

Material Type	Examples
Cohesive	Most clays soils, includes cohesive soils e.g. sandy soils
Granular	Type 1 & 2 sub-base, lean mix, and Cement Bound Granular Material (CBGM)

Table 600-5: Compaction of Earthworks Material: Plant and Methods

Method 2	 Stoney cohesive material Well graded granular material Dry cohesive material
Method 3	 Uniformly graded or granular material Silty cohesive material Granular drainage layers
Method 5	1. Course granular material (starter layer)
Method 6	 Cement stabilized granular material Course and finely graded granular capping layers

- 7 Where method compaction is required to be adopted it shall comply with sub-Clauses 6 to 11 of this Clause.
- 8 Except as stated in sub-Clause 7 of this Clause, method compaction shall be undertaken using the plant and methods in Table 600-14 appropriate to the compaction requirements as listed in Tables 600-2 to 600-5 for the Class of material being compacted.
- 9 Plant and methods not included in Tables 600-3 to 600-6 shall only be used providing the Contractor demonstrates at site trials that a state of compaction is achieved by the alternative method equivalent to that obtained using the specified method.
- 10 Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier

plant be taken into account when assessing the amount of compaction required for any layer.

- 11 If more than one Class of material is being used in such a way that it is not practicable to define the areas in which each Class occurs, the Contractor shall compact with plant operating as if only the material which requires the greater compactive effort is being compacted.
- 12 The Contractor or Overseeing Organisation may carry out field dry density tests as described in sub-Clause 16 of this Clause on material compacted to method requirements at a frequency defined in contract specific IM Appendix 6/3. If the results of field tests show densities which indicate the state of compaction to be inadequate, then if this is due to failure of the Contractor to comply with the requirements of the contract, the Contractor shall carry out such further work as is required to comply with the contract.
- 13 For the purposes of Table 600-14 the following shall apply:
 - a) The minimum number of passes N is the minimum number of times that each point on the surface of the layer being compacted shall be traversed by the item of compaction plant in its operating mode or struck by power rammers or falling weight compactors.
 D is the maximum depth of the compacted layer.
 - b) In column headed N # the number of passes shown is to be doubled for material Classes 1A and 1B when such materials occur within 600 mm of sub-formation (if capping is required) or formation. Such extra compaction shall, unless otherwise described in contract specific IM Appendix 6/3, either be carried out for the full width of the embankment or, in other areas of fill which are to receive a pavement, between the outer extremities of the verges.
 - c) The compaction plant in Table 600-14 is categorised in terms of static mass. The mass per metre width of roll is the total mass on the roll divided by the total roll width. Where a smooth wheeled roller has more than one axle the category of the machine shall be determined on the basis of the axle giving the highest value of mass per metre width.
 - d) A grid roller is a machine with a compacting roll or rolls constructed of heavy steel mesh of square pattern.
 - e) A deadweight tamping roller is a machine with a roll or rolls from which 'feet' project and where the projected end area of each 'foot' exceeds 0.01 m² and the sum of the areas of the feet exceeds 15% of the area of the cylinder swept by the ends of the feet. The requirements for tamping rollers apply to machines that have 2 rolls in tandem. If only one tamping roll traverses each point on the surface of the layer on any one pass of the machine, the minimum number of passes shall be twice the number given in Table 600-14 plus any further doubling required to satisfy (b) above.

- f) For pneumatic-tyred rollers the mass per wheel is the total mass of the roller divided by the number of wheels. In assessing the number of passes of pneumatic-tyred rollers the effective width shall be the sum of the widths of the individual wheel tracks together with the sum of the spacings between the wheel tracks provided that each spacing does not exceed 230 mm. Where the spacings exceed 230 mm the effective width shall be the sum of the widths of the individual wheel tracks only.
- g) A vibratory tamping roller, which may be self-propelled or towed, is a machine having a means of applying mechanical vibration to one or more rolls. The roll or rolls have projecting feet where the height of each foot exceeds 10% of the radius of the roll drum, the projected end area of each foot exceeds 0.1% of the roll drum surface area, and the sum of the areas of the feet exceeds 10% of the area of the cylinder swept by the ends of the feet. The requirements for the operation of vibratory tamping rollers shall be the same as those stated for vibratory rollers in sub-Clause (h) except that vibratory tamping rollers operating without vibration will be classified as deadweight tamping rollers.
- h) Vibratory rollers are self-propelled or towed smooth-wheeled rollers having means of applying mechanical vibration to one or more rolls except that vibratory rollers employed for Method 5 compaction shall be single roll types. Vibratory rollers operating without vibration will be classified as smooth-wheeled rollers. The requirements for vibratory rollers are based on the use of the lowest gear on a selfpropelled machine with mechanical transmission and a speed of 1.5 to 2.5 km/h for a towed machine, or a self- propelled machine with hydrostatic transmission. If higher gears or speeds are used an increased number of passes shall be provided in proportion to the increase in speed of travel. Where the mechanical vibration is applied to two rolls in tandem, the minimum number of passes shall be half the number given in Table 600-14 for the appropriate mass per metre width of one vibrating roll but if one roll differs in mass per metre width from the other the number of passes shall be calculated as for the roll with the smallest value. Alternatively, the minimum number of passes may be determined by treating the machine as having a single vibrating roll with a mass per metre width equal to that of the roll with the higher value. Vibratory rollers shall be operated with their vibratory mechanism operating only at the frequency of vibration recommended by the manufacturers. Where more than one amplitude setting is available and/ or a range of frequencies is recommended, the machine shall be operated at the maximum amplitude setting and at the maximum recommended frequency for that setting. Vibratory rollers shall be equipped or provided with devices indicating the frequency at which the mechanism is operating and the speed of travel. Both devices shall be capable of being read by an inspector alongside the machine.

- i) Vibrating-plate compactors are machines having a base-plate to which is attached a source of vibration consisting of one or two eccentrically weighted shafts and:
 - The mass per square metre of the base-plate of a vibrating-plate compactor is calculated by dividing the total mass of the machine in its working condition by its area in contact with compacted material;
- j) Vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturers. They shall normally be operated at travelling speeds of less than 1 km/h but if higher speeds are necessary the number of passes shall be increased in proportion to the increase in speed of travel. Vibro-tampers are machines in which an engine-driven reciprocating mechanism acts on a spring system through which oscillations are set up in a base-plate.
- k) Power rammers are machines which are actuated by explosions in an internal combustion cylinder, each explosion being controlled manually by the operator.
- I) Dropping weight compactors are machines in which a dead weight is dropped from a controlled height using a hoist mechanism and they include self-propelled machines with mechanical traversing mechanisms capable of compacting soil in trenches and close to structures.
- m) In the case of power rammers and dropping-weight compactors one pass will be considered as made when the compacting shoe has made one strike on the area in question.
- n) For items marked * in the Method 3 column of Table 600-14 the roller shall be towed by track-laying tractors. Self-propelled rollers are unsuitable.
- Where combinations of different types or categories of plant are used, the following shall apply:
 - i) The depth of layer shall be that for the type of plant requiring the least depth of layer; and
 - ii) The number of passes shall be that for the type of plant requiring the greatest number of passes.

End-product Compaction

- 14 Where end-product compaction is required it shall comply with sub-Clauses 13 to 19 of this Clause.
- 15 The Contractor shall at least 7 days before commencement of end-product compaction make available the following to the Overseeing Organisation:
 - a) The values of maximum dry density and the optimum moisture content obtained in accordance with BS 1377: Part 4 (or EN 13286 Part 2) using 4.5kg (modified)

rammer method or equivalent BS 1377: Part 4 (EN 13286-Part 4) vibrating hammer method as appropriate for each of the fills intended for use and which meet the requirements of the permitted Class or Classes.

 A graph of dry density plotted against moisture content from which each of the values in (a) above of the maximum dry density and optimum moisture content were determined.

Note 1: Where within any Class of material the fill contains material having different maximum dry densities and optimum moisture contents the Class shall be further subdivided, by extending the identification system, in order to monitor the compacted density.

Note 2: When so required in contract specific IM Appendix 6/3 the Overseeing Organization may require a Proctor test using the 15kg rammer and extra-large mould as described in EN 13286-2 and other methods as may be required.

Note 3: When so required in contract specific IM Appendix 6/3 corrections to the dry density values shall be made for material greater than 25mm as follows:

$$d_r = \frac{d_i^* P_c^{*(100-x)}}{100^* P_c^{-x^*} d_i},$$

where,

dr is the density of the material with particles greater than 25mm removed;

df is the density of the material including particles greater than 25mm;

Pc is the specific weight of the particles greater than 25mm

x is the percentage in mass of the materials greater than 25mm.

The above can be applied to "x" values between 25% and 40% by substituting "x" with the number "25". Alternative methods for corrections due to large particle may be permitted (Eg. ASTM D 4718 – 87).

- c) The California Bearing Ratio (CBR) in accordance with EN 13286-47 of the material at the following moisture values:
 - i. at the optimum moisture content
 - ii. after saturation
 - iii. at the moisture percent of the mid point of the range (optimum moisture content saturation moisture).
- 16 Once the information contained in sub-Clause 17 of this Clause has been made available to the Overseeing Organisation it shall form the basis (reference) for compaction including the

degree of compaction. EV₂ values information may be interpolated from the CBR values at the moisture values tested for guidance in wet conditions.

17 Fill compacted to end-product requirements shall have a field dry density, measured in accordance with sub-Clause 20 of this Clause , equal to or greater than the percentage given in Tables 600-2 to 600-5 of the maximum dry density for the relevant Class of fill previously made available to the Overseeing Organisation in accordance with sub- Clause 13 of this Clause.

Note 1: The size of the sand replacement cone (100mm to 200mm) shall be appropriate for the maximum particle size of the fill intended for use.

Note 2: When so described in contract specific IM Appendix 6/3 the Overseeing Organization may require large-scale in-situ density test methods (by agreement) in cases where the standard in situ density test methods are inadequate due to the largest particle size or excess contents of oversize particles.



Figure 600- 1 Large Scale In-Situ Density Test

- 18 The in situ (field) dry density referred to in sub-Clause 19 of this Clause shall be measured in accordance with BS 1377: Part 9, except that nuclear methods shall only be used where required or permitted in contract specific IM Appendix 6/3.
- 19 The in situ (field) dry density shall be compared to the reference baseline value from the laboratory proctor to compute the percent degree of compaction. The degree of compaction shall have a minimum value according to Table 600-6 for the specific fill material.
- 20 The in situ (field) dry density referred to in sub-Clause 20 may also be measured using a non-nuclear electromagnetic tester for in-place density and water content of soil/aggregate complying with ASTM D7830/7830M Standard Test Method for In-Place Density (Unit Weight) and Water Content of Soil and correlated with the direct method of test (sand replacement).

The following requirements shall be achieved and in conjunction with sub-Clauses 13 to 19 of this Clause:

 Compaction degree based on the Modified Proctor (4.5kg) shall not fall below Dpr = 95% for a depth up to 0.5m below the Formation level (i.e 0.5m below the subbase layer to Series 800). ii. Compaction degree based on the Modified Proctor (4.5kg) shall not fall below Dpr = 90% for a depth more than 0.5m below the Formation level.

End-product Strain Modulus, Ev

- 21 Independently of the field density testing the following requirements shall be achieved and in conjunction with sub-Clauses 13 to 19 of this Clause:
 - i. The strain modulus Ev2 according to DIN 18134 shall comply with the minimum requirements in Chart 1, Chart 2, Chart 3 and Chart 5 of the "Directives for the Standardization of Pavements for Traffic Areas". The ratio Ev2/Ev1 shall not exceed 2.2. Higher ratios than 2.2 may be permitted if the value Ev1 is at least 60% of the required Ev2 value.
 - a) The Ev2 test value for conformity shall be that performed on the final lift surface of the specific layer Eg. for fill placed in three (3) compacted layers the Ev2 need only be performed on the final layer;
 - b) The in-situ density test (sand replacement) shall be performed on each and every compacted fill layer lift.
- 22 The following tolerances are permissible in production control and control testing:
 - i) Less than five test values: all values to be above the minimum value.
 - i) Five or more test values: one value may fall below the required value by 10%.
- 23 The "indirect" DIN 18134 Ev2/Ev1 ratio shall not substitute the direct field density tests. The Overseeing Organization shall approve the extent to which the compaction control will be based on the relation Ev2/Ev1.

