

INTRODUCTION

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INTRODUCTION

000 Introduction

1 The Specification for Road Works is published as Volume 1 and Volume 2 of the Manual of Contract Documents for Road Works and in addition to the Introduction contains 28 Series.

The series 1400, 1500, 1600, 1700, 1800, 1900, 2100, 2200, 2300, 2500, 3000, and NG000 will be dealt with in the second version of the Specifications.

001 Not Used

002 Terms and Abbreviations

1. Unless specifically defined otherwise the definitions of terms used in the Specification and associated documents are those in BS 6100, Glossary of Building and Civil Engineering Terms.

The term Overseeing Organisation means the Malta Transport Authority.

2 Abbreviations are in accordance with the recommendations given in BS 5775. Abbreviations listed in Table 0/1 have the meanings shown therein.

003 Appendices

1 Numbered Appendices (identified by digits, e.g. 17/2) contain Contract-specific information and requirements. The Numbered Appendices incorporated in the Contract are listed in Appendix 0/3.

004 Maltese Standards, British Standards, British Standard Codes of Practice, Harmonised European Standards, European Standards and Other Reference Documents

1 The following publications are made reference in the Specification:

- (i) Maltese Standards (Published by the Malta Standards Authority;
- (ii) British Standards;
- (iii) British Standards Codes of Practice;

- (iv) British Standard Drafts for Development (DD) Documents;
- (v) European Standards;
- (vi) International Standards;
- (vii) UK Department of Transport Publications;
- (viii) Transport Research Laboratory Reports;
- (ix) Acts and Statutory Instruments;
- (x) British Board of Agreement Certificates;
- (xi) International Board of Agreement Certificates;
- (xii) Miscellaneous;

TABLE 0/1: Abbreviations

Abbreviation	Meaning
AASHTO	American Association of State Highway and Transportation Officials
AAV	Aggregate Abrasion Value
ADT	Malta Transport Authority
AISI	American Iron and Steel Institute
AMD	Amendment to British Standard
ASR	Alkali Silica Reaction
ASTM	American Society for Testing and Materials
BBA	British Board of Agreement
BRE	Building Research Establishment Ltd
BS	British Standard
BSI	British Standards Institution
CBM	Cement Bound Material
CBR	California Bearing Ratio
CHS	Circular Hollow Section
CP	British Standard Code of Practice
EN	European Standard
FTD	Flat Traffic Delineator
HAPAS	Highway Authorities Product Approval Scheme
HMSO/SO	Her Majesty's Stationery Office/The Stationery Office
HSE	Health and Safety Executive
ISO	International Organization for Standardization
MCV	Moisture Condition Value
MDPE	Medium Density Polyethylene
MSA	Malta Standards Authority
NG	Notes for Guidance on the Specification for Road Works
PC	Portland Cement
PCD	Percentage Impact Compactor Density
PSV	Polished Stone Value
PVC	Polyvinyl Chloride
RCD	Road Construction Detail
RHS	Rectangular Hollow Section
SRW	Specification for Road Works
SI	Statutory Instrument
SMC	Saturation Moisture Content
TRL	Transport Research Laboratory (formerly Transport and Road Research Laboratory)
UKAS	United Kingdom Accreditation Service
PVC-U	Unplasticised Polyvinyl Chloride
XLPE	Cross-linked Polyethylene
Dc	Direct current

Dft	Dry film thickness
Ggbs	Ground granulated blast furnace slag.
Mc	Moisture content
Mdft	Minimum dry film thickness (of paint)
Omc	Optimum moisture content
Pfa	Pulverised fuel ash.

2 Maltese Standards, British Standards and British Standard Codes of Practice incorporated in the Contract by a reference which does not include a date shall be the respective editions current on the date stated in the Contract, and incorporating all amendments current on that date. Maltese Standards, British Standards and British Standard Codes of Practice incorporated in the Contract by a reference that includes a date shall be deemed to exclude amendments issued after that date except any such amendments shown in brackets immediately following the stated date.

3 In respect of all other references the date of the edition applicable to the Contract shall be that stated in the Specifications or, where no date is stated, the date of the edition current on the date stated in the Contract and incorporating all published amendments current on that date.

4 Where a Maltese Standard or a British Standard incorporated in the Contract has been superseded by a Harmonised European Standard, or a European Standard, issued prior to the date stated in the Contract then such Harmonised European Standard or European Standard shall be substituted for the Maltese Standard or British Standard and any amendments thereto contained in the Specification.

005 Thickness of Material and Tolerances

1 Unless stated to the contrary, the thickness of material described shall mean the finished or compacted thickness.

2 The requirements for tolerances, where necessary, are incorporated in the Specification, on the Drawings and by reference in the publications stated in the Specification.

006 Acknowledgements

1 The Malta Transport Authority acknowledge the permission given by HMSO on whose publication 'Standards for Highway Works', the ADT Specification for Road Works is based.

2 The Malta Transport Authority also acknowledges the permission given by the German Road and Transportation Research Association (FGSV) for adapting the specifications established by its Committees, in the preparations of the ADT Specification for Road Works.

Chapter II

General Principles

General Principles

Method of Measurement

- 1 a The Method of Measurement is intended for use for road contracts with any form of contract. Amendments may be required for particular Contract Conditions.
- b The Method of Measurement, is based on the Specification for Road Works and of the Road Construction Details published as Volume 1 and Volume 3 of the Manual of Contract Documents for Road Works and on the principle that full details of construction requirements are provided in the Contract. Additions or amendments to the Specification for Road Works or the Road Construction Details which are not adequately covered by the Method of Measurement will necessitate appropriate amendment to suit. Provision is made in Chapter III Preambles to Bill of Quantities, “Amendments to the Method of Measurement” to accommodate such amendments.

Bill of Quantities

- 2 a In the Bill of Quantities the sub-headings and item descriptions identify the work covered by the respective items read in conjunction with the matters listed against the relevant marginal headings “Item coverage” in Chapter IV of the Method of Measurement, Chapter III Preambles to Bill of Quantities and amendments. The nature and extent of the work to be performed is to be ascertained by reference to the Drawings, Specification and Conditions of Contract.
- b Items included in the Bill of Quantities for work to be executed or goods, materials or services to be supplied by a Nominated Subcontractor shall be followed by separate items for:
 - (i) Labours in connection therewith in the form of a lump sum.
 - (ii) All other charges and profit in connection therewith in the form of a percentage.

Itemization - Groups and Features

- 3 Each item description is to be consistent with and be compounded from one or more of the Groups listed under the marginal headings “Itemisation” within the Series of Chapter IV of the Method of Measurement incorporating amendments introduced in the Preambles to the Bill of Quantities. An item description may contain Features from as many Groups as necessary to identify the work required, but may include only one Feature from any one Group.

Items in the Bill of Quantities

- 4 The Bill of Quantities, unless expressly stated otherwise in the Contract is to contain all those items compounded in accordance with the foregoing paragraph 3 required to comprise the Works (apart from Provisional Sums and Prime Cost Items which may be required).

Chapter III

Preparation of Bill of Quantities

(including Preambles to Bill of Quantities)

Preparation of Bill of Quantities

Sub-division of Bill of Quantities	1	The Bill of Quantities is to be divided as appropriate into separate levels of identification, in the sequence set down in Table 1.			
Quantities	2	Quantities shall be expressed in whole numbers except for units of measurement of tonnes and hectares in which case the quantities shall be to three decimal places.			
Units of Measurement	3	The following abbreviations shall be used for the units of measurement:			
		Unit	Abbreviation	Unit	Abbreviation
		millimetre	mm	sum	sum
		metre	M	number	no
		square millimetre	mm ²	hour	hr
		square metre	M ²	week	wk
		hectare	ha	item	iem
		cubic metre	M ³	vehicle week	v.wk
		kilogram	kg	man hour	man hr
		tonne	T	vehicle day	v. day
		day	day	operative day	op. day

Special Preliminary Items

4 Provision is made in Table 1 for the inclusion of “Special Preliminary” items in the Bill of Quantities.

“Special Preliminary” items are not included in Chapter IV Units and Method of Measurement as their use is intended to be restricted and particular to a given Contract.

“Special Preliminary” items shall not be used for Temporary Works, cofferdams, accesses, advance operations and the like unless the work or operation is unusual in relation to the Works, and:

- a) the magnitude of such work, not separately measured, is such as to be disproportionately high in cost in relation to the measured work with which it is associated; or
- b) an operation, not separately measured, is required to be executed far in advance or after the main measured operation to which it relates.

The inclusion of “Special Preliminary” items in a Contract shall be entirely at the discretion of the Overseeing Organisation. Whether a “Special Preliminary” item is included in the Bill of Quantities or not shall in no way relieve the Contractor of his obligations under the Contract.

Alternative Pavement **Types of** **5** Where the Contract provides for the tenderer to select the Type of Pavement to be constructed from a range of alternatives a separate Bill of Quantities is to be provided within Series 600 : Earthworks, of the Roadworks General Bill; and Series 700 : Pavements, of the Main Carriageway, Interchanges and Side Roads Bills as appropriate, for each Type of Pavement permitted by the Contract.

Each of the individual Bills of Quantities within Series 600 of the Roadworks General Bill and in Series 700 of the Main Carriageway, Interchanges and Side Roads Bills as appropriate, is to be based on the thinnest pavement permitted by the Contract for the particular Type of Pavement to which it refers.

Immediately preceding the separate sets of alternative Bills in Series 600 : Earthworks and Series 700: Pavements respectively an Index (Table 2) is to be provided of the Types of Pavement permitted by the Contract.

Provision is to be made for only the one Bill of Quantities in Series 600 of the Roadworks General Bill and in Series 700 of the Main Carriageway, Interchanges and Side Roads Bills as appropriate which relates to the Type of Pavement elected to be constructed by the Contractor, to be priced and included in the Tender Total.

**Alternative Types of 6
Safety Fence**

Where the Contract provides for the tenderer to select either wire rope safety fence or tensioned corrugated beam safety fence to be constructed over given lengths, separate Bills of Quantities are to be provided containing alternative types of safety fence for the lengths in question. These Bills of Quantities are to be included within Series 400: Safety Fences, Safety Barriers and Pedestrian Guardrails.

Immediately preceding the separate alternative Bills in Series 400 an Index (Table 3) is to be provided for the alternative types of safety fence permitted by the Contract.

Provision is to be made for only the one Bill of Quantities in Series 400 of the Roadworks General Bill which relates to the type of safety fence elected to be constructed by the Contractor to be priced and included in the Tender Total.

**Structures Where a 7
Choice of Designs is Offered**

Where the Contract provides for a structure designed by the Contractor to be constructed as an alternative to the structure which has been designed by the Overseeing Organisation, a separate Bill of Quantities is to be provided for each of the two construction procedures permitted by the Contract.

Each of the two individual Bills of Quantities is to be provided in accordance with the various Chapters and Series of the Method of Measurement for all the works contained within the Designated Outline (with the exception of those works scheduled as not to be included). For the structure designed by the Contractor the Bill of Quantities is to comprise a single item in accordance with Series 2500. The Bill for the structure designed by the Overseeing Organisation is to be compiled in accordance with the appropriate Series. Those works scheduled as not to be included in either of these alternative Bills of Quantities shall be included by the Overseeing Organisation in other Bills compiled in accordance with the appropriate Series.

Provision is to be made for only the one Bill of Quantities which relates to the form of construction elected to be constructed by the Contractor to be priced and included in the Tender Total.

Immediately preceding the separate alternative Bills of Quantities an Index (Table 4) is to be provided for the alternative forms of construction permitted by the Contract.

**Structures Designed 8 by the
Contractor**

Where the Contract provides only for a structure designed by the Contractor to be constructed a Bill of Quantities comprising a single item for all the works within the Designated Outline (with the exception of those works scheduled as not to be included) is to be provided in accordance with Series 2500. Those works scheduled as not to be included in this single item are to be included by the Overseeing Organisation in other Bills compiled in accordance with the appropriate Series. Earthworks within the Designated Outlines shall not be included in the Earthworks Schedules.

Landscape and Ecology

9 Where the Contract includes for Landscape and Ecology a separate Bill of Quantities shall be provided within the Roadworks Bill as set down in Table 1.

Payments for new planting, seeding and turfing measured in accordance with Series 3000 paragraphs 6 to 13 inclusive shall be subject to staged payments as set out in Table 5 which shall be completed by the compiler. This table shall be inserted immediately preceding the Collection page for the separate Bill of Quantities for Landscape and Ecology.

Preambles to Bill of Quantities
10

The matters set out under the heading “Preambles to Bill of Quantities” (1-18) hereafter are always to be included as a Preamble to the Bill of Quantities. Additional numbered Preambles may be included as necessary. Amendments to the Method of Measurement are to follow paragraph 20 (see notes to compiler).

Table 1

LEVEL 1 DIVISION	LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMRW SERIES HEADINGS	NOTES
(i) Preliminaries	Preliminaries	100 Preliminaries	Special Preliminaries Should be inserted under level 3
(ii) Roadworks	Roadworks general	200 Site Clearance 300 Fencing 400 Safety Fences, Safety Barriers and pedestrian Guardrails 600 Earthworks	Goetechnics and Hedgebanks and the like should be inserted under level 3 Series 600
	Main Carriageway	500 Drainage and Service Ducts 700 Pavements 1100 Kerbs, Footways and Paved Areas	Police observations platforms, cycle tracks, and the like should be inserted under level 3 Series 1100
	Interchanges	500 Drainage and Service Ducts 700 Pavements	Cycle tracks and the like should be inserted under level 3 Series 1100
	Side Roads	500 Drainage and Service Ducts 700 Pavements 1100 Kerbs, Footways and Paved Areas	Cycle tracks and the like should be inserted under level 3 Series 1100
	Signs, Motorway Communications and Lighting	1200 Traffic Signs and Road Markings 1300 Road Lighting Columns, Brackets and CCTV Masts 1400 Electrical Work for Road Lighting and Traffic Signs 1500 Motorway Communications	
	Landscape and Ecology (05/01)	3000 Landscape and Ecology	

LEVEL 1 DIVISION		LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMRW SERIES HEADINGS	NOTES
DIVISION	SUB-DIVISION			
(iii) Structures	Structure in form of Bridge or Viaduct; Name or Reference	Special Preliminaries		Special Preliminaries should be inserted as a separate construction heading under level 2
		Piling	1600 Piling and Embedded Retaining walls	
		Substructure – End Supports	500 Drainage and Ducts 600 Earthworks 1100 Kerbs, Footways and Paved Areas 1700 Structural Concrete 1800 Structural Steelwork 1900 Protection of Steelwork. Against Corrosion 2300 Bridge Expansion Joints and Sealing of Gaps 2400 Brickwork, Blockwork and Stonework	
		Substructure-Intermediate Supports Substructure – Main Span Substructure – Approach Spans	As for End Supports	To include piers and columns

LEVEL 1 DIVISION		LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMRW SERIES HEADINGS	NOTES
DIVISION	SUB-DIVISION			
		Superstructure – Main Span Superstructure – Approach Spans Superstructure – Arch Ribs	500 Drainage and Service Ducts 1700 Structural Concrete 1800 Structural Steelwork 1900 Protection of Steelwork Against Corrosion 2100 Bridge Bearings 2300 Joints and Sealing of Gaps 2400 Brickwork, Blockwork and Stonework	
		Finishings	400 Safety Fences, Safety Barriers And Pedestrian Guardrails 600 Earthworks 700 Pavements 1100 Kerbs, Footways and Paved Areas 2000 Waterproofing for Structures 2200 Parapets 2400 Brickwork, Blockwork and Stonework	Pavements, footways and the like to be included here if no Roadworks Bills of Quantities
	Retaining Wall, Culvert Subway, Gantry, Large Headwall, Gabion Wall, Diaphragm Wall, Pocket Type Reinforced Brickwork Retaining Wall and the like; Name or Reference	Special Preliminaries		Special Preliminaries should be inserted as a separate construction heading under level 2

LEVEL 1 DIVISION		LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMRW SERIES HEADINGS	NOTES
DIVISION	SUB-DIVISION			
		Main Construction	500 Drainage and Service Ducts 600 Earthworks 1100 Kerbs, Footways and Paved Areas 1600 Piling and Embedded Retaining Walls 1700 Structural Steelwork 1800 Structural Steelwork 1900 Protection of Steelwork Against Corrosion 2300 Bridge Expansion Joints and Sealing of Gaps 2400 Brickwork, Blockwork and Stonework	
		Finshings	400 Safety Fences, Safety Barriers And Pedestrian Guardrails 600 Earthworks 700 Pavements 1100 Kerbs, Footways and Paved Areas 2000 Waterproofing for Structures 2200 Parapets 2400 Brickwork, Blockwork and Stonework	Pavements, Footways and the like to be included here if no Roadworks Bill of Quantities

LEVEL 1 DIVISION		LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMRW SERIES HEADINGS	NOTES
DIVISION	SUB-DIVISION			
(iv) Structures Where a Choice of Designs is Offered	Structure Designed by the overseeing Organisation; Name or Reference			To include works within Designated outlines with the exception of works scheduled as not to be included. This division is not to be used where the Contract provides only for a structure designed by the Contractor
	Structure Designed by the Contractor, Name or Reference			
(v) Structures Designed by the Contractor	Structure: Name or Reference			To include works within Designated Outlines with the exception of works scheduled as not to be included
(vi) Service Areas		Roadworks Structures	To comply with the principles set down above for Roadworks and Structures	
(vii) Maintenance Compounds		Roadworks Structures		
(viii) Accommodation Works		Interest; Name or Reference		
(ix) Works for Statutory or other Bodies		Body; Name or Reference	To comply with the principles set down above for Roadworks and Structures	
(x) Daywork		Daywork		
(xi) PC and Provisional Sum		PC and Provisional Sum		To include PC and Provisional sums not allocated to a particular construction heading

Table 2

(This Table 2 is an example of the introduction and index to be inserted as a separate page immediately preceding each set of the separate Bills of Quantities included within Series 600: Earthworks in the Roadworks General Bill and Series 700: Pavements in the main Carriageway, Interchanges and Side Roads Bills, to cover the alternative Types of Pavement included in the Contract.)

# (Bill No.....Roadworks General – Series 600: Earthworks) * (Bill No.....Main Carriageway – Series 700: Pavements) * (Bill No.....Interchanges – Series 700: pavements) * (Bill No..... Side Roads – Series 700: Pavements)		
A separate Bill of Quantities is provided for each of the Types of Pavement permitted by the Contract. Notwithstanding the provision paragraph 4 of the Preambles to the Bill of Quantities, the tenderer shall price, extend and carry to the collection of # (bill No...Series 600 : earthworks) * (Bill No ... Series 700: Pavements only that Bill of Quantities appropriate to the Type of Pavement he has elected to construct . The tenderer shall price the Bill of Quantities in Series 600 : Earthworks corresponding to the Type of Pavement he prices in Series 700 : Pavements which he has elected to construct.		
Index		
Type of Pavement	Bill No.	Page(s)
Flexible	# (6A) * (7A)	
Flexible Composite	# (6B) * (7 B)	
Rigid	# (6 C) *(7 C)	

(# Include when Index is for Series 600: Earthworks in Roadworks General Bill)
(* Include when Index is for Series 700: Pavements in Main Carriageway, interchanges and Side Roads Bills as Appropriate)

Table 3

(This Table 3 is an example of the introduction and index to be inserted as a separate page immediately preceding the separate Bills of Quantities included within Series 400: Safety Fences , Safety Barriers and Pedestrian Guardrails in the Roadwork's general Bill to cover the 4 alternative types of safety fence included in the Contract.)

(bill No.....Roadworks General – Series 400: Safety Fence, Safety Barriers and Pedestrian Guardrails)		
A separate Bill of Quantities is provided to include for each of the alternative types of safety fence for the lengths permitted by the Contract.		
Notwithstanding the provisions of paragraph 4 of the Preambles to the Bill of Quantities, the tenderer shall price, extend and carry to the collection of Bill 4 : Safety Barriers and Pedestrian Guardrails only that Bill of Quantities appropriate to the type of safety fence he has elected to construct.		
Index		
Safety Fence Type	Bill No.	Page(s)
Beam	4A	
Wire Rope	4B	

(The lengths of safety fence for which no alternative is permitted are to be included in both the beam and the wire rope Bills).

Table 4

(This Table 4 is an example of the introduction and index to be inserted as a separate page immediately preceding the separate Bills of Quantities included within the Bill for Structures Where a Choice of Designs is Offered (as defined under paragraph 7 of the preparation under paragraph 7 of the preparation of Bill of Quantities.)

Bill No.....Structures Where a Choice of Designs is Offered			
A separate Bill of Quantities is provided for each of the two construction procedures permitted by the Contract. Notwithstanding the provisions of paragraph 4 of the Preambles to Bill of Quantities, the tenderer shall price, extend and carry to the collection of Bill No....Structures Where A Choice of Designs is Offered, only that Bill of Quantities appropriate to the form of construction he has elected to construct.			
Index			
Type of Structure	Structure No.	Bill No.	Page(s)
Structure Designed by the Overseeing Organisation		...A	
Structure Designed by the Contractor		...B	

(Repeat for each Structure)

Table 5

(This Table 5 is an example of the Staged Payment Scheduled for new Planting, Seeding and Turfing work to be inserted as a separate page immediately preceding the Collection Page for the separate Bill of Quantities for Series 3000 – Landscape and Ecology.)

Bill No.....Series 3000 – Landscape and Ecology
The following Staged Payments Schedule is to be used for the assessment of payments for work included in the Bill of Quantities in respect of new Planting, Seeding and Turfing measured in accordance with Series 3000 paragraph 6 to 13 inclusive.

Activity	Percentage to be paid on planting in accordance with Note 1 below. [To be inserted by compiler]	Percentage to be paid in respect of post-planting works in accordance with Note 2 below. [To be inserted by Compiler]	Total
Grass seeding:			
High Frequency Cuts			100%
Medium Frequency cuts			100%
Low Frequency Cuts			100%
Minimal Frequency Cuts			100%
Wildflower Seeding			100%
Turfing			100%
Shrubs including transplants			100%
Trees including transplants			100%
Wildflower Plants			100%
Hedge Plants			100%
Emergent, Marginal and Aquatic Plants			100%
Bulbs:			
In grassed areas			100%
In beds			100%

Note 1: The percentage entered in this column shall be the proportion of the rates and prices in the Bill of Quantities for those item which become due to the Contractor upon the completion of the particular operation.

Note 2: The percentage entered in this column shall be in proportion of the rates and prices in the Bill of Quantities in respect of post-planting works required to be carried out over the remainder of the Contract Period. This proportion shall be divided equally over the period of the contract remaining (in months) after the specific planting has taken place to give a 'periodic value' in respect of post-planting works. Notwithstanding the contract payment terms this 'periodic value' shall be paid on accrual at *..[to be inserted by the Compiler]..*monthly intervals with any balance due on completion of the whole of the Works.

TABLE 1 (05/01)

LEVEL 1 DIVISION	LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMHW SERIES HEADINGS	NOTES
(i) Preliminaries	Preliminaries	100 Preliminaries	Special Preliminaries should be inserted under level 3
(ii) Roadworks	Roadworks General	200 Site Clearance	Geotechnics and Hedgebanks and the like should be inserted under level 3 Series 600
		300 Fencing (05/01)	
		400 Safety Fences, Safety Barriers and Pedestrian Guardrails	
		600 Earthworks	
	Main Carriageway	500 Drainage and Service Ducts	Police observation platforms, cycle tracks, and the like should be inserted under level 3 Series 1100
		700 Pavements	
		1100 Kerbs, Footways and Paved Areas	
	Interchanges	500 Drainage and Service Ducts	Cycle tracks and the like should be inserted under level 3 Series 1100
		700 Pavements	
		1100 Kerbs, Footways and Paved Areas	
	Side Roads	500 Drainage and Service Ducts	Cycle tracks and the like should be inserted under level 3 Series 1100
		700 Pavements	
		1100 Kerbs, Footways and Paved Areas	
	Signs, Motorway Communications and Lighting	1200 Traffic Signs and Road Markings	
		1300 Road Lighting Columns, Brackets and CCTV Masts (05/01)	
		1400 Electrical Work for Road Lighting and Traffic Signs	
		1500 Motorway Communications	
	Landscape and Ecology (05/01)	3000 Landscape and Ecology	

LEVEL 1 DIVISION		LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMRW SERIES HEADINGS	NOTES
(iii) Structures	SUB-DIVISION			
	Structure in form of Bridge or Viaduct; Name or Reference	Special Preliminaries		Special Preliminaries should be inserted as a separate construction heading under level 2
		Piling	1600 Piling and Embedded Retaining walls	
		Substructure - End Supports	500 Drainage and Ducts 600 Earthworks 1100 Kerbs, Footways and Paved Areas 1700 Structural Concrete 1800 Structural Steelwork 1900 Protection of Steelwork Against Corrosion 2300 Bridge Expansion Joints and Sealing of Gaps 2400 Brickwork, Blockwork and Stonework	To include wingwalls and paved areas beneath structures
		Substructure - Intermediate Supports Substructure - Main Span Substructure - Approach Spans	As for End Supports	To include piers and columns

LEVEL 1 DIVISION		LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMRW SERIES HEADINGS	NOTES
DIVISION	SUB-DIVISION			
		Superstructure - Main Span Superstructure - Approach Spans Superstructure - Arch Ribs	500 Drainage and Service Ducts 1700 Structural Concrete 1800 Structural Steelwork 1900 Protection of Steelwork Against Corrosion 2100 Bridge Bearings 2300 Joints and Sealing of Gaps 2400 Brickwork, Blockwork and Stonework	
		Finishings	400 Safety Fences, Safety Barriers and Pedestrian Guardrails 600 Earthworks 700 Pavements 1100 Kerbs, Footways and Paved Areas 2000 Waterproofing for Structures 2200 Parapets 2400 Brickwork, Blockwork and Stonework	Pavements, footways and the like to be included here if no Roadworks Bill of Quantities
	Retaining Wall, Culvert, Subway, Gantry, Large Headwall, Gabion Wall, Diaphragm Wall, Pocket Type Reinforced Brickwork Retaining Wall and the like; Name or Reference	Special Preliminaries		Special Preliminaries should be inserted as a separate construction heading under level 2

LEVEL 1 DIVISION		LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMRW SERIES HEADINGS	NOTES
DIVISION	SUB-DIVISION			
		Main Construction	500 Drainage and Service Ducts 600 Earthworks 1100 Kerbs, Footways and Paved Areas 1600 Piling and Embedded Retaining Walls 1700 Structural Concrete 1800 Structural Steelwork 1900 Protection of Steelwork Against Corrosion 2300 Bridge Expansion Joints and Sealing of Gaps 2400 Brickwork, Blockwork and Stonework	
		Finishings	400 Safety Fences, Safety Barriers and Pedestrian Guardrails 600 Earthworks 700 Pavements 1100 Kerbs, Footways and Paved Areas 2000 Waterproofing for Structures 2200 Parapets 2400 Brickwork, Blockwork and Stonework	Pavements, Footways and the like to be included here if no Roadworks Bill of Quantities

LEVEL 1 DIVISION		LEVEL 2 CONSTRUCTION HEADING	LEVEL 3 MMRW SERIES HEADINGS	NOTES
DIVISION	SUB-DIVISION			
(iv) Structures Where a Choice of Designs is Offered	Structure Designed by the Overseeing Organisation; Name or Reference	To comply with the principles set down above for Structures		To include works within Designated Outlines with the exception of works scheduled as not to be included. This division is not to be used where the Contract provides only for a structure designed by the Contractor
	Structure Designed by the Contractor; Name or Reference			
(v) Structures Designed by the Contractor	Structure; Name or Reference			To include works within Designated Outlines with the exception of works scheduled as not to be included
(vi) Service Areas		Roadworks Structures	To comply with the principles set down above for Roadworks and Structures	
(vii) Maintenance Compounds		Roadworks Structures		
(viii) Accommodation Works		Interest; Name or Reference		
(ix) Works for Statutory or Other Bodies		Body; Name or Reference	To comply with the principles set down above for Roadworks and Structures	
(x) Daywork		Daywork		
(xi) PC and Provisional Sum		PC and Provisional Sum		To include PC and Provisional sums not allocated to a particular construction heading

TABLE 2

(This Table 2 is an example of the introduction and index to be inserted as a separate page immediately preceding each set of the separate Bills of Quantities included within Series 600 : Earthworks in the Roadworks General Bill and Series 700 : Pavements in the Main Carriageway, Interchanges and Side Roads Bills, to cover the alternative Types of Pavement included in the Contract.)

# (Bill NoRoadworks General - Series 600: Earthworks) * (Bill No Main Carriageway - Series 700: Pavements) * (Bill No Interchanges - Series 700: Pavements) * (Bill No Side Roads - Series 700: Pavements)		
A separate Bill of Quantities is provided for each of the Types of Pavement permitted by the Contract. Notwithstanding the provisions paragraph 4 of the Preambles to Bill of Quantities, the tenderer shall price, extend and carry to the collection of # (Bill No ... Series 600 :Earthworks) * (Bill No ... Series 700: Pavements) only that Bill of Quantities appropriate to the Type of Pavement he has elected to construct. The tenderer shall price the Bill of Quantities in Series 600 : Earthworks corresponding to the Type of Pavement he prices in Series 700 : Pavements which he has elected to construct.		
Index		
Type of Pavement	Bill No.	Page(s)
Flexible	#(6A) *(7A)	
Flexible Composite	#(6B) *(7B)	
Rigid	#(6C) *(7C)	

(# Include when Index is for Series 600: Earthworks in Roadworks General Bill)

(* Include when Index is for Series 700: Pavements in Main Carriageway, Interchanges and Side Roads Bills as appropriate)

TABLE 3

(This Table 3 is an example of the introduction and index to be inserted as a separate page immediately preceding the separate Bills of Quantities included within Series 400: Safety Fences, Safety Barriers and Pedestrian Guardrails in the Roadworks General Bill to cover the alternative types of safety fence included in the Contract.)

(Bill No Roadworks General - Series 400: Safety Fences, Safety Barriers and Pedestrian Guardrails)		
A separate Bill of Quantities is provided to include for each of the alternative types of safety fence for the lengths permitted by the Contract.		
Notwithstanding the provisions of paragraph 4 of the Preambles to Bill of Quantities, the tenderer shall price, extend and carry to the collection of Bill 4 : Safety Fences, Safety Barriers and Pedestrian Guardrails only that Bill of Quantities appropriate to the type of safety fence he has elected to construct.		
Index		
Safety Fence Type	Bill No.	Page(s)
Beam	4A	
Wire Rope	4B	

(The lengths of safety fence for which no alternative is permitted are to be included in both the beam and the wire rope Bills).

TABLE 4

(This Table 4 is an example of the introduction and index to be inserted as a separate page immediately preceding the separate Bills of Quantities included within the Bill for Structures Where a Choice of Designs is Offered (as defined under paragraph 7 of the Preparation of Bill of Quantities).)

Bill No. Structures Where a Choice of Designs is Offered			
A separate Bill of Quantities is provided for each of the two construction procedures permitted by the Contract. Notwithstanding the provisions of paragraph 4 of the Preambles to Bill of Quantities, the tenderer shall price, extend and carry to the collection of Bill No. Structures Where a Choice of Designs is Offered, only that Bill of Quantities appropriate to the form of construction he has elected to construct.			
Index			
Type of Structure	Structure No.	Bill No.	Page(s)
Structure Designed by the Overseeing Organisation		A	
Structure Designed by the Contractor		...B	

(Repeat for each structure)

TABLE 5 (c)

(This Table 5 is an example of the Staged Payment Schedule for new Planting, Seeding and Turfing work to be inserted as a separate page immediately preceding the Collection Page for the separate Bill of Quantities for Series 3000 – Landscape and Ecology.)

Bill No. - Series 3000 - Landscape and Ecology
The following Staged Payments Schedule is to be used for the assessment of payments for work included in the Bill of Quantities in respect of new Planting, Seeding and Turfing measured in accordance with Series 3000 paragraphs 6 to 13 inclusive.

Activity	Percentage to be paid on planting in accordance with Note 1 below. [To be inserted by Compiler]	Percentage to be paid in respect of post-planting works in accordance with Note 2 below. [To be inserted by Compiler]	Total
Grass Seeding:			
High Frequency Cuts			100%
Medium Frequency Cuts			100%
Low Frequency Cuts			100%
Minimal Frequency Cuts			100%
Wildflower Seeding			100%
Turfing			100%
Trees including whips			100%
Shrubs including transplants			100%
Wildflower Plants			100%
Hedge Plants			100%
Emergent, Marginal and Aquatic Plants			100%
Bulbs:			
in grassed areas			100%
in beds			100%

Note 1: The percentage entered in this column shall be the proportion of the rates and prices in the Bill of Quantities for those items which become due to the Contractor upon the completion of the particular planting operation.

Note 2: The percentage entered in this column shall be the proportion of the rates and prices in the Bill of Quantities in respect of post-planting works required to be carried out over the remainder of the Contract Period. This proportion shall be divided equally over the period of the Contract remaining (in months) after the specific planting has taken place to give a 'periodic value' in respect of post-planting works. Notwithstanding the Contract payment terms this 'periodic value' shall be paid on accrual at . . . [to be inserted by the Compiler] . . . monthly intervals with any balance due on completion of the whole of the Works.

Preambles to Bill of Quantities

General Directions

1 The Bill of Quantities has been prepared in accordance with the Method of Measurement for Road Works.

2 In the Bill of Quantities the sub-headings and item descriptions identify the work covered by the respective items, read in conjunction with the matters listed against the relevant marginal headings “Item coverage” in Chapter IV of the Method of Measurement for Road Works, these Preambles and the amendments to the Method of Measurement immediately following these Preambles. The nature and extent of the work is to be ascertained by reference to the Drawings, Specification and Conditions of Contract. The rates and prices entered in the Bill of Quantities shall be deemed to be the full inclusive value of the work covered by the several items including the following, unless expressly stated otherwise:

- (i) Labour and costs in connection therewith.
- (ii) The supply of materials, goods, storage and costs in connection therewith including delivery to Site. Taking delivery of materials and goods supplied by others, unloading, storage, and costs in connection therewith.
- (iii) Plant and costs in connection therewith.
- (iv) Fixing, erecting and installing or placing of materials and goods in position.
- (v) Temporary Works.
- (vi) The effect on the phasing of the Works or any element of the Works to the extent set forth or reasonably implied in the documents on which the tender is based.
- (vii) General obligations, liabilities and risks involved in the execution of the Works set forth or reasonably implied in the documents on which the tender is based.
- (viii) Establishment charges, overheads and profit.
- (ix) Waste.
- (x) Testing carried out by the Contractor in accordance with the particular requirements of Appendix 1/5 including supplying results of tests, reports and certificates.
- (xi) Supply and delivery of samples to the Overseeing Organisation in accordance with the particular requirements of Appendix 1/6.
- (xii) Checking, inspecting, examining, measuring and verifying goods, materials and workmanship including supplying results, reports and certificates.
- (xiii) Attendance and transport for sampling and testing carried out by the Overseeing Organisation.
- (xiv) Complying with Quality Assurance requirements of the contract and

providing certificates of conformity.

(xv) Preparation and supply of detailed working drawings.

(xvi) Awaiting approvals and consent.

(xvii) Where stipulated complying with the particular requirements of Appendix 1/24.

Measurement

3 (i) The measurement of work shall be computed net from the dimensions stated in the Contract unless otherwise stated in the Method of Measurement.

(ii) Where the tender documents specify the Type of Pavement to be constructed then the measurement of work shall be based upon the thinnest pavement construction and surfacing over structures permitted by the Contract for that Type of Pavement. Where the tender documents provide for the Contractor to select the type of safety fence, pavement or buried structure (where the structure is not within Designated Outlines) to be constructed then the measurement of all work in each area so affected shall be based upon the thinnest pavement construction and surfacing over structures permitted by the Contract in that area for the particular type of safety fence, pavement or buried structure the Contractor has elected to construct.

Pricing of Items

4 Each individual item shall have a rate or price entered against it. Rates and prices shall be expressed to two decimal places.

Where in the Contract a choice of alternatives is permitted:

Alternative Specified Materials, Designs and Options Within Types of Pavement

(i) the description billed and the rates and prices inserted shall be deemed to cover any of the permitted alternative materials or designs the Contractor may elect to use;

(ii) and where separate Bills of Quantities are provided within Series 600: Earthworks for each Type of Pavement permitted by the Contract the rates and prices inserted in respect of the earthworks for the particular Type of Pavement shall be deemed to cover the earthworks for any inherent permitted option within the Type of Pavement elected to be constructed by the Contractor;

(iii) and where separate Bills of Quantities are provided within Series 700: Pavements for each Type of Pavement permitted by the Contract the rates and prices inserted in respect of the particular Type of Pavement shall also be deemed to cover any inherent permitted option within the Type of Pavement elected to be constructed by the Contractor.

In all cases the rates and prices inserted in all Series of the Bill of Quantities shall be deemed to include for any adjustments of work content, rates, costs and the like occasioned by the choice of alternatives elected to be used or constructed by the Contractor.

Privately and Publicly Owned Services or Supplies

6 The information in the Contract as to the whereabouts of existing services and mains is believed to be correct but the Contractor shall not be relieved thereby of his obligations under the Contract. The Contractor shall include in his rates and prices for locating and taking measures for the support and full protection of pipes, cables and other apparatus during the progress of

the Works, obtaining the written consent of the appropriate authority to interrupt the service or supply and for keeping the Overseeing Organisation informed of all arrangements he makes with the owners of privately owned services or supplies, Statutory Undertakers and Public Authorities as appropriate.

Labours

7 Labours in connection with Nominated Sub-contractors shall include:

- (i) in the case of work or services executed - for affording the use of existing working space, access, temporary roads, erected scaffolding, working shelters, staging, ladders, hoists, storage, latrines, messing, welfare and other facilities existing on Site and the provision of protection, water, electricity for lighting and clearing away rubbish and debris arising from the work;
- (ii) in the case of goods, materials or services supplied - for taking delivery, unloading, storing, protecting and returning crates, cartons and packing materials.

Roadworks Overall Requirements

8 The Contractor shall allow in his rates and prices for complying with requirements in respect of pavement construction, horizontal alignments, surface levels and surface regularity of pavement courses, dealing with changes in weather conditions, use of surfaces by traffic and construction plant, and general requirements for sub-bases and base courses.

Work Within and Below Non-tidal Open Water or Tidal Water

9 The Contractor shall allow in his rates and prices for taking measures required to execute work within and below non-tidal open water or tidal water. The Contractor shall include in his rates and prices for any investigations to ascertain actual boundaries, surface levels and ranges affected by non-tidal open water or tidal water.

Dealing with Flow

10 The Contractor shall allow in his rates and prices for taking measures to deal with the existing flow of water, sewage and the like.

Reimbursement of Fees, Overseeing Organisation's Telephone Calls

11 The Contractor will be reimbursed the actual price paid by the Contractor in respect of:

- (i) fees, rates and taxes - the sums certified as properly repayable to the Contractor in accordance with the Contract;
- (ii) Overseeing Organisation's telephone calls - telephone calls charged to the number or numbers allocated to the Overseeing Organisation. Any other cost, charge or expense in respect of these items shall be allowed for in the rates and prices for temporary accommodation.

Site Limitations and Constraints Hard Material

12 The Contractor shall allow in his rates and prices for complying with any limitations and constraints on the use of the Site.

13 For the purposes of the Contract the following are designated as Hard Material in accordance with Chapter 1 Definitions, paragraph 1(i)(i):

- (a)* strata;
- (b) those deposits designated by limits shown on the Drawings;
- (c) existing pavements, footways, paved areas (but excluding unbound materials) and foundations in masses in excess of 0.20 cubic metres.

Equivalent Products and Materials

14 Where the Contractor offers an equivalent product or material in place of the one identified or specified, then the rates and prices in the Bill of Quantities shall be deemed to include for all the obligations and costs associated with the incorporation of the equivalent into the Works, including design, provision of data and drawings, certificates, awaiting acceptance, resubmissions and modifications and amendments to the Works.

Unless specifically stated to the contrary in the Contract the measurement of the Works affected by the incorporation of the equivalent products and materials shall be based on the Tender documents and not on the Works as amended and completed to incorporate the equivalent products and materials.

Permanent Works Designed by the Contractor

15 Where the Contract requires part(s) of the Permanent Works to be designed by the Contractor, the rates and prices in the Bill of Quantities shall include for all the obligations and costs associated with the incorporation of the Contractor's design into the Works, including design, provision of data and drawings, certificates, awaiting approvals, resubmissions and modifications and amendments to the Works. Additionally the rates and prices in the Bill of Quantities shall include for the costs of all testing and sampling to be carried out by the Contractor in respect of workmanship, goods and materials incorporated into the Works or to prove the Contractor's design.

Structures Designed by the Contractor

16 In respect of each priced Bill for a structure designed by the Contractor, the Contractor shall prepare a priced schedule of quantities. This priced schedule shall be prepared in accordance with the relevant Chapters and Series of the Method of Measurement and submitted to the Overseeing Organisation for acceptance.

The quantities, rates and prices in the priced schedule of quantities shall in each case, when extended and totalled, give the amount entered in the priced Bill of Quantities against the item for the relevant structure designed by the Contractor.

The priced schedule of quantities shall only be used for Payment Applications and for the valuation of variations ordered under the Contract in connection with structures designed by the Contractor.

Unless specifically stated to the contrary in the Contract the measurement of the Works affected by the incorporation of the Contractor's design shall be based on the Tender documents and not on the Works as amended and completed to incorporate the Contractor's design.

The parts of the Works included by the Contractor in the priced schedule of quantities shall include all the parts of the Works within the Designated Outline except those designed and scheduled by the Overseeing Organisation as not to be included.

Testing

17 Testing as paragraph 2(x) above, is in respect of tests to be carried out by the Contractor to verify workmanship, goods and materials incorporated into the permanent works and testing of the permanent works in order to prove the Overseeing Organisation's design as set out in Appendix 1/5.

Checking, inspecting, examining, measuring and verifying goods, materials and workmanship incorporated in the permanent works, as paragraph 2(xii) above, is in respect of other operations set forth or reasonably implied in the Contract to be carried out by the Contractor to demonstrate compliance with the particular requirements of the Contract, or to prove the Overseeing Organisation's design where not separately listed in Appendix 1/5, but excluding trial erection of structural steelwork which shall be measured separately in accordance with Series 1800.

Procedural trials, trial panels and trial areas required to be carried out or constructed as separate operations in advance of the permanent works in order to verify goods, materials and workmanship shall not be measured separately but are included within the item coverage for the relevant Series.

Testing of existing structures and other investigative works shall be individually measured within the relevant Series.

Landscape and Ecology

18 The rates and prices inserted in the Bill of Quantities for new Planting, Seeding and Turfing measured in accordance with Volume 4 – Series 3000 include for all post-planting maintenance work required to be carried out in accordance with the Specification and the relevant Appendices.

In order to properly reflect the scope and duration of the planting and postplanting requirements a series of staged payments for the various items of planting, seeding and turfing will be made in accordance with the Staged Payments Schedule.

The Staged Payments Schedule is to be inserted in the Bill of Quantities immediately preceding the collection page for Landscape and Ecology and shall be used for assessing payments due to the Contractor in accordance with the Contract.

†Amendments to the Method of Measurement

19 For the purposes of the Contract the Method of Measurement for Highway Works is amended in accordance with the pages immediately following.

The Preambles to Bill of Quantities (duly completed) must be reproduced unaltered and bound in the Bill of Quantities.

* To be completed by compiler as appropriate.

† Where amendments to Chapter IV of the Method of Measurement are required in accordance with paragraph 1(b) of Chapter II, General Principles, this preamble should be the last numbered preamble and inserted immediately prior to the amendments.]

MALTA TRANSPORT AUTHORITY



MANUAL OF CONTRACT DOCUMENTS FOR ROAD WORKS: VOLUME 4

**SECTION 1: METHOD OF MEASUREMENT FOR
ROAD WORKS**

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**BILLS OF QUANTITIES
FOR ROAD WORKS**

VOLUME 4

SECTION 1

**METHOD OF MEASUREMENT
FOR ROAD WORKS**

MARCH 2003

Series 100: Preliminaries

Definitions

1

- (a) “until completion of the works” shall mean until completion of the whole of the works in accordance with the Conditions of Contract;
- (b) “after completion of the works” shall mean subsequent to (a) above for the period stated in the Specification;
- (c) “temporary diversion for traffic” shall mean (1) a temporary carriageway onto which vehicular traffic is diverted from a highway or (2) a temporary footpath or bridleway onto which pedestrian or equestrian traffic is diverted from a highway or (3) a combination of (1) and (2) or a temporary carriageway as in (1) with an associated footway and/or way for the use of animals and equestrian traffic; or (4) a temporary private means of access onto which traffic is diverted from a private means of access but in all cases shall not include a central reserve crossover constructed to permit contraflow traffic on an existing carriageway.

Temporary Accommodation

Units

2

The unit of measurement shall be:

- (i) erection, servicing, dismantling of temporary accommodation
..... item.

Itemisation

3

Separate items shall be provided for temporary accommodation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Erection. 2 Servicing. 3 Dismantling.
II	1 Principal offices for the Overseeing Organisation. 2 Principal laboratories for the Overseeing Organisation. 3 Portable offices for the Overseeing Organisation. 4 Portable laboratories for the Overseeing Organisation. 5 Offices and messes for the Contractor. 6 Stores and workshops for the Contractor.
III	1 Provided by the Overseeing Organisation.
IV	1 At the place of fabrication or manufacture.
V	1 Until completion of the works. 2 After completion of the works.

Note: Group IV and Group V features shall be applied only to items of temporary accommodation for the Overseeing Organisation.

Erection of Temporary Accommodation

4 The items for erection of temporary accommodation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

(i)

in the case of accommodation for the Contractor:

- (a) everything required by the Contractor.

(ii)

in the case of accommodation for the Overseeing Organisation:

- (a) initial accommodation and equipment, maintenance, servicing and removing;
- (b) sites for the accommodation;

- (c) preparation of sites;
- (d) foundations, bases and hardstandings;
- (e) water, sanitation, heating, power and lighting services;
- (f) fences, notice and direction boards;
- (g) vehicle access, hardstandings, parking areas and footpaths;
- (h) equipment, furnishings, fittings, supplies and initial consumable stores;
- (i) telephones, extensions, switchboard and switching systems separately connected to the telephone system;
- (j) in the case of accommodation provided by the Overseeing Organisation, alterations and refurbishments.

Servicing Temporary Accommodation

5 The items for servicing temporary accommodation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (i) in the case of accommodation for the Contractor:
 - (a) everything required by the Contractor.
- (ii) in the case of accommodation for the Overseeing Organisation:
 - (a) rental and leasing including telephone rental;
 - (b) heating, sanitation, power, lighting and water;
 - (c) depreciation and maintenance of buildings, services, fences, notice and direction boards, vehicle access, parking areas, hardstandings and footpaths;
 - (d) depreciation, maintenance and replacement of equipment, furnishings, fittings and supplies;
 - (e) cleaning accommodation;
 - (f) moving and re-establishing portable accommodation as required;
 - (g) replenishment of consumable stores;
 - (h) repairing, replacing, calibration of equipment;
 - (i) disposal of waste.

Dismantling Temporary Accommodation

6 The items for dismantling temporary accommodation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) receiving back from the Overseeing Organisation and removing equipment, furniture, fittings and supplies off Site;
- (b) disconnecting, removing and sealing off disused services;
- (c) demolishing and removing off Site temporary accommodation, vehicle access, hardstanding, parking areas, footpaths, fences, notice and direction boards;

- (d) disposal of material (as Series 600 paragraph 39);
- (e) reinstatement of the sites occupied by temporary accommodation;
- (f) in the case of accommodation for the Overseeing Organisation, the credit value of surplus equipment or material which becomes the property of the Contractor;
- (g) in the case of accommodation for the Overseeing Organisation, the transport and delivery to the Overseeing Organisation of equipment or material which becomes the property of the Overseeing Organisation;
- (h) in the case of accommodation provided by the Overseeing Organisation, handing back to the Overseeing Organisation in the condition specified.

Vehicles for the Overseeing Organisation

- | | | |
|-------------|----------|---|
| Units | 7 | The unit of measurement shall be: <ul style="list-style-type: none"> (i) vehicles for the Overseeing Organisation vehicle day. |
| Measurement | 8 | The measurement of vehicles for the Overseeing Organisation shall be each day or part thereof during which a vehicle is provided. |
| Itemisation | 9 | Separate items shall be provided for vehicles for the Overseeing Organisation in accordance with Chapter II paragraphs 3 and 4 and the following: |

Group	Feature
I	1 Each type of vehicle for the Overseeing Organisation.
II	1 Until completion of the works.
	2 After completion of the works.

Vehicles for the Overseeing Organisation The items for vehicles for the Overseeing Organisation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- | | |
|---------------|--|
| Item coverage | <ul style="list-style-type: none"> (a) equipment; (b) taxing for use on public highways and for the carriage of goods and samples; (c) comprehensive insurance; (d) suitable replacement including equipment; (e) depreciation; (f) maintaining in a roadworthy condition and in conformity with the vehicle manufacturer's recommendations; (g) fuel, oil and other consumable items; (h) keeping clean inside and out; (i) collecting from Site when the vehicle is returned. |
|---------------|--|

Communication System for the Overseeing Organisation

- Units **11** The unit of measurement shall be:
- (i) communication system for the Overseeing Organisationitem.
- Itemisation **12** Separate items shall be provided for communication system for the Overseeing Organisation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Communication system for the Overseeing Organisation.
II	1 Until completion of the works.
	2 After completion of the works.

- Communication System For the Overseeing Organisation:** **13** The items for communication system for the Overseeing Organisation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) confirming licences, wavelengths and channels and costs arising therefrom;
- (b) equipment and installation;
- (c) rental, running costs and power;
- (d) depreciation, maintenance and repairs;
- (e) replacement equipment;
- (f) receiving back from the Overseeing Organisation and removing equipment and supplies off Site;
- (g) connections and links to telephone systems.

Operatives for the Overseeing Organisation

- Units **14** The unit of measurement shall be:
- (i) operatives for the Overseeing Organisation operative day.
- Measurement **15** The measurement of operatives for the Overseeing Organisations shall be a continuous period of four hours or more within any one day during which the operative's services are supplied in accordance with the written order of the Overseeing Organisation.
- Itemisation **16** Separate items shall be provided for operatives for the Overseeing Organisation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each type of operative for the Overseeing Organisation.
II	1 Until completion of the works.
	2 After completion of the works.

Operatives for the Overseeing Organisation **17** The items for operatives for the Overseeing Organisation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) the wages and other emoluments paid including payment for overtime;
 - (b) working outside the Contractor's normal working hours if so required by the Overseeing Organisation;
 - (c) costs and expenses incurred consequent upon the employment or hiring;
 - (d) periods of less than four hours.

Information Board

Units **18** The unit of measurement shall be:

- (i) information board number.

Itemisation **19** Separate items shall be provided for information boards in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Information board.
II	1 Different types.

Information Board **20** The items for information board shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
 - (b) excavation of unacceptable material (as Series 600 paragraph 19);
 - (c) excavation in Hard Material (as Series 600 paragraph 23);
 - (d) backfilling and compaction;
 - (e) in situ concrete (as Series 1700 paragraph 5);
 - (f) formwork (as Series 1700 paragraph 15);
 - (g) disposal of material (as Series 600 paragraph 39);
 - (h) painting, reflectorisation and illumination;
 - (i) cleaning, maintaining and repairing;
 - (j) dismantling and removing from Site;
 - (k) reinstatement of surfaces.

Traffic Safety and Management

Units **21** The unit of measurement shall be:

- (i) traffic safety and management item.

		(ii)	Traffic safety and management for landscape and ecology item
		(iii)	taking measures for or construction, maintenance, removal of contraflow arrangements item.
Measurement	22		Traffic safety and management shall be measured once only for all works excluding landscape and ecology measured in accordance with Series 3000.
	23		Traffic safety and management for landscape and ecology shall only be measured when items measured in accordance with Series 3000 are included in the Bill of Quantities and shall be measured once only for all landscape and ecology works.
	24		Unless expressly stated otherwise in the Contract, taking measures for or construction, maintenance, removal of contraflow arrangements shall be measured once only to include for all contraflow arrangements specified in Appendix 1/17 and all contraflow arrangements proposed by the Contractor. Itemisation
	25		Separate items shall be provided for traffic safety and management in accordance with Chapter II paragraphs 3 and 4 and the following:
		Group	Feature
		I	1 Traffic safety and management.
			2 Traffic Safety and management for landscape and ecology.
			3 Taking measures for or construction, maintenance, removal of contraflow arrangements.
Traffic Safety and Management and Traffic Safety and Management for Landscape and Ecology	26		The items for traffic safety and management and traffic safety and management for landscape and ecology shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		(a)	complying with the recommendations contained in Chapter 8 of the "Traffic Signs Manual" published by The Stationery Office and any amendment thereto or where the circumstances of any particular case are not covered submitting proposals for dealing with such situations to the Overseeing Organisation for its consent;
		(b)	complying with particular requirements of the Contract;
		(c)	initiating or continuing consultation with statutory, police or other authorities concerned, proposing or developing and submitting to the Overseeing Organisation, proposals based on such consultation showing a scheme of traffic safety and management measures including details of safety zones and emergency routes and furnishing such details as necessitated by the works or as the Overseeing Organisation may require;
		(d)	design of traffic safety and management measures specified by the Overseeing Organisation;
		(e)	traffic safety and control personnel;
		(f)	modification and resubmission of proposals and designs;
		(g)	traffic signs, driver information signs, traffic signs provided by the Overseeing Organisation, road markings, lamps, barriers, and traffic control signals including maintaining, cleaning, repositioning, covering, uncovering and removing;

- (h) complying with the requirements for labour and plant working on or adjacent to a highway and at entry and exit points to the Site including signing;
- (i) road lighting, modification, and removal;
- (j) emergency telephones, modification, and removal;
- (k) giving of notice to the Overseeing Organisation;
- (l) collecting and returning traffic signs provided by the Overseeing Organisation;
- (m) surveillance and maintaining stocks;
- (n) immediate reinstatement and replacement of defective or damaged items;
- (o) maintenance of highways.

Taking Measures for or Construction, Maintenance, Removal of Contraflow Arrangements

27 The items for taking measures for or construction, maintenance, removal of contraflow arrangements shall in accordance with Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) traffic safety and management (as this Series paragraph 26);
- (b) temporary diversions for traffic (as this Series paragraphs 31, 32 and 33);
- (c) crossovers;
- (d) temporary removal and reinstatement;
- (e) design of contraflow arrangements specified by the Overseeing Organisation.

Temporary Diversion for Traffic

Units

28 The unit of measurement shall be:

- (i) taking measures for or construction, maintenance, removal of temporary diversion for traffic item.

Measurement

29 The measurement of taking measures for or construction, maintenance, removal of temporary diversion for traffic shall be in respect of the complete measures for or construction at the locations listed in Appendix 1/ 18 to the Specification and at locations proposed by the Contractor.

30 Separate items shall be provided for temporary diversion for traffic in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Taking measures for or construction of temporary diversion for traffic.
	2 Maintenance of measures for or construction of temporary diversion for traffic.
	3 Removal of measures for or construction of temporary diversion for traffic.
II	1 At locations listed in Appendix 1/18.
	2 At those locations listed in Appendix 1/18 but not measured individually.
	3 At locations proposed by the Contractor.

Taking Measures for or Construction of Temporary Diversion for Traffic

31 The items for taking measures for or construction of temporary diversion for traffic shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) obtaining licences and agreements;
- (b) making arrangements with owners and occupiers of land temporarily required and costs arising therefrom;
- (c) preparing, amending and submitting to the highway authority and other interested bodies, proposals and programme;
- (d) consulting with police and other authorities;
- (e) design of temporary diversions for traffic specified by the Overseeing Organisation;
- (f) preparation of site;
- (g) site clearance, fencing, safety fencing, concrete safety barriers, drainage, earthworks, pavements, kerbs, footways, traffic signs, road markings, road lighting, structures, parapets, ramps and accesses;
- (h) temporary diversions of services;
- (i) emergency lanes.

Maintenance of Measures for or Construction of Temporary Diversion for Traffic

The items for maintenance of measures for or construction of temporary diversion for traffic shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) continuous adequate provision for traffic flows;
- (b) modifications and amendments to suit the requirements of the Contract including temporary removal and subsequent reinstatement.

Removal of Measures for or Construction of Temporary Diversion for Traffic

The items for removal of measures for or construction of temporary diversion for traffic shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) breaking up;
- (b) disposal of material (as Series 600 paragraph 39);
- (c) reinstatement of the Site to its previous condition.

Recovery Vehicles

Units

34 The units of measurement shall be:

- (i) establishment of recovery vehicle item.
- (ii) maintenance of recovery vehicle vehicle day.
- (iii) removal of recovery vehicle item.

Measurement	35	Establishment and removal of recovery vehicle shall each be measured once only for each type of recovery vehicle. The measurement of maintenance of recovery vehicle shall be each day or part thereof during which each type of recovery vehicle is provided.												
Itemisation	36	Separate items shall be provided for establishment, maintenance and removal of recovery vehicles in accordance with Chapter II paragraphs 3 and 4 and the following:												
<table> <tr> <th>Group</th><th colspan="2">Feature</th></tr> <tr> <td>I</td><td>1</td><td>Establishment of each type of recovery vehicle.</td></tr> <tr> <td></td><td>2</td><td>Maintenance of each type of recovery vehicle</td></tr> <tr> <td></td><td>3</td><td>Removal of each type of recovery vehicle.</td></tr> </table>			Group	Feature		I	1	Establishment of each type of recovery vehicle.		2	Maintenance of each type of recovery vehicle		3	Removal of each type of recovery vehicle.
Group	Feature													
I	1	Establishment of each type of recovery vehicle.												
	2	Maintenance of each type of recovery vehicle												
	3	Removal of each type of recovery vehicle.												
Establishment of Recovery Vehicles	37	The items for establishment of recovery vehicles shall in accordance with the Preamble to Bill of Quantities General Directions include for:												
Item coverage	(a)	vehicle inspections and submission of certificates;												
	(b)	establishment of hardstandings and accommodation;												
	(c)	establishment of locations and facilities for vehicle removal;												
	(d)	bringing plant and equipment to site;												
	(e)	establishment of all equipment including communication equipment and identification signs.												
Maintenance of Recovery Vehicles	38	The items for maintenance of recovery vehicles shall in accordance with the Preambles to Bill of Quantities General Directions include for:												
Item coverage	(a)	maintenance of equipment including communication equipment and identification sign;												
	(b)	taxing for use on public highways;												
	(c)	comprehensive insurance;												
	(d)	replacement vehicle including equipment;												
	(e)	depreciation;												
	(f)	maintenance;												
	(g)	fuel, oil and other consumables;												
	(h)	qualified operatives and safety officer and provision of documents;												
	(i)	completion and submission of information log sheets and record sheets;												
	(j)	dealing with broken down, accident damaged or abandoned vehicles and removal;												
	(k)	explanatory leaflets and distribution;												
	(l)	liaising with police;												
	(m)	maintenance of hardstandings, accommodation and servicing;												

- (n) maintenance of locations and facilities for vehicle removal;
- (o) vehicle inspections and reports;
- (p) lighting board.

Removal of Recovery Vehicles **39** The items for removal of recovery vehicles shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) removal of all plant and equipment from site;
 - (b) removal of hardstandings and accommodation;
 - (c) removal of locations and facilities for vehicle removal;
 - (d) reinstatement.

Progress Photographs

- Units **40** The unit of measurement shall be:
- (i) set of progress photographs, set of aerial progress photographs number.
 - (ii) additional progress photographs, additional aerial progress photographs number.

Measurement **41** A set of photographs shall comprise such numbers of negatives and prints as described in the Contract taken on any one flight or visit to Site.

Where in any one flight or visit the Overseeing Organisation orders less than one complete set of photographs, then one set shall be measured.

Where in any flight or visit the Overseeing Organisation orders progress or aerial photographs in excess of the number in the set then the additional photographs shall be measured and be deemed to include the negative and the same number of prints per negative as those in the set.

Itemisation **42** Separate items shall be provided for progress photographs in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Set of progress photographs.
	2	Set of aerial progress photographs.
	3	Additional progress photographs.
	4	Additional aerial progress photographs.
II	1	Monochrome prints.
	2	Colour prints.

Progress Photographs, Aerial Progress Photographs, **43** The items for progress photographs, aerial progress photographs, additional progress photographs and additional aerial progress photographs shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Additonal Progress Photographs and Additional Aerial Progress Photographs

Item coverage	(a)	delivery of negatives and prints to the Overseeing Organisation;
	(b)	identification marking on the prints;
	(c)	albums.

Temporary Closed Circuit Television (CCTV) System for the Monitoring of Traffic

Units	44	The units of measurement shall be:
	(i)	installation of temporary closed circuit television (CCTV) system for the monitoring of traffic item.
	(ii)	maintenance of temporary closed circuit television (CCTV) system for the monitoring of traffic day.
	(iii)	removal of temporary closed circuit television (CCTV) system for the monitoring of traffic item.
Measurement	45	The measurement of installation and removal of temporary closed circuit television (CCTV) system for the monitoring of traffic shall be for the complete installation and removal and each item shall be measured once only.
		The measurement of maintenance of temporary closed circuit television (CCTV) system for monitoring of traffic shall be each day or part thereof during which the system is provided.
Itemisation	46	Separate items shall be provided for temporary closed circuit television (CCTV) system for the monitoring of traffic in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Installation of temporary closed circuit television (CCTV) system for the monitoring of traffic.
	2 Maintenance of temporary closed circuit television (CCTV) system for the monitoring of traffic.
	3 Removal of temporary closed circuit television (CCTV) system for the monitoring of traffic.

Installation of Temporary Closed Circuit Television (CCTV) System for the Monitoring of Traffic

		The items for installation of temporary closed circuit television (CCTV) system for the monitoring of traffic shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage	(a)	excavation of acceptable material (as Series 600 paragraphs 17 and 18)
	(b)	excavation of unacceptable material (as Series 600 paragraph 19);
	(c)	excavation of hard material (as Series 600 paragraph 23);
	(d)	concrete (as Series 1700 paragraphs 5 and 10);
	(e)	reinforcement (as Series 1700 paragraph 26);
	(f)	backfilling and compaction;
	(g)	formwork (as Series 1700 paragraph 15);
	(h)	disposal of material (as Series 600 paragraph 39);
	(i)	electrical equipment, wiring and connections;

- (j) cameras and associated equipment;
- (k) housings, camera poles and supports, associated safety fencing, paving, steps and handrails;
- (l) control and monitoring equipment;
- (m) replacement equipment;
- (n) communication link to the Police Control Office;
- (o) design and structural certification of camera poles and supports and the provision of drawings;
- (p) design of systems including preparation and supply of general layout drawings, electrical and communications cabling diagrams and layouts;
- (q) complying with wiring regulations, earthing and inspection;
- (r) earth electrodes (as Series 1400 paragraph 27);
- (s) wiring protection;
- (t) staff for monitoring of the works area, including training;
- (u) take up or down and set aside for reuse or remove to store or tip off site (as Series 200 paragraph 11);
- (v) modifications;
- (w) provision of electrical power feeds by mains connection or generators;
- (x) electrical power;
- (y) accommodation for monitoring equipment and staff;
- (z) testing and commissioning of the whole of the system.

**Maintenance of Temporary 48
Closed Circuit Television
(CCTV) System for the
Monitoring of Traffic**

The items for maintenance of temporary closed circuit television (CCTV) system for monitoring traffic shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) depreciation, maintenance and repair of equipment;
- (b) electrical power;
- (c) wiring protection;
- (d) modifications;
- (e) moving equipment, power feeds and all cabling to suit traffic management and phasing of the works;
- (f) re-installing poles (as this Series paragraph 47);
- (g) re-testing and re-commissioning after moving equipment;
- (h) provision of video tapes.

Removal of Temporary Closed Circuit Television (CCTV) System for the Monitoring of Traffic

The items for removal of temporary closed circuit television (CCTV) system for the monitoring of traffic shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) dismantling;
 - (b) reinstatement and making good;
 - (c) take up or down and set aside for reuse or remove to store or tip off site (as Series 200 paragraph 11).

Temporary Automatic Speed Camera System for the Enforcement of Mandatory Speed Limits at Roadworks

- Units
- 50** The units of measurement shall be:
- (i) installation of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks item.
 - (ii) maintenance of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks day.
 - (iii) removal of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworksitem.
- Measurement
- 51** The measurement of installation and removal of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks shall be for the complete installation and removal and each item shall be measured once only.
- The measurement of maintenance of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks shall be each day or part thereof during which the system is provided.
- 52** Separate items shall be provided for temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Installation of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks.
	2 Maintenance of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks.
	3 Removal of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks.
II	1 Different locations.

Installation of Temporary Automatic Speed Camera System for the Enforcement of Mandatory Speed Limits at Roadworks

The items for installation of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
 - (b) excavation of unacceptable material (as Series 600 paragraph 19);
 - (c) excavation of hard material (as Series 600 paragraph 23);

- (d) concrete (as Series 1700 paragraphs 5 and 10);
- (e) reinforcement (as Series 1700 paragraph 26);
- (f) backfilling and compaction;
- (g) formwork (as Series 1700 paragraph 15);
- (h) disposal of material (as Series 600 paragraph 39);
- (i) electrical equipment, wiring and connections;
- (j) cameras and associated equipment;
- (k) housings, camera poles and supports, associated safety fencing, paving and handrails;
- (l) control and monitoring equipment;
- (m) replacement equipment;
- (n) design and structural certification of camera poles and supports and the provision of drawings;
- (o) design of systems including preparation and supply of general layout drawings, electrical and communications cabling diagrams and layouts;
- (p) complying with wiring regulations, earthing and inspection;
- (q) earth electrodes (as Series 1400 paragraph 27);
- (r) wiring protection;
- (s) take up or down and set aside for reuse or remove to store or tip off site (as Series 200 paragraph 11);
- (t) moving equipment between phases of the works;
- (u) provision of electrical power feeds by mains connections or by generators;
- (v) electrical power;
- (w) commissioning of the whole system including provision of a second method of speed measurement;
- (x) liaison with the Chief Officer of Police and his delegated staff and providing access for them during commissioning and acceptance trials.

Maintenance of Temporary Automatic Speed Camera System for the Enforcement of Mandatory Speed Limits at Roadworks 54 The items for maintenance of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) depreciation, maintenance and repair of equipment;
 - (b) electrical power;
 - (c) wiring protection;

- (d) modifications including moving equipment to suit traffic management and phasing of the works;
- (e) liaison with the Chief Officer of Police and his delegated staff and providing access for them at all times;
- (f) assistance requested by the Chief Officer of Police through the Overseeing Organisation;
- (g) provision of films.