Light Weight Deflectometer (Indirect Test)

- 24 The following equipment may be used as a supplementary <u>indication</u> of the weakest location/s for the definitive "control testing" of earthworks using the DIN 18134 plate:
 - i. Light Weight Deflectometer complying with the German FGSV "Supplementary Technical Terms and Conditions of Contract and Guidelines for Earthworks in Road Construction ZTVE-StB 94 and/or to ASTM E2835 – Standard Test Method for Measuring Deflections using a Portable Impulse Plate Load Test Device or approved equivalent (including the correlation to DIN 18134). The correlation to the DIN 18134 Ev2 shall be as described in FGSV ZTVE-StB 94.
 - ii. The equipment shall be calibrated.

Stiffness (Indirect Test)

25 The Overseeing Organisation may also require supplementary testing to establish the stiffness value of compacted granular layers using the electro-mechanical measuring gauge for in-place stiffness and modulus of soil (and soil-aggregate mixture) complying with ASTM D6758 Standard Test Method for Measuring Stiffness and Apparent Modulus of Soil and Soil-Aggregate In-Place by Electro-mechanical Method. The Overseeing Organization may permit the use of stiffness modulus values as normative values subject to approval.

611 Sub-formation and Capping

- 1 Capping shall be provided only in those locations, and to the extent, particularly stated in the contract specific IM Appendix 6/7 to be constructed with capping. It shall comply with this Clause and Clause 610.
- 2 Capping shall be constructed with Class 6F1, 6F2, 6F3, 6F4, 6F5, 6S material as required or permitted in contract specific IM Appendix 6/7 and complying with Table 600-8.
- 3 Unless otherwise described in contract specific IM Appendix 6/7, capping shall either consist of one Class of capping material throughout its depth laid in one or more layers of compacted thickness complying with Clause 610 or be formed of not more than two elements of different capping materials. Each element shall be formed of one or more layers of the same capping material, each of compacted thickness complying with Clause 610.
- Where required in contract specific IM Appendix 6/7, before commencing the construction of capping in the permanent works, the Contractor shall demonstrate the methods, equipment and materials they propose to use by constructing an area, or areas as appropriate, of capping on a typical prepared sub-formation to the same thickness as required in the permanent works. The area of each capping construction demonstration shall be not less than 700 m².
- 5 The materials placed during the demonstration may form part of the permanent works, provided they meet the requirements of the contract, or be carried out elsewhere on the site where this is detailed in contract specific IM Appendix 6/7. After completion of each demonstration area the Contractor shall within a period of not greater than 5 days and before commencing the main construction of the appropriate capping in the permanent works, carry out tests on each demonstration area and provide the Overseeing Organisation with records substantiating compliance with the stipulated criteria of contract specific IM Appendix 6/7. Where required by contract specific IM Appendix 6/7 the Contractor shall provide sheeting, to protect the demonstration area.
- 6 The demonstration area shall, if it does not meet the requirements for the permanent works or is located elsewhere on site, be removed and the area reinstated in accordance with contract specific IM Appendix 6/7.

- 7 The methods and materials used in the accepted demonstration shall not be changed during the course of the works without the construction of a further demonstration where such demonstrations are required by contract specific IM Appendix 6/7.
- 8 Unless otherwise stated in contract specific IM Appendix 6/7, the sub-formation shall have the same longitudinal gradient, crossfall and surface level tolerances as the formation.
- 9 The Contractor shall limit any unprotected area of sub-formation, which is to receive capping to suit the output of the plant in use and the rate of deposition of capping.
- 10 No unprotected sub-formation which is to receive capping shall remain continuously exposed to rain causing degradation, nor be left uncovered overnight.
- 11 In cuttings the Contractor shall, as permitted or required in contract specific IM Appendix 6/7 carry out one of the following procedures:
 - a) For Class 6F granular capping material or Class 6S granular filter layer material, excavate below formation level to a depth to accept the capping, trim the surface to form the sub-formation and immediately compact with one pass of a smooth-wheeled roller having a mass per m width of roll not less than 2,100 kg or a vibratory roller having a mass per m width of roll not less than 700 kg or a vibrating plate compactor having a mass per m² of not less than 1,400 kg, except that only smooth
- 12 On embankments and other areas of fill the Contractor shall, as permitted or required in contract specific IM Appendix 6/7 carry out one of the following procedures:
 - a) Complete the embankment to form the sub-formation or remove any protection layer and trim the surface to form the sub-formation, and in both cases compact with one pass of a smooth-wheeled roller having
 - b) A mass per metre width of not less than 2,100 kg or a vibratory roller of not less than 700 kg per m width or a vibrating plate compactor having a mass per m² of not less than 1,400 kg, and immediately construct above it, in one or more layers, class 6f granular capping material or class 6s granular filter layer material; or
- 13 Not Used
- 14 For Class 6F3 material Optimum Moisture Content shall be determined according to BS 1377: Part 4 Method 3.7 (vibrating hammer test). Measurements of moisture content both for control purposes and for optimum moisture content determination shall be according to BS 1377: Part 2 Method 3 (oven dry method) but using an oven on a reduced temperature setting of 45 to 50°C.
- 15 Filter layers constructed of Class 6S granular filter layer material shall be protected from damage by traffic and construction plant. The Contractor shall so organise work that only the traffic directly engaged in depositing, spreading and compacting the filter layer shall be permitted access to the surface of this layer. At no time shall the Contractor permit the

leading edge of the filter layer to extend more than 100 metres beyond the leading edge of the succeeding layer of subbase.

612 Preparation and Surface Treatment of Formation

- 1 The formation shall, after completion of any subgrade drainage, and immediately before laying sub- base on areas of completed formation, have a surface level tolerance within +20 mm and -30 mm, or other level of tolerance defined in contract specific IM Appendix 6/7 relative to its designed level after completion of the following operations as necessary:
 - a) Any protection layer shall be removed and any soft or damaged areas shall be rectified by excavating them and replacing with acceptable material having the same characteristics and strength as the surrounding material. The surface of the formation shall be trimmed and immediately cleaned free from mud and slurry which shall be dealt with as unacceptable material in accordance with sub-Clause 601.2.
 - b) The formation shall immediately be compacted, in addition to the compaction required for the fill. This additional compaction shall for this purpose be assumed to be as for a layer of 250 mm finished thickness compacted in compliance with Clause 610 and Table 600-14 Method 6 shall be used. Immediately after the additional compaction the formation shall be trimmed to achieve the tolerances of this sub-Clause.
- 2 Where the tolerances in sub-Clause 1 of this Clause are exceeded, the Contractor shall determine the full extent of the area which is out of tolerance and shall make good the formation as follows:
 - a) If the surface is too high it shall be re-trimmed and re-compacted in compliance with Clause 610 and sub-Clause 1 of this Clause;
- If the surface is too low it shall be corrected by the addition of acceptable material complying with Tables 600-3 to 600-6, having characteristics and strength matching the overlain material, deposited and compacted in compliance with Clause 606 and 610 and sub-Clause 1 of this Clause. After trimming, or re-trimming if necessary, the formation shall be rolled with one pass of a smooth wheeled roller having a mass per metre width of roll not less than 2100 kg or, except for Class 3 material, a vibratory roller having a mass per metre width of vibrating roll of not less than 700 kg or a vibrating plate compactor having a mass per m² under the base plate of not less than 1,400 kg.
- 4 Where required in contract specific IM Appendix 6/7 or where the tolerances in sub-Clause 1 of this Clause cannot be achieved in the preparation of formation in rock then one of the following shall be carried out so as to achieve the above tolerances:
 - a) The material shall be excavated below formation to the depth described in contract specific IM Appendix 6/7. The excavated material shall be processed as described in contract specific IM Appendix 6/7 and re- deposited and compacted in compliance

with Clauses 606 and 610 and Table 600-14. Method 6 in compacted layers not greater than 250 mm thick; or where the rock surface is tabular it shall be regulated by depositing and compacting cement bound material as described in contract specific IM Appendix 6/7, complying with the 1000 Series, or ST1 concrete to Clause 2602.

- 5 The Contractor shall limit any areas of completed formation to suit the output of plant in use and the rate of deposition of sub-base.
- 6 The preparation of formation on existing sub-base material shall be completed as described in contract specific IM Appendix 6/7.

613 Use of Sub-formation or Formation by Construction Plant

- 1 Construction plant and other vehicular traffic (except that required for the construction of capping) shall not be operated on the sub-formation, unless adequate protection, if necessary, in addition to any weather protection, is provided.
- 2 Construction plant and other vehicular traffic (except for that required for preparation of the formation in compliance with Clause 612) shall not be operated on the formation unless adequate protection, if necessary, in addition to any weather protection is provided.
- 3 In addition to the requirements of sub-Clauses 1 and 2 of this Clause, the Contractor shall make available to the Overseeing Organisation his proposals for the protection of the subformation or formation in areas where they are within 300 mm of the existing ground level, after topsoil has been stripped, before using construction plant or other vehicular traffic at or above sub-formation or formation.

614 Topsoiling

- 1 Topsoiling shall be carried out using Class 5 material complying with Table 600-7. The provisions in Chapter 236 Fertile Soil (preservation) Act shall apply.
- 2 Imported topsoil, Class 5B material, shall only be imported when required in contract specific IM Appendix 6/8, or contract specific IM Appendix 30/6.
- 3 When required in contract specific IM Appendix 6/8 topsoil shall not be excavated from stockpiles, whether on site or imported:
 - a) Which have been exposed to a cumulative rainfall exceeding 100 mm, or other figure stated in contract specific IM Appendix 6/8, over the preceding 28 days measured at a point detailed in contract specific IM Appendix 6/8; or
 - b) When heavy rain is falling; or
 - c) With a tracked vehicle; or
 - d) Which have been stockpiled for more than 2 years; or

e) In the case of topsoil which has been stockpiled for more than 6 months, unless the stockpile has been treated with a total, non-residual herbicide as recently as is seasonally possible (allowing the period of time recommended by the manufacturer to elapse prior to excavation).

4 Topsoil shall:

- a) Be deposited and spread on the areas, to the thicknesses described in contract specific IM Appendix 6/8, in layers not exceeding 150 mm. Each layer shall be firmed before spreading the next. The thickness shall be reduced where necessary to allow for any subsequent turfing required in contract specific IM Appendix 30/5 (it shall not be spread using a tracked vehicle, when so stipulated in contract specific IM Appendix 6/8);
- b) Have stones and other debris removed and disposed off site which have:
 - i) Dimensions greater than 100 mm equivalent diameter, unless otherwise permitted in contract specific IM Appendix 6/8; and
 - i) Dimensions greater than 50 mm equivalent diameter which lie within 50 mm of the surface;
- c) Be graded to smooth contours, eliminating all mounds and depressions where water may collect;
- d) Not have stones or other debris protruding above the surface by more than 30 mm and comply with the further requirements of clauses 3004 and 3005.

615 Earthwork Environmental Bunds

- 1 Earthwork environmental bunds shall be constructed in the locations described in contract specific IM Appendix 6/9 with fill materials complying with the requirements therein and Clause 601 and Table 600-7. Deposition shall be in accordance with Clause 606 and compaction with the requirements of Table 600-7 unless otherwise described in contract specific IM Appendix 6/9 or the requirements of sub-Clauses 2 or 3 of this Clause apply.
- 2 Earthwork environmental bunds formed of reinforced or anchored earth shall be constructed in compliance with Clauses 2502 and 618.
- 3 Earthwork environmental bunds formed of strengthened embankments shall be constructed in accordance with Clause 617.
- 4 Where required in contract specific IM Appendix 6/9 earthwork environmental bunds shall be topsoiled in accordance with Clause 614 and seeded, or turfed, all in accordance with Clause 3001 and Clause 3005.

616 Landscape Areas

- 1 Landscape areas shall be constructed in the locations shown in contract specific IM Appendix 6/9 with Class 4 material as described therein and complying with Table 600-7.
- 2 Unless method compaction to Clause 610 is required in contract specific IM Appendix 6/9 the degree of compaction of Class 4 material shall be sufficient to remove large voids and to produce a coherent mass whilst preventing over-compaction and any build-up of excess pore pressures.
- 3 Following completion of filling of landscape areas, Class 4 material shall where required in contract specific IM Appendix 6/9, be shaped as described therein.
- 4 Class 4 material shall be deposited in landscape areas after any adjoining embankment or other area of fill has been completed. Where permitted in contract specific IM Appendix 6/9 and provided the adjoining embankment or other area of fill is always kept at least 1 m higher than the landscape area fill, construction of such landscape area may proceed until completion.
- 5 Landscape areas shall be topsoiled in accordance with Clause 614 and seeded or turfed in accordance with Clause 3001 and Clause 3005 to the requirements of contract specific IM Appendix 30/5.