**Removal of Temporary 55
Automatic Speed Camera
System for the Enforcement
of Mandatory Speed Limits
at Roadworks**

The items for removal of temporary automatic speed camera system for the enforcement of mandatory speed limits at roadworks shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) dismantling;
- (b) reinstatement and making good;
- (c) take up or down and set aside for reuse or remove to store or tip off site (as Series 200 paragraph 11).

Series 200: Site Clearance

1 (05/01) Unless otherwise stated in the Contract the items in this Series shall include for the removal of superficial obstructions down to existing ground level. With the exception of items measured under paragraph 8 and those including for the removal of stumps and roots, work below existing ground level in the demolition and removal of foundations, drains and sewers specified in Appendix 2/2, chambers, cellars, ground slabs, carriageways, kerbs, pavings, backfilling and the like shall be measured under Series 600 Earthworks. Lowering of carriageway levels shall be measured under Series 700 Pavements.

The measurement of General Site Clearance includes for the removal of superficial obstructions down to existing ground level. If no General Site Clearance item is measured and the Contract requires items to be taken to Tip, these shall be measured within paragraphs 8-11 Take Up or Down and Set Aside for Re-use or Remove to Store or Tip off Site.

Site Clearance

Units **2** (05/01) The units of measurement shall be:

- (i) general site clearance hectare.
- (ii) demolition of individual or groups of buildings or structures item.
- (iii) partial demolition of individual structures item.

Measurement **3** (05/01) The measurement of general site clearance shall be the plan area.

No deduction shall be made for buildings, structures, carriageways and the like.

The measurement of partial demolition shall be as stated in the Contract.

Itemisation **4** (05/01) Separate items shall be provided for site clearance in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 General site clearance.

2 General site clearance of separate sections.

3 Demolition of individual or groups of buildings or structures.

4 Partial demolition of individual structures.

General Site Clearance 5 (05/01) The items for general site clearance shall in accordance with the

Preambles to Bill of Quantities General Directions include for:

Item coverage (a) demolition, breaking up and removal;

(b) tree felling;

(c) grubbing up and blasting stumps and roots including backfilling and compaction;

(d) uprooting of bushes, small trees and hedges;

(e) credit value of materials;

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(f) disposal of material (as Series 600 paragraph 39);

(g) making good severed ends of existing fences, hedges and walls;

(h) cutting back trees, bushes and hedges;

(i) disconnecting, removing and sealing services and supplies;

(j) reinstatement and making good;

(k) preservation of individual or groups of trees, shrubs and the like;

(l) treatment of hazardous materials.

Demolition of Individual or 6 (05/01) The items for demolition of individual or groups of buildings or

Groups of Buildings or structures shall in accordance with the Preambles to Bill of Quantities General

Structures Directions include for:

Item coverage (a) blasting, breaking up and removal;

(b) credit value of materials;

- (c) disposal of material (as Series 600 paragraph 39);
- (d) disconnecting, removing and sealing services and supplies;
- (e) treatment of hazardous materials.

Partial Demolition of 7 (05/01) The items for partial demolition of individual structures shall in

Individual Structures accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) demolition of individual or groups of buildings or structures (as this Series paragraph 6);

- (b) cutting and trimming;
- (c) saw cutting;
- (d) cutting through reinforcement, removal, disposal, protecting cut ends with treatment, de-bonding existing reinforcement;
- (e) working between and behind reinforcement and other obstructions;
- (f) marking of surfaces;
- (g) preparation to receive new works;
- (h) measures in respect of specialist demolition techniques;
- (i) protection of unaffected parts of the structure.

Take Up or Down and Set Aside for Re-use or Remove to Store or Tip off Site (05/01)

Units **8 (05/01)** The units of measurement shall be:

Take up or down and set aside for re-use or remove to store or tip off Site the following:

- (i) blockwork and stonework cubic metre;
- (ii) paved areas and the like, brickwork square metre;
- (iii) kerbs, channels, edgings, combined drainage and kerb blocks, linear drainage channel systems, fencing, safety fences, safety barriers and pedestrian guardrails and the like, copings, string courses and the like linear metre;
- (iv) cable linear metre;

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(v) road lighting columns, brackets and wall mountings, traffic signs, road studs, gates, stiles, street furniture, feeder pillars, communications cabinets, posts, brackets, signal indicators, shelves, racking, frames, electronic units and the like number;

(vi) chamber covers and frames, gully gratings and frames and the like number;

(vii) individual blocks, features or stones number.

Measurement 9 (05/01) The measurement for take up or down and set aside for re-use or

remove to store or tip off Site blockwork, stonework, paved areas and the like, brickwork, kerbs, channels, edgings, combined drainage and kerb blocks, linear drainage channel systems, fencing, safety fences, safety barriers and pedestrian guardrails and the like, copings, string courses and the like, cable, road lighting columns, brackets and wall mountings, traffic signs, road studs, gates, stiles, street furniture and the like; feeder pillars, communications cabinets, posts, brackets, signal indicators, shelves, racking, frames, electronic units and the like; chamber covers and frames, gully gratings and frames and the like; individual blocks, features or stones shall be the volumes, areas, lengths or numbers stated in the Contract.

Itemisation 10 (05/01) Separate items shall be provided for take up or down and set aside

for re-use or remove to store or tip off Site in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

- I 1 Take up or down and set aside for reuse.
- 2 Take up or down and remove to store off Site.
- 3 Take up or down and remove to tip off Site.
- II 1 Blockwork and stonework.
- 2 Paved areas and the like.
- 3 Brickwork.
- 4 Kerbs, channels, edgings, combined drainage and kerb blocks, linear drainage channel systems, fencing, safety fences, safety barriers and pedestrian guardrails and the like.
- 5 Copings, string courses and the like.
- 6 Cable.
- 7 Road lighting columns, brackets and wall mountings, traffic signs, gates, stiles, street furniture, road studs and the like.
- 8 Feeder pillars, communications cabinets, posts, brackets, signal indicators and the like.
- 9 Shelves, racking, frames and the like.
- 10 Electronic units and the like.
- 11 Chamber covers and frames, gully gratings and frames and the like.
- 12 Individual blocks, features or stones.

III 1 Different types and sizes.

IV 1 Different arrangements.

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Take Up or Down and 11 (05/01) The items for take up or down and set aside for re-use or remove

Set Aside for Re-use or to store or tip off Site shall in accordance with the Preambles to Bill of

Remove to Store or Tip Off Quantities General Directions include for:

Site

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) excavation in Hard Material (as Series 600 paragraph 23);

(d) detensioning, dismantling and extracting posts;

(e) cleaning, stacking, protecting and labelling;

(f) transport and handling;

(g) disconnecting, removing, disposing of and sealing of services and supplies;

(h) sand and warning tape to cables where one or more are to remain in a shared trench;

(i) backfilling and compaction;

(j) making good to severed ends of existing walls, hedges, and fencing;

(k) disposal of material (as Series 600 paragraph 39);

(l) reinstatement and making good;

(m) storage facilities;

(n) replacing items damaged during the foregoing operations;

(o) credit value of materials;

(p) multiple handling of materials;

(q) treatment of hazardous materials.

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Fencing

Series 300: Fencing (05/01)

Fencing, Gates and Stiles

Units 1 (05/01) The units of measurement shall be:

- (i) fencing linear metre.
- (ii) concrete foundation to timber posts number.
- (iii) gates, stiles number.
- (iv) wire, wire mesh to existing fencing, gates and the like linear metre.
- (v) fenced tree guards number.

Measurement 2 (05/01) Where a particular type of temporary fencing is specified in Appendix 3/1 by the Overseeing Organisation and shown on the drawings it shall be measured. All other temporary fencing shall not be measured.

The measurement of fencing shall be the developed length along the centre line of the fence. The measurement of height of fencing shall be that stated in the Contract for the type of fence.

The measurement of wire and wire mesh shall only be separately measurable where it is required by the Contract to be fixed to existing fencing, gates and the like, and shall be the developed length along the centre line of the fence.

The measurement of width of gates shall be the distance between the outer edges of the stiles; the outer edges of hanging stiles in the case of double gates.

The measurement of height of gates shall be the distance between the upper surface of the top rail and the underside of the bottom rail.

Concrete foundation to timber posts shall only be measured for those locations stated in Appendices 1/15 or 3/1 of the Specification.

Itemisation 3 (05/01) Separate items shall be provided for fencing in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Each type of fencing.

2 Concrete foundation to each type of timber post for each type of fencing.

3 Each type of gate.

4 Each type of stile.

5 Each type of wire to existing fencing, gates and the like.

6 Each type of wire mesh to existing fencing, gates and the like.

7 Each type of fenced tree guard.

II 1 Fencing of different heights.

2 Gates of different heights and widths.

III 1 Painted fencing, gates or stiles.

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Fencing

Fencing 4 (05/01) The items for fencing shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) trimming ground on the line of the fencing;

(d) concrete (as Series 1700 paragraphs 5 and 10);

(e) formwork (as Series 1700 paragraph 15);

(f) reinforcement (as Series 1700 paragraph 26);

(g) backfilling and compaction;

(h) disposal of material (as Series 600 paragraph 39);

(i) preservation of timber;

(j) adjustment of fencing to a flowing alignment including additional length posts;

(k) fixings and fittings;

(l) joining to existing fencing, gates, hedges and walls;

(m) protective system (as Series 1900 paragraph 4);

- (n) inspection and maintenance of fencing and gates;
- (o) erection and removal of temporary fencing and gates;
- (p) additional posts and rails over ditches;
- (q) maintenance of access for owners, tenants and occupiers of adjoining land and patrolling gaps or openings;
- (r) epoxy resin compound and mastic filler to posts fixed in socket;
- (s) additional posts at junctions and changes in direction or adjacent to gates, stiles and other obstacles;
- (t) additional posts, stakes and ground anchors;
- (u) inspection of existing fencing and reports;
- (v) pegging, bending, turning and cutting mesh;
- (w) cutting curves and turfing (as Series 3000 paragraph 9);
- (x) patrolling.

Concrete Foundation 5 (05/01) The items for concrete foundation to timber posts shall in

to Timber Posts accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) in situ concrete (as Series 1700 paragraph 5);

(d) formwork (as Series 1700 paragraph 15);

(e) reinforcement (as Series 1700 paragraph 26);

(f) backfilling and compaction;

(g) disposal of material (as Series 600 paragraph 39).

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Fencing

Gates and Stiles 6 (05/01) The items for gates and stiles shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) trimming ground at entrance;

(d) in situ concrete (as Series 1700 paragraph 5);

(e) formwork (as Series 1700 paragraph 15);

(f) reinforcement (as Series 1700 paragraph 26);

(g) backfilling and compaction;

(h) disposal of material (as Series 600 paragraph 39);

(i) preservation of timber;

(j) protective system (as Series 1900 paragraph 4);

(k) posts, fittings and furniture;

(l) joining to existing fencing, hedges and walls;

(m) in the case of new gates and stiles in existing fencing, hedges or walls, forming openings and making good;

(n) stock-proofing.

Remove from Store and Re-erect Fencing, Gates and Stiles

Units 7 (05/01) The units of measurement shall be:

(i) remove from store and re-erect fencing linear metre.

(ii) concrete foundation to timber posts number.

(iii) remove from store and re-erect gates and stiles number.

Measurement 8 (05/01) The measurement of re-erected fencing shall be the developed length along the centre line of the re-erected fencing. The measurement of height of fencing shall be that stated in the Contract for the type of fence.

The measurement of width of gates shall be the distance between the outer edges of the stiles; the outer edges of hanging stiles in the case of double gates.

The measurement of height of gates shall be the distance between the upper surface of the top rail and the underside of the bottom rail.

Concrete foundation to timber posts shall only be measured for those locations stated in Appendices 1/15 or 3/1 of the Specification.

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Fencing

Itemisation **9** (05/01) Separate items shall be provided for re-erected fencing, gates and stiles in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Each type of re-erected fencing.

2 Concrete foundation to each type of timber post for each type of re-erected fencing.

3 Each type of re-erected gate.

4 Each type of re-erected stile.

II 1 Re-erected fencing of different heights.

2 Re-erected gates of different heights and widths.

III 1 Re-erected painted fencing, gates or stiles.

Remove from Store and 10 The items for remove from store and re-erect fencing shall in accordance

Re-erect Fencing with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) loading, transporting from store, unloading and positioning for re-erection;

(b) replacing items damaged during the foregoing operations;

(c) modification and new materials;

(d) painting existing painted items;

(e) fencing (as this Series paragraph 4).

Concrete Foundation 11 (05/01) The items for concrete foundation to timber posts shall in

to Timber Posts accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) concrete foundation to timber posts (as this Series paragraph 5).

Remove from Store and 12 The items for remove from store and re-erect gates and stiles shall in

Re-erect Gates and Stiles accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) loading, transporting from store, unloading and positioning for re-erection;

(b) replacing items damaged during the foregoing operations;

(c) modification and new materials;

(d) painting existing painted items;

(e) gates and stiles (as this Series paragraph 6).

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Fencing

Excavation in Hard Material (05/01)

Units **13** (05/01) The unit of measurement shall be:

(i) extra over excavation for excavation in Hard Material in fencing works cubic metre.

Measurement **14** (05/01) The measurement of extra over excavation for excavation in Hard

Material in fencing works shall be the plan area of the minimum size of the particular foundation required by the Contract multiplied by the depth of Hard Material removed.

Itemisation **15** (05/01) Separate items shall be provided for extra over excavation for excavation in Hard Material in fencing works in accordance with Chapter II

paragraphs 3 and 4 and the following:

Group Feature

I 1 Extra over excavation for excavation in Hard Material in fencing works.

Extra Over Excavation for 16 (05/01) The items for extra over excavation for excavation in Hard

Excavation in Hard Material Material in fencing works shall in accordance with the Preambles to Bill of

Quantities General Directions include for:

Item Coverage (a) excavation in Hard Material (as Series 600 paragraph 23).

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Series 400: Safety Fences, Safety Barriers and Pedestrian Guardrails

Definition 1 The term “beam” shall mean a longitudinal member spanning posts and mounting brackets within the limits defined in paragraph 4 below. The term “mounting bracket” shall be deemed to include the term “bridge pier or concrete parapet mounting connection”.

2 The term “wire rope” shall mean the complete rope system for the wire rope safety fence comprising upper and lower ropes together with inherent component ropes of all types and tail ropes but excluding safety check ropes.

Beam Safety Fences

Units 3 The units of measurement shall be:

(i) beams linear metre.

(ii) posts, mounting brackets, terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets, connection pieces, concrete foundations and socketed foundations to posts number.

Measurement 4 The measurement of beams shall be the developed length along the centre

line of the beams or in the case of double sided fences and double rail fences, measured once only along the centre line of the posts, between the following points:

(a) the end of each beam type at a connection to bridge parapet or within a connection piece assembly;

(b) the connection of beams to terminal sections, full height anchorages and expansion joint anchorages.

5 (05/01) The measurement of terminal sections, full height anchorages, expansion joint anchorages and connections to bridge parapets shall be the complete installation. Mounting brackets and all other posts required between those points defined in paragraph 4 shall be measured. Concrete foundations and socketed foundation to posts, between those points defined in paragraph 4, shall only be measured for those locations stated in the Contract.

6 The measurement of connection pieces shall be the complete installation.

7 The measurement of expansion joint anchorages shall be for each anchorage on each side of the expansion joint.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Itemisation 8 Separate items shall be provided for beam safety fences in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Each type of beam.

2 Each type of post.

3 Each type of mounting bracket.

4 Each type of terminal section.

- 5 Each type of full height anchorage.
- 6 Each type of expansion joint anchorage.
- 7 Each type of connection to bridge parapet.
- 8 Each type of connection piece.
- 9 Each type of concrete foundation to post.
- 10 Each type of socketed foundation to post.
- II 1 Straight or curved exceeding 120 metres radius.
- 2 Curved exceeding 50 metres radius but not exceeding 120 metres radius.
- 3 Curved not exceeding 50 metres radius.
- III 1 Double rail.
- IV 1 Double sided.

Beams 9 The items for beams shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage (a) fabrication (as Series 1800 paragraph 6);
(b) protective system (as Series 1900 paragraph 4);
(c) attachments, adjuster assemblies, expansion assemblies, fixings, closure pieces and stiffeners;
(d) adjustment of beams to flowing alignment;
(e) tensioning or retensioning;
(f) flaring;
(g) painting.

Posts 10 The items for posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage (a) fabrication (as Series 1800 paragraph 6);
(b) protective system (as Series 1900 paragraph 4);
(c) driving in any material;
(d) fixing to structures including attachment systems;
(e) fixing to beam including spacers;
(f) drilling or forming holes and pockets and casting in bolts, base plates and anchorage assemblies;
(g) bedding;
(h) filling.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Mounting Brackets 11 The items for mounting brackets shall in accordance with the Preambles

to Bill of Quantities General Directions include for:

- Item coverage (a) fabrication (as Series 1800 paragraph 6);
(b) protective system (as Series 1900 paragraph 4);
(c) fixing to structures including adaptor platforms;
(d) fixing to beam;
(e) drilling or forming holes and pockets and casting in bolts, base plates and anchorage assemblies.

Terminal Sections, Full 12 (05/01) The items for terminal sections, full height anchorages, expansion

Height Anchorages, joint anchorages, connections to bridge parapets and connection pieces shall in

Expansion Joint Anchorages, accordance with the Preambles to Bill of Quantities General Directions include

Connections to Bridge for:

Parapets and Connection Pieces

- Item coverage (a) posts (as this Series paragraph 10);
(b) beams (as this Series paragraph 9);
(c) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
(d) concrete (as Series 1700 paragraphs 5 and 10);

- (e) formwork (as Series 1700 paragraph 15);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) disposal of material (as Series 600 paragraph 39);
- (h) fixing to or setting in concrete;
- (i) terminal end shoes;
- (j) precast concrete fairings;
- (k) in the case of terminal sections to untensioned corrugated beam, acceptable material, ramp, backfilling and compaction;
- (l) casings and plastic sheeting;
- (m) sockets, socket covers and filling.

Concrete Foundations to 13 (05/01) The items for concrete foundations to posts shall in accordance

Posts with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);

- (b) disposal of material (as Series 600 paragraph 39);
- (c) concrete (as Series 1700 paragraphs 5 and 10);
- (d) formwork (as Series 1700 paragraph 15);
- (e) reinforcement (as Series 1700 paragraph 26);
- (f) plastic sheeting;
- (g) casings.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Socketed Foundations to 14 The items for socketed foundations to posts shall in accordance with the

Posts Preambles to Bill of Quantities General Directions include for:

Item coverage (a) fabrication (as Series 1800 paragraph 6);

- (b) protective system (as Series 1900 paragraph 4);
- (c) concrete foundations to posts (as this Series paragraph 13);
- (d) socket covers and filling.

Remove from Store and Re-erect Beam Safety Fences

Units 15 The units of measurement shall be:

- (i) remove from store and re-erect beams linear metre.
- (ii) remove from store and re-erect posts, mounting brackets, terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets, connection pieces number.
- (iii) concrete foundations and socketed foundations to re-erected posts number.

Measurement 16 The measurement of re-erected beam safety fences shall be in accordance

with paragraphs 4, 5, 6 and 7 of this Series.

Itemisation 17 Separate items shall be provided for remove from store and re-erect beam

safety fences in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Each type of re-erected beam.

2 Each type of re-erected post.

3 Each type of re-erected mounting bracket.

4 Each type of re-erected terminal section.

5 Each type of re-erected full height anchorage.

6 Each type of re-erected expansion joint anchorage.

7 Each type of re-erected connection to bridge parapet.

8 Each type of re-erected connection piece.

9 Each type of concrete foundation to re-erected post.

10 Each type of socketed foundation to re-erected post.

II 1 Straight or curved exceeding 120 metres radius.

2 Curved exceeding 50 metres radius but not exceeding

120 metres radius.

3 Curved not exceeding 50 metres radius.

Remove from Store and 18 The items for remove from store and re-erect beams shall in accordance

Re-erect Beams with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) loading, transporting from store, unloading and positioning for re-erection;

(b) replacing items damaged during the foregoing operations;

(c) modification and new materials;

(d) beams (as this Series paragraph 9);

(e) making good to protective system.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Remove from Store and 19 The items for remove from store and re-erect posts shall in accordance

Re-erect Posts with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) loading, transporting from store, unloading and positioning for re-erection;

(b) replacing items damaged during the foregoing operations;

(c) modification and new materials;

(d) posts (as this Series paragraph 10);

(e) making good to protective system.

Remove from Store and 20 The items for remove from store and re-erect mounting brackets shall in

Re-erect Mounting accordance with the Preambles to Bill of Quantities General Directions include

Brackets for:

Item coverage (a) loading, transporting from store, unloading and positioning for re-erection;

(b) replacing items damaged during the foregoing operations;

(c) modification and new materials;

(d) mounting brackets (as this Series paragraph 11);

(e) making good to protective system.

Remove from Store and 21 The items for remove from store and re-erect terminal sections, full

Re-erect Terminal Sections, height anchorages, expansion joint anchorages, connections to bridge parapets

Full Height Anchorages, and connection pieces shall in accordance with the Preambles to Bill of

Expansion Joint Anchorages, Quantities General Directions include for:

Connections to Bridge

Parapets and Connection

Pieces

Item coverage (a) loading, transporting from store, unloading and positioning for re-erection;

(b) replacing items damaged during the foregoing operations;

(c) modification and new materials;

(d) terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets and connection pieces (as this Series paragraph 12);

(e) making good to protective system.

Concrete Foundations and 22 The items for concrete foundations and socketed foundations to

Socketed Foundations to re-erected posts shall in accordance with the Preambles to Bill of Quantities

Re-erected Posts General Directions include for:

Item coverage (a) concrete foundations to posts (as this Series paragraph 13);

(b) socketed foundations to posts (as this Series paragraph 14).

Post Extension Units

Units **23** The unit of measurement shall be:

(i) post extension units number.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Itemisation **24** Separate items shall be provided for post extension units in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Each type of post extension unit.

Post Extension Units 25 The items for post extension units shall in accordance with the Preambles

to Bill of Quantities General Directions include for:

Item coverage (a) fabrication (as Series 1800 paragraph 6);

(b) protective system (as Series 1900 paragraph 4);

(c) drilling existing posts;

(d) fixing to existing posts.

Raising Existing Sockets

Units **26** The unit of measurement shall be:

(i) raising existing sockets number.

Itemisation **27** Separate items shall be provided for raising existing sockets in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Raising each type of existing socket.

Raising Existing Sockets 28 (05/01) The items for raising existing sockets shall in accordance with the

Preambles to Bill of Quantities General Directions include for:

Item coverage (a) removing existing posts and setting aside for re-use;

(b) cleaning out sockets;

(c) in situ concrete (as Series 1700 paragraph 5);

(d) formwork (as Series 1700 paragraph 15);

(e) loading, transporting from store, unloading and positioning for re-erection;

(f) removing from store and re-erecting posts (as this Series paragraph 19);

(g) replacing items damaged during the foregoing operations;

(h) making good to protective systems.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Wire Rope Safety Fence

Units **29** The units of measurement shall be:

(i) wire rope linear metre.

(ii) posts, intermediate anchorages, end anchorages, concrete foundations and socketed foundations to posts number.

Measurement **30** The measurement of wire rope shall be the undeveloped length measured

once only along the centre line of the fence on plan from midway between the anchor blocks at one end to midway between the anchor blocks at the other end.

31 The measurement of intermediate anchorages and end anchorages shall be the complete installation.

Concrete foundations and socketed foundations shall only be measured for those locations stated in the Contract.

Itemisation **32** Separate items shall be provided for wire rope safety fences in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

- I 1 Wire rope.
- 2 Each type of post.
- 3 Each type of intermediate anchorage.
- 4 Each type of end anchorage.
- 5 Each type of concrete foundation to post.
- 6 Each type of socketed foundation to posts.

Wire rope 33 The items for wire rope shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage (a) fabrication (as Series 1800 paragraph 6);
(b) protective system (as Series 1900 paragraph 4);
(c) rigging screws, threaded terminals, attachments, fittings and fixings;
(d) adjustments and tensioning;
(e) threading ropes into and around posts.

Posts 34 The items for posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage (a) fabrication (as Series 1800 paragraph 6);
(b) protective system (as Series 1900 paragraph 4);
(c) driving in any material;
(d) fixing to structures including attachment systems;
(e) post caps, excluders, hooks and fittings;
(f) drilling or forming holes and pockets and casting in bolts, base plates, sockets and anchorage assemblies;
(g) bedding;
(h) filling.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Intermediate Anchorages 35 (05/01) The items for intermediate anchorages and end anchorages shall in

and End Anchorages accordance with the Preambles to Bill of Quantities General Directions include

for:

- Item coverage (a) fabrication (as Series 1800 paragraph 6);
(b) protective system (as Series 1900 paragraph 4);
(c) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
(d) concrete (as Series 1700 paragraphs 5 and 10);
(e) formwork (as Series 1700 paragraph 15);
(f) reinforcement (as Series 1700 paragraph 26);
(g) disposal of material (as Series 600 paragraph 39);
(h) safety check ropes, fork terminals, pins, thimbles, ferrules, attachments, fixings and fittings;
(i) anchor frames, surface mounted anchors and sockets;
(j) fixing to anchor block including attachment systems;
(k) drilling or forming holes and pockets and casting in bolts, base plates, sockets and anchorage assemblies.

Concrete Foundations to 36 (05/01) The items for concrete foundations to posts shall in accordance

Posts with the Preambles to Bill of Quantities General Directions include for:

- Item coverage (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
(b) disposal of material (as Series 600 paragraph 39);
(c) concrete (as Series 1700 paragraphs 5 and 10);
(d) formwork (as Series 1700 paragraph 15);
(e) reinforcement (as Series 1700 paragraph 26);
(f) plastic sheeting;
(g) casings.

Socketed Foundations to 37 The items for socketed foundations to posts shall in accordance with the

Posts Preambles to Bill of Quantities General Directions include for:

- Item coverage (a) fabrication (as Series 1800 paragraph 6);
- (b) protective system (as Series 1900 paragraph 4);
- (c) concrete foundations to posts (as this Series paragraph 36);
- (d) socket covers and filling.

Concrete Safety Barriers

Units 38 The units of measurement shall be:

- (i) concrete safety barriers linear metre.
- (ii) concrete safety barrier terminations, transitions number.

Measurement 39 The measurement of concrete safety barriers shall be the developed length along the centre line of the barriers between terminations.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Itemisation 40 Separate items shall be provided for concrete safety barriers in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Each type of barrier.

2 Each type of termination.

3 Each type of transition.

II 1 Straight or curved exceeding 50 metres radius.

2 Curved not exceeding 50 metres radius.

Concrete Safety Barriers 41 (05/01) The items for concrete safety barriers shall in accordance with the

Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);

(b) disposal of material (as Series 600 paragraph 39);

(c) concrete (as Series 1700 paragraph 5 and 10);

(d) formwork (as Series 1700 paragraph 15);

(e) reinforcement (as Series 1700 paragraph 26);

(f) joints and gaskets including movement joints;

(g) foundations and bases;

(h) filling;

(i) attachment systems and fixings;

(j) adjustment to flowing alignment;

(k) fabrication (as Series 1800 paragraph 6);

(l) protective system (as Series 1900 paragraph 4);

(m) cast-in sockets, bolts, nuts, washers;

(n) make-up units;

(o) dowel bars;

(p) treatment at lighting columns and the like including cover plates, sub-frames, plates and fixings.

Concrete Safety Barrier 42 The items for concrete safety barrier terminations and transitions shall in

Terminations and Transitions accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) concrete safety barriers (as this Series paragraph 41);

(b) fixing to or setting in concrete;

(c) attachment systems and connectors for fixing to beam safety fences.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Pedestrian Guardrails and Handrails

Units **43** The unit of measurement shall be:

(i) pedestrian guardrails, handrails linear metre.

Measurement **44** The measurement of pedestrian guardrails and handrails shall be the developed length along the centre line. The height of pedestrian guardrails shall be the height between the top of the top rail and the finished level of the surface directly beneath the guardrail.

Itemisation **45** Separate items shall be provided for pedestrian guardrails and handrails in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Each type of pedestrian guardrail.

2 Each type of handrail.

II 1 Different heights.

III 1 Elements curved in plan to different radii.

Pedestrian Guardrails and Handrails **46** (05/01) The items for pedestrian guardrails and handrails shall in

Handrails accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);

(b) disposal of material (as Series 600 paragraph 39);

(c) in situ concrete (as Series 1700 paragraph 5);

(d) formwork (as Series 1700 paragraph 15);

(e) reinforcement (as Series 1700 paragraph 26);

(f) backfilling and compaction;

(g) metal parapets (as Series 2200 paragraph 5);

(h) gates (as Series 300 paragraph 6);

(j) rivets, nuts, bolts, shims, washers, welds, clamps and the like.

Loading Tests on Post Foundations (05/01)

Units **47** (05/01) The unit of measurement for loading test on post foundation shall be:

(i) loading test on post foundation carried out by Contractor, loading test on post foundation carried out by Overseeing Organisation

..... number.

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Safety Fences, Safety Barriers and Pedestrian Guardrails

Itemisation **48** (05/01) Separate items shall be provided for loading test on post foundation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Loading test on post foundation carried out by Contractor.

2 Loading test on post foundation carried out by Overseeing Organisation.

II 1 Different types of safety fence posts.

III 1 Different sizes of safety fence posts.

Loading Test on Post **49** (05/01) The items for loading test on post foundation carried out by

Foundation Carried out by Contractor shall in accordance with the Preambles to Bill of Quantities

Contractor General Directions include for:

Item coverage (a) posts (as this Series paragraph 10);

(b) concrete foundations to posts (as this Series paragraph 13);

(c) socketed foundations to posts (as this Series paragraph 14);

(d) provision, maintenance and subsequent removal of test equipment;

(e) provision, maintenance and subsequent removal of reaction vehicle;

(f) preparation and submission of results to the Overseeing Organisation;

- (g) removal of test posts and foundations;
- (h) disposal of material (as Series 600 paragraph 39);
- (i) reinstatement and making good;
- (j) traffic safety and management (as Series 100 paragraph 26).

Loading Test on Post 50 (05/01) The items for loading test on post foundation carried out by

Foundation Carried out by Overseeing Organisation shall in accordance with the Preambles to Bill of

Overseeing Organisation Quantities General Directions include for:

Item coverage (a) posts (as this Series paragraph 10);

(b) concrete foundations to posts (as this Series paragraph 13);

(c) socketed foundations to posts (as this Series paragraph 14);

(d) provision, maintenance and subsequent removal of reaction vehicle;

(e) removal of test posts and foundations;

(f) disposal of material (as Series 600 paragraph 39);

(g) reinstatement and making good;

(h) traffic safety and management (as Series 100 paragraph 26).

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Chapter IV Series 500

Drainage and Service Ducts

Series 500: Drainage and Service Ducts

Definitions 1 (05/01) Any reference to 'drain' shall be deemed to include sewers and piped culverts.

2 (05/01) Drains exceeding 900 mm internal diameter, box culverts, piped culverts and all associated chambers, headwalls, outfall works and concrete bagwork shall be measured in accordance with Series 2500 Special Structures.

3 (05/01) Trenches and ducts in connection with electrical work for road lighting and traffic signs cabling shall be measured in accordance with Series 1400.

4 (05/01) Trenches and ducts in connection with motorway communications cabling shall be measured in accordance with Series 1500.

5 (05/01) The Earthworks Outline is defined in Series 600 Earthworks paragraphs 1 to 6 inclusive and shall apply equally to this Series.

6 (05/01) Where the ground level has been subjected to treatment, under the Contract, in respect of ground improvement, mine workings, swallow holes and the like, for the purposes of this Series Existing Ground Level shall be the level obtained upon completion of any such treatment of the areas affected.

7 (05/01) Sub-soil Level is defined as the level of the ground after the removal of topsoil required by the Contract.

8 (05/01) Surcharge is defined as material placed on embankments for the purpose of loading the embankment for the periods stated in the Contract.

Drains and Service Ducts (Excluding Filter Drains, Narrow Filter Drains and Fin Drains) (05/01)

Units 9 (05/01) The unit of measurement for drains and service ducts shall be:

- (i) drains, service ducts linear metre.

Measurement 10 (05/01) The measurement of drains and service ducts shall be the summation of their individual lengths measured along the centre lines of the pipes between any of the following:

- (a) the internal faces of chambers;
- (b) the external faces of headwalls;
- (c) the intersections of the centre lines at pipe junctions;
- (d) the centre of gully gratings (or where no grating is provided, the centre of the gully);
- (e) the position of terminations shown in the Contract;
- (f) the point of change of stage depth.

11 (05/01) The depth of drains and service ducts shall be the vertical measurement between the invert and the following:

- (a) where the invert is below the Existing Ground Level - the Existing

Ground Level except that where the Earthworks Outline is below the Existing Ground Level the measurement shall be taken to the Earthworks Outline;

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Drainage and Service Ducts

(b) where the invert is at or above the Existing Ground Level - the datum stated in the Contract, or where none is stated, the Earthworks Outline.

Notwithstanding the foregoing, where in the Contract a commencing level or a minimum level of cover is stated from which excavation shall commence, then the depth shall be taken to that stated level.

12 (05/01) The average depth to invert shall be the calculated arithmetic mean of the depths taken at intervals of 10 metres along the pipelines starting from the outfall end. For terminal lengths and pipelines less than 10 metres long the measurement of depths shall be taken at their ends.

13 (05/01) The measurement of service ducts shall be for the complete construction irrespective of the number of ducts contained within any one trench.

Where more than one duct is laid in a trench then the number of ducts shall be stated in the item description.

14 (05/01) Drains and service ducts required to be designed by the Contractor shall be measured in accordance with Series 2500.

Itemisation **15 (05/01)** Separate items shall be provided for drains and service ducts (excluding filter drains, narrow filter drains and fin drains) in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Drains.

2 Service ducts.

II 1 Different internal diameters.

III 1 Depths to invert not exceeding 2 metres. The average depth to invert to be stated to the nearest 25 mm.

2 Depths to invert exceeding 2 metres but not exceeding 4 metres and so on in steps of 2 metres. The average depth to invert to be stated to the nearest 25 mm.

IV 1 Specified design groups.

2 Particular designs stated in the Contract.

V 1 Construction in trench.

2 Construction in heading.

3 Construction by jacking or thrust boring.

4 Suspended on discrete supports.

VI 1 In side slopes of cuttings or side slopes of embankments.

Note: For each item which includes Group III Feature 1 or 2, an associated item shall be provided for adjustment of the rate for each 25 mm of difference in excess of 150 mm where the average depth to invert calculated from site measurement varies from that stated in the Bill of Quantities. The foregoing shall apply to both increases and decreases of average in excess of 150 mm, and will result in either a positive or negative adjustment of the rate.

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Drainage and Service Ducts

Drains and Service Ducts 16 (05/01) The items for drains and service ducts shall in accordance with

the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

- (c) access shafts to headings and their subsequent reinstatement;
- (d) thrust pits and thrust blocks for pipe jacking and their removal on completion;
- (e) articulated pipes and fittings;
- (f) cutting, laying, jointing and bedding;
- (g) building in pipes to headwalls and outfall works;
- (h) hangers, stools and discrete supports;
- (i) bedding, haunching and surrounding;
- (j) formwork (as Series 1700 paragraph 15);
- (k) backfilling and compaction;
- (l) disposal of material (as Series 600 paragraph 39);
- (m) movement joints to beds, surrounds and the like;
- (n) reinstatement of unpaved areas;
- (o) checking and cleaning;
- (p) recording, staking and labelling;
- (q) in the case of ducts, fixing draw ropes, removable stoppers, marker blocks and posts;
- (r) pipe schedules;
- (s) lubricants, packing, grouting and caulking;
- (t) surveys and recordings;
- (u) protective system (as Series 1900 paragraph 4).

Filter Drains

Units **17** (05/01) The units of measurement for filter drains shall be:

- (i) filter drains linear metre.
- (ii) filter material contiguous with filter drains cubic metre.
- (iii) sub-base material cubic metre.
- (iv) lightweight aggregate infill cubic metre.
- (v) excavate and replace filter material cubic metre.

Measurement **18** (05/01) The measurement of filter drains, excluding narrow filter drains,

shall be the summation of their individual lengths measured along the centre lines of the pipe (or trench where no pipe is provided), between any of the following:

- (a) the internal faces of chambers;
- (b) the external faces of headwalls;

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- (c) the intersection of centre lines at junctions;
- (d) the centre of gully gratings (or where no grating is provided the centre of the gully);
- (e) the position of terminations shown in the Contract;
- (f) the point of change of stage depth.

19 (05/01) The depth of filter drains shall be the vertical measurement between the invert (or the centre line of the trench bottom where no pipe is provided) and the following:

- (a) where the invert is below the Existing Ground Level - the Existing Ground Level or the Earthworks Outline whichever is the lower, except that where the finished level of the filter material is above the Existing Ground Level the measurement shall be taken to the finished level of the filter material;
- (b) where the invert is at or above the Existing Ground Level - the datum stated in the Contract, or where none is stated, the finished level of the filter material.

The calculation of average depth to invert of filter drains shall be as paragraph 12 of this Series taken along the centre line of the filter drain.

Narrow filter drains shall be measured in accordance with paragraphs 25 to 28 of this Series.

20 (05/01) The measurement of contiguous filter material shall be the volume

of the material occupying the void between the filter drain and the adjacent carriageway, hardshoulder and hardstrip. The side of the contiguous filter material next to the filter drain shall be taken as the vertical extension of the trench side above capping or where no capping is provided above subgrade level.

The measurement of sub-base material shall be the volume of the sub-base material within non-pavement verge or central reserve adjacent to the carriageway, hardshoulder and hardstrip filled to the outline stated in the Contract.

The measurement of lightweight aggregate infill shall be the volume of the lightweight aggregate infill above the filter drain filled to the outline stated in the Contract.

The measurement of excavate and replace filter material shall be the product of the lengths, widths and depths instructed by the Overseeing Organisation with no deduction for pipes, ducts or chambers. Lengths and widths shall be taken as the lengths and widths at the level of the drain invert or, in the case that partial excavation is instructed, at the depth to which excavation is instructed by the Overseeing Organisation.

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Itemisation **21** (05/01) Separate items shall be provided for filter drains in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Filter drains.

2 Filter material contiguous with filter drains.

3 Sub-base material.

4 Lightweight aggregate infill.

5 Excavate and replace filter material.

II 1 Different internal diameters.

2 Different types of filter material.

3 Different types of sub-base material.

4 Different types of lightweight aggregate infill.

III 1 Depths to invert not exceeding 2 metres. The average depth to invert to be stated to the nearest 25 mm.

2 Depths to invert exceeding 2 metres but not exceeding 4 metres and so on in steps of 2 metres. The average depth to invert to be stated to the nearest 25 mm.

IV 1 Specified design groups.

2 Particular designs stated in the Contract.

V 1 In side slopes of cuttings or side slopes of embankments.

Note: For each item which includes Group III Feature 1 or 2 an associated item shall be provided for adjustment of the rate for each 25 mm of difference in excess of 150 mm where the average depth to invert calculated from site measurement varies from that stated in the Bill of Quantities. The foregoing shall apply to both increases and decreases of average in excess of 150 mm, and will result in either a positive or negative adjustment of the rate.

Filter Drains 22 (05/01) The items for filter drains shall in accordance with the Preambles

to Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) disposal of material (as Series 600 paragraph 39);

(d) articulated pipes, and fittings;

(e) cutting, laying, jointing and bedding;

(f) bedding, haunching and surrounding;

(g) formwork (as Series 1700 paragraph 15);

(h) filter material and compaction;

- (i) reinstatement of unpaved areas;
- (j) checking and cleaning;
- (k) recording, staking and labelling;
- (l) geotextiles;

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- (m) topsoiling, seeding and turfing;
- (n) mesh;
- (o) pipe schedules;
- (p) protective system (as Series 1900 paragraph 4).

Filter Material Contiguous 23 (05/01) The items for filter material contiguous with filter drains, sub-base

with Filter Drains, Sub-base material and lightweight aggregate infill shall in accordance with the Preambles

Material and Lightweight to Bill of Quantities General Directions include for:

Aggregate Infill

- Item coverage (a) compaction;
- (b) formwork (as Series 1700 paragraph 15);
 - (c) geotextiles;
 - (d) mesh.

Excavate and Replace Filter 24 (05/01) The items for excavate and replace filter material shall in

Material (05/01) accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage (a) excavation (as Series 600 paragraphs 18 and 19);
- (b) disposal of material (as Series 600 paragraph 39);
 - (c) compaction of fill (as Series 600 paragraph 52);
 - (d) geotextiles.

Fin Drains and Narrow Filter Drains

Units 25 (05/01) The unit of measurement shall be:

- (i) fin drains linear metre.
- (ii) narrow filter drains linear metre.

Measurement 26 (05/01) The measurement of fin drains and narrow filter drains shall be the

summation of their individual lengths measured along their centre lines between any of the following:

- (a) the internal faces of chambers;
- (b) the position of terminations shown in the Contract;
- (c) the external faces of headwalls.

The depth of the fin drain or narrow filter drain shall be the vertical measurement between the invert and the Earthworks Outline.

Itemisation 27 (05/01) Separate items shall be provided for fin drains and narrow filter drains in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Fin drains.

2 Narrow filter drains.

II 1 Specified design group.

2 Particular designs stated in the Contract.

III 1 Depth not exceeding 1.5 metres.

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Fin Drains and Narrow Filter 28 (05/01) The items for fin drains and narrow filter drains shall in

Drains accordance with the Preambles to Bill of Quantities General Directions include

for:

- Item coverage (a) geotextiles and cores;
- (b) backfilling and compaction;
- (c) filter drains (as this Series paragraph 22);
- (d) protection from ultra-violet light;
- (e) marker tapes;
- (f) lapping and jointing;
- (g) connections, attachments and fittings;
- (h) treatment at chambers, gullies, pipelines and the like.

Connections

Units **29** (05/01) The unit of measurement for connections shall be:

- (i) connection to existing drain, existing piped culvert, existing chamber, permanently severed land or mole drain number.

Measurement **30** (05/01) Connections shall only be separately measured for connection to

existing drains, existing piped culverts or existing chambers, and permanently severed land or mole drains.

Itemisation **31** (05/01) Separate items shall be provided for connections in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Connection to existing drain and existing piped culvert.

2 Connection to existing chamber.

3 Connection to permanently severed land or mole drain.

II 1 Different diameters.

III 1 Depths to invert not exceeding 2 metres.

2 Depths to invert exceeding 2 metres but not exceeding 4 metres and so on in steps of 2 metres.

Connections to Existing 32 (05/01) The items for connection to existing drains, existing piped

Drains, Existing Piped culverts, existing chambers, permanently severed land or mole drains shall in

Culverts, Existing accordance with the Preambles to Bill of Quantities General Directions include

Chambers, Permanently for:

Severed Land or Mole

Drains (05/01)

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) locating and making entry;

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(d) backfilling and compaction;

(e) disposal of material (as Series 600 paragraph 39);

(f) making entry into chambers, concrete benching and channels, and making good the benching, channels and walls;

(g) locating severed ends of land and mole drains;

(h) pipes, fittings and saddles;

(i) bedding, haunching and surrounding, and filter material;

(j) formwork (as Series 1700 paragraph 15);

(k) sealing off disused ends;

(l) re-laying existing pipes disturbed.

Chambers and Gullies

Units **33** (05/01) The unit of measurement shall be:

- (i) chambers, gullies number.

Measurement **34** (05/01) The measurement shall be of the complete chamber or gully.

35 (05/01) Depths of chambers shall be the distance between the top surface

of the cover and the invert of the main channel, or where no channel is required by the Contract, the uppermost surface of the base slab. Where no base slab is required the depth shall be taken to the bottom of the excavation.

Itemisation 36 (05/01) Separate items shall be provided for chambers and gullies in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Chambers.

2 Gullies.

II 1 Specified design groups.

2 Particular designs stated in the Contract.

III 1 Depths not exceeding 1 metre.

2 Depths exceeding 1 metre but not exceeding 2 metres and so on in steps of 1 metre.

IV 1 Different types of covers or gratings.

Chambers 37 (05/01) The items for chambers shall in accordance with the Preambles to

Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) locating existing drains;

(d) breaking into existing drains;

(e) connecting and re-connecting existing drains;

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(f) construction of bases, walls, roof and cover slabs and shafts, surrounds and corbelling for cover;

(g) channels, fittings, benchings, building in pipes and fin drain connections;

(h) cleaning;

(i) steps, safety chains, ladders, handholds and the like;

(j) covers, frames, seatings and bedding;

(k) lifting keys;

(l) concrete (as Series 1700 paragraphs 5 and 10);

(m) formwork (as Series 1700 paragraph 15);

(n) reinforcement (as Series 1700 paragraph 26);

(o) backfilling and compaction;

(p) disposal of material (as Series 600 paragraph 39);

(q) filling;

(r) notices;

(s) sealants (as Series 2300 paragraph 10);

(t) brickwork (as Series 2400 paragraph 4);

(u) re-laying existing pipes disturbed;

(v) pipework and fittings;

(w) penstocks and ancillary equipment.

Gullies 38 (05/01) The items for gullies shall in accordance with the Preambles to

Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) fittings including in situ concrete (as Series 1700 paragraph 5) bed and surround and jointing to pipes;

(d) gratings, frames, slabs, surrounds, aprons, seatings, liners and bedding;

(e) formwork (as Series 1700 paragraph 15);

(f) cleaning;

(g) backfilling and compaction;

(h) disposal of material (as Series 600 paragraph 39);

- (i) brickwork (as Series 2400 paragraph 4);
- (j) re-laying existing pipes disturbed.

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Headwalls and Outfall Works

Measurement **39** (05/01) Headwalls and outfall works and the like to pipes up to 900 mm

internal diameter shall be measured in accordance with this Series paragraphs 40 to 42.

Headwalls and outfall works and the like to pipes exceeding 900 mm internal diameter shall be measured in accordance with Series 2500.

Headwalls and outfall works and the like constructed using concrete bagwork shall be measured in accordance with this Series paragraphs 77 to 80.

Units **40** (05/01) The unit of measurement shall be:

- (i) headwalls, revetments number.

Itemisation **41** (05/01) Separate items shall be provided for headwalls and revetments in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Headwalls.

2 Revetments.

II 1 Different types.

III 1 Different materials.

IV 1 Pipe not exceeding 100 mm internal diameter.

2 Pipe exceeding 100 mm but not exceeding 300 mm internal diameter.

3 Pipe exceeding 300 mm but not exceeding 600 mm internal diameter.

4 Pipe exceeding 600 mm but not exceeding 900 mm internal diameter.

Headwalls and 42 (05/01) The items for headwalls and outfall works shall in accordance with

Outfall Works the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) concrete (as Series 1700 paragraphs 5 and 10);

(d) formwork (as Series 1700 paragraph 15);

(e) backfilling and compaction;

(f) disposal of material (as Series 600 paragraph 39);

(g) brickwork, copings, string courses and the like (as Series 2400 paragraph 4);

(h) blockwork, stonework, copings, string courses, individual blocks, features or stones (as Series 2400 paragraph 8);

(i) lining of watercourses (as Series 600 paragraph 89);

(j) drainage channel blocks (as Series 1100 paragraph 4);

(k) building in pipes and fin drain connections;

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(l) reinforcement (as Series 1700 paragraph 26);

(m) miscellaneous metalwork (as Series 1800 paragraph 14);

(n) waterproofing (as Series 2000 paragraph 4);

(o) flap valves.

Soft Spots and Other Voids

Units **43** (05/01) The unit of measurement shall be:

- (i) soft spots, other voids cubic metre.

Measurement 44 (05/01) The measurement of soft spots and other voids shall be the volume

of the void directed to be excavated or filled. For this measurement the width shall be taken for drains, service ducts and filter drains, as the internal diameter of the pipe plus 600 mm. Where no pipe is required the width shall be taken as 600 mm. For chambers, gullies and the like the measurement shall be taken as the horizontal area of the base slab or where no base slab is required the bottom of the excavation. The depths shall be measured from the underside of the thinnest permitted bed in any one group for trenches and from the underside of the base slab for chambers, gullies and the like.

Itemisation 45 (05/01) Separate items shall be provided for soft spots and other voids in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Excavation of soft spots and other voids.

2 Filling of soft spots and other voids.

II 1 Different types of fill.

Excavation of Soft Spots and 46 (05/01) The items for excavation of soft spots and other voids shall in

Other Voids accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) disposal of material (as Series 600 paragraph 39).

Filling of Soft Spots and 47 (05/01) The items for filling of soft spots and other voids shall in

Other Voids accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) deposition of fill (as Series 600 paragraph 33);

(b) compaction of fill (as Series 600 paragraph 52);

(c) in situ concrete (as Series 1700 paragraph 5);

(d) formwork (as Series 1700 paragraph 15).

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Supports Left in Excavation

Units 48 (05/01) The unit of measurement shall be:

(i) supports left in excavation square metre.

Measurement 49 (05/01) The measurement shall be the area of face required by the Contract

to be left with supports in position.

Itemisation 50 (05/01) Separate items shall be provided for supports left in excavation in

accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Supports.

II 1 Timber.

2 Steel.

III 1 Different types.

IV 1 Construction in trench.

2 Construction in pits.

3 Construction in heading.

Supports Left in Excavation 51 (05/01) The items for supports left in excavation shall in accordance with

the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) struts, walings and the like and working around them.

Drainage and Service Ducts in Structures (Including Reinforced

Earth Structures and Anchored Earth Structures)

Units **52** (05/01) The unit of measurement shall be:

(i) drainage and service ducts in structures item.

Measurement **53** (05/01) The components comprising the items of drainage and service ducts in structures shall be identified and scheduled in the Contract.

Itemisation **54** (05/01) Separate items shall be provided for drainage and service ducts in

structures in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Drainage.

2 Service ducts.

II 1 Substructure - end supports.

2 Substructure - intermediate supports.

3 Superstructure.

4 Reinforced earth structure.

5 Anchored earth structure.

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Drainage and Service Ducts

Drainage and Service Ducts 55 (05/01) The items for drainage and service ducts in structures shall in

in Structures accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) drains, service ducts, filter drains, fin drains and narrow filter drains and connections (as this Series paragraphs 16, 22, 28 and 32);

(b) chambers (as this Series paragraph 37);

(c) gullies (as this Series paragraph 38);

(d) pipework, gullies, downpipes, fittings and the like including brackets, hangers and straps, fixing to or building into the structure;

(e) making good protective system, waterproofing;

(f) permeable backing including compaction and supports;

(g) channels.

Filling to Pipe Bays and Verges on Bridges

Units **56** (05/01) The unit of measurement shall be:

(i) filling to pipe bays and verges on bridges cubic metre.

Measurement **57** (05/01) The measurement shall be the volume of the void stated in the Contract to be filled except that no deduction shall be made for drains, service ducts, services, supplies and the like and their supports.

Itemisation **58** (05/01) Separate items shall be provided for filling to pipe bays and verges

on bridges in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Filling to pipe bays and verges on bridges.

II 1 Different types.

Filling to Pipe Bays and 59 (05/01) The items for filling to pipe bays and verges on bridges shall in

Verges on Bridges accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) deposition;

(b) complying with any restrictions on the placing and compacting of materials;

(c) compaction around drains, service ducts, services, supplies, supports and the like.

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Replacement, Raising or Lowering of Covers and Gratings on Existing Chambers and Gullies (05/01)

Definition 60 (05/01) For the purpose of paragraphs 61 to 64 of this Series any reference

to covers and gratings shall be deemed to include associated frames.

Units 61 (05/01) The units of measurement shall be:

(i) replacement of covers and gratings on existing chambers and gullies number.

(ii) raising or lowering of covers and gratings on existing chambers and gullies number.

Measurement 62 (05/01) When an existing cover or grating is to be raised/lowered and replaced, separate items shall be measured for raising/lowering and replacement.

Itemisation 63 (05/01) Separate items shall be provided for replacement, raising or lowering of covers and gratings on existing chambers and gullies in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Replacement.

2 Raising the level.

3 Lowering the level.

II 1 Different sizes of cover.

2 Different sizes of grating.

III 1 Different types of cover.

2 Different types of grating.

IV 1 Different sizes of chamber.

2 Different sizes of gully.

V 1 Different construction of chamber.

2 Different construction of gully.

VI 1 Not exceeding 150 mm.

2 Exceeding 150 mm but not exceeding 300 mm and so on in steps of 150 mm.

Replacement, Raising or 64 (05/01) The items for replacement, raising or lowering of covers and

Lowering of Covers and gratings on existing chambers and gullies shall in accordance with the

Gratings on Existing Preambles to Bill of Quantities General Directions include for:

Chambers and Gullies

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) excavation of Hard Material (as Series 600 paragraph 23);

(d) take up existing cover or grating including frame and clean and set aside for re-use;

(e) demolition and preparation to receive new construction;

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(f) construction of walls, roof and cover slabs and shafts, surrounds and corbelling for cover and making good;

(g) steps, safety chains, ladders, handholds, lifting keys and the like;

(h) bedding cover or grating including frame;

(i) concrete (as Series 1700 paragraphs 5 and 10);

(j) formwork (as Series 1700 paragraph 15);

(k) reinforcement (as Series 1700 paragraph 26);

(l) backfilling and compaction;

(m) disposal of material (as Series 600 paragraph 39);

- (n) taking precautions to avoid damage to drains;
- (o) cleaning;
- (p) reinstatement of adjacent surfaces;
- (q) brickwork (as Series 2400 paragraph 4);
- (r) sealants (as Series 2300 paragraph 10);
- (s) modification and new materials;
- (t) replacing items damaged during the foregoing operations.

Remove from Store and Reinstall Chamber Covers and Frames, and Gully Gratings and Frames

Units **65** (05/01) The unit of measurement shall be:

- (i) remove from store and reinstall chamber covers and frames, and gully gratings and frames number.

Measurement **66** (05/01) The measurement of remove from store and reinstall chamber covers and frames and gully gratings and frames shall be the complete installation.

Itemisation **67** (05/01) Separate items shall be provided for remove from store and reinstall chamber covers and frames and gully gratings and frames in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Remove from store and reinstall different types of chamber covers and frames.

2 Remove from store and reinstall different types of gully gratings and frames.

II 1 Different sizes.

Remove from Store and 68 (05/01) The items for remove from store and reinstall chamber covers

Reinstall Chamber Covers and frames and gully gratings and frames shall in accordance with the

and Frames and Gully Preambles to Bill of Quantities General Directions include for: **Gratings and Frames**

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Item coverage (a) loading, transporting from store, unloading and positioning for reinstallation;

(b) replacing items damaged during the foregoing operations;

(c) modification and new materials;

(d) replacement, raising or lowering of covers and gratings on existing chambers and gullies (as this Series paragraph 64).

Grouting Up of Existing Drains and Service Ducts (05/01)

Units **69** (05/01) The unit of measurement shall be:

- (i) grouting up of existing drains and service ducts linear metre.

Measurement **70** (05/01) The measurement of grouting up of existing drains and service ducts shall be the length to be grouted as stated in the Contract.

Itemisation **71** (05/01) Separate items shall be provided for grouting up of existing drains

and service ducts in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Grouting up of existing drains and service ducts.

II 1 Different diameters.

III 1 Different types of grout.

Grouting Up of Existing 72 (05/01) The items for grouting up of existing drains and service ducts shall

Drains and Service Ducts in accordance with the Preambles to Bill of Quantities General Directions

include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) breaking into drain or service duct and cleaning;
- (d) mixing and placing grout;
- (e) in situ concrete (as Series 1700 paragraph 5);
- (f) formwork (as Series 1700 paragraph 15);
- (g) backfilling and compaction;
- (h) disposal of material (as Series 600 paragraph 39).

Excavation in Hard Material

Units **73** (05/01) The unit of measurement shall be:

- (i) extra over excavation for excavation in Hard Material in drainage
..... cubic metre.

Measurement **74** (05/01) The measurement shall be the volume of the voids formed by the removal of the Hard Material.

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For the measurement of:

- (a) drains, service ducts and filter drains (except fin drains and narrow filter drains), the width shall be taken as the internal diameter of the pipe plus 600 mm. Where no pipe is required the width shall be taken as 600 mm;
- (b) fin drains and narrow filter drains the width shall be taken as 300 mm;
- (c) chambers, gullies and the like the area shall be taken as the horizontal area of the base slab or where no base slab is required the area of the bottom of the excavation;
- (d) Excavation in hard material shall not be measured separately in connection with replacement and raising or lowering of covers and gratings on existing chambers and gullies.

Itemisation **75** (05/01) Separate items shall be provided for extra over excavation for excavation in Hard Material in drainage in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Extra over excavation for excavation in Hard Material in drainage.

Extra Over Excavation for 76 (05/01) The items for extra over excavation for excavation in Hard

Excavation in Hard Material Material in drainage shall in accordance with the Preambles to Bill of

Quantities

General Directions include for:

Item coverage (a) excavation in Hard Material (as Series 600 paragraph 23).

Concrete Bagwork (05/01)

Units **77** (05/01) The unit of measurement shall be:

- (i) Concrete bagworkcubic metre.

Measurement **78** (05/01) No deduction shall be made for holes, ducts, pockets, sockets, mortices and the like not exceeding 0.15 cubic metres each in volume.

Itemisation **79** (05/01) Separate items shall be provided for concrete bagwork in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Concrete bagwork.

II 1 In headwalls.

2 Other stated location.

III 1 With battered face.

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Drainage and Service Ducts

Concrete Bagwork 80 (05/01) The items for concrete bagwork shall in accordance with the

Preambles to Bill of Quantities General Directions include for:

Item Coverage (a) excavation (as Series 600 paragraphs 18 and 19);

(b) disposal of material (as Series 600 paragraph 39);

(c) trials and trial panels;

(d) deposition, fill and compaction (as Series 600 paragraphs 33, 45 and 52);

(e) filling bags with concrete and tucking in ends of bags;

(f) shaping bags and soaking;

(g) dowel bars (as Series 1700 paragraph 27);

(h) building in pipes;

(i) tying into existing work;

(j) construction of bagwork in more than one lift;

(k) in situ concrete (as Series 1700 paragraph 5);

(l) formwork (as Series 1700 paragraph 15);

(m) reinforcement (as Series 1700 paragraph 26);

(n) geotextiles (as Series 600 paragraph 60);

(o) water supply.

Cleaning Existing Drainage Systems (05/01)

Units **81** (05/01) The units of measurement shall be:

(i) cleaning of piped drainage systems, drainage channels, linear drainage channel systems, combined drainage and kerb systems.....linear metre.

(ii) cleaning of bridge drainage systemitem.

(iii) cleaning of chambers, gulliesnumber.

Measurement **82** (05/01) The measurement of cleaning piped drainage systems, drainage

channels, linear drainage channel systems and combined drainage and kerb systems shall be the individual lengths measured along the centre lines between any of the following:

(a) the internal faces of chambers;

(b) the external faces of headwalls;

(c) the intersections of the centre lines at pipe junctions;

(d) the centre of gully gratings (or where no grating is provided, the centre of the gully);

(e) the position of terminations shown in the Contract.

The measurement of cleaning drainage channels, linear drainage channel systems, combined drainage and kerb systems and bridge drainage systems shall be deemed to include associated chambers, sumps and the like.

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Chapter IV Series 500

Drainage and Service Ducts

Itemisation **83** (05/01) Separate items shall be provided for cleaning existing drainage systems in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Cleaning.

II 1 Piped drainage system.

2 Drainage channels.

3 Linear drainage channel system.

4 Combined drainage and kerb system.

5 Bridge drainage system.

6 Chambers.

7 Gullies.

III 1 Different stated sizes.

IV 1 Different stated locations.

Cleaning Existing Drainage 84 (05/01) The items for cleaning existing drainage systems shall in

Systems accordance with the Preambles to Bill of Quantities General Directions include for:

- Item Coverage (a) marking;
- (b) lifting chamber covers, replacement and bedding;
- (c) rodding;
- (d) flushing;
- (e) water supply;
- (f) mandrelling;
- (g) disposal of material (as Series 600 paragraph 39);
- (h) recording and reporting;
- (i) greasing;
- (j) cleaning covers, gratings and frames, offlets and the like;
- (k) filling with water;
- (l) vacuum/air suction;
- (m) locating obstructions and the like;
- (n) contamination prevention measures;
- (o) locating chambers and gullies.

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Chapter IV Series 600

Earthworks

Series 1200: Traffic Signs and Road Markings

Traffic Signs

Units **1** The unit of measurement shall be:

- (i) traffic signs number.

Measurement **2** (05/01) The measurement of traffic signs shall be the complete installation

except for earth electrodes which shall be measured separately under

Series 1400 (paragraphs 24 to 27).

Itemisation **3** Separate items shall be provided for traffic signs in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Permanent traffic signs.

2 Prescribed temporary traffic signs.

II 1 Particular sign reference.

III 1 Retroreflective.

2 Non-retroreflective.

3 Enhanced retroreflective.

IV 1 Lit Sign Units.

2 Non Lit Sign Units.

V 1 Different types.

VI 1 Different sizes.

VII 1 Different posts or supports.

Permanent Traffic Signs 4 (05/01) The items for permanent traffic signs shall in accordance with the

Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) excavation in hard material (as Series 600 paragraph 23);

(d) backfilling and compaction;

(e) in situ concrete (as Series 1700 paragraph 5);

(f) formwork (as Series 1700 paragraph 15);

(g) reinforcement (as Series 1700 paragraph 26);

(h) ducts in bases;

(i) reinstatement of surfaces;

(j) covering and removal of covering of signs;

(k) disposal of material (as Series 600 paragraph 39);

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- (l) doors, locks and keys;
- (m) location lettering and marking;
- (n) drilling or forming holes and pockets in structures, lighting columns or foundations and casting in bolts, sockets, base plates and anchorage assemblies;
- (o) bedding and grouting;
- (p) protective system (as Series 1900 paragraph 4);
- (q) rivets, bolts, nuts and the like;
- (r) electrical equipment, wiring, and connections, excluding supply and control cabling;
- (s) conduit including screwed and threaded connections, bends, tees, and the like and draw wires;
- (t) threading cable through ducts, sleeves, conduit and the like;
- (u) backboard, fixings, protective caps, sealing, grommets, spacers, mounting plates and strips;
- (v) complying with wiring regulations, earthing (other than earth electrodes), and inspection;
- (w) protective treatment;
- (x) notices and recording;
- (y) preparation and supply of record drawings;
- (z) light spill screens;
- (aa) fixing to structures and foundations including attachment systems.

Prescribed Temporary 5 (05/01) The items for prescribed temporary traffic signs shall in

Traffic Signs accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage (a) permanent traffic signs (as this Series paragraph 4);
- (b) take up or down and set aside for reuse or remove to store off Site (as Series 200 paragraph 11);
- (c) maintaining and servicing equipment.

Remove from Store and Re-erect Traffic Signs

Units **6** The unit of measurement shall be:

- (i) remove from store and re-erect traffic signs number.

Itemisation **7** Separate items shall be provided for remove from store and re-erect traffic signs in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Remove from store and re-erect traffic signs.

II 1 Retroreflective.

2 Non-retroreflective.

3 Enhanced retroreflective.

III 1 Lit Sign Units.

2 Non Lit Sign Units.

IV 1 Different types.

V 1 Different sizes.

VI 1 Different posts or supports.

Remove from Store and 8 The items for remove from store and re-erect traffic signs shall in

Re-erect Traffic Signs accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage (a) loading, transporting from store, unloading and positioning for reerection;
- (b) replacing items damaged during the foregoing operations;
- (c) modification and new materials;
- (d) painting existing painted items;
- (e) permanent traffic signs (as this Series paragraph 4).

Road Markings

Units **9** The units of measurement shall be:

- (i) marking and removal of solid areas square metre.
- (ii) marking and removal of lines linear metre.
- (iii) marking and removal of triangles, circles with enclosing arrows, arrows, kerb markings, symbols, letters and numerals number. (The diagram number from the Traffic Signs Regulations and General Directions to be stated.)

Measurement **10** The removal of road markings shall only be measured where specifically required by the Contract.

The marking and removal of solid areas shall only be measured for the solid infilling between converging lines, the enclosing lines themselves shall be measured as lines.

Road markings which form part of a traffic signal installation or a controlled or uncontrolled crossing shall not be separately measured.

Road markings which require enhanced reflectorised marking materials for 'wet-night' conditions stated in Appendix 12/3 shall be identified and measured separately.

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11 Road markings other than those measured under sub-paragraphs 9(i) and (iii) above shall be measured as lines and shall be grouped together according to width.

In the case of intermittent lines the measurement shall be of the marks only but the length of the mark and gap shall be stated. Double lines shall be measured as two single lines.

Diagonal lines between double lines and short transverse lines at the ends of any longitudinal lines shall be measured with the lines of which they form part. Ancillary lines shall include lines forming hatched areas, chevrons, zigzag lines, boxed areas and lines enclosing boxed areas. In the case of hatched areas and chevrons the enclosing lines shall be measured as the longitudinal line of which they form part. The measurement of zigzag lines shall include any transverse or longitudinal lines at their ends.

12 The measurement of circles with enclosing arrows (mini roundabouts) shall be for the complete marking, the external diameter of the circle being stated. Distinction shall be made for all other arrows between straight, curved, turning or double headed.

13 Kerb markings shall be measured as a single item irrespective of the number of lines forming any one marking.

14 Each letter or numeral shall be separately measured with all letters or numerals grouped together according to height.

15 Symbols shall be measured separately and grouped together according to size.

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Itemisation **16** Separate items shall be provided for marking and removal of road markings in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Removal of road markings.

2 Road markings.

II 1 Solid areas.

2 Continuous lines.

3 Intermittent lines.

4 Ancillary lines.

- 5 Raised rib lines.
- 6 Triangles.
- 7 Circle with enclosing arrows.
- 8 Arrows.
- 9 Kerb markings.
- 10 Letters and numerals.
- 11 Symbols.
- III 1 Different materials.
- IV 1 Different widths of lines.
- 2 Different sizes of circles with enclosing arrows.
- 3 Different lengths of arrows.
- 4 Different lengths of kerb markings.
- 5 Different heights of letters and numerals.
- 6 Different sizes of symbols.
- V 1 Different lengths of mark and gap for intermittent lines.
- 2 Different diagram numbers for arrows, kerb markings and symbols.
- VI 1 Different types.
- VII 1 Different colours.
- VIII 1 Reflectorised.
- IX 1 Different rib spacings.