617 Strengthened Embankments

1 Strengthened embankments shall be constructed in the locations and to the details described in contract specific IM Appendix 6/9 with fill materials and strengthening materials described therein.

618 Earthworks for Reinforced Soil and Anchored Earth Structures

- 1 The construction of earthworks for reinforced soil and anchored earth structures together with assembly and erection of reinforcing and anchor elements and associated components shall be in compliance with this Clause and Clause 2502.
- 2 Excavation shall be carried out in compliance with Clause 604.
- 3 Fill for reinforced soil structures shall, except for their associated drainage layers, be of Class 6I and 6Jselected material complying with Table 600-8 as permitted in contract specific IM Appendix 6/1 together with any other additional requirements therein.
- 4 Non-metallic reinforcing elements shall be used and metallic fasteners shall be of stainless steel.
- 5 Fill for anchored earth structures shall, except for their associated drainage layers, be of 6l or 6J selected material complying with Table 600-8 as permitted in contract specific IM Appendix 6/1 together with any other additional requirements therein.

- 6 Drainage layers to reinforced soil and anchored earth structures shall be one of the following as appropriate:
 - a) Class 6H material complying with Table 600-8 and contract specific IM Appendix 6/1.
 - b) Type B filter drain material complying with Clause 505 for use only in horizontal drainage layers.
 - c) Vertical layers of drainage layer material shall be brought up at the same rate as the adjoining fill material without mixing or contamination.
- 7 In addition to the requirements of sub-Clauses 7 and 8 of this Clause, fill for reinforced soil and anchored earth structures shall be deposited and compacted in compliance with Clause 606 and Table 600-8, with method compaction for Classes 6H, 6I and 6Jmaterials. Drainage layer material other than Class 6H shall be deposited in accordance with Clause 606 and compacted as described in contract specific IM Appendix 6/3.
- 8 Reinforced soil and anchored earth structures shall have:
 - a) The deposition and compaction carried out so that all layers of reinforcing and anchor elements are fixed at the required levels on top of compacted fill;
 - b) The deposition, spreading, levelling and compaction of the fill carried out generally in a direction parallel to the facing and executed in stages to alternate with the placing and fixing of the reinforcing and anchor elements and the facing elements;
 - c) The reinforcing and anchor elements kept as free as possible from damage or displacement during deposition, spreading, levelling and compaction of the fill (also the programme of filling shall be arranged so that no machines or vehicles run on the reinforcing or anchor elements);
 - d) All construction plant, and all other vehicles, having a mass exceeding 1,000 kg, kept at least 2 m away from the back of the facing;
 - e) Within 2 m of the back of the facing, the plant used for compacting the fill restricted to the following items as described in sub-clause 610.11 and listed in Table 600-8.
 - Vibratory roller having a mass per metre width of roll not exceeding 1,300 kg with a total mass not exceeding 1,000kg;
 - i) Vibrating plate compactor having a mass not exceeding 1,000kg;
 - iii) Vibro tamper having a mass not exceeding 75kg;
 - f) At the Contractor's option, the reinforced soil and anchored earth fill beyond the 2 m zone referred to in (e) above, raised in thicker layers than within the 2 m zone, providing this is compatible with the arrangement of the reinforcing and anchor elements and the difference in compacted level does not exceed 300 mm;

- g) During construction of the reinforced soil or anchored earth structure the retained fill at the rear of the structure, as defined in sub-Clause 8 of this Clause, maintained at the same level as the adjoining reinforced soil or anchored earth fill;
- h) If the retained material at the rear of the reinforced soil or anchored earth structure, as defined in sub-Clause 8 of this Clause, is an existing earthwork or natural slope which requires supporting by temporary shoring, this shoring shall be removed progressively as the work proceeds to prevent the formation of voids.
- 9 The rear of the reinforced soil or anchored earth structure is the position coinciding with the ends of the reinforcing or anchor elements furthest from the facing units.

619 Earthworks for Corrugated Steel Buried Structures

- 1 The construction of earthworks for corrugated steel buried structures together with assembly and erection of their components shall be in compliance with this Clause and Clause 2501.
- 2 Excavation shall be carried out in compliance with Clause 604 and any additional requirements given in contract specific IM Appendix 6/3.
- 3 Fill for corrugated steel buried structures shall be of the following selected granular materials complying with Table 600-8.
 - a) Lower bedding material Class 6K;
 - b) Upper bedding material Class 6L;
 - c) Surround material Class 6M.

and the overlying fill shall be:

- d) Well graded, uniformly graded or coarse, granular material Class 6Q
- In addition to the requirements of sub-Clauses 5 to 14 of this Clause, Class 6K, 6L and 6M materials shall be deposited in compliance with Clause 606 and shall (except for Class 6L upper bedding material which shall be uncompacted) be end-product compacted in compliance with Clause 610 and Table 600-8, except that the compacted layers shall not exceed 150 mm thickness. The compaction and testing requirements for Class 6K lower bedding and Class 6M surround materials shall also comply with any additional requirements given in contract specific IM Appendix 6/3.
- 5 As far as possible, the Class 6K lower bedding material shall be shaped to fit the invert such that it supports 20% of the circumference of circular structures or the whole of the portion of circumference occupied by the bottom plates of multi-radii structures. In the case of structures of span less than 3 m where this cannot be met and the structure is erected on a flat or partially pre-shaped bedding, care shall be taken to ensure that the lower bedding material is properly placed and compacted under the haunches. A uniform layer of uncompacted Class 6L upper bedding material shall be deposited before the placing of any

part of the steel structure, over the whole width of the shaped lower bedding material and shall be of sufficient depth to fill the corrugations of the underside of the structure.

- 6 Class 6M surround material shall be used for filling all excavations above the bedding, except those in hard material for which Class 6K lower bedding material shall be used throughout. Additional requirements for making good are given in Clause 604.
- 7 Class 6M surround material shall be deposited and compacted uniformly on either side of the structure. The maximum difference in fill level on opposite sides of the structure shall be no more than 250mm at all times unless otherwise permitted in contract specific IM Appendix 6/3.
- 8 Class 6M surround material shall be deposited and compacted in accordance with sub-Clause 4 of this Clause, above the concrete foundations of arch-profile corrugated steel buried structures.
- 9 Class 6M surround material under the structure shall be well compacted by hand using a suitably sized pole or length of rectangular timber between the corrugations, or by another suitable method.
- 10 Plant for compaction of Class 6M surround material within 1 m of either side of the structure and up to a height of 1 m, or one fifth of the span if greater, above the crown, shall be restricted to the following items, as described in sub-Clause 610.11 and listed in Table 600-14:
 - a) Vibratory rollers having a mass per metre width of roll not exceeding 750 kg;
 - b) Vibrating plate compactors having mass not exceeding 750 kg;
 - c) Vibro-tampers.
- 11 Fill placed above the level of the crown of the structure, including Class 6M surround material, shall be deposited, spread and compacted in such a manner that any out of balance forces transmitted to the culvert are kept to a minimum. This will require that trafficking by construction plant is not all in one direction and that the compacted surface of the fill is kept as near horizontal as practicable.
- 12 During all operations of filling, compaction, road pavement construction and of any other traffic movements which affect the shape of the structure, the changes in the horizontal and vertical diameters of the structure shall not exceed \pm 5% for circular structures and \pm 2% for structures of other cross-sections. The longitudinal straightness over any 10 m length of the structure shall not deviate by more than 25 mm, and the rotational displacement in any 10 m length of structure shall not be greater than 25 mm.
- 13 Only that compaction plant described in sub-Clause 10 of this Clause, shall be used in the vicinity of the structure unless the depth of compacted Class 6M surround material placed above the crown of the structure is more than 1 m, or one fifth of the span, whichever is the

greater. The structure shall not be subjected to a surcharge greater than the depth of fill required in the contract and permitted depth of any protection layer given in contract specific IM Appendix 6/3.

- 14 No material shall be placed by tipping either onto the structure or within a distance on either side of the structure of 2 m or half the span of the structure, whichever is the greater.
- 15 Method compaction shall be used for the overlying fill (Class 6Q) according to Clause 610; the method used being that for the corresponding general fill in Table 600-8.

620 Ground Anchorages

- 1 The Contractor shall design the ground anchorages required as part of the permanent works and listed in contract specific IM Appendix 1/10, in accordance with the design requirements described in contract specific IM Appendix 6/10. The ground anchorages shall be installed and where required in contract specific IM Appendix 6/10 proof loaded, in accordance with the requirements therein.
- 2 Ground anchorages not forming part of the permanent works will only be permitted where such anchorage will not affect the permanent works.

621 Crib Walling

1 The Contractor shall design the crib walling listed in contract specific IM Appendix 1/10 in accordance with the design specification and procedures in contract specific IM Appendix 6/10.

622 Gabions

- 1 Gabions shall be manufactured and constructed in compliance with this Clause and with requirements stated in contract specific IM Appendix 6/10. Gabion units shall be assembled in accordance with the manufacturer's instructions.
- 2 Unless otherwise stated in contract specific IM Appendix 6/10 they shall be filled with Class 6G material complying with Table 600-8. The grading of fill shall be as described in IM Appendix 6/10, the maximum size of fill material shall not exceed two thirds of the minimum dimension of the gabion compartment or 200mm whichever is smaller, and the minimum size of the fill material shall be not less than the size of the mesh opening. Gabion units shall be filled to fully achieve the required minimum cage density and compaction of fill. At no point before, during or after filling shall the cage be deformed by working methods or in use loading. The required cage density shall be as stated in contract specific IM Appendix 6/10. Internal tie wires shall be inserted, and units shall be tensioned in accordance with the manufacturer's instructions. Gabion units shall be constructed so as to maintain tightness of mesh and shall be laced securely with wire, complying with sub-Clause 3 of this Clause.
- 3 Gabion wire mesh units shall be woven steel wire conforming to MSA EN 10223-3 or welded steel mesh conforming to MSA EN 10223-8. The Contractor shall submit documentary evidence to the Overseeing Organisation to demonstrate compliance of the gabion units at least four weeks prior to the commencement of gabion work. Documentation that demonstrates compliance with a product acceptance scheme as described in Clause 104 sub- Clauses 16 and 17 can be supplied to meet this requirement where the scheme demonstrates that the gabion units meet the level of performance required by the specification.
- Unless otherwise stated in contract specific IM Appendix 6/10 the site environment level shall be High Aggressive: C4; and the Assumed Working Life shall be 120 years or greater. Coating requirements for all wire shall be as required by Tables 1 and A.1 of MSA EN 10223-3 and MSA EN 10223-8.
- 5 Unless otherwise stated in contract specific IM Appendix 6/10 woven steel gabions shall be of mesh designation 6x8 or 8x10 with minimum wire diameter of 2.7 mm.
- 6 Unless otherwise stated in contract specific IM Appendix 6/10 welded mesh shall be 3mm to 5mm diameter bars with the mesh size 75mm x 75mm maximum.

623 Sink Holes and Other Naturally Occurring Cavities

- Infilled sink holes and other naturally occurring cavities shall where required in contract specific IM Appendix 6/11 be excavated, filled and capped as described in contract specific IM Appendix 6/11.
- 2 Open sink holes and other shallow cavities shall where required in contract specific IM Appendix 6/11 be flushed, cleared of rubbish where to do so would not endanger operatives, and filled and capped as described in contract specific IM Appendix 6/11.

624 Instrumentation and Monitoring

- 1 Instrumentation shall be as described in contract specific IM Appendix 6/12 and shall be installed in the locations shown therein.
- 2 Monitoring of instrumentation shall be carried out as required in the contract specific IM Appendix 6/12 and the results supplied to the Overseeing Organisation as required therein.

626 Ground Improvement

Dynamic Compaction

1 Dynamic compaction, carried out to either method or end-product as required in contract specific IM Appendix 6/13 and achieved by dropping a free-falling heavy mass (pounder) a number of times at pre- determined spacings on the surface of the ground or fill, shall be applied to the areas described in contract specific IM Appendix 6/13.

- 2 Dynamic compaction shall be completed before the commencement of construction of any permanent works, or work on the placement or diversion of Statutory Undertaker's equipment, within that part of the site defined in the contract specific IM Appendix 6/13 which contains the area to be dynamically compacted.
- 3 The Contractor shall ensure that no damage or injury is caused to persons or property on or off the site as a result of the dynamic compaction.

Vibrated Stone Columns

- 4 Vibrated stone columns in existing natural soils or fill by vibro-replacement or vibrodisplacement shall be formed in the manner and in the areas described in contract specific IM Appendix 6/13.
- 5 Unless otherwise described in contract specific IM Appendix 6/13, materials shall comply with sub-Clause 8 of this Clause.
- 6 The Contractor shall report immediately to the Overseeing Organisation any circumstance which indicates that in the Contractor's opinion the ground conditions differ from those expected from his interpretation of the ground investigation reports.
- 7 Columns shall be installed as shown on the drawings and within the permitted tolerances stated in contract specific IM Appendix 6/13.

Materials

8 The material used to form the columns shall be clean, hard, inert material and shall be natural sand, gravel, crushed rock other than argillaceous rocks, crushed hardcore, crushed concrete, crushed slag or well burnt non-plastic shale. The material shall be appropriate to the ground conditions in which the stone columns are formed and its use shall not be detrimental to any other work on site. The material shall be nominally single sized coarse aggregate with a value of upper (D) sieve size in the range 10 mm to 40 mm or a graded material complying with Clause 802 (Type 1 unbound mixtures for subbase) except the material passing the 0.425 mm sieve shall be non- plastic when tested in accordance with BS1377: Part 2.

Testing of Ground Treatment

9 Testing of treated ground shall be undertaken for control purposes during the treatment and on completion of the ground treatment. The performance criteria for treated ground are given in contract specific IM Appendix 6/13. 10 Improvement in treated ground shall be measured in accordance with the criteria stated in contract specific IM Appendix 6/13.

Types of Test

11 The following tests or alternatives permitted in contract specific IM Appendix 6/13 shall be carried out at the positions and frequency given in contract specific IM Appendix 6/13.

Plate tests

12 Plate bearing tests are loading tests carried out using a plate on treated ground. The test is described in BS 1377: Part 9: 1990 Method 4.1.

Zone Tests

13 Zone tests are loading tests carried out with a slab, intended to test bearing pressure over a wider and deeper zone than in the plate tests. The test is described in BS 1377: Part 9: 1990 Method 4.2.

Penetration Tests

14 In granular soils the static cone (Dutch cone) penetration test, the standard penetration test (SPT) or dynamic cone penetration tests shall be employed as described in contract specific IM Appendix 6/13.

Trial Areas

- 15 Trial areas are to be treated and tested where required in contract specific IM Appendix 6/13. Trial areas which meet the performance requirements may form part of the permanent works.
- 16 Equipment and materials used in trial areas shall be identical to those proposed for the permanent works.
- 17 Testing in trial areas shall be carried out as given in contract specific IM Appendix 6/13.
- 18 Detailed reports shall be prepared for all testing as defined in Table 600-15.

Records and Reports

- 19 Complete records of plant, equipment and materials shall be maintained during all ground treatment operations.
- 20 Records shall be made available to the Overseeing Organisation including all information identified in Table 600-15 and any other information required by contract specific IM Appendix 6/13. All records pertaining to a particular day's operations shall be made available to the Overseeing Organisation at the start of the following day's operations.

Other Methods

21 Other methods of ground improvement shall be carried out where required in contract specific IM Appendix 6/13 and as described therein.

627 Earthworks Materials Tests

1 Unless otherwise described in the contract sampling and testing of earthworks materials shall be carried out in accordance with BS 1377: Part 1 to Part 9 inclusive.

628 Determination of Moisture Condition Value (MCV) of Earthworks Materials

- 1 Where the Moisture Condition Value (MCV) is to be determined, the determination shall be carried out in accordance with BS 1377: Part 4.
- 2 The determination of the MCV/moisture content relation in accordance with BS 1377: Part 4 shall be carried out when required in contract specific IM Appendix 6/1.
- 3 Where permitted in contract specific IM Appendix 6/1 the rapid assessment procedure for material acceptability also given in BS 1377: Part 4 may be used.

629 Determination of Undrained Shear Strength of Re-moulded Cohesive Material

- 1 Where required in contract specific IM Appendix 6/1, the undrained shear strength of cohesive soil under total stress conditions shall be determined from triaxial compression tests performed on remoulded specimens and tested under conditions where the lateral pressure is maintained constant and there is no change in total water content of the specimens. Unless otherwise required in contract specific IM Appendix 6/1, the tests shall be in accordance with BS 1377: Part 7 and the additional requirements of sub-Clauses 2 to 4 of this Clause.
- 2 The specimens shall be prepared in accordance with BS 1377: Part 7 using remoulded material compacted into a split mould of nominal diameter 100 mm and nominal height 200 mm. The soil shall be at its natural moisture content and compacted in accordance with BS 1377: Part 1 using the 2.5 kg rammer method described in BS 1377: Part 4.
- 3 The specimens shall be tested at an operating cell pressure of $200 \pm 10 \text{ kN/m}^2$ and an axial strain rate of 1% per minute. Where contract specific IM Appendix 6/1 requires c and φ to be determined, the test shall be modified to enable Mohr circles to be plotted and c and φ reported.
- 4 Where stated and described in contract specific IM Appendix 6/1, other tests may be used during construction to supplement the test described above, provided the results have been correlated to ensure compatibility.

630 Los Angeles and Other Tests for Particle Soundness

Resistance to Fragmentation – Los Angeles Coefficient (LA)

The value of Los Angeles coefficient shall be determined in accordance with MSA EN 1097 2.

Other Tests for Particle Soundness

2 Where contract specific IM Appendix 6/1 requires magnesium sulfate soundness tests to be carried out, they shall be carried out in accordance with MSA EN 1367-2. Where contract specific IM Appendix 6/1 requires slake durability, point load or other tests for soundness to be carried out, they shall be carried out in accordance with the procedures given therein.

631 Determination of Effective Angle of Internal Friction (ϕ') and Effective Cohesion (c') of Earthworks Materials

1 The effective angle of internal friction and effective cohesion c[/] shall be determined by shear box or triaxial tests as required in Tables 600-3 to 600-6 and contract specific IM Appendix 6/1. Unless otherwise required in contract specific IM Appendix 6/1 the tests shall be in accordance with the requirements in sub-Clause 2 of this Clause.

Shear Box Tests

- 2 For Classes 6N, 6P, 6I and 6J granular materials, the tests shall be carried out in accordance with BS 1377: Part 7 and the following:
 - a) The plan size of the shear box shall be nominally 300 mm square.
 - b) Three samples shall be tested, each sample occupying the full depth of the shear box and shall be compacted at the optimum moisture content to a dry density of 92% ± 2% of the maximum dry density determined in accordance with BS 1377: Part 4 using the vibrating hammer method. The samples shall not be immersed in water.
 - c) Each of the samples shall be subjected to a different normal stress equal to the maximum vertical pressure in the fill at the base, quarter height and mid-height of the structure respectively. Each of the samples shall be sheared in a single stage test within one hour of compaction and the rate of shearing shall be such that no pore water pressure is generated.
 - d) The values of c' and ϕ' reported shall be those corresponding to the maximum strength envelope.

632 Determination of Resistivity (r_s) to Assess Corrosivity of Soil, Rock or Earthworks Materials

Method of Test

1 Where the resistivity of the ground or of material to be used in the permanent works is required to be determined, this shall be obtained by in situ tests as described in sub-Clause 2 of this Clause or, when required in contract specific IM Appendix 6/1, by laboratory tests on samples in accordance with BS 1377: Part 3.

In Situ Resistivity Tests

- 2 In situ resistivity shall be determined at the site of the structure or the cutting or the proposed borrow pit or on stockpiles in accordance with BS 1377: Part 9 and the requirements of contract specific IM Appendix 6/1.
- 3 Details of the area and volume of material to be tested shall be made available to the Overseeing Organisation together with the arrangement of electrodes in each test. The Overseeing Organisation shall be given notice of the date, time and location of each test.
- 4 At any test location, at each selected depth, two measurements shall be made such that the electrode alignment for the second measurement is approximately at right angles to the electrode alignment for the first measurement.
- 5 At any test location, the first selected depth shall be no more than 1.5 m below the ground surface or no more than 1.5 m below the upper surface of the material to be tested, whichever is appropriate. Following the measurements at the first selected depth, further measurements shall be made at selected depths increasing by approximately 2 m each time until measurements have been carried out on the full depth of ground or material to be tested.
- 6 Where the depth of material to be tested is too great to be tested from the surface within the confines of the site, the Contractor shall undertake all necessary arrangements for testing such material, including subsequent tests which may be required at a lower level following excavation. Details of his arrangements shall be made available to the Overseeing Organisation.

633 Determination of Redox Potential (E_h) to Assess Corrosivity of Earthworks Materials for Reinforced Soil and Anchored Earth Structures

Method of Test

1 Where the redox potential of material to be incorporated into reinforced earth or anchored earth structures is required to be determined, this shall be obtained by in situ tests as described in sub-Clauses 2 to 6 of this Clause or, when required in contract specific IM Appendix 6/1, by laboratory tests on samples in accordance with BS 1377: Part 3.

In Situ Redox Potential Tests

- 2 In situ redox potential shall be determined in undisturbed ground at the site of the cutting or the proposed borrow pit or on stockpiles in accordance with BS 1377: Part 9 and the requirements of contract specific IM Appendix 6/1.
- 3 Details of the area and volume of material to be tested shall be made available to the Overseeing Organisation together with the locations of the test pits.
- 4 The Overseeing Organisation shall be given notice of the date, time and location of each test.
- 5 At each test location the tests shall be carried out in a test pit not less than 600 mm square in plan excavated to a depth given in contract specific IM Appendix 6/1.
- 6 At each test location, a sample shall be taken from the base of the excavation and kept in a hermetically sealed container for determining the pH value of the fill which shall be obtained in accordance with BS 1377: Part 3.

634 Determination of Coefficient of Friction and Adhesion Between Fill and Reinforcing Elements or Anchor Elements for Reinforced Soil and Anchored Earth Structures

Reinforcing Elements

- 1 The coefficient of friction and the adhesion shall be determined by tests carried out in a 300 mm size shear box with the element material fixed at the top of the lower half of the box and the fill sample occupying the top half only.
- 2 The test shall be carried out following the procedure given in Clause 631 for the determination of the effective angle of internal friction and effective cohesion of earthworks materials except that:
 - a) The apparatus shall in addition include a steel block fitting closely inside the lower half of the shear box and equal in height to it less the thickness of the reinforcing element material. (The flat toothed grid fitting the bottom of the shear box is not required).
 - b) The preparation of test specimens shall be as follows:

Element material shall be cut to fit the interior plan shape of the shear box using a sufficient number of strips of such material abutting to completely fill the interior plan area without overlap. They shall be firmly fixed to the top of the steel block so that the top face of the material is flush with the top edge of the lower half of the box and aligned so that shearing occurs in a direction parallel to the longitudinal axis of a reinforcing element.

A sample of the fill material to be used in the permanent works, of sufficient size to carry out the tests, and within the range of moisture contents permitted in Tables 600-2 to 600-5 for such material, shall be sieved to obtain a test sample passing the 20 mm BS sieve, of sufficient quantity after compaction to fill the top half of the shear box. The top and bottom of the shear box shall be fixed together, and the test sample of the sieved fill materials immediately placed and compacted in the top half of the box as described in Clause 631.

- 3 The value of the coefficient of friction between the fill and the reinforcing element shall be obtained by plotting the values of peak shear stress, obtained in the tests, against applied normal stress and by measuring the slope of the resulting straight-line graph. The adhesion between the fill and the reinforcement shall be obtained by taking the shear stress corresponding with zero normal stress.
- 4 The following additional information shall be recorded for each test:
 - a) Normal stress applied (kN/m²).
 - b) Peak shear stress (kN/m²).
 - c) Strain at peak shear stress (%).

Anchor Elements

5 Where required in contract specific IM Appendix 6/1, tests shall be carried out as described therein to assess the interaction between the fill and the element.