Removal of Road Markings 17 The items for the removal of road markings shall in accordance with the

Preambles to Bill of Quantities General Directions include for:

Item coverage (a) disposal of material (as Series 600 paragraph 39);

(b) reinstatement;

(c) apostrophes in the case of letters and numerals;

(d) markings down the face of kerbs;

Road Markings 18 The items for road markings shall in accordance with the Preambles to

Bill of Quantities General Directions include for:

Item Coverage (a) cleaning, brushing and drying surfaces;

(b) application of the marking materials including the incorporation of specified reflecting medium;

(c) thinners, primers and tack coats;

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(d) apostrophes in the case of letters and numerals;

(e) markings down the face of kerbs;

(f) adhesives;

Road Studs (05/01)

Units 19 (05/01) The unit of measurement shall be:

(i) road studs number.

Measurement 20 (05/01) The measurement of road studs shall be the complete installation.

Road studs which form part of a traffic signals installation or a pedestrian crossing shall not be separately measured.

Itemisation 21 (05/01) Separate items shall be provided for road studs in accordance with

Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Road studs.

II 1 Different sizes.

III 1 Different types.

IV 1 Different coloured reflectors.

Road Studs (05/01) 22 (05/01) The items for road studs shall in accordance with the Preambles to

Bill of Quantities General Directions include for:

Item coverage (a) cutting or forming holes;

(b) milling;

(c) adhesives and grout;

(d) reinstatement of surfaces;

(e) disposal of material (as Series 600 paragraph 39).

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Remove from Store and Re-install Road Studs (05/01)

Units **23** (05/01) The unit of measurement shall be:

(i) remove from store and re-install road studs number.

Itemisation **24** (05/01) Separate items shall be provided for remove from store and reinstall

road studs in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Remove from store and re-install road studs.

II 1 Different sizes.

III 1 Different types.

Remove from Store and 25 The items for remove from store and re-install road studs shall in

Re-install Road Studs (05/01) accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) loading, transporting from store, unloading and positioning for re-installation;

(b) replacing items damaged during the foregoing operations;

(c) new materials;

(d) road studs (as this Series paragraph 22).

Traffic Signal Installations (05/01)

Definitions (05/01) 26 (05/01) For the purposes of measurement of Traffic Signal Installations the

network is defined as all cabling emanating from either an outstation transmission unit (O.T.U), an outstation monitoring unit (O.M.U.) or an outstation monitoring and control unit (O.M.C.U.) and terminating at a location outside the limits of the site.

Units **27** (05/01) The unit of measurement shall be:

(i) traffic signal installations item.

Measurement **28** (05/01) The measurement of traffic signal installations shall be the complete installations except for earth electrodes which shall be measured separately under Series 1400 (paragraphs 24 to 27).

Itemisation **29** (05/01) Separate items shall be provided for traffic signal installations in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Permanent traffic signal installations.

2 Prescribed temporary traffic signal installations.

II 1 Different locations.

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Permanent Traffic Signal 30 (05/01) The items for permanent traffic signal installations shall in

Installations (05/01) accordance with the Preambles to Bill of Quantities General Directions include

for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

(b) excavation of unacceptable material (as Series 600 paragraph 19);

(c) excavation in hard material (as Series 600 paragraph 23);

(d) in situ concrete (as Series 1700 paragraph 5);

(e) backfilling and compaction;

(f) disposal of material (as Series 600 paragraph 39);

(g) detectors;

(h) detector loops (as Series 1500 paragraph 31);

(i) detector feeders;

(j) trench for cable (as Series 1400 paragraph 8) excluding network cabling;

(k) cable (as Series 1400 paragraph 13) excluding network cabling;

(l) control equipment;

(m) electrical equipment, wiring, and connections, excluding network cabling;

(n) marking out, cutting or forming slots, drying, damming, backfilling, cleaning and sealing;

(o) road markings (as this Series paragraph 18);

(p) notices and recording;

(q) numbering and lettering;

(r) complying with wiring regulations and earthing (other than earth electrodes);

(s) reinstatement of surfaces;

(t) preparation and supply of record drawings;

(u) road studs;

(v) ducts;

(w) chambers (as Series 500 paragraph 37);

(x) protective system (as Series 1900 paragraph 4).

Prescribed Temporary Traffic 31 (05/01) The items for prescribed temporary traffic signal installations shall

Signal Installations (05/01) in accordance with the Preambles to Bill of Quantities General Directions

include for:

Item coverage (a) permanent traffic signal installations (as this Series paragraph 30);

(b) take up or down and set aside for reuse or remove to store off Site

(as Series 200 paragraph 11);

(c) removal of road markings (as this Series paragraph 17);

(d) maintaining and servicing equipment.

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Traffic Signs and Road Markings

Controlled and Uncontrolled Crossings

Units 32 (05/01) The unit of measurement shall be:

(i) controlled crossings item.

(ii) uncontrolled crossings item.

Measurement 33 (05/01) The measurement of controlled and uncontrolled crossings shall be

the complete installation.

Itemisation 34 (05/01) Separate items shall be provided for prescribed, controlled and uncontrolled crossings in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

1 Permanent controlled crossings.

2 Permanent uncontrolled crossings.

3 Prescribed temporary controlled crossings.

4 Prescribed temporary uncontrolled crossings.
II 1 Different locations.

Permanent Controlled and 35 (05/01) The items for permanent controlled and uncontrolled crossings

Uncontrolled Crossings shall in accordance with the Preambles to Bill of Quantities General Directions

include for:

Item coverage (a) permanent traffic signal installations (as this Series paragraph 30);

(b) road studs;

(c) kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems (as Series 1100 paragraph 4);

(d) footways and paved areas (as Series 1100 paragraph 21);

(e) flashing beacons and additional lighting.

Prescribed Temporary 36 (05/01) The items for prescribed temporary controlled and uncontrolled

Controlled and Uncontrolled crossings shall in accordance with the Preambles to Bill of Quantities General

Crossings Directions include for:

Item coverage (a) permanent controlled and uncontrolled crossings (as this Series paragraph 35);

(b) take up or down and set aside for reuse or remove to store off Site (as Series 200 paragraph 11);

(c) removal of road markings (as this Series paragraph 17);

(d) maintaining and servicing equipment.

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Marker Posts

Units **37** (05/01) The unit of measurement shall be:

(i) marker posts number.

Itemisation **38** (05/01) Separate items shall be provided for marker posts in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Marker posts.

II 1 Different types.

Marker Posts 39 (05/01) The items for marker posts shall in accordance with the Preambles

to Bill of Quantities General Directions include for:

Item coverage (a) protective system (as Series 1900 paragraph 4);

(b) numerals, symbols and reflectorised strips or discs including adhesive;

(c) driving or excavating in any material (as Series 600 paragraphs 17, 18, 19 and 23);

(d) backfilling and compaction;

(e) sockets;

(f) galvanized fixings and fittings;

(g) preservation of timber;

(h) disposal of material (as Series 600 paragraph 39);

(i) in-situ concrete (as Series 1700 paragraph 5);

(j) formwork (as Series 1700 paragraph 15);

(k) reinforcement (as Series 1700 paragraph 26);

(l) reinstatement of surfaces.

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Permanent Bollards

Units **40** (05/01) The unit of measurement shall be:

(i) permanent bollards number.

Itemisation **41** (05/01) Separate items shall be provided for permanent bollards in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Permanent bollards.

II 1 Internally illuminated.

2 Non-illuminated.

III 1 Different types.

IV 1 Different sizes.

Permanent Bollards 42 (05/01) The items for permanent bollards shall in accordance with the

Preambles to Bill of Quantities General Directions include for:

Item coverage (a) permanent traffic signs (as this Series paragraph 4);

(b) preservation of timber.

Node Markers

Units **43** (05/01) The unit of measurement shall be:

(i) node markers number.

Itemisation **44** (05/01) Separate items shall be provided for node markers in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Node markers.

II 1 Different types.

III 1 Different sizes.

Node Markers 45 (05/01) The items for node markers shall in accordance with the Preambles

to Bill of Quantities General Directions include for:

Item coverage (a) coring pockets in carriageway;

(b) cleaning and drying pockets;

(c) disposal of material (as Series 600 paragraph 39);

(d) incorporation of solid glass beads.

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Chapter IV Series 1300

Road Lighting Columns, Brackets and CCTV

Masts

Series 1300: Road Lighting Columns, Brackets and CCTV

Masts (05/01)

Road Lighting Columns, Brackets, Wall Mountings and CCTV

Masts (05/01)

Units **1** (05/01) The unit of measurement shall be:

(i) road lighting columns, brackets, wall mountings, CCTV masts..... number.

Measurement **2** (05/01) The measurement of road lighting columns, brackets, wall mountings and CCTV masts shall be the complete installation except for earth electrodes which shall be measured separately (under Series 1400 paragraphs 24 to 27).

Itemisation **3** (05/01) Separate items shall be provided for road lighting columns, brackets, wall mountings and CCTV masts in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Road lighting columns and brackets.

2 Wall mountings.

3 CCTV masts.

II 1 Different height of lighting columns.

2 Different height of CCTV masts.

III 1 Different projection of brackets.

IV 1 Different luminaires.

V 1 Different types.

Road Lighting Columns, 4 (05/01) The items for road lighting columns, brackets, wall mountings

Brackets, Wall Mountings and CCTV masts shall in accordance with the Preambles to Bill of

and CCTV Masts (05/01) Quantities General Directions include for:

- Item coverage (a) design;
- (b) certificates;
- (c) provision of data and drawings;
- (d) resubmissions and modifications;
- (e) amendments to the Works;
- (f) obtaining aesthetic approval;
- (g) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (h) excavation of unacceptable material (as Series 600 paragraph 19);

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Road Lighting Columns, Brackets and CCTV Masts

- (i) excavation in Hard Material (as Series 600 paragraph 23);
- (j) rivets, nuts, bolts, shims, washers, welds, clamps and the like;
- (k) blinding concrete and paving slab;
- (l) in situ concrete (as Series 1700 paragraph 5);
- (m) formwork (as Series 1700 paragraph 15);
- (n) reinforcement (as Series 1700 paragraph 26);
- (o) drilling or forming holes and pockets in structures or foundations, and casting in bolts, sockets, base plates and anchorage assemblies;
- (p) bedding, grouting and filling;
- (q) backfilling and compaction;
- (r) protective system (as Series 1900 paragraph 4);
- (s) marking and lettering;
- (t) electrical equipment, wiring and making connections, excluding supply and control cabling;
- (u) disposal of material (as Series 600 paragraph 39);
- (v) reinstatement of surfaces;
- (w) plugging cable entry slots;
- (x) doors, locks and keys;
- (y) ducts in bases;
- (z) conduit including screwed and threaded connections, bends, tees and the like and draw wires;
- (aa) threading cable through ducts, sleeves, conduit and the like;
- (bb) backboards, fixings, protective caps, sealing, grommets, spacers, mounting plates and strips;
- (cc) complying with wiring regulations and earthing (other than earth electrodes);
- (dd) protective treatment;
- (ee) notices, recording and preparation and supply of record drawings;
- (ff) fixing to structures and foundations including attachment systems.

Remove from Store and Re-erect Road Lighting Columns, Brackets, and Wall Mountings

Units **5** The unit of measurement shall be:

- (i) remove from store and re-erect road lighting columns, brackets and wall mountings number.

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Chapter IV Series 1300

Road Lighting Columns, Brackets and CCTV

Masts

Itemisation **6** Separate items shall be provided for remove from store and re-erect road

lighting columns, brackets and wall mountings in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I 1 Remove from store and re-erect road lighting columns and brackets.

2 Remove from store and re-erect wall mountings.

II 1 Different height of columns.

III 1 Different projections of brackets.

IV 1 Different luminaires.

V 1 Different types.

Remove from Store and 7 The items for remove from store and re-erect road lighting columns,

Re-erect Road Lighting brackets and wall mountings shall in accordance with the Preambles

Columns, Brackets and to Bill of Quantities General Directions include for:

Wall Mountings

Item coverage (a) loading, transporting from store, unloading and positioning for re-erection;

(b) replacing items damaged during the foregoing operations;

(c) modification and new materials;

(d) painting existing painted items;

(e) road lighting columns, brackets and wall mountings

(as this Series paragraph 4).

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Chapter IV Series 1400

Electrical Work for Road Lighting and Traffic Signs

Series 200: Site Clearance

1 Unless otherwise stated in the Contract the items in this Series shall include for the removal of superficial obstructions down to existing ground level. With the exception of items measured under paragraph 8 and those including for the removal of stumps and roots, work below existing ground level in the demolition and removal of foundations, drains and sewers specified in Appendix 2/2, chambers, cellars, ground slabs, carriageways, kerbs, pavings, backfilling and the like shall be measured under Series 600 Earthworks. Lowering of carriageway levels shall be measured under Series 700 Pavements.

The measurement of General Site Clearance includes for the removal of superficial obstructions down to existing ground level. If no General Site Clearance item is measured and the Contract requires items to be taken to Tip, these shall be measured within paragraphs 8-11 Take Up or Down and Set Aside for Re-use or Remove to Store or Tip off Site.

Site Clearance

Units	2	The units of measurement shall be:												
	(i)	general site clearance hectare.												
	(ii)	demolition of individual or groups of buildings or structures item.												
	(iii)	partial demolition of individual structures item.												
Measurement	3	The measurement of general site clearance shall be the plan area. No deduction shall be made for buildings, structures, carriageways and the like.												
		The measurement of partial demolition shall be as stated in the Contract.												
Itemisation	4	Separate items shall be provided for site clearance in accordance with Chapter II paragraphs 3 and 4 and the following:												
		<table><tr><th>Group</th><th>Feature</th></tr><tr><td rowspan="4">I</td><td>1</td><td>General site clearance.</td></tr><tr><td>2</td><td>General site clearance of separate sections.</td></tr><tr><td>3</td><td>Demolition of individual or groups of buildings or structures.</td></tr><tr><td>4</td><td>Partial demolition of individual structures.</td></tr></table>		Group	Feature	I	1	General site clearance.	2	General site clearance of separate sections.	3	Demolition of individual or groups of buildings or structures.	4	Partial demolition of individual structures.
Group	Feature													
I	1	General site clearance.												
	2	General site clearance of separate sections.												
	3	Demolition of individual or groups of buildings or structures.												
	4	Partial demolition of individual structures.												
General Site Clearance	5	The items for general site clearance shall in accordance with the Preambles to Bill of Quantities General Directions include for:												
Item coverage	(a)	demolition, breaking up and removal;												
	(b)	tree felling;												
	(c)	grubbing up and blasting stumps and roots including backfilling and compaction;												
	(d)	uprooting of bushes, small trees and hedges;												
	(e)	credit value of materials;												
	(f)	disposal of material (as Series 600 paragraph 39);												
	(g)	making good severed ends of existing fences, hedges and walls;												

- (h) cutting back trees, bushes and hedges;
- (i) disconnecting, removing and sealing services and supplies;
- (j) reinstatement and making good;
- (k) preservation of individual or groups of trees, shrubs and the like;
- (l) treatment of hazardous materials.

Demolition of Individual or Groups of Buildings or Structures 6

The items for demolition of individual or groups of buildings or structures shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) blasting, breaking up and removal;
- (b) credit value of materials;
- (c) disposal of material (as Series 600 paragraph 39);
- (d) disconnecting, removing and sealing services and supplies;
- (e) treatment of hazardous materials.

Partial Demolition 7 of Individual Structures

The items for partial demolition of individual structures shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) demolition of individual or groups of buildings or structures (as this Series paragraph 6);
- (b) cutting and trimming;
- (c) saw cutting;
- (d) cutting through reinforcement, removal, disposal, protecting cut ends with treatment, de-bonding existing reinforcement;
- (e) working between and behind reinforcement and other obstructions;
- (f) marking of surfaces;
- (g) preparation to receive new works;
- (h) measures in respect of specialist demolition techniques;
- (i) protection of unaffected parts of the structure.

Take Up or Down and Set Aside for Re-use or Remove to Store or Tip off Site

Units

8 The units of measurement shall be:

Take up or down and set aside for re-use or remove to store or tip off Site the following:

- (i) blockwork and stonework cubic metre;
- (ii) paved areas and the like, brickwork square metre;
- (iii) kerbs, channels, edgings, combined drainage and kerb blocks, linear drainage channel systems, fencing, safety fences, safety barriers and pedestrian guardrails and the like, copings, string courses and the like linear metre;
- (iv) cable linear metre;
- (v) road lighting columns, brackets and wall mountings, traffic signs, road studs, gates, stiles, street furniture, feeder pillars, communications cabinets, posts, brackets, signal indicators, shelves, racking, frames, electronic units and the likenumber;
- (vi) chamber covers and frames, gully gratings and frames and the like..... number;
- (vii) individual blocks, features or stones number.

Measurement

9 The measurement for take up or down and set aside for re-use or remove to store or tip off Site blockwork, stonework, paved areas and the like, brickwork, kerbs, channels, edgings, combined drainage and kerb blocks, linear drainage channel systems, fencing, safety fences, safety barriers and pedestrian guardrails and the like, copings, string courses and the like, cable, road lighting columns, brackets and wall mountings, traffic signs, road studs, gates, stiles, street furniture and the like; feeder pillars, communications cabinets, posts, brackets, signal indicators, shelves, racking, frames, electronic units and the like; chamber covers and frames, gully gratings and frames and the like; individual blocks, features or stones shall be the volumes, areas, lengths or numbers stated in the Contract.

Itemisation

10 Separate items shall be provided for take up or down and set aside for re-use or remove to store or tip off Site in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Take up or down and set aside for reuse.
	2 Take up or down and remove to store off Site.
	3 Take up or down and remove to tip off Site.
II	1 Blockwork and stonework.
	2 Paved areas and the like.
	3 Brickwork.
	4 Kerbs, channels, edgings, combined drainage and kerb blocks, linear drainage channel systems, fencing, safety fences, safety barriers and pedestrian guardrails and the like.
	5 Copings, string courses and the like.
	6 Cable.
	7 Road lighting columns, brackets and wall mountings, traffic signs, gates, stiles, street furniture, road studs and the like.
	8 Feeder pillars, communications cabinets, posts, brackets, signal indicators and the like.
	9 Shelves, racking, frames and the like.

	10	Electronic units and the like.
	11	Chamber covers and frames, gully gratings and frames and the like.
	12	Individual blocks, features or stones.
III	1	Different types and sizes.
IV	1	Different arrangements.

**Take Up or Down
Set Aside for Re-use
Or Remove to Store or
Tip Off Site**

11 The items for take up or down and set aside for re-use or remove to store or tip off Site shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) excavation in Hard Material (as Series 600 paragraph 23);
- (d) detensioning, dismantling and extracting posts;
- (e) cleaning, stacking, protecting and labelling;
- (f) transport and handling;
- (g) disconnecting, removing, disposing of and sealing of services and supplies;
- (h) sand and warning tape to cables where one or more are to remain in a shared trench;
- (i) backfilling and compaction;
- (j) making good to severed ends of existing walls, hedges, and fencing;
- (k) disposal of material (as Series 600 paragraph 39);
- (l) reinstatement and making good;
- (m) storage facilities;
- (n) replacing items damaged during the foregoing operations;
- (o) credit value of materials;
- (p) multiple handling of materials;
- (q) treatment of hazardous materials.

Series 300: Fencing

Fencing, Gates and Stiles

Units	<p>1 The units of measurement shall be:</p> <ul style="list-style-type: none"> (i) fencing linear metre. (ii) concrete foundation to timber posts number. (iii) gates, stiles number. (iv) wire, wire mesh to existing fencing, gates and the like linear metre. (v) fenced tree guards number. 															
Measurement	<p>2 Where a particular type of temporary fencing is specified in Appendix 3/1 by the Overseeing Organisation and shown on the drawings it shall be measured. All other temporary fencing shall not be measured. The measurement of fencing shall be the developed length along the centre line of the fence. The measurement of height of fencing shall be that stated in the Contract for the type of fence.</p> <p>The measurement of wire and wire mesh shall only be separately measurable where it is required by the Contract to be fixed to existing fencing, gates and the like, and shall be the developed length along the centre line of the fence.</p> <p>The measurement of width of gates shall be the distance between the outer edges of the stiles; the outer edges of hanging stiles in the case of double gates.</p> <p>The measurement of height of gates shall be the distance between the upper surface of the top rail and the underside of the bottom rail.</p> <p>Concrete foundation to timber posts shall only be measured for those locations stated in Appendices 1/15 or 3/1 of the Specification.</p>															
Itemisation	<p>3 Separate items shall be provided for fencing in accordance with Chapter II paragraphs 3 and 4 and the following:</p> <table border="1"> <thead> <tr> <th>Group</th><th>Feature</th></tr> </thead> <tbody> <tr> <td rowspan="7">I</td><td>1 Each type of fencing.</td></tr> <tr> <td>2 Concrete foundation to each type of timber post for each type of fencing.</td></tr> <tr> <td>3 Each type of gate.</td></tr> <tr> <td>4 Each type of stile.</td></tr> <tr> <td>5 Each type of wire to existing fencing, gates and the like.</td></tr> <tr> <td>6 Each type of wire mesh to existing fencing, gates and the like.</td></tr> <tr> <td>7 Each type of fenced tree guard.</td></tr> <tr> <td rowspan="2">II</td><td>1 Fencing of different heights.</td></tr> <tr> <td>2 Gates of different heights and widths.</td></tr> <tr> <td>III</td><td>1 Painted fencing, gates or stiles.</td></tr> </tbody> </table>	Group	Feature	I	1 Each type of fencing.	2 Concrete foundation to each type of timber post for each type of fencing.	3 Each type of gate.	4 Each type of stile.	5 Each type of wire to existing fencing, gates and the like.	6 Each type of wire mesh to existing fencing, gates and the like.	7 Each type of fenced tree guard.	II	1 Fencing of different heights.	2 Gates of different heights and widths.	III	1 Painted fencing, gates or stiles.
Group	Feature															
I	1 Each type of fencing.															
	2 Concrete foundation to each type of timber post for each type of fencing.															
	3 Each type of gate.															
	4 Each type of stile.															
	5 Each type of wire to existing fencing, gates and the like.															
	6 Each type of wire mesh to existing fencing, gates and the like.															
	7 Each type of fenced tree guard.															
II	1 Fencing of different heights.															
	2 Gates of different heights and widths.															
III	1 Painted fencing, gates or stiles.															
Fencing	<p>4 The items for fencing shall in accordance with the Preambles to Bill of Quantities General Directions include for:</p>															
Item coverage	<p>(a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);</p>															

- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) trimming ground on the line of the fencing;
- (d) concrete (as Series 1700 paragraphs 5 and 10);
- (e) formwork (as Series 1700 paragraph 15);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) backfilling and compaction;
- (h) disposal of material (as Series 600 paragraph 39);
- (i) preservation of timber;
- (j) adjustment of fencing to a flowing alignment including additional length posts;
- (k) fixings and fittings;
- (l) joining to existing fencing, gates, hedges and walls;
- (m) protective system (as Series 1900 paragraph 4);
- (n) inspection and maintenance of fencing and gates;
- (o) erection and removal of temporary fencing and gates;
- (p) additional posts and rails over ditches;
- (q) maintenance of access for owners, tenants and occupiers of adjoining land and patrolling gaps or openings;
- (r) epoxy resin compound and mastic filler to posts fixed in socket;
- (s) additional posts at junctions and changes in direction or adjacent to gates, stiles and other obstacles;
- (t) additional posts, stakes and ground anchors;
- (u) inspection of existing fencing and reports;
- (v) pegging, bending, turning and cutting mesh;
- (w) cutting turves and turfing (as Series 3000 paragraph 9);
- (x) patrolling.

**Concrete Foundation 5
to Timber Posts**

The items for concrete foundation to timber posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- | | |
|---------------|---|
| Item coverage | (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18); |
| | (b) excavation of unacceptable material (as Series 600 paragraph 19); |
| | (c) in situ concrete (as Series 1700 paragraph 5); |

- (d) formwork (as Series 1700 paragraph 15);
- (e) reinforcement (as Series 1700 paragraph 26);
- (f) backfilling and compaction;
- (g) disposal of material (as Series 600 paragraph 39).

Gates and Stiles

6 The items for gates and stiles shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) trimming ground at entrance;
- (d) in situ concrete (as Series 1700 paragraph 5);
- (e) formwork (as Series 1700 paragraph 15);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) backfilling and compaction;
- (h) disposal of material (as Series 600 paragraph 39);
- (i) preservation of timber;
- (j) protective system (as Series 1900 paragraph 4);
- (k) posts, fittings and furniture;
- (l) joining to existing fencing, hedges and walls;
- (m) in the case of new gates and stiles in existing fencing, hedges or walls, forming openings and making good;
- (n) stock-proofing.

Remove from Store and Re-erect Fencing, Gates and Stiles

Units

7 The units of measurement shall be:

- (i) remove from store and re-erect fencing linear metre.
- (ii) concrete foundation to timber posts number.
- (iii) remove from store and re-erect gates and stiles number.

Measurement

8 The measurement of re-erected fencing shall be the developed length along the centre line of the re-erected fencing. The measurement of height of fencing shall be that stated in the Contract for the type of fence.

The measurement of width of gates shall be the distance between the outer edges of the stiles; the outer edges of hanging stiles in the case of double gates.

Concrete foundation to timber posts shall only be measured for those locations stated in Appendices 1/15 or 3/1 of the Specification.

Group	Feature	
I	1	Each type of re-erected fencing.
	2	Concrete foundation to each type of timber post for each type of re-erected fencing.
	3	Each type of re-erected gate.
	4	Each type of re-erected stile.
II	1	Re-erected fencing of different heights.
	2	Re-erected gates of different heights and widths.
III	1	Re-erected painted fencing, gates or stiles.

Item coverage	(a)	loading, transporting from store, unloading and positioning for re-erection;
	(b)	replacing items damaged during the foregoing operations;
	(c)	modification and new materials;
	(d)	painting existing painted items;
	(e)	fencing (as this Series paragraph 4).

Item coverage (a) concrete foundation to timber posts (as this Series paragraph 5).

Item coverage	<ul style="list-style-type: none"> (a) loading, transporting from store, unloading and positioning for re-erection; (b) replacing items damaged during the foregoing operations; (c) modification and new materials; (d) painting existing painted items; (e) gates and stiles (as this Series paragraph 6).
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Units **13** The unit of measurement shall be:

- (i) extra over excavation for excavation in Hard Material in fencing works
..... cubic metre.

Measurement **14** The measurement of extra over excavation for excavation in Hard Material in fencing works shall be the plan area of the minimum size of the particular foundation required by the Contract multiplied by the depth of Hard Material removed.

Itemisation **15** Separate items shall be provided for extra over excavation for excavation in Hard Material in fencing works in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Extra over excavation for excavation in Hard Material in fencing works.

Extra Over Excavation for Excavation in Hard Material **16** The items for extra over excavation for excavation in Hard Material in fencing works shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item Coverage** (a) excavation in Hard Material (as Series 600 paragraph 23).

Series 400: Safety Fences, Safety Barriers and Pedestrian Guardrails

Definition

1 The term “beam” shall mean a longitudinal member spanning posts and mounting brackets within the limits defined in paragraph 4 below. The term “mounting bracket” shall be deemed to include the term “bridge pier or concrete parapet mounting connection”.

2 The term “wire rope” shall mean the complete rope system for the wire rope safety fence comprising upper and lower ropes together with inherent component ropes of all types and tail ropes but excluding safety check ropes.

Beam Safety Fences

Units

3 The units of measurement shall be:

- (i) beams linear metre.
- (ii) posts, mounting brackets, terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets, connection pieces, concrete foundations and socketed foundations to posts number.

Measurement

4 The measurement of beams shall be the developed length along the center line of the beams or in the case of double sided fences and double rail fences, measured once only along the centre line of the posts, between the following points:

- (a) the end of each beam type at a connection to bridge parapet or within a connection piece assembly;
- (b) the connection of beams to terminal sections, full height anchorages and expansion joint anchorages.

5 The measurement of terminal sections, full height anchorages, expansion joint anchorages and connections to bridge parapets shall be the complete installation. Mounting brackets and all other posts required between those points defined in paragraph 4 shall be measured. Concrete foundations and socketed foundation to posts, between those points defined in paragraph 4, shall only be measured for those locations stated in the Contract.

6 The measurement of connection pieces shall be the complete installation.

7 The measurement of expansion joint anchorages shall be for each anchorage on each side of the expansion joint.

Itemisation

8 Separate items shall be provided for beam safety fences in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each type of beam.
	2 Each type of post.
	3 Each type of mounting bracket.
	4 Each type of terminal section.
	5 Each type of full height anchorage.
	6 Each type of expansion joint anchorage.
	7 Each type of connection to bridge parapet.
	8 Each type of connection piece.
	9 Each type of concrete foundation to post.
	10 Each type of socketed foundation to post.
II	1 Straight or curved exceeding 120 metres radius.

	2	Curved exceeding 50 metres radius but not exceeding 120 metres radius.
	3	Curved not exceeding 50 metres radius.
III	1	Double rail.
IV	1	Double sided.

Beams

9 The items for beams shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) fabrication (as Series 1800 paragraph 6);
- (b) protective system (as Series 1900 paragraph 4);
- (c) attachments, adjuster assemblies, expansion assemblies, fixings, closure pieces and stiffeners;
- (d) adjustment of beams to flowing alignment;
- (e) tensioning or retensioning;
- (f) flaring;
- (g) painting.

Posts

10 The items for posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) fabrication (as Series 1800 paragraph 6);
- (b) protective system (as Series 1900 paragraph 4);
- (c) driving in any material;
- (d) fixing to structures including attachment systems;
- (e) fixing to beam including spacers;
- (f) drilling or forming holes and pockets and casting in bolts, base plates and anchorage assemblies;
- (g) bedding;
- (h) filling.

Mounting Brackets

11 The items for mounting brackets shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) fabrication (as Series 1800 paragraph 6);
- (b) protective system (as Series 1900 paragraph 4);
- (c) fixing to structures including adaptor platforms;
- (d) fixing to beam;
- (e) drilling or forming holes and pockets and casting in bolts, base plates and anchorage assemblies.

Terminal Sections, Full Height Anchorages, Expansion Joint Anchorages,

12 The items for terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets and connection pieces shall in accordance with the Preambles to Bill of Quantities General Directions include

**Connections to Bridge
Parapets and Connection
Pieces**

for:

Item coverage

- (a) posts (as this Series paragraph 10);
- (b) beams (as this Series paragraph 9);
- (c) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
- (d) concrete (as Series 1700 paragraphs 5 and 10);
- (e) formwork (as Series 1700 paragraph 15);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) disposal of material (as Series 600 paragraph 39);
- (h) fixing to or setting in concrete;
- (i) terminal end shoes;
- (j) precast concrete fairings;
- (k) in the case of terminal sections to untensioned corrugated beam, acceptable material, ramp, backfilling and compaction;
- (l) casings and plastic sheeting;
- (m) sockets, socket covers and filling.

**Concrete Foundations to
Posts**

13 The items for concrete foundations to posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
- (b) disposal of material (as Series 600 paragraph 39);
- (c) concrete (as Series 1700 paragraphs 5 and 10);
- (d) formwork (as Series 1700 paragraph 15);
- (e) reinforcement (as Series 1700 paragraph 26);
- (f) plastic sheeting;
- (g) casings.

**Socketed Foundations
to Posts**

14 The items for socketed foundations to posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) fabrication (as Series 1800 paragraph 6);
- (b) protective system (as Series 1900 paragraph 4);
- (c) concrete foundations to posts (as this Series paragraph 13);
- (d) socket covers and filling.

Remove from Store and Re-erect Beam Safety Fences

Units	15	The units of measurement shall be:
	(i)	remove from store and re-erect beams linear metre.
	(ii)	remove from store and re-erect posts, mounting brackets, terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets, connection pieces number.
	(iii)	concrete foundations and socketed foundations to re-erected posts.... number.

Measurement	16	The measurement of re-erected beam safety fences shall be in accordance with paragraphs 4, 5, 6 and 7 of this Series.
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Itemisation	17	Separate items shall be provided for remove from store and re-erect beam safety fences in accordance with Chapter II paragraphs 3 and 4 and the following:
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Group	Feature
I	1 Each type of re-erected beam.
	2 Each type of re-erected post.
	3 Each type of re-erected mounting bracket.
	4 Each type of re-erected terminal section.
	5 Each type of re-erected full height anchorage.
	6 Each type of re-erected expansion joint anchorage.
	7 Each type of re-erected connection to bridge parapet.
	8 Each type of re-erected connection piece.
	9 Each type of concrete foundation to re-erected post.
	10 Each type of socketed foundation to re-erected post.
II	1 Straight or curved exceeding 120 metres radius.
	2 Curved exceeding 50 metres radius but not exceeding 120 metres radius.
	3 Curved not exceeding 50 metres radius.

Remove from Store and Re-erect Beams	18	The items for remove from store and re-erect beams shall in accordance with the Preambles to Bill of Quantities General Directions include for:
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Item coverage	(a)	loading, transporting from store, unloading and positioning for re-erection;
	(b)	replacing items damaged during the foregoing operations;
	(c)	modification and new materials;
	(d)	beams (as this Series paragraph 9);
	(e)	making good to protective system.

Remove from Store and Re-erect Posts	19	The items for remove from store and re-erect posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:
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Item coverage	(a)	loading, transporting from store, unloading and positioning for re-erection;
	(b)	replacing items damaged during the foregoing operations;

- (c) modification and new materials;
- (d) posts (as this Series paragraph 10);
- (e) making good to protective system.