635 Determination of Permeability of Earthworks Materials

1 Where required in Tables 600-3 to 600-6 or contract specific IM Appendix 6/1 the permeability of earthworks materials shall be determined as described in contract specific IM Appendix 6/1.

636 Determination of the Constrained Soil Modulus (M*) of Earthworks Materials for Corrugated Steel Buried structures

Not Used

637 Determination of Sulfate Content

1 Where required in Table 600-6, Table 600-7, Table 600-8 and

Table *600-9* or contract specific IM Appendix 6/1, the effects of water-soluble sulfate, oxidisable sulfides and total potential sulfate shall be assessed in accordance with MSA EN 1744-1 clauses 10, 11 and 13.

- 2 Test results and limiting values for sulfate shall be given as SO₄.
- 3 At least five samples of each material shall be tested for WS, OS and TPS. The mean of the highest two values shall be used for comparison with the limiting values. This also applies if six to nine results are available. If ten or more results are available, the mean of the highest 20% of the results shall be used for comparison with the limiting values.

Class		General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti to Requirements Testing in Clause Property (See Exceptions in Previous Column)	es Required for Ac on Use of Fill Mate e 627) Defined and Tested in Accordance with:	cceptability (I erials in Clau Acceptable Lower	n Addition se 601 and Limits Within: Upper	Compaction Requirements in Clause 610
GENERAL GRANULAR FILL	A	Well graded granular material	General Fill	Any material, or combination of materials. Recycled aggregate; Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8 and 9; P (natural aggregates); A (construction and demolition recycling industries);	(i) grading (ii) uniformity coefficient (iii) mc (iv) MCV	BS 1377: Part 2 or MSA EN 13242 See Note 5 BS 1377: Part 2 See Note 4 Clause 627	Table 600-11 10 App 6/1 App 6/1	Table 600-11 – App 6/1 App 6/1	Table 600-14 Method 2; End- Product: 95%;

Table 600-6: Acceptable Earthworks Materials: Classification and Compaction Requirements – General Granular Fill

Class		General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Inted Constituents (All Subject to internal Properties Required for Acceptability (In Addition internal Properties Required for Acceptable 501 and internal Properties Required for Acceptable 501 and internal Property (See Defined and Exceptions in Tested in Previous Accordance Column) Internal Property (See Defined and Exceptions in Property (See Column) Acceptable Limits Within: Upper				
GENERAL GRANULAR FILL	1B	Uniformly graded granular material	General Fill	Any material, or combination of materials. Recycled aggregate Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9, and 10: P (natural aggregates); A (construction and demolition recycling industries); H1 (dredge spoil sand)	(i) grading (ii) uniformity coefficient (iii) mc (iv) MCV	BS 1377: Part 2 or MSA EN 13242 See Note 5 BS 1377: Part 2 See Note 4 Clause 627	Table 600-11 10 App 6/1 App 6/1	Table 600-11 – App 6/1 App 6/1	Table 600-14 Method 3

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti to Requirements Testing in Clause Property (See Exceptions in Previous Column)	es Required for Ad on Use of Fill Mat e 627) Defined and Tested in Accordance with:	cceptability (I erials in Clau Acceptable Lower	n Addition se 601 and Limits Within: Upper	Compaction Requirements in Clause 610
GENERAL GRANULAR FILL	Coarse granular material	General Fill	Any material, or combination of materials where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9, and 10: P (natural aggregates); A (construction and demolition recycling industries);	 (i) grading (ii) uniformity coefficient (iv) Los Angeles Coefficient 	BS 1377: Part 2 or MSA EN 13242 See Note 5 Clause 630	Table 600-11 5	Table 600-11 - 50	Table 600-14 Method 5; End product: 95%

Class	•	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti to Requirements Testing in Clause Property (See Exceptions in Previous Column)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 627)Property (SeeDefined and Tested inAcceptable Limits Within: LowerUpperPreviousAccordance with:Upper			Compaction Requirements in Clause 610
GENERAL GRANULAR FILL	D	Well graded granular material	General Fill	Any material, or combination of materials. Recycled aggregate; Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8 and 9; P (natural aggregates); A (construction and demolition recycling industries).	(i) grading (ii) mc (iii) Los Angeles Coefficient (iv) MCV	BS 1377: Part 2 or MSA EN 13242 See Note 5 BS 1377: Part 2 See Note 4 Clause 627	Table 600-11 - App 6/1 App 6/1	Table 600-11 10 App 6/1 App 6/1	Table 600-14 Method 5; End product: 95%

CidSS		General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properties Required for Acceptability (in Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 627) Property (See Defined and Exceptions in Tested in Previous Column) Accordance with:			Compaction Requirements in Clause 610	
LANDSCAPE FILL	4	Various	Fill to landscape areas	See App 6/1	(i) grading (ii) mc (iii) MCV	BS 1377: Part 2 BS 1377: Part 2 See Note 4 Clause 628	App 6/1 - App 6/1	App 6/1 App 6/1 App 6/1	See Clause 616 and App 6/1
SOIL	5A	Topsoil, or turf, existing on site	Topsoiling	Topsoil or turf designated as Class 5A in the Contract	(i) grading	Clause 614	-	Clause 614	-
TOP	5B	Imported topsoil	Topsoiling	General purpose grade complying with BS 3882	_	-	_	_	_

Table 600-7: Acceptable Earthworks Materials: Classification and Compaction Requirements – Landscape Fill and Topsoil

С	Material Subject to Requirements of Description Clause 601 and contract specific IM Appendix 6/1) IM Appendix 6/1) 6A Selected well Below water Natural gravel, natural sand, arrushed gravel, explored roots attemption			Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous Column)	es Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	dition to and Testing in hits Within: Upper	Compaction Requirements in Clause 610
SELECTED GRANULAR FILL	6A	Selected well graded granular material	Below water	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock, crushed concrete, or any combination thereof. Recycled aggregate where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9, and 10: P (natural aggregates); A (construction and demolition recycling industries);	(i) grading (ii) uniformity (iii) plasticity index	BS 1377: Part 2 (On-site) MSA EN 933-2 (Imported onto site) See Note 5 BS 1377: Part 2	Table 600-11 Table 600-12 10 Non-plastic	Table 600-11 Table 600-12 -	No compaction
	6B	Selected coarse granular material	Starter layer	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, or any combination thereof. Recycled aggregate where material is	(i) grading	BS 1377: Part 2 (On-site) MSA EN 933-2 (Imported onto	Table 600-11	Table 600-11	Table 600-14 Method 5; End product: 95%

Table 600-8: Acceptable Earthworks Materials: Classification and Compaction Requirements – Selected Granular Fill

С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements on Clause 627) Property (See Exceptions in Previous	es Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	dition to and Testing in nits Within: Upper	Compaction Requirements in Clause 610
				imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9, and 10: P (natural aggregates); A (construction and demolition recycling industries);	(ii) plasticity index (iii) Los Angeles coefficient (iv) mc	site) BS 1377: Part 2 Clause 630 BS 1377: Part 2 See Note 4	Table 600-12 Non-plastic – App 6/1	Table 600-12 50 App 6/1	Modified Proctor
SELECTED GRANULAR	6C	Selected uniformly graded granular material	Starter layer	Natural gravel, natural sand, crushed gravel, crushed rock other than argillaceous rock, crushed concrete, or any combination thereof. Recycled aggregate where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from	(i) grading (ii) uniformity	BS 1377: Part 2 (On-site) MSA EN 933-2 (Imported onto site) See Note 5	Table 600-11 Table 600-12	Table 600-11 Table 600-12 10	Table 600-14 Method 3; End product: 95% Modified Proctor

C	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements of Clause 627) Property (See Exceptions in Previous Column)	ies Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	dition to and Testing in nits Within: Upper	Compaction Requirements in Clause 610
				one or more of the following source codes, see Notes 8, 9, and 10: P (natural aggregates); A (construction and demolition recycling industries);	coefficient (iii) plasticity index (iv) Los Angeles coefficient (v) mc	BS 1377: Part 2 Clause 630 BS 1377: Part 2 See Note 4	Non-plastic – App 6/1	50 App 6/1	
	6F1	Selected granular material (fine grading)	Capping	Any material, or combination of materials – including recycled aggregates with not more than 50% by mass of recycled bituminous planings and granulated asphalt. Property (vi) in the next column shall not apply if the Class Ra	 (i) grading (ii) optimum mc (iii) mc 	BS 1377: Part 2 (On site materials only) BS 1377: Part 4 (vibrating hammer method) BS 1377: Part 2	Table 600-11 - Optimum mc -	Table 600-11 - Optimum	Table 600-14 Method 6; End product: 95% Modified Proctor

C	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See	ies Required for Acc n Use of Fill Material Defined and	eptability (In Ado s in Clause 601 a Acceptable Lir	dition to and Testing in nits Within:	Compaction Requirements in Clause 610
					Previous Column)	Accordance with:	Lower	Upper	
				(asphalt) content of any recycled aggregate is 20% or less. Where material in this Class is imported onto site it shall be classified as Class 6F4 and comply with the requirements for that material.	(iv) Los Angeles coefficient (v) Class Ra (asphalt) content (vi) bitumen content	See Note 4 Clause 630 Clause 709 MSA EN 12697-1 or MSA EN 12697-39	2% - -	mc 60 50% 2.0%	
SELECTED GRANULAR FILL	6F2	Selected granular material (coarse grading)	Capping	Any material, or combination of materials - including recycled aggregates with not more than 50% by mass of recycled bituminous planings and granulated asphalt. Property (vi) in the next column shall not apply if the Class Ra (asphalt) content of any recycled	 (i) grading (ii) optimum mc (iii) mc 	BS 1377: Part 2 (On site materials only) BS 1377: Part 4 (vibrating hammer method) BS 1377: Part 2 See Note 4	Table 600-11 – Optimum mc - 2%	Table 600-11 Optimum mc	Table 600-14 Method 6; End product: 95% Modified Proctor

С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements of Clause 627) Property (See	ies Required for Acc n Use of Fill Material Defined and	eptability (In Ado s in Clause 601 a Acceptable Lin	dition to and Testing in nits Within:	Compaction Requirements in Clause 610
					Exceptions in Previous Column)	Tested in Accordance with:	Lower	Upper	
				aggregate is 20% or less. Where material in this Class is imported onto site it shall be	(iv) Los Angeles coefficient	Clause 630	_	50	
				classified as Class 6F5 and comply with the requirements for that material.	(v) Class Ra (asphalt) content	Clause 709	_	50%	
					(vi) bitumen content	MSA EN 12697- 1 or MSA EN 12697-39	_	2.0%	
	6F3	Selected granular material	Capping	Any material, or combination of materials with not less than 50% by mass of recycled bituminous	(i) grading	BS 1377: Part 2 (On-site)	Table 600-11	Table 600-11	Table 600-14 Method 6 Maximum
				planings and granulated asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN		MSA EN 933-2 (Imported onto site)	Table 600-12	Table 600-12	Compacted layer thickness shall be 200
				13242 from the following source codes, see Notes 8, 9 and 10: A1 (reclaimed asphalt) A4 (mixed recycled aggregate)	(ii) optimum mc (iii) mc	Clause 611 Clause 611 See Note 4	- Optimum mc -2%	- Optimum mc	mm; End product: 95% Modified

С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous Column)	es Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Add s in Clause 601 a Acceptable Lin Lower	lition to and Testing in hits Within: Upper	Compaction Requirements in Clause 610
				Aggregates from source code A4 shall contain at least 50% of constituents in Class Ra (bituminous materials).	(iv) Class Ra (asphalt) content (v) bitumen content	Clause 709 MSA EN 12697- 1 or MSA EN 12697-39	-	- 10%	Proctor
ELECTED GRANULAR FILL	6F4	Selected granular material (fine grading) – imported on to the Site	Capping	Unbound mixture complying with MSA EN 13285 containing aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates) A2 (crushed concrete) A3 (crushed bricks, masonry) A4	 (i) Size designation and overall grading category (ii) Maximum fines and oversize categories 	MSA EN 13285 - 0/31.5 and GE MSA EN 13285 - UF ₁₅ and OC ₇₅	Table 600-12 Table 600-12	Table 600-12 Table 600-12	Table 600-14 Method 6; End product: 95% Modified Proctor
SE				(mixed recycled aggregate) Aggregates from source code A4	(iii) Los Angeles coefficient	MSA EN 13242 <i>LA</i> 60	_	60	

Class General Typical Use Permitted Constituents (All Material Subject to Requirements of Description Clause 601 and contract specific IM Appendix 6/1)				Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific	Material Properti Requirements or Clause 627)	dition to and Testing in	Compaction Requirements in Clause 610		
					Property (See	Defined and	Acceptable Lin	nits Within:	
					Exceptions in	Tested in	Lower	Upper	
					Previous	Accordance with:			
					Column)				
				shall contain not more than 50% of	(iv) Volume	MSA EN 13242	-	-	
				constituents in Class Ra	stability of	– free from			
				(bituminous materials).	blast furnace	dicalcium silicate			
				Property (x) in the next column	slag	and iron			
				shall not apply if the Class Ra		disintegration			
				(asphalt) content of any recycled	(v) Volume	MSA EN 13242	_	_	
				aggregate is 20% or less.	stability of	- V5			
					steel (BOF)				
					and EAF) slag				
					(vi) Other	MSA EN 13242	_	-	
					aggregate	_			
					requirements	Category NR (no			
						requirement)			
					(vii) Laboratory	MSA EN 13285,	_	-	
					dry density	Clause 5.3 –			
					and optimum	declared values			
					water content				
					(viii) Water	MSA EN 1097-5	Optimum wc	Optimum	
					content		2%	wc	
					(ix) Class Ra	Clause 709	_	50%	

Class		General Typical Use Permitted Constituents (All Material Subject to Requirements of Description Clause 601 and contract specific IM Appendix 6/1) IM Appendix 6/1)		Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 627)Property (SeeDefined and Tested in Acceptable Limits Within:Exceptions in PreviousTested in Accordance with:Column)LowerUpper				Compaction Requirements in Clause 610	
					(asphalt) content (x) bitumen content	MSA EN 12697- 1 or MSA EN 12697-39	_	2.0%	
FILL	6F5	Selected granular material (coarse grading) –	Capping	Unbound mixture complying with MSA EN 13285 containing aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes	(i) Size designation and overall grading category	MSA EN 13285 0/80 and G _E	Table 600-12	Table 600-12	Table 600-14 Method 6; End product: 95% Modified
SELECTED GRANULAR I		imported on to the Site		 8, 9 and 10: P (natural aggregates) A2 (crushed concrete) A3 (crushed bricks, masonry) A4 (mixed recycled aggregate) Aggregates from source code A4 shall contain not more than 50% of constituents in Class Ra 	 (ii) Maximum fines and oversize categories (iii) Los Angeles coefficient (iv) Volume 	MSA EN 13285 - UF ₁₂ and OC ₇₅ MSA EN 13242 - <i>LA</i> ₅₀ MSA EN 13242	Table 600-12 -	Table 600-12 50	Proctor
				(bituminous materials). Property (x) in the next column	stability of blast furnace	 – free from dicalcium silicate 			

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific	Material Properti Requirements of Clause 627)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 627)					
			IM Appendix 6/1)	Property (See	Defined and	Acceptable Lir	nits Within:			
				Exceptions in	Tested in	Lower	Upper			
				Previous Column)	Accordance with:					
			shall not apply if the Class Ra	slag	and iron					
			(asphalt) content of any recycled	0.29	disintegration					
			aggregate is 20% or less.							
				(v) Volume	MSA EN 13242	_	_			
				stability of	- V ₅					
				steel (BOF)						
				and EAF) slag						
				(vi) Other	MSA EN 13242	_	-			
				aggregate	_					
				requirements	Category NR (no					
					requirement)					
				(vii) Laboratory	MSA EN 13285,	_	-			
				dry density	Clause 5.3 –					
				and optimum	declared values					
				water content						
				(viii) Water	MSA EN 1097-5	Optimum wc	Optimum			
				content		– - 2%	wc			
				(ix) Class Ra	Clause 709	_	50%			
				(asphalt)						
				content						

C	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous Column) (x) bitumen content	es Required for Acc n Use of Fill Material Defined and Tested in Accordance with: MSA EN 12697- 1 or MSA EN	eptability (In Ado s in Clause 601 a Acceptable Lin Lower –	dition to and Testing in nits Within: Upper 2.0%	Compaction Requirements in Clause 610
	6G	Selected granular material	Gabion filling	Natural gravel, crushed rock, crushed concrete or any combination thereof. None of these constituents shall include any argillaceous rock. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates); A2 (crushed concrete).	(i) grading (ii) Los Angeles coefficient	12697-39 BS 1377: Part 2 (On-site) MSA EN 933-2 (Imported onto site) Clause 630	Table 600-11 Table 600-12 –	Table 600-11 Table 600-12 50	None
SELECTED	6H	Selected well graded granular material	Drainage layer to reinforced soil and	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, or any combination thereof.	(i) grading	BS 1377: Part 2 (On-site) BS EN 933-2 (Imported onto	Table 600-11	Table 600-11	Table 600-14 Method 3;

Class		General Material Description	Typical Use	Typical UsePermitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Propert Requirements of Clause 627) Property (See	Compaction Requirements in Clause 610			
					Exceptions in Previous Column)	Tested in Accordance with:	Lower	Upper	
			anchored earth structures	None of these constituents shall include any argillaceous rock. (Properties (vi), (vii), (viii), (ix),	(ii) plasticity	site) BS 1377: Part 2	Table 600-12 Non-plastic	Table 600-12 Non-plastic	
				(x), (xi) and (xii) in next column only apply when metallic reinforcing or anchor elements, facing units or	index (iii) Los Angeles coefficient	Clause 630	_	50	
				fastenings are used.) (Properties (ii) and (v) in next column shall not apply to chalk.) Recycled aggregate	(iv) mc	BS 1377: Part 2 See Note 4	Арр 6/1	Арр 6/1	
				except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be	(v) MCV (vi) pH value	Clause 628 BS 1377: Part 3	App 6/1 Table 600-13	App 6/1 Table 600-13	
				aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes	(vii) chloride ion content	BS EN 1744-1	_	Table 600-13	
				8, 9 and 10: P (natural aggregates);	(viii) water soluble (WS) sulfate content	BS EN 1744-1 clause 10	_	Table 600-13	
				A2 (crushed concrete) A3 (crushed bricks, masonry)	(ix) oxidisable sulfides (OS)	BS EN 1744-1 clause 13	_	Table 600-13	

С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 627)Property (SeeDefined and Tested in Accordance with:Acceptable Limits Within:Exceptions in PreviousTested in Accordance with:Upper				Compaction Requirements in Clause 610
					content (x) resistivity (xi) redox potential (xii) organic content (xiii) microbial activity index (i) grading (xv) microbial	Clause 632 Clause 633 BS 1377: Part 3 Table 600-6 BS 1377: Part 2 (On-site) BS EN 933-2 (Imported onto	Table 600-13 Table 600-13 - - Table 600-11	- Table 600-13 Table 600-13 Table 600-11	
SELECT	61	Selected uniformly graded	Fill to reinforced soil and anchored	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, or any	activity index (i) grading	BS 1377: Part 2 (On-site)	Table 600-12 Table 600-11	Table 600-12 Table 600-11	Table 600-14 Method 3;

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in	ies Required for Acc n Use of Fill Material Defined and Tested in	eptability (In Ad s in Clause 601 a Acceptable Lir Lower	dition to and Testing in nits Within: Upper	Compaction Requirements in Clause 610
				Previous Column)	Accordance with:			
	granular material	earth	combination thereof. None of these constituents shall include any argillaceous rock. (Properties (viii), (ix), (x), (xi), (xii),		MSA EN 933-2 (Imported onto site)	Table 600-12	Table 600-12	
			(xiii) and (xiv) in next column only apply when metallic reinforcing or anchor elements, facing units or fastenings are used.) (Properties	 (ii) uniformity coefficient (iii) SMC of chalk 	See Note 5	5	20%	
	 (i), (ii) and (v) in next column shall not apply to chalk.) Recycled aggregate except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates); A2 (crushed concrete) 		(i), (ii) and (v) in next column shallnot apply to chalk.) Recycledaggregate except recycled	(iv) mc	BS 1377: Part 2 See Note 4	App 6/1	App 6/1	
		asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes	 (v) MC v (vi) effective angle of friction (φ') and effective cohesion (c') 	Clause 631	Арр 6/1	-		
		8, 9 and 10: P (natural aggregates); A2 (crushed concrete)	(vii) coefficient of friction and adhesion (fill/ elements)	Clause 634	Арр 6/1	-		

С	lass	General Material Description	eral Typical Use Permitted Constituents (All Material Properties Required for Acceptability (In Addition to rial Subject to Requirements of Clause 601 and contract specific Requirements on Use of Fill Materials in Clause 601 and Testing in ription IM Appendix 6/1) Property (See Defined and Acceptable Limits Within: Exceptions in Previous Accordance with: Lower Upper			Compaction Requirements in Clause 610			
				A3 (crushed bricks, masonry)	(viii) pH value	BS 1377: Part 3	Table 600-13	Table 600-13	
					(ix) chloride ion content	MSA EN 1744-1	_	Table 600-13	
					(x) water soluble (WS) sulfate content	MSA EN 1744-1 clause 10	-	Table 600-13	
					(xi) oxidisable sulfides (OS) content	MSA EN 1744-1 clause 13	-	Table 600-13	
					(xii) resistivity	Clause 632	Table 600-13	-	
					(xiii) redox potential	Clause 633	Table 600-13	-	
					(xiv) organic content	BS 1377: Part 3	-	Table 600-13	
					(xv) microbial activity index	Table 600-6	-	Table 600-13	
SELECT	6J	Selected uniformly graded	Fill to reinforced soil and	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, or any	(i) grading	BS 1377: Part 2 (On-site)	Table 600-11	Table 600-11	Table 600-14 Method 3;

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous Column)	es Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ad s in Clause 601 a Acceptable Lir Lower	dition to and Testing in nits Within: Upper	Compaction Requirements in Clause 610
	granular material	anchored earth	combination thereof. None of these constituents shall include any argillaceous rock. (Properties (viii), (ix), (x), (xi), (xii), (xiii) and (xiv) in next column only apply when metallic reinforcing or	(ii) uniformity coefficient	BS EN 933-2 (Imported onto site) See Note 5	Table 600-12 5	Table 600-12 10	
			apply when metallic reinforcing or anchor elements, facing units or fastenings are used.) (Properties (i), (ii) and (v) in next column shall not apply to chalk.) Recycled aggregate except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates – except shale, siltstone or slate, see Note	coefficient (iii) SMC of chalk (iv) mc (v) MCV (vi) effective angle of friction (φ') and effective cohesion (c') (vii) coefficient of friction and adhesion (fill/ elements)	- BS 1377: Part 2 See Note 4 Clause 628 Clause 631 Clause 634	- App 6/1 App 6/1 App 6/1	20% App 6/1 App 6/1 -	

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific	Material Properti Requirements of Clause 627)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 627)					
			IM Appendix 6/1)	Property (See	Defined and	Acceptable Lir	nits Within:			
				Exceptions in	Tested in	Lower	Upper			
				Previous	Accordance with:					
				Column)						
			7);	(viii) pH value	BS 1377: Part 3	Table 600-13	Table			
			A2 (crushed concrete)				600-13			
			A3 (crushed bricks, masonry)	(ix) chloride	BS EN 1744-1	_	Table 600-12			
				ion content						
							Table 600-12: Imported onto Site Grading Requiremen ts for Class 6 Acceptable Earthworks			
							Materials Class Size 500 6A 100 6B 100 6C 6F3			

Cla	ss General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific	Material Propert Requirements of Clause 627)	ies Required for Acc n Use of Fill Material	eptability (In A s in Clause 60 [.]	ddition to 1 and Testing in	Compaction Requirements in Clause 610		
			IM Appendix 6/1)	Property (See	Defined and	Acceptable L	imits Within:			
				Exceptions in Previous Column)	Tested in Accordance with:	Lower	Upper			
							6F4			10
							6F5	100	75-99	
							6H			
							6I & 6J	100	85-100	
							6K			1
							6L 6M 6N & 6P		100	10
							Table 600-12			
				(x) water	RS EN 1744 1			•		
					DO EN 1744-1	_	600-13			
				sulfate content						
		1	1	1	1	1		1	1	