Remove from Store and Re-erect Mounting Brackets **20** The items for remove from store and re-erect mounting brackets shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) loading, transporting from store, unloading and positioning for re-erection;
 - (b) replacing items damaged during the foregoing operations;
 - (c) modification and new materials;
 - (d) mounting brackets (as this Series paragraph 11);
 - (e) making good to protective system.

Remove from Store and Re-erect Terminal Sections Full Height Anchorages Expansion Joint Anchorages Connections to Bridge parapets and Connection Pieces **21** The items for remove from store and re-erect terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets and connection pieces shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) loading, transporting from store, unloading and positioning for re-erection;
 - (b) replacing items damaged during the foregoing operations;
 - (c) modification and new materials;
 - (d) terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets and connection pieces (as this Series paragraph 12);
 - (e) making good to protective system.

Concrete Foundations and Socketed Foundations to Re-erected Posts **22** The items for concrete foundations and socketed foundations to re-erected posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) concrete foundations to posts (as this Series paragraph 13);
 - (b) socketed foundations to posts (as this Series paragraph 14).

Post Extension Units

Units **23** The unit of measurement shall be:

- (i) post extension units number.

Itemisation **24** Separate items shall be provided for post extension units in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each type of post extension unit.

Post Extension Units **25** The items for post extension units shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) fabrication (as Series 1800 paragraph 6);
 - (b) protective system (as Series 1900 paragraph 4);
 - (c) drilling existing posts;
 - (d) fixing to existing posts.

Raising Existing Sockets

Units **26** The unit of measurement shall be:

(i) raising existing sockets number.

Itemisation **27** Separate items shall be provided for raising existing sockets in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Raising each type of existing socket.

Raising Existing Sockets 28 The items for raising existing sockets shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) removing existing posts and setting aside for re-use;
 - (b) cleaning out sockets;
 - (c) in situ concrete (as Series 1700 paragraph 5);
 - (d) formwork (as Series 1700 paragraph 15);
 - (e) loading, transporting from store, unloading and positioning for re-erection;
 - (f) removing from store and re-erecting posts (as this Series paragraph 19);
 - (g) replacing items damaged during the foregoing operations;
 - (h) making good to protective systems.

Wire Rope Safety Fence

Units **29** The units of measurement shall be:

(i) wire rope linear metre.

- (ii) posts, intermediate anchorages, end anchorages, concrete foundations and socketed foundations to posts number.

Measurement **30** The measurement of wire rope shall be the undeveloped length measured once only along the centre line of the fence on plan from midway between the anchor blocks at one end to midway between the anchor blocks at the other end.

31 The measurement of intermediate anchorages and end anchorages shall be the complete installation.

Concrete foundations and socketed foundations shall only be measured for those locations stated in the Contract.

temisation **32** Separate items shall be provided for wire rope safety fences in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Wire rope.
	2 Each type of post.
	3 Each type of intermediate anchorage.
	4 Each type of end anchorage.
	5 Each type of concrete foundation to post.
	6 Each type of socketed foundation to posts.

Wire rope **33** The items for wire rope shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) fabrication (as Series 1800 paragraph 6);
 - (b) protective system (as Series 1900 paragraph 4);
 - (c) rigging screws, threaded terminals, attachments, fittings and fixings;
 - (d) adjustments and tensioning;
 - (e) threading ropes into and around posts.

Posts **34** The items for posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) fabrication (as Series 1800 paragraph 6);
 - (b) protective system (as Series 1900 paragraph 4);
 - (c) driving in any material;
 - (d) fixing to structures including attachment systems;
 - (e) post caps, excluders, hooks and fittings;
 - (f) drilling or forming holes and pockets and casting in bolts, base plates, sockets and anchorage assemblies;
 - (g) bedding;
 - (h) filling.

Intermediate Anchorages and End Anchorages **35** The items for intermediate anchorages and end anchorages shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage		<ul style="list-style-type: none"> (a) fabrication (as Series 1800 paragraph 6); (b) protective system (as Series 1900 paragraph 4); (c) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23); (d) concrete (as Series 1700 paragraphs 5 and 10); (e) formwork (as Series 1700 paragraph 15); (f) reinforcement (as Series 1700 paragraph 26); (g) disposal of material (as Series 600 paragraph 39); (h) safety check ropes, fork terminals, pins, thimbles, ferrules, attachments, fixings and fittings; (i) anchor frames, surface mounted anchors and sockets; (j) fixing to anchor block including attachment systems; (k) drilling or forming holes and pockets and casting in bolts, base plates, sockets and anchorage assemblies.
Concrete Foundations To Posts	36	The items for concrete foundations to posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		<ul style="list-style-type: none"> (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23); (b) disposal of material (as Series 600 paragraph 39); (c) concrete (as Series 1700 paragraphs 5 and 10); (d) formwork (as Series 1700 paragraph 15); (e) reinforcement (as Series 1700 paragraph 26); (f) plastic sheeting; (g) casings.
Socketed Foundations to Posts	37	The items for socketed foundations to posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		<ul style="list-style-type: none"> (a) fabrication (as Series 1800 paragraph 6); (b) protective system (as Series 1900 paragraph 4); (c) concrete foundations to posts (as this Series paragraph 36); (d) socket covers and filling.
Concrete Safety Barriers		
Units	38	The units of measurement shall be: <ul style="list-style-type: none"> (i) concrete safety barriers linear metre. (ii) concrete safety barrier terminations, transitions number.
Measurement	39	The measurement of concrete safety barriers shall be the developed length along the centre line of the barriers between terminations.

Itemisation **40** Separate items shall be provided for concrete safety barriers in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each type of barrier.
	2 Each type of termination.
	3 Each type of transition.
II	1 Straight or curved exceeding 50 metres radius.
	2 Curved not exceeding 50 metres radius.

Concrete Safety Barriers 41 The items for concrete safety barriers shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
 - (b) disposal of material (as Series 600 paragraph 39);
 - (c) concrete (as Series 1700 paragraph 5 and 10);
 - (d) formwork (as Series 1700 paragraph 15);
 - (e) reinforcement (as Series 1700 paragraph 26);
 - (f) joints and gaskets including movement joints;
 - (g) foundations and bases;
 - (h) filling;
 - (i) attachment systems and fixings;
 - (j) adjustment to flowing alignment;
 - (k) fabrication (as Series 1800 paragraph 6);
 - (l) protective system (as Series 1900 paragraph 4);
 - (m) cast-in sockets, bolts, nuts, washers;
 - (n) make-up units;
 - (o) dowel bars;
 - (p) treatment at lighting columns and the like including cover plates, sub-frames, plates and fixings.

Concrete Safety Barrier Terminations and Transitions 42 The items for concrete safety barrier terminations and transitions shall in accordance with the Preambles to Bill of Quantities General Directions included for:

- Item coverage
- (a) concrete safety barriers (as this Series paragraph 41);
 - (b) fixing to or setting in concrete;
 - (c) attachment systems and connectors for fixing to beam safety fences.

Pedestrian Guardrails and Handrails

Units	43	The unit of measurement shall be:	
	(i)	pedestrian guardrails, handrails linear metre.	
Measurement	44	The measurement of pedestrian guardrails and handrails shall be the developed length along the centre line. The height of pedestrian guardrails shall be the height between the top of the top rail and the finished level of the surface directly beneath the guardrail.	
Itemisation	45	Separate items shall be provided for pedestrian guardrails and handrails in accordance with Chapter II paragraphs 3 and 4 and the following:	
		Group	Feature
		I	1 Each type of pedestrian guardrail.
			2 Each type of handrail.
		II	1 Different heights.
		III	1 Elements curved in plan to different radii.
Pedestrian Guardrails and Handrails	46	The items for pedestrian guardrails and handrails shall in accordance with the Preambles to Bill of Quantities General Directions include for:	
Item coverage		(a)	excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
		(b)	disposal of material (as Series 600 paragraph 39);
		(c)	in situ concrete (as Series 1700 paragraph 5);
		(d)	formwork (as Series 1700 paragraph 15);
		(e)	reinforcement (as Series 1700 paragraph 26);
		(f)	backfilling and compaction;
		(g)	metal parapets (as Series 2200 paragraph 5);
		(h)	gates (as Series 300 paragraph 6);
		(j)	rivets, nuts, bolts, shims, washers, welds, clamps and the like.

Loading Tests on Post Foundations

Units

47

The unit of measurement for loading test on post foundation shall be:

(i)

loading test on post foundation carried out by Contractor, loading test on post foundation carried out by Overseeing Organisation number.

Itemisation

48

Separate items shall be provided for loading test on post foundation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Loading test on post foundation carried out by Contractor.
	2 Loading test on post foundation carried out by Overseeing Organisation.
II	1 Different types of safety fence posts.
III	1 Different sizes of safety fence posts.

Loading Test on Post Foundation Carried Out by Contractor

49

The items for loading test on post foundation carried out by Contractor shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) posts (as this Series paragraph 10);
 - (b) concrete foundations to posts (as this Series paragraph 13);
 - (c) socketed foundations to posts (as this Series paragraph 14);
 - (d) provision, maintenance and subsequent removal of test equipment;
 - (e) provision, maintenance and subsequent removal of reaction vehicle;
 - (f) preparation and submission of results to the Overseeing Organisation;
 - (g) removal of test posts and foundations;
 - (h) disposal of material (as Series 600 paragraph 39);
 - (i) reinstatement and making good;
 - (j) traffic safety and management (as Series 100 paragraph 26).

Loading Test on Post Foundation Carried Out by Overseeing Organisation

50 The items for loading test on post foundation carried out by Overseeing Organisation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) posts (as this Series paragraph 10);
 - (b) concrete foundations to posts (as this Series paragraph 13);
 - (c) socketed foundations to posts (as this Series paragraph 14);
 - (d) provision, maintenance and subsequent removal of reaction vehicle;
 - (e) removal of test posts and foundations;
 - (f) disposal of material (as Series 600 paragraph 39);
 - (g) reinstatement and making good;
 - (h) traffic safety and management (as Series 100 paragraph 26).

Series 500: Drainage and Service Ducts

Definitions

- 1 Any reference to 'drain' shall be deemed to include sewers and piped culverts.
- 2 Drains exceeding 900 mm internal diameter, box culverts, piped culverts and all associated chambers, headwalls, outfall works and concrete bagwork shall be measured in accordance with Series 2500 Special Structures.
- 3 Trenches and ducts in connection with electrical work for road lighting and traffic signs cabling shall be measured in accordance with Series 1400.
- 4 Trenches and ducts in connection with motorway communications cabling shall be measured in accordance with Series 1500.
- 5 The Earthworks Outline is defined in Series 600 Earthworks paragraphs 1 to 6 inclusive and shall apply equally to this Series.
- 6 Where the ground level has been subjected to treatment, under the Contract, in respect of ground improvement, mine workings, swallow holes and the like, for the purposes of this Series Existing Ground Level shall be the level obtained upon completion of any such treatment of the areas affected.
- 7 Sub-soil Level is defined as the level of the ground after the removal of topsoil required by the Contract.
- 8 Surcharge is defined as material placed on embankments for the purpose of loading the embankment for the periods stated in the Contract.

Drains and Service Ducts (Excluding Filter Drains, Narrow Filter Drains and Fin Drains)

Unit

- 9 The unit of measurement for drains and service ducts shall be:
 - (i) drains, service ducts linear metre.

Measurement

- 10 The measurement of drains and service ducts shall be the summation of their individual lengths measured along the centre lines of the pipes between any of the following:
 - (a) the internal faces of chambers;
 - (b) the external faces of headwalls;
 - (c) the intersections of the centre lines at pipe junctions;
 - (d) the centre of gully gratings (or where no grating is provided, the centre of the gully);
 - (e) the position of terminations shown in the Contract;
 - (f) the point of change of stage depth.
- 11 The depth of drains and service ducts shall be the vertical measurement between the invert and the following:
 - (a) where the invert is below the Existing Ground Level - the Existing Ground Level except that where the Earthworks Outline is below the Existing Ground Level the measurement shall be taken to the Earthworks Outline;
 - (b) where the invert is at or above the Existing Ground Level - the

datum stated in the Contract, or where none is stated, the Earthworks Outline.

Notwithstanding the foregoing, where in the Contract a commencing level or a minimum level of cover is stated from which excavation shall commence, then the depth shall be taken to that stated level.

12 The average depth to invert shall be the calculated arithmetic mean of the depths taken at intervals of 10 metres along the pipelines starting from the outfall end. For terminal lengths and pipelines less than 10 metres long the measurement of depths shall be taken at their ends.

13 The measurement of service ducts shall be for the complete construction irrespective of the number of ducts contained within any one trench.

Where more than one duct is laid in a trench then the number of ducts shall be stated in the item description.

14 Drains and service ducts required to be designed by the Contractor shall be measured in accordance with Series 2500.

Itemisation

15 Separate items shall be provided for drains and service ducts (excluding filter drains, narrow filter drains and fin drains) in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Drains.
	2 Service ducts.
II	1 Different internal diameters.
III	1 Depths to invert not exceeding 2 metres. The average depth to invert to be stated to the nearest 25 mm.
	2 Depths to invert exceeding 2 metres but not exceeding 4 metres and so on in steps of 2 metres. The average depth to invert to be stated to the nearest 25 mm.
IV	1 Specified design groups.
	2 Particular designs stated in the Contract
V	1 Construction in trench.
	2 Construction in heading.
	3 Construction by jacking or thrust boring.
	4 Suspended on discrete supports.
VI	1 In side slopes of cuttings or side slopes of embankments.

Note: For each item which includes Group III Feature 1 or 2, an associated item shall be provided for adjustment of the rate for each 25 mm of difference in excess of 150 mm where the average depth to invert calculated from site measurement varies from that stated in the Bill of Quantities. The foregoing shall apply to both increases and decreases of average in excess of 150 mm, and will result in

either a positive or negative adjustment of the rate.

Drains and Service Ducts

- 16** The items for drains and service ducts shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage
- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
 - (b) excavation of unacceptable material (as Series 600 paragraph 19);
 - (c) access shafts to headings and their subsequent reinstatement;
 - (d) thrust pits and thrust blocks for pipe jacking and their removal on completion;
 - (e) articulated pipes and fittings;
 - (f) cutting, laying, jointing and bedding;
 - (g) building in pipes to headwalls and outfall works;
 - (h) hangers, stools and discrete supports;
 - (i) bedding, haunching and surrounding;
 - (j) formwork (as Series 1700 paragraph 15);
 - (k) backfilling and compaction;
 - (l) disposal of material (as Series 600 paragraph 39);
 - (m) movement joints to beds, surrounds and the like;
 - (n) reinstatement of unpaved areas;
 - (o) checking and cleaning;
 - (p) recording, staking and labelling;
 - (q) in the case of ducts, fixing draw ropes, removable stoppers, marker blocks and posts;
 - (r) pipe schedules;
 - (s) lubricants, packing, grouting and caulking;
 - (t) surveys and recordings;
 - (u) protective system (as Series 1900 paragraph 4).

Filter Drains

Units

- 17** The units of measurement for filter drains shall be:
- (i) filter drains linear metre.
 - (ii) filter material contiguous with filter drains cubic metre.
 - (iii) sub-base material cubic metre.

		(iv) lightweight aggregate infill cubic metre.
		(v) excavate and replace filter material cubic metre.
Measurement	18	<p>The measurement of filter drains, excluding narrow filter drains, shall be the summation of their individual lengths measured along the center lines of the pipe (or trench where no pipe is provided), between any of the following:</p> <p>(a) the internal faces of chambers;</p> <p>(b) the external faces of headwalls;</p> <p>(c) the intersection of centre lines at junctions;</p> <p>(d) the centre of gully gratings (or where no grating is provided the centre of the gully);</p> <p>(e) the position of terminations shown in the Contract;</p> <p>(f) the point of change of stage depth.</p>
	19	<p>The depth of filter drains shall be the vertical measurement between the invert (or the centre line of the trench bottom where no pipe is provided) and the following:</p> <p>(a) where the invert is below the Existing Ground Level - the Existing Ground Level or the Earthworks Outline whichever is the lower, except that where the finished level of the filter material is above the Existing Ground Level the measurement shall be taken to the finished level of the filter material;</p> <p>(b) where the invert is at or above the Existing Ground Level - the datum stated in the Contract, or where none is stated, the finished level of the filter material.</p> <p>The calculation of average depth to invert of filter drains shall be as paragraph 12 of this Series taken along the centre line of the filter drain.</p> <p>Narrow filter drains shall be measured in accordance with paragraphs 25 to 28 of this Series.</p>
	20	<p>The measurement of contiguous filter material shall be the volume of the material occupying the void between the filter drain and the adjacent carriageway, hardshoulder and hardstrip. The side of the contiguous filter material next to the filter drain shall be taken as the vertical extension of the trench side above capping or where no capping is provided above subgrade level.</p> <p>The measurement of sub-base material shall be the volume of the sub-base material within non-pavement verge or central reserve adjacent to the carriageway, hardshoulder and hardstrip filled to the outline stated in the Contract.</p> <p>The measurement of lightweight aggregate infill shall be the volume of the lightweight aggregate infill above the filter drain filled to the outline stated in the Contract.</p> <p>The measurement of excavate and replace filter material shall be the product of the lengths, widths and depths instructed by the Overseeing Organisation with no deduction for pipes, ducts or chambers. Lengths and widths shall be taken as the lengths and widths at the level of the drain invert or, in the case that partial excavation is instructed, at the depth to which excavation is instructed by the Overseeing Organisation.</p>
Itemisation	21	<p>Separate items shall be provided for filter drains in accordance with Chapter II paragraphs 3 and 4 and the following:</p>

Group I	1	Filter drains.
	2	Filter material contiguous with filter drains.
	3	Sub-base material.
	4	Lightweight aggregate infill.
	5	Excavate and replace filter material.
II	1	Different internal diameters.
	2	Different types of filter material.
	3	Different types of sub-base material.
	4	Different types of lightweight aggregate infill.
III	1	Depths to invert not exceeding 2 metres. The average depth to invert to be stated to the nearest 25 mm.
	2	Depths to invert exceeding 2 metres but not exceeding 4 metres and so on in steps of 2 metres. The average depth to invert to be stated to the nearest 25 mm.
IV	1	Specified design groups.
	2	Particular designs stated in the Contract.
V	1	In side slopes of cuttings or side slopes of embankments.

Note: For each item which includes Group III Feature 1 or 2 an associated item shall be provided for adjustment of the rate for each 25 mm of difference in excess of 150 mm where the average depth to invert calculated from site measurement varies from that stated in the Bill of Quantities. The foregoing shall apply to both increases and decreases of average in excess of 150 mm, and will result in either a positive or negative adjustment of the rate.

Filter Drains

22 The items for filter drains shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) disposal of material (as Series 600 paragraph 39);
- (d) articulated pipes, and fittings;
- (e) cutting, laying, jointing and bedding;
- (f) bedding, haunching and surrounding;
- (g) formwork (as Series 1700 paragraph 15);
- (h) filter material and compaction;
- (i) reinstatement of unpaved areas;

- (j) checking and cleaning;
- (k) recording, staking and labelling;
- (l) geotextiles;
- (m) topsoiling, seeding and turfing;
- (n) mesh;
- (o) pipe schedules;
- (p) protective system (as Series 1900 paragraph 4).

Filter Material Contiguous with Filter Drains, Sub-base Material and Lightweight **23** The items for filter material contiguous with filter drains, sub-base material and lightweight aggregate infill shall in accordance with the Preambles to Bill of Quantities General **Aggregate Infill**
Directions include for:

- Item coverage
- (a) compaction;
 - (b) formwork (as Series 1700 paragraph 15);
 - (c) geotextiles;
 - (d) mesh.

Excavate and Replace Filter Material **24** The items for excavate and replace filter material shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation (as Series 600 paragraphs 18 and 19);
 - (b) disposal of material (as Series 600 paragraph 39);
 - (c) compaction of fill (as Series 600 paragraph 52);
 - (d) geotextiles.

Fin Drains and Narrow Filter Drains

Units **25** The unit of measurement shall be:

- (i) fin drains linear metre.
- (ii) narrow filter drains linear metre.

Measurement **26** The measurement of fin drains and narrow filter drains shall be the summation of their individual lengths measured along their centre lines between any of the following:

- (a) the internal faces of chambers;
- (b) the position of terminations shown in the Contract;

(c) the external faces of headwalls.

The depth of the fin drain or narrow filter drain shall be the vertical measurement between the invert and the Earthworks Outline.

Itemisation

27 Separate items shall be provided for fin drains and narrow filter drains in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Fin drains.
	2 Narrow filter drains.
II	1 Specified design group.
	2 Particular designs stated in the Contract.
III	1 Depth not exceeding 1.5 metres.

Fin Drains and Narrow Filter Drains

Item coverage

28 The items for fin drains and narrow filter drains shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- (a) geotextiles and cores;
- (b) backfilling and compaction;
- (c) filter drains (as this Series paragraph 22);
- (d) protection from ultra-violet light;
- (e) marker tapes;
- (f) lapping and jointing;
- (g) connections, attachments and fittings;
- (h) treatment at chambers, gullies, pipelines and the like.

Connections

Units

29 The unit of measurement for connections shall be:

- (i) connection to existing drain, existing piped culvert, existing chamber, permanently severed land or mole drain number.

Measurement

30 Connections shall only be separately measured for connection to existing drains, existing piped culverts or existing chambers, and permanently severed land or mole drains.

Itemisation

31 Separate items shall be provided for connections in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Connection to existing drain and existing piped culvert.
	2 Connection to existing chamber.
	3 Connection to permanently severed land or mole drain.
II	1 Different diameters.
III	1 Depths to invert not exceeding 2 metres.
	2 Depths to invert exceeding 2 metres but not exceeding 4 metres and so on in steps of 2 metres.

Connections to Existing Drains, Existing Piped Culverts, Existing Chambers, Permanently Severed Land or Mole Drains

Item coverage

The items for connection to existing drains, existing piped culverts, existing chambers, permanently severed land or mole drains shall in accordance with the Preambles to Bill of Quantities General for:

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) locating and making entry;
- (d) backfilling and compaction;
- (e) disposal of material (as Series 600 paragraph 39);
- (f) making entry into chambers, concrete benching and channels, and making good the benching, channels and walls;
- (g) locating severed ends of land and mole drains;
- (h) pipes, fittings and saddles;
- (i) bedding, haunching and surrounding, and filter material;
- (j) formwork (as Series 1700 paragraph 15);
- (k) sealing off disused ends;
- (l) re-laying existing pipes disturbed.

Chambers and Gullies

Units	33	The unit of measurement shall be: (i) chambers, gullies number.
Measurement	34	The measurement shall be of the complete chamber or gully.
	35	Depths of chambers shall be the distance between the top surface of the cover and the invert of the main channel, or where no channel is required by the Contract, the uppermost surface of the base slab. Where no base slab is required the depth shall be taken to the bottom of the excavation.

Itemisation

36 Separate items shall be provided for chambers and gullies in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Chambers.
	2	Gullies.
II	1	Specified design groups.
	2	Particular designs stated in the Contract.
III	1	Depths not exceeding 1 metre.
	2	Depths exceeding 1 metre but not exceeding 2 metres
	3	and so on in steps of 1 metre
IV	1	Different types of covers or gratings.

Chambers

37 The items for chambers shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) locating existing drains;
- (d) breaking into existing drains;
- (e) connecting and re-connecting existing drains;
- (f) construction of bases, walls, roof and cover slabs and shafts, surrounds and corbelling for cover;
- (g) channels, fittings, benchings, building in pipes and fin drain connections;
- (h) cleaning;
- (i) steps, safety chains, ladders, handholds and the like;
- (j) covers, frames, seatings and bedding;
- (k) lifting keys;
- (l) concrete (as Series 1700 paragraphs 5 and 10);
- (m) formwork (as Series 1700 paragraph 15);
- (n) reinforcement (as Series 1700 paragraph 26);
- (o) backfilling and compaction;
- (p) disposal of material (as Series 600 paragraph 39);

- (q) filling;
- (r) notices;
- (s) sealants (as Series 2300 paragraph 10);
- (t) brickwork (as Series 2400 paragraph 4);
- (u) re-laying existing pipes disturbed;
- (v) pipework and fittings;
- (w) penstocks and ancillary equipment.

Gullies

38

The items for gullies shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) fittings including in situ concrete (as Series 1700 paragraph 5) bed and surround and jointing to pipes;
- (d) gratings, frames, slabs, surrounds, aprons, seatings, liners and bedding;
- (e) formwork (as Series 1700 paragraph 15);
- (f) cleaning;
- (g) backfilling and compaction;
- (h) disposal of material (as Series 600 paragraph 39);
- (i) brickwork (as Series 2400 paragraph 4);
- (j) re-laying existing pipes disturbed.

Headwalls and Outfall Works

Measurement

39

Headwalls and outfall works and the like to pipes up to 900 mm internal diameter shall be measured in accordance with this Series paragraphs 40 to 42.

Headwalls and outfall works and the like to pipes exceeding 900 mm internal diameter shall be measured in accordance with Series 2500.

Headwalls and outfall works and the like constructed using concrete bagwork shall be measured in accordance with this Series paragraphs 77 to 80.

Units

40

The unit of measurement shall be:

- (i) headwalls, revetments number.

Itemisation

41

Separate items shall be provided for headwalls and revetments in accordance with Chapter II paragraphs 3 and 4 and the following:

Group

Feature

	I	1	Headwalls.
		2	Revetments
	II	1	Different types.
	III	1	Different materials
	IV	1	Pipe not exceeding 100 mm internal diameter.
		2	Pipe exceeding 100 mm but not exceeding 300 mm internal diameter.
		3	Pipe exceeding 300 mm but not exceeding 600 mm internal diameter.
		4	Pipe exceeding 600 mm but not exceeding 900 mm internal diameter.
Headwalls and Outfall Works	42	The items for headwalls and outfall works shall in accordance with the Preambles to Bill of Quantities General Directions include for:	
Item coverage		<p>(a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);</p> <p>(b) excavation of unacceptable material (as Series 600 paragraph 19);</p> <p>(c) concrete (as Series 1700 paragraphs 5 and 10);</p> <p>(d) formwork (as Series 1700 paragraph 15);</p> <p>(e) backfilling and compaction;</p> <p>(f) disposal of material (as Series 600 paragraph 39);</p> <p>(g) brickwork, copings, string courses and the like (as Series 2400 paragraph 4);</p> <p>(h) blockwork, stonework, copings, string courses, individual blocks, features or stones (as Series 2400 paragraph 8);</p> <p>(i) lining of watercourses (as Series 600 paragraph 89);</p> <p>(j) drainage channel blocks (as Series 1100 paragraph 4);</p> <p>(k) building in pipes and fin drain connections;</p> <p>(l) reinforcement (as Series 1700 paragraph 26);</p> <p>(m) miscellaneous metalwork (as Series 1800 paragraph 14);</p> <p>(n) waterproofing (as Series 2000 paragraph 4);</p> <p>(o) flap valves.</p>	
		Soft Spots and Other Voids	
Units	43	The unit of measurement shall be:	
		(i) soft spots, other voids cubic metre.	
Measurement	44	The measurement of soft spots and other voids shall be the volume	

of the void directed to be excavated or filled. For this measurement the width shall be taken for drains, service ducts and filter drains, as the internal diameter of the pipe plus 600 mm. Where no pipe is required the width shall be taken as 600 mm. For chambers, gullies and the like the measurement shall be taken as the horizontal area of the base slab or where no base slab is required the bottom of the excavation. The depths shall be measured from the underside of the thinnest permitted bed in any one group for trenches and from the underside of the base slab for chambers, gullies and the like.

Itemisation **45** Separate items shall be provided for soft spots and other voids in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Excavation of soft spots and other voids. 2 Filling of soft spots and other voids.
II	1 Different types of fill.

Excavation of Soft Spots and other Voids 46

The items for excavation of soft spots and other voids shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
(b) excavation of unacceptable material (as Series 600 paragraph 19);
(c) disposal of material (as Series 600 paragraph 39).

Filling of Soft Spots and Other Voids

47 The items for filling of soft spots and other voids shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) deposition of fill (as Series 600 paragraph 33);
(b) compaction of fill (as Series 600 paragraph 52);
(c) in situ concrete (as Series 1700 paragraph 5);
(d) formwork (as Series 1700 paragraph 15).

Supports Left in Excavation

Units **48** The unit of measurement shall be:
(i) supports left in excavation square metre.

Measurement **49** The measurement shall be the area of face required by the Contract to be left with supports in position

Itemisation **50** Separate items shall be provided for supports left in excavation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Supports.

II	1	Timber.
	2	Steel
III	1	Different types.
IV	1	Construction in trench.
	2	Construction in pits.
	3	Construction in heading.

Supports Left in Excavation

51 The items for supports left in excavation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) struts, walings and the like and working around them.

Drainage and Service Ducts in Structures (Including Reinforced Earth Structures and Anchored Earth Structures)

Units **52** The unit of measurement shall be:

(i) drainage and service ducts in structures item.

Measurement **53** The components comprising the items of drainage and service ducts in structures shall be identified and scheduled in the Contract.

Itemisation **54** Separate items shall be provided for drainage and service ducts in structures in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Drainage.
	2 Service ducts

II	1	Substructure - end supports.
	2	Substructure - intermediate supports.
	3	Superstructure.
	4	Reinforced earth structure.
	5	Anchored earth structure.

Drainage and Service Ducts in Structures **55** The items for drainage and service ducts in structures shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) drains, service ducts, filter drains, fin drains and narrow filter drains and connections (as this Series paragraphs 16,22, 28 and 32);
- (b) chambers (as this Series paragraph 37);
- (c) gullies (as this Series paragraph 38);
- (d) pipework, gullies, downpipes, fittings and the like including brackets, hangers and straps, fixing to or building into the structure;
- (e) making good protective system, waterproofing;
- (f) permeable backing including compaction and supports;

(g) channels.

Filling to Pipe Bays and Verges on Bridges

Units	56	The unit of measurement shall be:
	(i)	filling to pipe bays and verges on bridges cubic metre.
Measurement	57	The measurement shall be the volume of the void stated in the Contract to be filled except that no deduction shall be made for drains, service ducts, services, supplies and the like and their supports.
Itemisation	58	Separate items shall be provided for filling to pipe bays and verges on bridges in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Filling to pipe bays and verges on bridges.
II	1 Different types.

Filling to Pipe Bays and Verges on Bridges	59	The items for filling to pipe bays and verges on bridges shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage	(a)	deposition;
	(b)	complying with any restrictions on the placing and compacting of materials;
	(c)	compaction around drains, service ducts, services, supplies, supports and the like.

Replacement, Raising or Lowering of Covers and Gratings on Existing Chambers and Gullies

Definition	60	For the purpose of paragraphs 61 to 64 of this Series any reference to covers and gratings shall be deemed to include associated frames.
Units	61	The units of measurement shall be:
	(i)	replacement of covers and gratings on existing chambers and gullies number.
	(ii)	raising or lowering of covers and gratings on existing chambers and gullies number.
Measurement	62	When an existing cover or grating is to be raised/lowered and replaced, separate items shall be measured for raising/lowering and replacement.
Itemisation	63	Separate items shall be provided for replacement, raising or lowering of covers and gratings on existing chambers and gullies in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Replacement.
	2	Raising the level.
	3	Lowering the level.
II	1	Different sizes of cover.
	2	Different sizes of grating.
III	1	Different types of cover.
	2	Different types of grating.
IV	1	Different sizes of chamber.
	2	Different sizes of gully.
V	1	Different construction of chamber.
	2	Different construction of gully.
VI	1	Not exceeding 150 mm.
	2	Exceeding 150 mm but not exceeding 300 mm and so on in steps of 150 mm.

**Replacement, Raising
or Lowering of Covers
Existing the Preambles to
Chambers and Gullies**

Item coverage

64 The items for replacement, raising or lowering of covers and gratings on existing chambers and gullies shall in accordance with **and gratings on** Bill of Quantities General Directions include for:

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) excavation of Hard Material (as Series 600 paragraph 23);
- (d) take up existing cover or grating including frame and clean and set aside for re-use;
- (e) demolition and preparation to receive new construction;
- (f) construction of walls, roof and cover slabs and shafts, surrounds and corbelling for cover and making good;
- (g) steps, safety chains, ladders, handholds, lifting keys and the like;
- (h) bedding cover or grating including frame;
- (i) concrete (as Series 1700 paragraphs 5 and 10);
- (j) formwork (as Series 1700 paragraph 15);
- (k) reinforcement (as Series 1700 paragraph 26);

- (l) backfilling and compaction;
- (m) disposal of material (as Series 600 paragraph 39);
- (n) taking precautions to avoid damage to drains;
- (o) cleaning;
- (p) reinstatement of adjacent surfaces;
- (q) brickwork (as Series 2400 paragraph 4);
- (r) sealants (as Series 2300 paragraph 10);
- (s) modification and new materials;
- (t) replacing items damaged during the foregoing operations.

**Remove from Store and Reinstall Chamber Covers and Frames,
and Gully Gratings and Frames**

Units	65	The unit of measurement shall be: (i) remove from store and reinstall chamber covers and frames, and gully gratings and frames number.
Measurement	66	The measurement of remove from store and reinstall chamber covers and frames and gully gratings and frames shall be the complete installation.
Itemisation	67	Separate items shall be provided for remove from store and reinstall chamber covers and frames and gully gratings and frames in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Remove from store and reinstall different types of chamber covers and frames.
	2	Remove from store and reinstall different types of Gully gratings and frames.
II	1	Different sizes.