Column)	Table	
(xi) oxidisable BS EN 1744-1 - sulfides (OS) clause 13 - (xii) resistivity Clause 632 Table 600-13 (xiii) redox Clause 633 Table 600-13 potential - -	600-13 - -	
(xiv) organic content (xv) microbial activity index BS 1377: Part 3 - Table 600-6 -	Table 600-13 Table 600-13	
Image: Displaying the second structure seco	Table 600-11 Table 600-12 –	End product 90% of maximum dry density of BS 1377: Part 4 (Vibrating hammer method)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific	Material Properti Requirements of Clause 627)	Compaction Requirements in Clause 610			
			IM Appendix 6/1)	Property (See	Defined and	Acceptable Lir	nits Within:	
				Exceptions in Previous Column)	Tested in Accordance with:	Lower	Upper	
			aggregate conforming to MSA EN 13242 from one or more of the	(iii) plasticity index	BS 1377: Part 2	_	6	
			following source codes, see Notes 8, 9 and 10: P (natural aggregates); A2 (crushed concrete)	(iv) optimum mc	BS 1377: Part 4 (vibrating hammer method)	-	_	
			A3 (crushed bricks, masonry)	(v) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +1%	
				(vi) MCV	Clause 628	App 6/1	App 6/1	
				(vii) Los Angeles coefficient	Clause 630	_	40	
				(viii) resistivity	Clause 632	2000 ohm cm	_	
				(ix) water soluble (WS) sulfate content	MSA EN 1744-1 clause 10	_	300 mg/ I as SO4	
				(x) oxidisable sulfides (OS) content	MSA EN 1744-1 clause 13	_	0.06% as SO4	

Class		General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous Column)	es Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	dition to and Testing in nits Within: Upper	Compaction Requirements in Clause 610
					(xi) chloride ion content (xii) pH value (xiii) sulfide and hydrogen sulfide	MSA EN 1744-1 BS 1377: Part 3 Standard textbook of qualitative inorganic	6 -	0.025% 9 Rapid blackening of lead acetate	
SELECTED GRANULAR FILL	6L	Selected uniformly graded granular material	Upper bedding for corrugated steel buried structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the	(i) grading (ii) grading (iii) resistivity (iii) water soluble (WS) sulfate content	analysis BS 1377: Part 2 (On-site) MSA EN 933-2 (Imported onto site) Clause 632 MSA EN 1744-1 clause 10	Table 600-11 Table 600-12 2000 ohm cm –	paper Table 600-11 Table 600-12 - 300 mg/ I as SO4	End product 90% of maximum dry density of BS 1377: Part 4 (Vibrating hammer method) unless otherwise stated in App 6/1

Class		General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous Column)	es Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	dition to and Testing in hits Within: Upper	Compaction Requirements in Clause 610
				following source codes, see Notes 8, 9 and 10: P (natural aggregates); A2 (crushed concrete) A3 (crushed bricks, masonry)	 (iv) oxidisable sulfides (OS) content (v) chloride ion content (vi) pH value (vii) sulfide and hydrogen sulfide 	MSA EN 1744-1 clause 13 MSA EN 1744-1 BS 1377: Part 3 Standard textbook of qualitative inorganic analysis	- 6 -	0.06% as SO4 0.025% 9 Rapid blackening of lead acetate paper	
SELECTED GRANULAR FILL	6M	Selected granular material	Surround to corrugated steel buried structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt. Where material is imported onto	(i) grading (ii) uniformity	BS 1377: Part 2 (On-site) MSA EN 933-2 (Imported onto site) See Note 5	Table 600-11 Table 600-12 5	Table 600-11 Table 600-12 –	End product 90% of maximum dry density of BS 1377: Part 4 (Vibrating hammer method)

Class	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 627)				Compaction Requirements in Clause 610	
				Exceptions in Previous Column)	Tested in Accordance with:	Lower	Upper		
			site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates); A2 (crushed concrete) A3 (crushed bricks, masonry)	coefficient (iii) plasticity index	BS 1377: Part 2	_	6	unless otherwise stated in App 6/1	
				(iv) optimum mc	BS 1377: Part 4 (vibrating hammer method)	-	_		
				(v) mc	BS 1377: Part 2 See Note 4	Optimum mc - 2%	Optimum mc +1%		
				(vi) MCV	Clause 628	App 6/1	Арр 6/1		
				(vii) Los Angeles coefficient	Clause 630	_	40		
				(viii) resistivity	Clause 632	2000 ohm cm	_		
				(ix) water soluble (WS) sulfate content	MSA EN 1744-1 clause 10	_	300 mg/ I as SO4		
				(x) oxidisable sulfides (OS) content	MSA EN 1744-1 clause 13	_	0.06% as SO4		
				(xi) chloride ion	MSA EN 1744-1	-	0.025%		
С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in	es Required for Acc n Use of Fill Material Defined and Tested in	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	dition to and Testing in hits Within: Upper	Compaction Requirements in Clause 610
---------------------	------	------------------------------------	-----------------------	--	---	--	--	---	--
	1				Column)	Accordance with.			
AR FILL	6N	Selected well graded	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed	content (xii) pH value (xiii) sulfide and hydrogen sulfide (i) grading	BS 1377: Part 3 Standard textbook of qualitative inorganic analysis BS 1377: Part 2 (On-site)	6 - Table 600-11	9 Rapid blackening of lead acetate paper Table	End product 95% of
SELECTED GRANULAR F		granular material	structures	concrete, or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10:	(ii) uniformity coefficient (iii) Los Angeles coefficient (iv) undrained shear	MSA EN 933-2 (Imported onto site) See Note 5 Clause 630 Clause 629	Table 600-12 10 – App 6/1	Table 600-12 - 40	density of BS 1377: Part 4 (vibrating hammer method)

С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous	es Required for Acc In Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	Compaction Requirements in Clause 610	
				P (natural aggregates); A2 (crushed concrete) A3 (crushed bricks, masonry)	parameters (c and φ) (v) effective angle of internal friction (φ') and effective cohesion (c') (vi) permeability (vii) mc (vii) MCV (ix) slope stability test (where required in App 6/6)	Clause 631 Clause 635 BS 1377: Part 2 See Note 4 Clause 628 Clause 608	App 6/1 App 6/1 App 6/1 App 6/1 App 6/6	– Арр 6/1 Арр 6/1	
SELECTED	6P	Selected granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, or any combination thereof. None of these constituents shall include any argillaceous rock.	(i) grading	BS 1377: Part 2 (On-site) MSA EN 933-2 (Imported onto	Table 600-11	Table 600-11	End product 95% of maximum dry density of BS 1377: Part

С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous	es Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	Compaction Requirements in Clause 610	
				(Properties (i), (ii) and (ix) in next column shall not apply to chalk.) Recycled aggregate	(ii) uniformitu	site)	Table 600-12	Table 600-12	4 (vibrating hammer method)
				except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be	(iv) Los Angeles coefficient	Clause 630	-	60	
				aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10:	(v) undrained shear parameters (c and φ)	Clause 629	Арр 6/1	_	
				A2 (crushed concrete) A3 (crushed bricks, masonry)	(vi) effective angle of internal friction (φ') and effective cohesion (c')	Clause 631	Арр 6/1	_	
					(vii) permeability (viii) mc	Clause 635 BS 1377: Part 2	Арр 6/1 Арр 6/1	– App 6/1	
					(ix) MCV	See Note 4 Clause 628	Арр 6/1	App 6/1	

С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous Column)	ies Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	Compaction Requirements in Clause 610	
					(x) slope stability test (where required in App 6/6)	Clause 608	Арр 6/6		
FILL	6Q	Selected granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, or any	As for Class 1A, 1 addition of the foll (i) water soluble	B or 1C with the owing: MSA EN 1744-1	_	300 mg/ I as	End product 95% of maximum dry
ELECTED GRANULAR				combination thereof. None of these constituents shall include any argillaceous rock. (Properties (i), (ii) and (ix) in next column shall not apply to chalk.) Recycled aggregate except recycled asphalt.	(WS) sulfate content (ii) oxidisable sulfides (OS) content (iii) chloride ion	clause 10 MSA EN 1744-1 clause 13 MSA EN 1744-1	-	SO4 0.06% as SO4 0.025%	density of BS 1377: Part 4 (vibrating hammer method)
S				Where material is imported onto site which is not 'as dug' it shall be	content (iv) pH value	BS 1377: Part 3	6	9	

С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific IM Appendix 6/1)	Material Properti Requirements or Clause 627) Property (See Exceptions in Previous Column)	es Required for Acc n Use of Fill Material Defined and Tested in Accordance with:	eptability (In Ado s in Clause 601 a Acceptable Lin Lower	dition to and Testing in nits Within: Upper	Compaction Requirements in Clause 610
				aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates) A2 (crushed concrete) A3 (crushed bricks, masonry)	(v) sulfide and hydrogen sulfide	Standard textbook of qualitative inorganic analysis	_	Rapid blackening of lead acetate paper	
	6S	Selected well graded granular material	Filter layer below subbase	Crushed rock or sand. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates)	(i) grading (ii) plasticity index	BS 1377: Part 2 (On-site) MSA EN 933-2 (Imported onto site) BS 1377: Part 2	Table 600-11 Table 600-12 –	Table 600-11 Table 600-12 Non-plastic	

С	lass	General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause	Material Properties Requirements on U Clause 629)	on to Testing in	Compaction Requirements in Clause 610		
				601 and contract specific	Property (See	Defined and	Acceptable Limits	s Within:	
				IM Appendix 6/1)	Exceptions in Previous Column)	Tested in Accordance with:	Lower	Upper	
MISC FILL	8	Class 1	Lower trench fill	Any material; except no stones or lumps of clay shall be retained on the 40mm test sieve. Recycled aggregate, where material is imported onto site which is not 'as dug' it shall be aggregate conforming to MSA EN 13242 from one or more of the following source codes, see	(i) mc (ii) MCV	BS 1377: Part 2 See Note 4 Clause 628	Арр 6/1 Арр 6/1	Арр 6/1 Арр 6/1	Table 600-14
				Notes 8, 9 and 10: P (natural aggregates) & A (construction and demolition recycling industries)	(ii) bearing ratio (iii) mc	MSA EN 13286- 47 MSA EN 13286-2	App 6/1 To enable compa 610	- ction to Clause	

Table 000-9. Acceptable Lattinworks materials. Classification and Compaction Requirements – misc i in and Stabilized material

Table 600-10: Footnotes for Tables 600-3 to 600-6

1	App = Contract specific IM Appendix
2	Not Used
3	Where in the Acceptable Limits column reference is made to App 6/1, only those properties having limits ascribed to them in contract specific IM Appendix 6/1 shall
	apply. Where contract specific IM Appendix 6/1 gives limits for other properties not listed in this Table such limits shall also apply.
4	Where BS 1377: Part 2 is specified for mc, this shall mean BS 1377: Part 2 where the material is a soil or MSA EN 1097-5 where the material is required to conform
	to a harmonised European Standard.
5	Uniformity coefficient is defined as the ratio of the particle diameters D60 to D10 on the particle-size distribution curve, where: D60 = particle diameter at which 60%
	of the soil by weight is finer
	D10 = particle diameter at which 10% of the soil by weight is finer
6	The limiting values for Class U1B material are given in contract specific IM Appendix 6/14 and contract specific IM Appendix 6/15.
7	Where material source codes are referenced these are as listed in Table 600-16.
8	Where materials are required to be aggregates conforming to MSA EN 13242 materials certificated as being compliant with MSA EN 13285 are acceptable for use
	provided that they meet all the specification requirements and the Declaration of Performance for constituent parts to MSA EN 13242 are provided to the
	Overseeing Organisation.
9	Materials shall comply with the current Environmental Regulations at the time of use. Reference shall be made to Annex ZA (informative) of MSA EN 13242.

Class	Size	e (mm)						Size	(mm) B	S Serie	es					Siz	e (micr	ons) BS S	Series
	500	300	125	90	75	37.5	28	20	14	10	6.3	5	3.35	2	1.18	600	300	150	63
1A		100	95-100													<35			<15
1B			100																<15
1C	100		10-95													0-25			<15
1D					100				<75					<50			<30		<15
6A	100									0-100		0-85				0-45			0-5
6B	100		0-10																
6C			100			0-100					0-100		0-35	0-10		0-2			
6F1					100	75- 100				40-95		30-85				10-50			<15
6F2			100	80- 100	65- 100	45- 100				15-60		10-45				0-25			0-12
6F3			100	80- 100	65- 100	45- 100				15-60		10-45				0-25			0-12
6H								100				60- 100			15-45	0-25		0-5	
6I & 6J			100		85- 100				25- 100					15- 100		9-100			<15
6K								100											0-10
6L										100		89- 100		60- 100	30-100	15-100	5-70	0-15 except 0-20 for crushed rock	

Table 600-11: Grading Requirements for Acceptable Earthworks Materials

Class	Size	e (mm)			Size (mm) BS Series										Size (microns) BS Series				
6M				100														0-10	
6N & 6P				100														<15	
6S				100									60- 100		30-90		4-45	0-16	

Table 600-12: Imported onto Site Gradine	Poquiromonts for Class 6 Acco	ntable Earthworks Materials
Table 000-12. Imported Onto Site Grading	requirements for class o Acce	

Class	Size (r	nm)		Size (mm)									Size (microns)						
								MSA EN	933-2 Se	eries							MSA	EN 933-2	
																	S	Series	
	500	300	125	80	63	40	31.5	20	16	10	8	6.3	4	2	1	500	250	125	63
6A	100									0-100		0-85				0-45			0-5
6B	100		0-10																
6C			100			0-100						0-100	0-35	0-10		0-2			
6F3			100	75-99		50-90		30-75		15-60				0-35					0-12
6F4					100		75-99		50-90		30-75		15-60		0-35				<15
6F5			100	75-99		50-90		30-75		15-60				0-35					0-12
6H								100				60-100			15-45	0-25		0-5	
6I & 6J			100	85-100					25-100					15-100		9-100			<15
6K								100											0-10
6L										100			85- 100	60-100	30-100	15-100	5-70	0-15 except 0- 20 for crushed rock	
6M				100															0-10
6N & 6P				100															<15
6S					100									60-100		30-90		8-45	0-16

Table 600-13: Limits of Material Properties of Fill for Use With Metal Components in Reinforced Soil and Anchored Earth Structures for Class	6H, 6I
and 6J Materials	

Reinforcing		Properties of Fill										
Element Material	pH Value		erial pH Value		Max Chloride	Max Organic	Max Water	Maximum Oxidisable	Minimum	Minimum	Microbial	
	Min	Max	Ion Content	Content	Soluble (WS) Sulfides (OS)		Restivity	Redox	Activity Index			
			%	%	Sulfate Content	Content	Ohm.cm	Potential				
					mg/l as SO₄	% as SO₄		volts				
Galvanised Steel	5	10	0.02	0.2	300	0.06	5000	0.40	Less than 5			
Stainless Steel	5	10	0.025	0.2	600	0.12	3000	0.35				

NOTES

- 1. A method of calculating the Microbial Activity Index may be obtained by reference to TRRL Contractor Report 54 'Soil Corrosivity Assessment'.
- 2. The corrosion potential of frictional fill shall be assessed from resistivity, pH, chloride, water soluble sulfate and oxidisable sulfides tests. For cohesive soil it will be necessary to test additionally for organic content. Should either organic content or sulfate be in excess of the specified levels, then tests shall also be included for Redox Potential and Microbial Activity Index.
- 3. The water soluble sulfate content and oxidisable sulfides content shall be determined in accordance with the methods described in MSA EN 1744-1 clause 10, 11 and 13.
- 4. Methods of test (except for Microbial Activity Index, water soluble sulfate content and oxidisable sulfides content) are given in BS 1377: Part 3.
- 5. Table 600-14: Method Compaction for Earthworks Materials: Plant and Methods (Method's 2, 3, 5 and 6 This Table is to be read in conjunction with sub-Clause 610.11)

Table 600-14: Method Compaction for Earthworks Materials: Plant and Methods (Method's 2, 3, 5 and 6). This Table is to be read in conjunction with sub-Clause 612.10 & sub-Clause 610.4)

Type of	Ref	Category	Meth	nod 2	Meth	nod 3	Method 5			Method 6		
Compaction Plant	No.		D	N#	D	N#	D	N	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm	
Smoothed wheeled roller (or vibratory roller operating without vibration)		Mass per metre width of roll:										
	1	over 2100 kg up to 2700 kg	125	10	125	10*	unsuitable		unsuitable	unsuitable	unsuitable	
	2	over 2700 kg up to 5400 kg	125	8	125	8*	unsu	itable	16	unsuitable	unsuitable	
	3	over 5400 kg	150	8	unsu	itable	unsu	itable	8	16	unsuitable	
Grid roller		Mass per metre width of roll:										
	1	over 2700 kg up to 5400 kg	unsu	itable	150	10	unsuitable		unsuitable	unsuitable	unsuitable	
	2	over 5400 kg up to 8000 kg	125	12	unsu	unsuitable		itable	20	unsuitable	unsuitable	
	3	over 8000 kg	150	12	unsu	itable	unsu	itable	12	20	unsuitable	
Deadweight tamping roller		Mass per metre width of roll:										
	1	over 4000 kg up to 6000 kg	150	12	250	4	unsu	itable	12	20	unsuitable	

Type of	Ref	Category	Meth	od 2	Method 3		Method 5			Method 6	
Compaction Plant	No.		D	N#	D	N#	D	N	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
	2	over 6000 kg	200	12	300	3	unsu	itable	8	12	2020
Pneumatic-tyred roller		Mass per wheel:									
	1	over 1000 kg up to 1500 kg	unsui	itable	150 10*		unsuitable		unsuitable	unsuitable	unsuitable
	2	over 1500 kg up to 2000 kg	unsu	itable	unsu	itable	unsuitable		unsuitable	unsuitable	unsuitable
	3	over 2000 kg up to 2500 kg	125	12	unsuitable		unsuitable		unsuitable	unsuitable	unsuitable
	4	over 2500 kg up to 4000 kg	125	10	unsu	itable	unsuitable		unsuitable	unsuitable	unsuitable
	5	over 4000 kg up to 6000 kg	150	8	unsu	unsuitable		itable	12	unsuitable	unsuitable
	6	over 8000 kg up to 12000 kg	150	8	unsu	itable	unsuitable		12	unsuitable	unsuitable
	7	over 6000 kg up to 8000 kg	150	8	unsu	itable	unsu	itable	10	16	unsuitable
	8	over 12000 kg	175	6	unsu	itable	unsu	itable	8	12	unsuitable
Vibratory tamping		Mass per meter width of a vibrating roll:									

Type of	Ref	Category	Meth	nod 2	Meth	od 3	Meth	nod 5		Method 6	
Compaction	No.		D	N#	D	N#	D	N	N for	N for	N for
Plant									D = 110 mm	D = 150 mm	D = 250 mm
roller	1	over 700 kg up to	100	12	150	12	unsu	itable	unsuitable	unsuitable	unsuitable
		1300 kg									
	2	over 1200 kg up to	105	10	175	10*		itabla	10	Linguitable	unquitable
	2	1800 kg up to	125	12	175	12	unsu	ilable	12	Unsulable	unsulable
	3	over 1800 kg up to	150	12	200	12*	unsu	itable	8	12	
		2300 kg									
	4	over 2300 kg up to	150	9	250	12*	400	5	6	10	unsuitable
		2900 kg									
	5	over 2900 kg up to	200	9	275	12*	500	6	6	10	unsuitable
		3600 kg									
	6	over 3600 kg up to	225	9	300	12*	600	6	4	8	unsuitable
		4300 kg									
	7	over 4300 kg up to	250	9	300	9*	700	6	3	7	12
		5000 kg									
	8	over 5000 kg	275	9	300	7*	800	6	3	6	10
Vibratory roller		Mass per metre width									
		of vibratory roll:									
	1	over 270 kg up to 450	75	16	150	16	unsui	itabla	unsuitable	unsuitable	unsuitable
	I	kg	10	10	100	10	unsu	lable	unsultable	unsultable	unsultable
	2	over 450 kg up to 700	75	12	150	12	แทรม	itable	unsuitable	unsuitable	unsuitable
	2	kg	10	12	100	12	unou	labio	anoundatio	unoutable	unoutable
	3	over 700 kg up to	125	10	150	6	unsu	itable	16	unsuitable	unsuitable
		1300 kg	0			5	4.150				

Type of	Ref	Category	Meth	nod 2	Meth	od 3	Meth	od 5	Method 6		
Compaction	No.		D	N#	D	N#	D	Ν	N for	N for	N for
Plant									D = 110 mm	D = 150 mm	D = 250 mm
	4	over 1300 kg up to 1800 kg	150	8	200	10*	unsui	table	6	16	unsuitable
	5	over 1800 kg up to 2300 kg	150	4	225	12*	unsui	table	4	6	12
	6	over 2300 kg up to 2900 kg	175	4	250	10*	400	5	3	5	11
	7	over 2900 kg up to 3600 kg	200	4	275	8*	500	5	3	5	10
	8	over 3600 kg up to 4300 kg	225	4	300	8*	600	5	2	4	8
	9	over 4300 kg up to 5000 kg	250	4	300	6*	700	5	2	4	7
	10	over 5000 kg	275	4	300	4*	800	5	2	3	6
Vibrating plate		Mass per m ² of base									
compactor		plate:									
	1	over 880 kg up to 1100 kg	unsu	itable	75	6	unsui	table	unsuitable	unsuitable	unsuitable
	2	over 1100 kg up to 1200 kg	75	10	100	6	unsui	table	unsuitable	unsuitable	unsuitable
	3	over 1200 kg up to 1400 kg	75	6	150	6	unsui	table	unsuitable	unsuitable	unsuitable
	4	over 1400 kg up to 1800 kg	125	6	150	4	unsui	table	8	unsuitable	unsuitable

Type of	Ref	Category	Meth	od 2	Meth	od 3	Meth	od 5		Method 6		
Compaction	No.		D	N#	D	N#	D	Ν	N for	N for	N for	
Plant									D = 110 mm	D = 150 mm	D = 250 mm	
	5	over 1800 kg up to 2100 kg	150	5	200	4	unsu	table	5	8	unsuitable	
	6	over 2100 kg	200	5	250	4	unsu	table	3	6	12	
Vibro-tamper		Mass:										
	1	over 50 kg up to 65 kg	100	3	150	3	unsu	table	4	8	unsuitable	
	2	over 65 kg up to 75 kg	125	3	200	3	unsu	table	3	6	12	
	3	over 75 kg up to 100 kg	150	3	225	3	unsuitable		2	4	10	
	4	over 100 kg	200	3	225	3	unsu	table	2	4	10	
Power rammer		Mass:										
	1	100 kg up to 500 kg	150	6	unsu	itable	unsu	table	5	8	unsuitable	
	2	over 500 kg	275	12	unsu	itable	unsu	table	5	8	14	
Dropping-weight compactor		Mass of rammer over 500 kg weight drop:										
	1	over 1 m up to 2 m	600	8	450	8	unsu	table	unsuitable	unsuitable	unsuitable	
	2	over 2 m	600	8	unsu	itable	unsu	table	unsuitable	unsuitable	unsuitable	

Ground Treatment	In situ Testing			
For each column/area treated:	For each area tested:			
Date Contract title	Date Contract Title			
Area identification Unique grid location	Area identification			
Ground level at commencement Material used	Test position, co-ordinates and level			
Approximate column diameter	Method of test used			
Depth of penetration of each compaction point Vibrator	All information required by			
power consumption during operation Jetting pressure	appropriate British Standard test			
(where applicable)	procedure			
Duration of penetration Duration of compaction				
Obstructions and delays				
Number and type of tests carried out				

Table 600-15: Records and Reports - Information Required

6. This table is taken from MSA EN 13242:2013 which was published on 31st May 2013 and subsequently withdrawn on 10th January 2014. All other specification requirements which reference MSA EN 13242 shall be taken as reference to the version of that standard current at the Contract Reference Document Date unless otherwise detailed in the contract specific specification.

Source	Source	Sub-Code	Specific Material
Code			
Р	Natural Aggregates	Р	All petrographic types included in MSA EN 932-3
А	Construction and	A1	Reclaimed asphalt
	demolition recycling industries	A2	Crushed concrete
		A3	Crushed bricks, masonry
		A4	Mix of A1, A2 and A3
Н	Maintenance dredging	H1	Dredge spoil sand
	works		
I	Miscellaneous	11	Excavated soil
			Crushed glass

Table 600-16: Material Sources and Source Codes for Imported Materials