Remove from Store and Reinstall Chamber and Frames and Gully Gratings and Frames Item coverage	68	The items for remove from store and reinstall chamber covers and frames and gully gratings and frames shall in accordance with the Preambles to Bill of Quantities General Directions include for: (a) loading, transporting from store, unloading and positioning for reinstallation; (b) replacing items damaged during the foregoing operations; (c) modification and new materials; (d) replacement, raising or lowering of covers and gratings on existing chambers and gullies (as this Series paragraph 64).
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Grouting Up of Existing Drains and Service Ducts

Units	69	The unit of measurement shall be:	
		(i) grouting up of existing drains and service ducts linear metre.	
Measurement	70	The measurement of grouting up of existing drains and service ducts shall be the length to be grouted as stated in the Contract.	
Itemisation	71	Separate items shall be provided for grouting up of existing drains and service ducts in accordance with Chapter II paragraphs 3 and 4 and the following:	
		Group	Feature
		I	1 Grouting up of existing drains and service ducts.
		II	1 Different diameters.
		III	1 Different types of grout.
Grouting Up of Existing Drains and Service Ducts			
	72	The items for grouting up of existing drains and service ducts shall in accordance with the Preambles to Bill of Quantities General Directions include for:	
Item coverage		(a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);	
		(b) excavation of unacceptable material (as Series 600 paragraph 19);	
		(c) breaking into drain or service duct and cleaning;	
		(d) mixing and placing grout;	
		(e) in situ concrete (as Series 1700 paragraph 5);	
		(f) formwork (as Series 1700 paragraph 15);	
		(g) backfilling and compaction;	
		(h) disposal of material (as Series 600 paragraph 39).	
Excavation in Hard Material			
Units	73	The unit of measurement shall be:	
		(i) extra over excavation for excavation in Hard Material in drainage cubic metre.	
Measurement	74	The measurement shall be the volume of the voids formed by the removal of the Hard Material.	
		For the measurement of:	
		(a) drains, service ducts and filter drains (except fin drains and narrow filter drains), the width shall be taken as the internal diameter of the pipe plus 600 mm. Where no	

pipe is required the width shall be taken as 600 mm;

(b) fin drains and narrow filter drains the width shall be taken as 300mm

(c) chambers, gullies and the like the area shall be taken as the horizontal area of the base slab or where no base slab is required the area of the bottom of the excavation;

(d) Excavation in hard material shall not be measured separately in connection with replacement and raising or lowering of covers and gratings on existing chambers and gullies.

Itemisation **75** Separate items shall be provided for extra over excavation for excavation in Hard Material in drainage in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
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I	1	Extra over excavation for excavation in Hard Material in drainage.
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Extra Over Excavation for Excavation in Hard Material

76 The items for extra over excavation for excavation in Hard Material in drainage shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation in Hard Material (as Series 600 paragraph 23).

Concrete Bagwork

Units **77** The unit of measurement shall be:

(i) Concrete bagworkcubic metre.

Measurement **78** No deduction shall be made for holes, ducts, pockets, sockets, mortices and the like not exceeding 0.15 cubic metres each in volume.

Itemisation **79** Separate items shall be provided for concrete bagwork in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
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I	1	Concrete bagwork.
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II	1	In headwalls.
	2	Other stated location.

III	1	With battered face.
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Concrete Bagwork

80 The items for concrete bagwork shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item Coverage	<ul style="list-style-type: none"> (a) excavation (as Series 600 paragraphs 18 and 19); (b) disposal of material (as Series 600 paragraph 39); (c) trials and trial panels; (d) deposition, fill and compaction (as Series 600 paragraphs 33, 45 and 52); (e) filling bags with concrete and tucking in ends of bags; (f) shaping bags and soaking; (g) dowel bars (as Series 1700 paragraph 27); (h) building in pipes; (i) tying into existing work; (j) construction of bagwork in more than one lift; (k) in situ concrete (as Series 1700 paragraph 5); (l) formwork (as Series 1700 paragraph 15); (m) reinforcement (as Series 1700 paragraph 26); (n) geotextiles (as Series 600 paragraph 60); (o) water supply.
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Cleaning Existing Drainage Systems

Units	<p>81 The units of measurement shall be:</p> <ul style="list-style-type: none"> (i) cleaning of piped drainage systems, drainage channels, linear drainage channel systems, combined drainage and kerb systems.....linear metre. (ii) cleaning of bridge drainage systemitem. (iii) cleaning of chambers, gulliesnumber.
Measurement	<p>82 The measurement of cleaning piped drainage systems, drainage channels, linear drainage channel systems and combined drainage and kerb systems shall be the individual lengths measured along the centre lines between any of the following:</p> <ul style="list-style-type: none"> (a) the internal faces of chambers; (b) the external faces of headwalls; (c) the intersections of the centre lines at pipe junctions; (d) the centre of gully gratings (or where no grating is provided, the centre of the gully); (e) the position of terminations shown in the Contract.

The measurement of cleaning drainage channels, linear drainage channel systems, combined drainage and kerb systems and bridge drainage systems shall be deemed to include associated chambers, sumps and the like.

Itemisation **83** Separate items shall be provided for cleaning existing drainage systems in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Cleaning.
II	1 Piped drainage system. 2 Drainage channels. 3 Linear drainage channel system. 4 Combined drainage and kerb system. 5 Bridge drainage system. 6 Chambers. 7 Gullies.
III	1 Different stated sizes.
IV	1 Different stated locations.

Cleaning Existing Drainage Systems

84 The items for cleaning existing drainage systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item Coverage
- (a) marking;
 - (b) lifting chamber covers, replacement and bedding;
 - (c) rodding;
 - (d) flushing;
 - (e) water supply;
 - (f) mandrelling;
 - (g) disposal of material (as Series 600 paragraph 39);
 - (h) recording and reporting;
 - (i) greasing;
 - (j) cleaning covers, gratings and frames, offlets and the like;
 - (k) filling with water;
 - (l) vacuum/air suction;
 - (m) locating obstructions and the like;
 - (n) contamination prevention measures;
 - (o) locating chambers and gullies.

Series 600: Earthworks

Definitions

1 The Earthworks Outline, unless expressly stated otherwise, is defined as the finished earthworks levels and dimensions (prior to topsoiling) required by the Contract for the construction, where specified, of:

- (a) carriageway, hard shoulder, hard strip, footway, paved area, central reserve, verge, side slope;
- (b) sub-base;
- (c) fill on sub-base material, base and capping;
- (d) contiguous filter material, lightweight aggregate infill;
- (e) surface water channels;
- (f) landscape areas, screening mounds, environmental bunds.

In all cases of filter drains, except narrow filter drains, the Earthworks Outline shall be the top of the filter material.

2 Where capping or stabilisation to form capping is required by the Contract in cutting or on embankment, the Earthworks Outline shall be as defined in paragraph 1 of this Series i.e. as the top of capping.

3 Where an embankment is required by the Contract to be surcharged, the Earthworks Outline shall be as defined in paragraph 1 of this Series and exclude the surcharge.

4 Where permanent storage or stockpiling of topsoil is required by the Contract, the Earthworks Outline shall be as defined in paragraph 1 of this Series and exclude stored topsoil.

5 Where the bottom of a structural foundation for an earth retaining structure (other than for reinforced earth and an anchored earth structure) is below Existing Ground Level, the Earthworks Outline shall be the permanently exposed face of the structure below Existing Ground Level.

6 Where the bottom of the facing foundation for a reinforced earth structure or an anchored earth structure is below Existing Ground Level, the Earthworks Outline shall be the inside face of the facing above Existing Ground Level to the underside of the capping unit, or where no capping unit is required, to the finished earthworks level prior to topsoiling.

7 Where the ground has been subjected to treatment under the Contract in respect of ground improvement, mine workings, swallow holes and the like, for the purpose of this Series Existing Ground Level shall be the level obtained upon completion of any such treatment of the areas affected.

8 Sub-soil Level is defined as the level of the ground after the removal of topsoil required by the Contract.

9 Surcharge is defined as material placed on embankments for the purpose of loading the embankment for the periods stated in the Contract.

Measurement General

10 For the purposes of this Series it shall be assumed that one cubic metre of material excavated forms one cubic metre of compacted fill. No allowance shall be made in the measurement for bulking and shrinkage of any material.

11 Earthworks within Designated Outlines shall not be measured in this Series.

12 For the purpose of this Series no account shall be taken of excavated material arising from the Works measured in accordance with Series 100 to 500 and 700 to 3000 hereof.

13 Where deposition and compaction of an embankment has been carried out in accordance with the Contract and settlement occurs:

- (a) subsequent to the Earthworks Outline having been reached, or in the case of a surcharged embankment subsequent to the removal of the surcharge; or
- (b) from settlement of or penetration into the ground beneath the embankment;

then the additional fill, deposition and compaction required shall be measured immediately prior to the preparation of formation, provided that the first 75 mm of settlement or penetration shall not be measured.

In the case of landscape areas, screening mounds, environmental bunds and other areas of fill where settlement or penetration occurs, the additional fill, deposition and compaction required shall not be measured.

Excavation

Units

14 The unit of excavation shall be:

- (i) excavation cubic metre.

Measurement

15 The measurement of excavation shall be, for:

- (a) Topsoil Class 5A - the volume of the void formed by the excavation of material designated topsoil Class 5A.
- (b) Cutting and other excavation:
 - (i) cutting and bulk excavation - the volume of the void formed by the excavation of material from Existing Ground Level down to the Earthworks Outline, together with the volume of the void formed by the excavation of material below that Outline; or
 - (ii) under embankments and other areas of fill - the volume of the void formed by the excavation of material below Existing Ground Level;

less in each case the volume of topsoil Class 5A in the void included in the measurement under paragraph 15(a). The volume of excavation of soft spots measured under paragraph 62 of this Series shall not be included.

- (c) Removal of surcharge - the volume of material remaining as

surcharge to be removed down to the datum stated in the Contract, or if none is stated, to the Earthworks Outline.

- (d) Structural foundations - the volume of the void to accommodate the structural foundation calculated on the basis of the horizontal area of the bottom of the foundation with the depth being measured from the bottom of the foundation (including blinding concrete) to:

- (i) where the bottom of the foundation is below Existing Ground Level - the Existing Ground Level; provided that where the Earthworks Outline is below Existing Ground Level the depth shall be measured to the Earthworks Outline;
- (ii) where the bottom of the foundation is at or above Existing Ground Level - the datum stated in the Contract, or where none is stated to the Earthworks Outline;

less in each case the volume of topsoil Class 5A in the void included in the measurement under paragraph 15(a). The volume of excavation of soft spots measured under paragraph 62 of this Series shall not be included.

The classification of stage depths for the excavation of structural foundations shall be the maximum depth of excavation obtained in accordance with this sub-paragraph.

- (e) Foundations for corrugated steel buried structures and the like – the volume of the void to accommodate the structure, bedding and surround down to the outline stated in the Contract from:

- (i) where the bottom of the bedding is below Existing Ground Level - Existing Ground Level;
- (ii) where the bottom of the bedding is at or above Existing Ground Level - the datum stated in the Contract or where none is stated - Earthworks Outline;

less in each case the volume of topsoil Class 5A in the void included in the measurement under paragraph 15(a). The volume of excavation of soft spots measured under paragraph 62 of this Series shall not be included.

The classification of stage depths for the excavation of the foundation shall be the maximum depth of excavation obtained in accordance with this sub-paragraph.

- (f) New and enlarged watercourses, intercepting ditches - the volume of the void formed from Existing Ground Level down to the outline stated in the Contract less the volume of topsoil Class 5A in the void included in the measurement under paragraph 15(a) of this Series.
- (g) Clearing abandoned watercourses - the volume of the void formed from Existing Ground Level down to the outline stated in the Contract.
- (h) Gabion walling, mattresses and crib walling - as for structural foundations sub-paragraph (d) of this paragraph.

- (i) Caps to mine working, well, swallow hole and the like – the volume of the voids formed to accommodate the caps.

Itemisation

16 Separate items shall be provided for excavation in accordance with Chapter II paragraphs 3 and 4, and the following:

Group Feature		
I	1	Excavation.
II	1	Acceptable material Class 5A.
	2	Acceptable material excluding Class 5A.
	3	Unacceptable material Class U1.
	4	Unacceptable material Class U2.
III	1	Cutting and other excavation.
	2	Structural foundations.
	3	Foundations for corrugated steel buried structures and the like.
	4	New watercourses.
	5	Enlarged watercourses.
	6	Intercepting ditches.
	7	Clearing abandoned watercourses.
	8	Removal of surcharge.
	9	Gabion walling and mattresses.
	10	Crib walling.
	11	Caps to mine working, well, swallow hole and the like.
IV	1	0 metres to 3 metres in depth.
	2	0 metres to 6 metres in depth and so on in steps of 3 metres.

Note 1: Acceptable material Class 5A shall not be separately identified by any Group III or IV feature.

Note 2: Group IV features shall be applied only to Features 2, 3, 9, 10 and 11 of Group III.

Excavation of Acceptable Material Class 5A

17 The items for excavation of acceptable material Class 5A shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) selection and separation of materials;
- (b) loading into transport;
- (c) multiple handling of material;
- (d) keeping earthworks free of water;
- (e) haulage and deposition in temporary stockpiles including the provision of sites for stockpiles;
- (f) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like;
- (g) grading beds and trimming side slopes of watercourses and the like;
- (h) replacing acceptable material rendered unacceptable.
- (i) facilitating Archaeologist

**Excavation of Acceptable
Material Excluding Class 5A**

18 The items for excavation of acceptable material excluding Class 5A shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) loosening or breaking up material before or in the process of excavation;
- (b) upholding the sides;
- (c) working around and between piles;
- (d) overbreak and making good;
- (e) keeping earthworks free of water;
- (f) selection and separation of materials;
- (g) forming and trimming side slopes, benchings and berms;
- (h) trimming the bottom and sides of foundations;
- (i) grading beds and trimming sides of watercourses and the like;
- (j) protection of subgrade;
- (k) additional excavation the Contractor may require for working space, timbering, formwork or other temporary works and its subsequent backfilling with approved materials and compaction;
- (l) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like;
- (m) treatment of faces of cuttings which are not to receive topsoil;
- (n) loading into transport;
- (o) multiple handling of material;
- (p) disposal of surcharge material (as this Series paragraph 39)
- (q) disposal of surcharge material rendered unacceptable (as this Series paragraph 39);
- (r) haulage, deposition and compaction in temporary stockpiles including provision of sites for stockpiles;
- (s) replacing acceptable material rendered unacceptable;
- (t) breaking down and processing material necessary to comply with the requirements of fill;
- (u) complying with special requirements for materials requiring special treatments.
- (v) excavation difficulties due to the presence of traffic on public road
- (w) facilitating installation of permanent drainage before excavation reaches 300mm before formation.

Excavation of Unacceptable Material Classes U1 and U2

19 The items for excavation of unacceptable material U1 and U2 shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation (as this Series paragraph 18);
- (b) special measures for dealing with Class U2 material.

Excavation in Hard Material

Units

20 The unit of measurement shall be:

- (i) extra over excavation for excavation in Hard Material cubic metre.

Measurement

21 The measurement of extra over excavation for excavation in Hard Material shall be the volume of Hard Material within the void measured under paragraph 15 of this Series.

Itemisation

22 Separate items shall be provided for extra over excavation for excavation in Hard Material in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Extra over excavation for excavation in Hard Material.
II	1	Cutting and other excavation.
	2	Structural foundations.
	3	Foundations for corrugated steel buried structures and the like.
	4	New watercourses.
	5	Enlarged watercourses.
	6	Intercepting ditches.
	7	Clearing abandoned watercourses.
	8	Gabion walling and mattresses.
	9	Crib walling.
	10	Caps to mine working, well, swallow hole and the like.

Extra Over Excavation for Excavation in Hard Material

23 The items for extra over excavation for excavation in Hard Material shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preliminary site trials of blasting;
- (b) blasting, splitting, breaking and the like;
- (c) cutting through reinforcement;
- (d) saw cutting and trimming;
- (e) removal of existing paved areas by course or layer, cleaning surfaces, milling or planing, stepping out and treatment to bottoms of foundations.

Processing of Unacceptable Material Class U1

Definition

24 The term 'processing' shall refer to treatment whereby material arising from the Site is rendered acceptable for a particular use in the Works by mechanical, chemical, hydraulic or other means.

- Units **25** The unit of measurement shall be:
- (i) processing of unacceptable material Class U1 cubic metre.
- Measurement **26** The processing of unacceptable material Class U1 shall be measured only when the Contract specifically requires particular material to be obtained for use in the Works by processing. Other processing carried out by the Contractor shall not be measured. The measurement of processing of unacceptable material Class U1 shall be the volume of the void required to be filled with the processed material.
- Itemisation **27** Separate items shall be provided for processing of unacceptable material Class U1 in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Processing of unacceptable material Class U1.
II	1 Different locations.
III	1 Into different classes of acceptable material.

Processing of Unacceptable Material Class U1

28 The items for processing of unacceptable material Class U1 shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) selection and separation of materials;
- (b) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like;
- (c) loading into transport;
- (d) multiple handling of material;
- (e) replacing acceptable material rendered unacceptable;
- (f) haulage, deposition and compaction in temporary stockpiles including provision of sites for stockpiles;
- (g) crushing, screening, mixing, grading, drying, wetting and sieving;
- (h) mechanical, chemical, hydraulic and other methods;
- (i) producing the required classification of material from Site-won materials;
- (j) obtaining permissions and approvals.

Deposition of Fill

- Units **29** The unit of measurement shall be:
- (i) deposition of fill cubic metre.
- Measurement **30** The measurement of deposition of fill shall be the volume of compacted fill, calculated in accordance with paragraphs 47, 48 and 49 of this Series, less the volume of imported fill calculated in accordance with paragraphs 41 and 42 of this Series.
- 31** Deposition of Class 1C and 6B materials shall be separately measured only where Class 1C or 6B material is specifically stated by the Contract to be required

to be placed in a particular location.

Itemisation

32 Separate items shall be provided for deposition of fill in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Deposition.
II	1 Acceptable material. 2 Acceptable material Class 1C. 3 Acceptable material Class 6B.
III	1 Embankments and other areas of fill. 2 Strengthened embankments. 3 Reinforced earth structures. 4 Anchored earth structures. 5 Landscape areas. 6 Environmental bunds. 7 Fill to structures. 8 Fill above structural concrete foundations. 9 Fill on sub-base material, base and capping. 10 Fill on bridges (under footways, verges and central reserves). 11 Upper bedding to corrugated steel buried structures and the like. 12 Lower bedding to corrugated steel buried structures and the like. 13 Surround to corrugated steel buried structures and the like. 14 Fill above corrugated steel buried structures and the like.

Deposition of Fill

33 The items for deposition of fill shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) protection of subgrade;
- (b) multiple handling of material;
- (c) keeping earthworks free of water;
- (d) complying with requirements and constraints on the sequence, timing and rate of deposition and filling, and equalisation of earth pressures;
- (e) complying with the special requirements for materials requiring special treatments;
- (f) complying with the particular requirements and constraints with regard to soil stabilisation, reinforced earth structures, strengthened embankments, anchored earth structures, corrugated steel buried structures and the like;
- (g) taking precautions to avoid damage to property, structures, sewers, drains, services, instrumentation and the like;
- (h) haulage;
- (i) replacing acceptable material rendered unacceptable;
- (j) selection of material of stated Classes and layering or depositing in locations stated in the Contract;
- (k) depositing fill to slope away from vertical drainage layers and measures to prevent surface water entering such layers;

- (l) treatment of soil as the Contractor may require to facilitate the use of particular plant;
- (m) trimming and shaping to levels and contours;
- (n) deposition of fill resulting from settlement and penetration of landscape areas, environmental bunds and other areas of fill, and from the first 75 mm of settlement and penetration of embankments.

Disposal of Material

Units

34 The unit of measurement shall be:

- (i) disposal of material cubic metre.

Measurement

35 The measurement of disposal of acceptable material shall be, for:

- (a) acceptable material excluding Class 5A - the volume excavated from within the Site measured in this Series less the volume of compacted fill calculated in accordance with paragraphs 47, 48 and 49 of this Series, after deduction from the latter of the volume of imported fill calculated in accordance with paragraphs 41 and 42 of this Series.
- (b) acceptable material Class 5A - the volume excavated from within the Site measured in accordance with paragraph 15(a) of this Series less the volume of topsoil to be permanently stored and the volume of topsoil calculated from the areas and thicknesses to be topsoiled in accordance with paragraph 78 of this Series.

36 The measurement of disposal of unacceptable material Class U1 shall be the volume of unacceptable material Class U1 excavated from within the Site and measured under this Series less the volume of processed unacceptable material Class U1 calculated in accordance with paragraph 26 of this Series.

37 The measurement of disposal of unacceptable material Class U2 shall be the volume of unacceptable material Class U2 excavated from within the Site and measured under this Series.

Itemisation

38 Separate items shall be provided for disposal of material in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Disposal.
II	1	Acceptable material excluding Class 5A.
	2	Acceptable material Class 5A.
	3	Unacceptable material Class U1.
	4	Unacceptable material Class U2.

Disposal of Material

39 The items for disposal of material shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) haulage and deposition in tips off Site provide by the Contractor;
- (b) multiple handling of material;
- (c) special measures for dealing with Class U2 material;

- (d) allowing for deposition in lieu of disposal of acceptable fill resulting from settlement and penetration of landscape areas, environmental bunds and other areas of fill, and from the first 75 mm of settlement and penetration of embankments.

Imported Fill

Units

40 The unit of measurement shall be:

- (i) imported fill cubic metre.

Measurement

41 The measurement of imported acceptable fill shall be the volume of compacted fill, calculated in accordance with paragraphs 47, 48 and 49 of this Series less the volumes of:

- (a) acceptable material (including that measured in accordance with this Series paragraph 26), excluding topsoil Class 5A and acceptable material of a particular Class being both surplus to the requirements of the Contract for that Class of material and which does not meet the requirements for acceptability for use elsewhere within the measured volume of compacted fill, excavated from within the Site and measured in this Series;
- (b) other stated classes of imported acceptable fill excluding topsoil Class 5B.

42 The measurement of other stated classes of imported acceptable fill, other than topsoil Class 5B, shall be the volume of the void filled with the stated class of imported acceptable fill to the outline stated in the Contract.

43 The measurement of imported topsoil Class 5B shall be the volume of topsoil calculated from the areas and thicknesses to be topsoiled less the volume of topsoil Class 5A excavated from within the Site and measured in accordance with paragraph 15(a) of this Series. Notwithstanding paragraph 45(j) and (k) of this Series, when an item for imported topsoil is measured, corresponding items for placing shall be measured under paragraphs 77 to 81 inclusive of this Series for Topsoiling and Storage of Topsoil.

Itemisation

44 Separate items shall be provided for imported acceptable fill in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Imported acceptable material.
	2 Other stated classes of imported acceptable fill.
	3 Imported topsoil Class 5B
II	1 Embankments and other areas of fill.
	2 Strengthened embankments.
	3 Reinforced earth structures.
	4 Anchored earth structures.
	5 Landscape areas.
	6 Environmental bunds.
	7 Fill to structures.
	8 Fill above structural concrete foundations.
	9 Fill on sub-base material, base and capping.
	10 Fill on bridges (under footways, verges, and central reserves).
	11 Upper bedding to corrugated steel buried structures and the like.
	12 Lower bedding to corrugated steel buried structures and the like.

-
- | | |
|----|--|
| 13 | Surround to corrugated steel buried structures and the like. |
| 14 | Fill above corrugated steel buried structures and the like. |
-

Note: Group I Feature 3 imported topsoil Class 5B shall not be separately identified by any Group II feature.

Imported Fill

45 The items for imported fill shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) protection of subgrade;
- (b) multiple handling of material;
- (c) keeping earthworks free of water;
- (d) complying with requirements and constraints on the sequence, timing and rate of deposition and filling, and equalisation of earth pressures;
- (e) complying with the special requirements for materials requiring special treatments;
- (f) complying with the particular requirements and constraints with regard to soil stabilisation, reinforced earth structures, strengthened embankments, anchored earth structures, corrugated steel buried structures and the like;
- (g) taking precautions to avoid damage to property, structures, sewers, drains, services, instrumentation and the like;
- (h) fill provided by the Contractor from sources outside the Site;
- (i) replacing acceptable material rendered unacceptable;
- (j) selection of material of stated Classes and layering or depositing in locations stated in the Contract;
- (k) depositing fill to slope away from vertical drainage layers and measures to prevent surface water entering such layers;
- (l) trimming and shaping to levels and contours;
- (m) imported fill resulting from settlement and penetration of landscape areas, environmental bunds and other areas of fill, and from the first 75 mm of settlement and penetration of embankments;
- (n) reports.

Compaction of Fill

Units

46 The unit of measurement shall be:

- (i) compaction of fill cubic metre.

Measurement

47 The measurement of compaction of fill in embankments and other areas of fill, in strengthened embankments, in reinforced earth structures, in anchored earth structures, in landscape areas and in environmental bunds shall be the volume of the embankment or void filled from Existing Ground Level up to the Earthworks

Outline plus, where required by the Contract, the volume of:

- (a) the void formed by the removal of topsoil Class 5A beneath the fill in question, and included in the measurement under paragraph 15(a) of this Series;
- (b) the void formed by excavation for the fill in question:
 - (i) below the Earthworks Outline included in the measurement under paragraph 15(b)(i) of this Series; and
 - (ii) below Existing Ground Level included in the measurement under paragraph 15(b) (ii) of this Series;
- (c) surcharge, being the void filled from the Earthworks Outline up to the profile stated in the Contract to which the surcharge is required to be constructed;

less in each case the volume of any compaction of fill to structures, and bedding and surround to corrugated steel buried structures and the like included in the volume so obtained and which is measured separately under paragraph 49 of this Series.

48 The measurement of compaction of fill above structural concrete foundations shall be the volume of the void measured in accordance with paragraph 15(d) of this Series less the volume of the structural foundation and structure within that void.

49 The measurement of compaction of:

- (a) fill to structures;
- (b) fill on sub-base material, base course and capping;
- (c) fill on bridges (under footways, verges and central reserves);
- (d) bedding to corrugated steel buried structures and the like;
- (e) surround to corrugated steel buried structures and the like;

in each case, shall be the volume of the voids filled to the outline stated in the Contract less the volume of corrugated steel buried structures and the like within that void.

50 Compaction of Class 1C and 6B materials shall be separately measured only where Class 1C or 6B material as such is specifically stated by the Contract to be required to be placed in a particular location.

Itemisation

51 Separate items shall be provided for compaction of fill in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Compaction.
II	1 Acceptable material.
	2 Acceptable material Class 1C.
	3 Acceptable material Class 6B.
III	1 Embankments and other areas of fill.
	2 Strengthened embankments.
	3 Reinforced earth structures.

- 4 Anchored earth structures.
- 5 Landscape areas.
- 6 Environmental bunds.
- 7 Fill to structures.
- 8 Fill above structural concrete foundations.
- 9 Fill on sub-base material, base course and capping.
- 10 Fill on bridges (under footways, verges and central reserves).
- 11 Upper bedding to corrugated steel buried structures and the like.
- 12 Lower bedding to corrugated steel buried structures and the like.
- 13 Surround to corrugated steel buried structures and the like.
- 14 Fill above corrugated steel buried structures and the like.

Compaction of Fill

52 The items for compaction of fill shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) protection of subgrade;
- (b) multiple handling of material;
- (c) keeping earthworks free of water;
- (d) complying with requirements and constraints on the sequence, timing and rate of deposition and filling, and equalisation of earth pressures;
- (e) complying with the requirements for materials requiring special treatment;
- (f) complying with the particular requirements and constraints with regard to soil stabilisation, reinforced earth structures, strengthened embankments, anchored earth structures, corrugated steel buried structures and the like;
- (g) taking precautions to avoid damage to property, structures, sewers, drains, services, instrumentation and the like;
- (h) spreading and levelling;
- (i) trial areas, trials and demonstrations;
- (j) making good after sampling and testing;
- (k) forming and trimming side slopes, benchings and berms;
- (l) treatment of side slopes and berms;
- (m) compaction of fill resulting from settlement and penetration of landscape areas, environmental bunds and other areas of fill, and from the first 75 mm of settlement and penetration of embankments;
- (n) blinding.

Soil Stabilisation

Units

53 The unit of measurement shall be:

- (i) soil stabilisation cubic metre.

Measurement

54 The measurement of soil stabilisation shall be the volume of the material to be stabilised measured to the outlines stated in the Contract irrespective of the number of layers or thicknesses, methods or sequences of operations involved in stabilising the material to the depth required.

Note: Soil stabilisation means the process of stabilisation whether the material is intact and undisturbed or deposited and compacted prior to stabilisation.

Excavation, fill, import, disposal, deposition and compaction required to expose or produce the layer to be stabilised, as appropriate, shall be included under the measurement of earthworks elsewhere in this Series.

Excavation, deposition and compaction involved in the process of stabilization itself shall not be measured.

Itemisation

55 Separate items shall be provided for soil stabilisation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Soil stabilisation.
II	1 Capping.
III	1 Cement.
	2 Lime.

Soil Stabilisation with Cement, Soil Stabilisation with Lime

56 The items for soil stabilisation shall in accordance with the Peambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);
- (b) deposition (as this Series paragraph 33);
- (c) compaction of fill (as this Series paragraph 52);
- (d) pulverising, measuring and mixing;
- (e) laps and joints;
- (f) curing, protection and sealing;
- (g) shaping to cambers, falls and crowns;
- (h) edge supports;
- (i) additional fill, deposition, compaction or disposal resulting from the process of stabilisation;
- (j) additional fill and stabilisation resulting from the first 75 mm of settlement and penetration of embankments.

Geotextiles

- Units** **57** The unit of measurement shall be:
- (i) geotextile square metre.
- Measurement** **58** The measurement of geotextile shall be the developed area of the geotextile measured to the limits stated in the Contract.
- Itemisation** **59** Separate items shall be provided for geotextile in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Geotextile.
II	1	Different types.
III	1	Different grades.

- Geotextile** **60** The items for geotextile shall in accordance with the Preambles to Bill of Quantities General Directions include for:
- Item coverage** (a) cleaning, trimming, regulating and preparing surfaces;
- (b) laps;
- (c) measures to protect material;
- (d) cutting, jointing, sealing and fixing;
- (e) securing material in place;
- (f) complying with the requirements of strengthened earthworks.
- (g) turn ups and overlaps at edges

Soft Spots and Other Voids

- Units** **61** The unit of measurement shall be:
- (i) soft spots, other voids cubic metre.
- Measurement** **62** The measurement of soft spots and other voids shall be the volume of the voids directed to be excavated or filled. Soft spots and other voids shall be measured separately from the main excavation or filling where the volume:
- (a) below structural foundations, foundations for corrugated steel buried structures or in side slopes of cuttings is less than 1 cubic metre;
- (b) elsewhere is less than 25 cubic metres.
- Itemisation** **63** Separate items shall be provided for soft spots and other voids in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Excavation of soft spots and other voids.
	2	Filling of soft spots and other voids.
II	1	Below cuttings or under embankments.

	2	In side slopes.
	3	Below structural foundations and foundations for corrugated steel buried structures.
	III	1 Different types of fill.
Excavation of Soft Spots and Other Voids	64	The items for excavation of soft spots and other voids shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage	(a)	excavation of acceptable material (as this Series paragraphs 17 and 18);
	(b)	excavation of unacceptable material (as this Series paragraph 19);
	(c)	disposal of material (as this Series paragraph 39);
	(d)	trimming back cutting faces.
Filling of Soft Spots and Other Voids	65	The items for filling of soft spots and other voids shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage	(a)	deposition of fill (as this Series paragraph 33);
	(b)	compaction of fill (as this Series paragraph 52);
	(c)	formwork (as Series 1700 paragraph 15);
	(d)	treatment of cutting faces;
	(e)	in situ concrete (as Series 1700 paragraph 5).
		Disused Sewers, Drains, Cables, Ducts, Pipelines and the Like Occurring at Formation or Sub-formation Level; Disused Basements, Cellars and the Like and Gullies
Definition	66	The term 'services' in paragraphs 67 to 72 inclusive shall be deemed to include sewers, drains, cables, ducts, pipelines and the like, together with associated chambers, fittings etc. Units
	67	The units of measurement shall be:
	(i)	removal of disused services linear metre.
	(ii)	backfilling disused services cubic metre.
	(iii)	backfilling disused basement, cellar and the like cubic metre.
	(iv)	backfilling disused gullies number.
Measurement	68	The measurement of removal of disused services shall be applied only to those existing services occurring at or below formation or sub-formation level in cutting and/or which are specifically stated in the Contract to be removed. The measurement shall be the distance along the centre line of the route of the services and, unless stated otherwise in the Contract no deduction shall be made for chambers and the like.
		The measurement of backfilling disused services shall be applied only to those

existing services occurring at or below formation or sub-formation level in cutting and/or which are specifically stated in the Contract to be backfilled. The measurement shall be the volume of the void directed to be filled, and unless stated otherwise in the Contract shall include chambers and the like. The removal or backfilling of other disused services occurring elsewhere in the Works shall not qualify for separate measurement under this paragraph.

69 The measurement of backfilling disused basements, cellars and the like shall be the volume of the void directed to be filled. The measurement of backfilling disused gullies shall be the complete operation.

Itemisation

70 Separate items shall be provided for removal, backfilling disused services, backfilling disused basements, cellars and the like and gullies in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Removal.
	2	Backfilling.
II	1	Different types.
III	1	Different sizes.
IV	1	Disused service with one metre or less of cover to formation level.
	2	Disused service exceeding one metre and not exceeding two metres of cover to formation level, and so on in steps of one metre.
	3	Disused basement, cellar and the like.
	4	Disused gully.
V	1	Different materials.

Note: Group IV Features 3 and 4 shall not be applied to Group I Feature 1.

Removal of Disused

71 The items for removal of disused services shall be in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);
- (b) excavation of unacceptable material (as this Series paragraph 19);
- (c) breaking up beds, haunches and surrounds;
- (d) disposal of material (as this Series paragraph 39);
- (e) sealing ends of services;
- (f) credit value of materials.

Backfilling, Disused Services, Basements, Cellars and the Like and Gullies

72 The items for backfilling disused services, basements, cellars and the like and gullies shall in accordance with the Preambles to Bill of Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) compaction (as this Series paragraph 52);
- (b) perforation of existing slabs and cleaning;
- (c) in situ concrete (as Series 1700 paragraph 5);
- (d) reinforcement (as Series 1700 paragraph 26);

- (e) formwork (as Series 1700 paragraph 15);
- (f) sealing ends of services;
- (g) grouting.

Supports Left in Excavation

- Units **73** The unit of measurement shall be:
- (i) supports left in excavation square metre.
- Measurement **74** The measurement of supports left in excavation shall be the area of face directed to be left with supports in position.
- Itemisation **75** Separate items shall be provided for supports left in excavation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Supports.
II	1	Timber.
	2	Steel.
III	1	Different types.

- Supports Left in Excavation** **76** The items for supports left in excavation shall in accordance with the Preambles to Bill of Quantities General Directions include for:
- Item coverage (a) struts, wallings and the like and working around them.

Topsoiling and Storage of Topsoil

- Units **77** The units of measurement shall be:
- (i) topsoiling..... square metre.
 - (ii) permanent storage of topsoil cubic metre.
- Measurement **78** The measurement of the topsoiling shall be the area of the surface to be topsoiled and shall include topsoil Class 5A excavated from within the site and imported topsoil Class 5B. The measurement of the permanent storage of topsoil shall be the volume of topsoil Class 5A excavated from within the Site and measured in accordance with paragraph 15(a) of this Series less the volume of topsoil calculated from the areas and thicknesses to be topsoiled.
- Itemisation **79** Separate items shall be provided for topsoiling in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Topsoiling of different thicknesses.
	2	Permanent storage of topsoil.
II	1	Surfaces sloping at 10o or less to the horizontal.
	2	Surfaces sloping at more than 10o to the horizontal.

Note: Group I feature 2 shall not be identified by any Group II feature.

Topsoiling

80 The items for topsoiling shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) the removal of debris;
- (b) taking delivery of imported topsoil;
- (c) excavation from stockpile;
- (d) loading into transport;
- (e) haulage, deposition, spreading, levelling and compaction;
- (f) trimming and shaping to levels and contours;
- (g) herbicide treatment.

Permanent Storage of Topsoil

81 The items for permanent storage of topsoil shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation from stockpile;
- (b) loading into transport;
- (c) hauling, deposition, spreading, levelling and compaction in permanent storage area;
- (d) trimming and shaping to levels and contours;
- (e) multiple handling of material.

Grass seeding and Turfing

Units

82 Unit of measurement shall be:

- (i) grass seeding, turfing square metre

Itemisation

83 Separate items shall be provided for grass seeding and turfing in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Grass Seeding
	2	Turfing
	3	Hydraulic mulch grass seeding
II	1	Surfaces sloping at 10 °C or less to the horizontal
	2	Surface slopping at more than 10 °C to the horizontal
III	1	Turfing in two layers
IV	1	Different mixture

Grass seeding and Turfing

84 The item for grass seeding and turfing topsoil shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item Coverage

- (a) freeing surfaces of areas to be grassed or turfed from stones and other debris and reducing the soil to a tilth immediately prior to grassing;
- (b) fertilising including additional plant nutrients
- (c) mowing and clearance of grass cuttings;

- (d) pegging and wiring of turfs;
- (e) raking, watering, retaining agent and herbicide treatment;
- (f) additives;

Completion of Formation and Sub-formation

Units

85 The unit of measurement shall be:

- (i) completion of formation, sub-formation square metre.

Measurement

86 The measurement of completion of formation shall be the area of the surface immediately beneath the sub-base except that where capping is required the measurement shall be the area of the surface of the capping excluding sloping sides and edges.

The measurement of completion of sub-formation shall be the area of the surface immediately beneath capping.

Completion of formation and sub-formation on Classes 1C and 6B materials shall be measured separately only when the Contract states specifically that those materials are to be provided at formation or sub-formation level.

Itemisation

87 Separate items shall be provided for completion of formation and sub-formation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Completion of sub-formation.
	2	Completion of formation.
II	1	On material other than Class 1C, 6B or rock in cuttings.
	2	On Class 1C material.
	3	On Class 6B material.
	4	On rock in cuttings.

Completion of Formation and Sub-formation

88 The items for completion of formation and sub-formation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) removal of protective layer, mud and slurry;
- (b) compaction;
- (c) cleaning, trimming, regulating, making good and rolling;
- (d) cement bound materials;
- (e) excavation, processing, compaction of naturally occurring Hard Material;
- (f) measures to protect formation and sub-formation against deterioration or degradation.

Lining of Watercourses

Units

89 The unit of measurement shall be:

- (i) lining of watercourses square metre.

Measurement **90** The measurement of lining of watercourses shall be the permanently exposed face area of the work.

The measurement of bagwork shall be the flat undeveloped area of the work.

Itemisation **91** Separate items shall be provided for lining of watercourses in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Lining of new watercourse.
	2	Lining of enlarged watercourse.
	3	Lining of intercepting ditches.
II	1	To inverts.
	2	To side slopes.
III	1	Different types.
IV	1	Different thicknesses.

Lining of Watercourses **92** The items for lining of watercourses shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) bedding and compaction;
 - (b) laying, setting, bedding, jointing, wedging, cutting and pointing;
 - (c) building in pipes;
 - (d) concrete (as Series 1700 paragraphs 5 and 10);
 - (e) formwork (as Series 1700 paragraph 15);
 - (f) reinforcement (as Series 1700 paragraph 26);
 - (g) bags, filling, staking and securing.
 - (h) blinding concrete (as series 1720 Paragraph 4)

Clearing of Existing Ditches

Units **93** The unit of measurement shall be:

- (i) clearing of existing ditches linear metre.

Measurement **94** The measurement of clearing of existing ditches shall be the length along the centre line of the ditch.

Itemisation **95** Separate items shall be provided for clearing of existing ditches in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Clearing of existing ditches.
II	1	Different locations.

Clearing of Existing Ditches **96** The items for clearing of existing ditches shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);

- (b) excavation of unacceptable material (as this Series paragraph19);
- (c) disposal of material (as this Series paragraph39);
- (d) clearing debris and vegetable growth;
- (e) trimming side slopes and grading bottoms;
- (f) maintaining existing outfalls.

Ground Improvement - Establishment of Plant

Units

97 The unit of measurement shall be:

- (i) establishment of ground improvement plant item.

Measurement

98 The establishment of ground improvement plant shall be measured once only to each separate location for each method of ground improvement on the Site. Any additional establishment of plant to suit the Contractor's method of working shall not be measured.

Itemisation

99 Separate items shall be provided for establishment of ground improvement plant in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Establishment of dynamic compaction plant.
	2	Establishment of vibrated stone columns plant.
II	1	Different locations.

Establishment of Ground Improvement Plant

100 The items for establishment of ground improvement plant shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) bringing plant and equipment to the location of the ground improvement;
- (b) erecting and setting up plant and equipment including site preparation, levelling, and access ramps;
- (c) moving and setting up plant and equipment at each position including site preparation, levelling and access ramps;
- (d) dismantling and removing plant and equipment from the Site on completion.

Ground Improvement - Dynamic Compaction

Units

101 The units of measurement shall be:

- (i) dynamic compaction linear metre.
- (ii) dynamic compaction plant standing time hour.
- (iii) granular blanket tonne.

Measurement

102 The measurement of dynamic compaction shall be the sum of the distances through which the pounder is required to fall. The distance for each drop shall be the vertical measurement from the underside of the pounder immediately prior to release, to the level of the ground beneath the pounder immediately prior to the first drop at that point.

103 The measurement of dynamic compaction plant standing time shall be for the period or periods of standing time ordered by the Overseeing Organisation. Periods of less than half an hour shall not be measured. Any other standing time due to the Contractor's method of working, necessitated by the process of ground improvement provided for in the Contract or other than that ordered by the Overseeing Organisation shall not be measured.

104 The measurement of granular blanket shall be the tonnage of material certified by the Overseeing Organisation, being only that material included on delivery tickets which is incorporated within the Permanent Works in the locations to the extent and thicknesses stated in the Contract or ordered by the Overseeing Organisation.

Itemisation

105 Separate items shall be provided for dynamic compaction, dynamic compaction plant standing time, and granular blanket in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Dynamic compaction.
	2	Dynamic compaction plant standing time.
	3	Granular blanket.
II	1	Trial compaction.
	2	Main compaction.
III	1	Different weight of pounder.
IV	1	Different materials.

Note: Group II and III features shall be applied only to Group I Feature 1.

Dynamic Compaction

106 The items for dynamic compaction shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparation and levelling prior to placing the granular blanket;
- (b) pounding;
- (c) filling craters with adjacent material and compaction;
- (d) keeping earthworks free of water;
- (e) compaction of surface after the final pass;
- (f) complying with particular requirements and constraints;
- (g) keeping records;
- (h) extracting buried pounder.

Dynamic Compaction Plant Standing Time

107 The items for dynamic compaction plant standing time shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) ancillary plant;
- (b) equipment and operatives;
- (c) periods of less than half an hour.

Granular Blanket

108 The items for granular blanket shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- (a) deposition of fill (as this Series paragraph 33);
- (b) compaction of fill (as this Series paragraph 52).

Ground Improvement - Vibrated Stone Columns

Units

109 The units of measurement shall be:

- (i) vibrated stone columns linear metre.
- (ii) vibrated stone column plant standing time hour.

Measurement

110 The measurement of vibrated stone columns shall be the length measured along the axis of the stone column from the maximum depth of the vibrator tip to the specified finished level.

111 The measurement of vibrated stone column plant standing time shall be for the period or periods of standing time ordered by the Overseeing Organisation. Periods of less than half an hour shall not be measured. Any other standing time due to the Contractor's method of working, necessitated by the process of ground improvement provided for in the Contract or other than that ordered by the Overseeing Organisation shall not be measured.

Itemisation

112 Separate items shall be provided for vibrated stone columns and vibrated stone columns plant standing time in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Vibrated stone columns.
	2	Vibrated stone columns plant standing time.
II	1	Different minimum diameters.
III	1	Different methods of installation.
IV	1	Columns not exceeding 5 metres in length.
	2	Columns exceeding 5 metres in length but not exceeding 10 metres and so on in steps of 5 metres.

Note: Group II, III and IV features shall be applied only to Group I Feature 1.

Vibrated Stone Columns

113 The items for vibrated stone columns shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) complying with design criteria;
- (b) certificates;
- (c) provision of data and drawings;
- (d) resubmissions and modifications;
- (e) amendments to the Works;
- (f) air or water supply;
- (g) effluent/slurry disposal;

- (h) precautions to prevent ingress of surface water or foreign matter;
- (i) preliminary treatment areas;
- (j) trial areas;
- (k) demonstrations;
- (l) site control, observations, records and reports;
- (m) additional stone required due to penetration into surrounding ground.

**Vibrated Stone Columns
Plant Standing Time**

114 The items for vibrated stone columns plant standing time shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) ancillary plant;
- (b) equipment and operatives;
- (c) periods of less than half an hour.

Gabion Walling and Mattresses

Units

115 The unit of measurement shall be:

- (i) gabion walling, mattresses cubic metre.

Measurement

116 The measurement of gabion walling and mattresses shall be the volume contained within the outline of the gabions or mattresses as stated in the Contract.

Itemisation

117 Separate items shall be provided for gabion walling and mattresses in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Gabion walling.
	2	Mattresses.
II	1	Different mesh materials.
III	1	Different mesh size.
IV	1	Different types of fill.
V	1	Mattresses installed at 10o or less to the horizontal.
	2	Mattresses installed at more than 10o to the horizontal.
VI	1	In environmental bunds.

**Gabion Walling and
Mattresses**

118 The items for gabion walling and mattresses shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) assembling, tying, fixing, staking and tensioning;
- (b) fill, compaction and finishes;
- (c) mesh including cutting and folding to form special units and shapes;
- (d) bracing and wiring lids.

Crib Walling

- Units** **119** The unit of measurement shall be:
- (i) crib walling square metre.
- Measurement** **120** The measurement shall be the flat undeveloped area of crib walling. No deduction shall be made for openings within the wall which are part of the modular system, nor for other openings of one square metre or less.
- Itemisation** **121** Separate items shall be provided for crib walling in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Crib walling.
II	1	Different types.
III	1	Curved on plan.
IV	1	With a battered face.
V	1	Different finishes.
VI	1	Different infill.

- Crib Walling** **122** The items for crib walling shall in accordance with the Preamble to Bill of Quantities General Directions include for:

- Item coverage** (a) bedding and jointing;
- (b) dowels and pins;
- (c) granular infill and compaction;
- (d) special units and forming ends and corners;
- (e) obtaining manufacturer's certificate and supplying copy to the
Overseeing Organisation;
- (f) building in pipes and forming small openings.

Filling and Caps to Mine Working, Well, Swallow Hole and the Like

- Units** **123** The units of measurement shall be:
- (i) filling to mine working, well, swallow hole and the like
tonne.
- (ii) caps to mine working, well, swallow hole and the like cubic
metre.

- Measurement** **124** The measurement of filling to mine working, well, swallow hole and the like shall be calculated from the tonnage of material certified by the Overseeing Organisation, being only that material, included on delivery tickets, which is incorporated in the Permanent Works in the locations and to the extent and thickness required by the Contract. Material in excess of the requirements of the Contract and material used for any other purpose shall not be included within the certified tonnage.

- 125** The measurement of caps to mine working, well, swallow hole and the like shall be the volume of concrete forming the caps.

Itemisation

126 Separate items shall be provided for filling and caps to mine working, well, swallow hole and the like in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Filling.
	2	Caps.
II	1	Mine working.
	2	Well.
	3	Swallow hole and the like.
III	1	Different materials.

Filling and Caps to Mine Working, Well, Swallow Hole and the Like

127 The items for filling and caps to mine working, well, swallow hole and the like shall in accordance with the Preambles to Bill of Quantities and the like. Directions include for:

Item coverage

- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);
- (b) excavation of unacceptable material (as this Series paragraph 19);
- (c) backfilling and compaction;
- (d) concrete (as Series 1700 paragraphs 5 and 10);
- (e) formwork including permanent formwork (as Series 1700 paragraph 15);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) flushing;
- (h) disposal of material (as this Series paragraph 39);
- (i) investigation and monitoring;
- (j) material not used as filling.

Ground Anchorages - Ground Anchorage Plant

Units

128 The unit of measurement shall be:

- (i) establishment of ground anchorage plant item.

Measurement

129 The establishment of ground anchorage plant shall be measured once only to each separate location of ground anchorages on the Site. Any additional establishment of ground anchorage plant to suit the Contractor's method of working shall not be measured.

Itemisation

130 Separate items shall be provided for ground anchorage plant in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Establishment of ground anchorage plant.
II	1	Different locations.

Establishment of Ground Anchorage Plant

131 The items for establishment of ground anchorage plant shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) bringing plant and equipment to the location of ground anchorages;
 - (b) erecting and setting up plant and equipment including site preparation, levelling and access ramps;
 - (c) moving and setting up plant and equipment at each position including site preparation, levelling and access ramps;
 - (d) dismantling and removing plant and equipment from Site on completion.

Ground Anchorages

Units **132** The unit of measurement shall be:

- (i) ground anchorages linear metre.

Measurement **133** The measurement of ground anchorages shall be for the complete anchorage assembly and shall be the length from the bottom of the fixed anchorage to the bearing face.

Itemisation **134** Separate items shall be provided for ground anchorages in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Ground anchorages.
II	1	Different types.
III	1	Different capacities.
IV	1	Not exceeding 5 metres in length.
	2	Exceeding 5 metres in length but not exceeding 10 metres in length and so on in steps of 5 metres.
V	1	Trial anchorages.
	2	Main anchorages.

Ground Anchorages **135** The items for ground anchorages shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) design;
 - (b) provision of data and drawings;
 - (c) certificates;
 - (d) resubmissions and modifications;
 - (e) amendments to the Works;
 - (f) boring, augering, lining, under-reaming, removing and disposing of material;
 - (g) cables, wires or strands with couplers, binders and spacers;
 - (h) anchorages, bearing plates, reinforcing helices, grout inlets, vents and the like;
 - (i) applying water under pressure and proving watertightness of boreholes;

- (j) flushing borehole, cleaning and preparation;
- (k) protective system (as Series 1900 paragraph 4);
- (l) grouting ground anchorages including fixed length and free stressing length;
- (m) applying prestress in one or more stages;
- (n) checking the accuracy of load measuring equipment and adjusting;
- (o) taking observations and compiling a record of stressing and grouting operations and supplying one copy to the Overseeing Organisation;
- (p) measures to prove anchorage suitability.
- (q) proof loading
- (r) facilities for Engineers's poof loading;

Ground Anchorages - Waterproofing Anchorage Boreholes

Units

136 The unit of measurement shall be:

- (i) waterproofing of boreholes linear metre.

Measurement

137 The measurement of waterproofing of boreholes shall be the total length of waterproofing operation instructed by the Overseeing Organisation.

Itemisation

138 Separate items shall be provided for waterproofing of boreholes in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Waterproofing of boreholes.
II	1	Standard grouting.
	2	Pressure grouting.

Waterproofing of Boreholes

139 The items for waterproofing of boreholes shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) pre-grouting;
- (b) re-drilling and applying water under pressure and proving watertightness of borehole.

Instrumentation and Monitoring - Boring Plant

Units

140 The unit of measurement shall be:

- (i) establishment of boring plant item.

Measurement

141 The establishment of boring plant shall be measured once only to each separate location of boring on the Site. Any additional establishment of boring plant to suit the Contractor's method of working shall not be measured.

Itemisation

142 Separate items shall be provided for boring plant in accordance with

Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Establishment of boring plant.
II	1	Different locations.

Establishment of Boring Plant

143 The items for establishment of boring plant shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) bringing plant and equipment to the location of boring;
- (b) erecting and setting up plant and equipment including site preparation, levelling and access ramps;
- (c) moving and setting up plant at each position including site preparation, levelling, and access ramps;
- (d) dismantling and removing plant and equipment from Site on completion.

Instrumentation and Monitoring - Boring Holes

Units

144 The unit of measurement shall be:

- (i) boring holes linear metre.

Measurement

145 The measurement of boring holes shall be the linear distance along the axis of the borehole between the instrument base and the level stated in the Contract.

Itemisation

146 Separate items shall be provided for boring holes in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Boring holes.
II	1	Vertical.
	2	Raking.
III	1	Depth not exceeding 10 metres.
	2	Depth exceeding 10 metres but not exceeding 20 metres and so on in steps of 10 metres.

Boring Holes

147 The items for boring holes shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) boring holes in any material, including changing bits and tools;
- (b) disposal of material (as this Series paragraph 39);
- (c) taking measures to deal with the presence of water in the boreholes;
- (d) drilling fluid;
- (e) standing time including ancillary plant, equipment and operatives.

Instrumentation and Monitoring - Instrumentation

Units

148 The units of measurement shall be:

- (i) installation of instruments number.
- (ii) installation of tubing, cabling and the like linear metre.
- (iii) grouting linear metre.

Measurement

149 The measurement of installation of instruments shall be the complete installation.

The measurement of tubing and the like shall be the length measured from the instrument to the underside of the screw cap, plug or the like, along the centre line of the trench or borehole.

The measurement of cabling and the like shall be the length measured from the instrument to the base of the instrument hut or cabinet along the centre line of the trench or borehole.

The measurement of grouting shall be the distance from the top of the seal to either the bottom of the trench or to the underside of the screw cap plug or the like whichever is the lower.

Itemisation

150 Separate items shall be provided for instrumentation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Installation.
II	1	Different types of instruments.
	2	Different types of tubing or cabling.
	3	Different types of grouting.
III	1	Length or depth not exceeding 10 metres.
	2	Length or depth exceeding 10 metres but not exceeding 50 metres, and so on in steps of 50 metres.

Installation of Instruments

151 The items for installation of instruments shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) recording water levels;
- (b) cleaning and keeping hole free of deleterious materials;
- (c) connections and joints;
- (d) keeping items clean during installation;
- (e) sand filters including allowing time for settlement;
- (f) removing contaminated water;
- (g) recording data and supplying one copy to the Overseeing Organisation;
- (h) proving correct functioning;
- (i) bedding and surround.

Installation of Tubing and Cabling

152 The items for installation of tubing and cabling shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) standpipes;
- (b) cutting and jointing tubing including fittings and screw caps;
- (c) connections and joints;
- (d) excavation in any material (as this Series paragraphs 17, 18, 19 and 23);
- (e) bedding and surround to cable or tube;
- (f) backfilling and compaction;
- (g) marking tape or cable covers;
- (h) extra length of cable for connection to monitoring equipment;
- (i) twisting and snaking;
- (j) incremental installation;
- (k) ducts (as Series 500 paragraph 16).

Grouting

153 The items for grouting shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) mixing and placing;
- (b) in situ concrete (as Series 1700 paragraph 5);
- (c) formwork (as Series 1700 paragraph 15);
- (d) backfilling and compaction;
- (g) disposal of material (as this Series paragraph 39);
- (h) covers, frames, seatings and bedding;
- (i) locks and keys.

Instrumentation and Monitoring - Instrument Hut or Cabinet

Units

154 The unit of measurement shall be:

- (i) erection, servicing, dismantling of instrument hut or cabinet .
..... item.

Itemisation

155 Separate items shall be provided for instrument hut or cabinet in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

- | | | |
|---|---|--------------|
| I | 1 | Erection. |
| | 2 | Servicing. |
| | 3 | Dismantling. |

II	1	Instrument hut for the Overseeing Organisation.
	2	Instrument cabinet for the Overseeing Organisation.
III	1	Until completion of the works.
	2	After completion of the works.

Erection of Instrument Hut

156 The items for erection of instrument hut shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparation of site;
- (b) foundations, bases and hardstandings;
- (c) heating, power, water and lighting services;
- (d) security fence and lockable gates;
- (e) furnishings and fittings;
- (f) locks and keys.

Servicing Instrument Hut

157 The items for servicing instrument hut shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) depreciation and maintenance of building, services and fences;
- (b) depreciation and maintenance of furnishings, fittings and supplies.

Dismantling Instrument Hut

158 The items for dismantling instrument hut shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) receiving back from the Overseeing Organisation and removing furnishings and fittings;
- (b) disconnecting, removing and sealing off disused services;
- (c) demolishing and removing including hardstandings, fences and gates;
- (d) disposal of material (as this Series paragraph 39);
- (e) reinstatement of the site.

Erection of Instrument Cabinet

159 The items for erection of instrument cabinet shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparation of site;
- (b) foundations and bases;
- (c) power and water services;
- (d) locks and keys.

Servicing of Instrument Cabinet

160 The items for servicing of instrument cabinet shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) depreciation and maintenance of cabinet and services;
- (b) depreciation and maintenance of fittings and supplies;

(c) servicing.

Dismantling of Instrument Cabinet

161 The items for dismantling of instrument cabinet shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) disconnecting, removing, and sealing off disused services;
- (b) removing instrument cabinet off Site;
- (c) breaking up and removal of foundations, and bases, and disposal of surplus material;
- (d) disposal of material (as this Series paragraph 39);
- (e) reinstatement of the site.

Instrumentation and Monitoring - Monitoring Equipment

Units

162 The unit of measurement shall be:

- (i) monitoring equipment item.

Itemisation

163 Separate items shall be provided for monitoring equipment in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Monitoring equipment.
II	1	Different types.

Monitoring Equipment

164 The items for monitoring equipment shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) installing, commissioning, calibrating and maintaining monitoring equipment in instrument hut or cabinet;
- (b) installing, commissioning, calibrating and maintaining monitoring equipment in vehicles for the Overseeing Organisation;
- (c) copies of reports and results and supplying to the Overseeing Organisation;
- (d) instructing the Overseeing Organisation's staff in the operation and maintenance of the instrumentation;
- (e) attendance during measurement carried out by the Overseeing Organisation;
- (f) removing on completion.

Ground Water Lowering

Units

165 The unit of measurement shall be:

- (i) ground water lowering item.

Measurement

166 The measurement of ground water lowering shall be the complete installation. Ground water lowering shall be separately measured only where ground water lowering is specifically required in the Contract.

Itemisation

167 Separate items shall be provided for ground water lowering in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Ground water lowering.
II	1	Different locations.

Ground Water Lowering

168 The items for ground water lowering shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparing, amending and submitting proposals to the Overseeing Organisation;
- (b) installation, operation, maintenance and removal of plant;
- (c) making arrangements with owners and occupiers of land temporarily acquired, and cost arising therefrom;
- (d) diversion of rivers and the like;
- (e) soakaways, lagoons and the like;
- (f) measures to safeguard water supplies including liaising with water companies.

Trial Pits

Units

169 The unit of measurement shall be:

- (j) trial pits cubic metre.

Measurement

170 The measurement of trial pits shall be the volume of the void, calculated on the basis of the horizontal area of the bottom of the excavation with the depth being measured from the bottom of the excavation to the level at which excavation is directed to be commenced.

Itemisation

171 Separate items shall be provided for trial pits in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Trial pits.
II	1	0 metres to 3 metres in depth.
	2	0 metres to 6 metres in depth, and so on in steps of 3 metres.

Trial Pits

172 The items for trial pits shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);
- (b) excavation of unacceptable material (as this Series paragraph 19);
- (c) excavation in Hard Material (as this Series paragraph 23);
- (d) locating, working around and supporting pipes, cables, services, apparatus and the like;

- (e) attendance on the Overseeing Organisation and others for inspection and investigation purposes;
- (f) disposal of material (as this Series paragraph 39);
- (g) backfilling and compaction;
- (h) reinstatement of surfaces.

Breaking Up and Perforation of Redundant Pavements

Units

173 The unit of measurement shall be:

- (i) breaking up of redundant pavements, perforation of redundant pavements square metre.

Measurement

174 The measurement of breaking up and perforation of redundant pavements shall be the areas stated in the Contract to be broken up or perforated and left in place. The depth of the pavement shall be the depth from the existing surface of the pavement to the underside of bituminous or cementitious material.

Itemisation

175 Separate items shall be provided for breaking up and perforation of redundant pavements in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Breaking up of redundant pavements.
	2	Perforation of redundant pavements.
II	1	Different types of pavement.
III	1	Depth not exceeding 100 mm.
	2	Depth exceeding 100 mm but not exceeding 200 mm, and so on in steps of 100 mm.

Breaking up and Perforation of Redundant Pavements

176 The items for breaking up and perforation of redundant pavements shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation in Hard Material (as this Series paragraph 23);
- (b) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like.

Perforation of Redundant Slabs, Basements and the Like

Units

177 The unit of measurement shall be:

- (i) perforation of redundant slabs, basements and the like square metre.

Measurement

178 The measurement of perforation of redundant slabs, basements and the like shall be the areas stated in the Contract to be perforated and left in place.

Itemisation

179 Separate items shall be provided for perforation of redundant slabs, basements and the like in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Perforation of redundant slabs, basements and the like.
II	1	Different types of slabs, basements and the like.
III	1	Thickness not exceeding 100 mm.
	2	Thickness exceeding 100 mm but not exceeding 200 mm, and so on in steps of 100 mm.

**Perforation of Redundant
Slabs, Basements and the
Like**

180 The items for perforation of redundant slabs, basements and the like shall in accordance with the Preambles to Bill of Quantities General
Directions include for:

Item coverage

- (a) excavation in Hard Material (as this Series paragraph 23);
- (b) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like.

Series 700: Pavements

Sub-base (Foundation Course CBM)

Units	1	The unit of measurement shall be:											
	(i)	sub-base square metre.											
Measurement	2	The measurement of sub-base shall be calculated using the width and thickness required by the contractor.											
		Note: See note paragraph 7											
	3	No deduction shall be made for openings of 1 square metre or less.											
Itemisation	4	Separate items shall be provided for sub-base in accordance with Chapter II paragraphs 3 and 4 and the following:											
		<table><tr><th>Group</th><th>Feature</th></tr><tr><td>I</td><td>1 Each group or type of sub-base.</td></tr><tr><td>II</td><td>1 In carriageway, hardshoulder and hardstrip.</td></tr><tr><td></td><td>2 In emergency crossing.</td></tr><tr><td></td><td>3 In lay-by and bus bay.</td></tr></table>		Group	Feature	I	1 Each group or type of sub-base.	II	1 In carriageway, hardshoulder and hardstrip.		2 In emergency crossing.		3 In lay-by and bus bay.
Group	Feature												
I	1 Each group or type of sub-base.												
II	1 In carriageway, hardshoulder and hardstrip.												
	2 In emergency crossing.												
	3 In lay-by and bus bay.												
Sub-base	5	The items for sub-base shall in accordance with the Preambles to Bill of Quantities General Directions include for:											
Item coverage		<div><div>(a)</div><div>trial areas and trials;</div></div> <div><div>(b)</div><div>making good after sampling and testing;</div></div> <div><div>(c)</div><div>protection of material in transit and while awaiting tipping;</div></div> <div><div>(d)</div><div>designing and verifying mixes</div></div> <div><div>(e)</div><div>grading, measuring, mixing and depositing materials;</div></div> <div><div>(f)</div><div>spreading and compaction;</div></div> <div><div>(g)</div><div>cleaning, preparing and working on or up to existing surfaces and features;</div></div> <div><div>(h)</div><div>curing and protection;</div></div> <div><div>(i)</div><div>edge support;</div></div> <div><div>(j)</div><div>maintenance of surface;</div></div> <div><div>(k)</div><div>induced cracking;</div></div> <div><div>(l)</div><div>taking measures to protect the subgrade and sub-base from deterioration due to the ingress of water and the use of constructional plant;</div></div>											

- (m) taking measures to improve the sub-base to protect the sub-base and subgrade from damage due to the Contractor's method of construction and choice of constructional plant;
- (n) shaping to cambers, falls and crowns;
- (o) provision of soundness test certificate.

Note: As the pavement according to the Directive for the standardization of Pavements for Traffic Areas' includes also the foundation course and the CBM layer, this paragraph 5 may also need items of paragraph 9 of this series.

Pavement

Units

6 The unit of measurement shall be:

- (i) base course, lower base course (unbound material), upper base course (asphalt), binder course, surface course, concrete slab square metre.

Measurement

7 The measurement of base course, lower base course, upper base course, binder course, surface course and concrete slab shall be calculated using the width of the top surface of the course or slab and the required thickness.

Note: The width of the "top surface" of the course or slab shall be the width required by the Contract and shall exclude sloping sides or edges.

No deductions shall be made for openings of 1 square metre or less.

Itemisation

8 Separate items shall be provided for base course, lower base course, upper base course, binder course, surface course and concrete slab in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Pavement.
II	1 Base Course.
	2 Lower base Course.
	3 Upper base Course.
	4 Binder course.
	5 Surface course.
	6 Concrete slab.
III	1 Each group or type.
IV	1 Different thicknesses.
V	1 Reinforced.
VI	1 In carriageway, hardshoulder and hardstrip.
	2 In emergency crossing.
	3 In lay-by and bus bay.
VII	1 In overlay.

Base Course, Lower Base Course Upper Base course, Binder Course, Surface Course and Concrete Slab

9 The items for base course, lower base course, upper base course, surface course and concrete slab shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage	<ul style="list-style-type: none">(a) trial areas and trials;(b) making good after sampling and testing;(c) protection of material in transit and while awaiting tipping;(d) designing and verifying mixes;(e) grading, measuring, reclaiming, mixing and depositing materials;(f) air entrainment;(g) spreading and compaction;(h) cutting back, saw cutting, cleaning, preparing and working on or up to existing surfaces and features;(i) edge support;(j) reinforcement (as Series 1700 paragraph 26);(k) waterproof and separation membranes;(l) chippings;(m) surface texturing;(n) formwork (as Series 1700 paragraph 15);(o) making joints;(p) forming or sawing grooves, cleaning, grit blasting, priming, caulking, temporary and permanent sealing of joints;(q) longitudinal, expansion, contraction, warping and construction joint assemblies, including joint filler and crack inducers, tie and dowel bars, dowel bar cradles, caps and sheaths and inspection of dowel bars and corrosion protection to tie bars and coating to transverse reinforcement;(r) shaping to cambers, falls and crowns;(s) forming sockets, recesses, openings, and bays;(t) curing and protection;(u) protection and masking and unmasking of kerbs, drainage channels, chamber covers, gully gratings, expansion joints, and the like;(v) maintenance of surface;(w) taking measures to protect and maintain the pavement from deterioration by the use of constructional plant and the ingress of water and other materials;
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- (x) anchorages including excavation and disposal, steel beams, ground beams and thickening of slab;
- (y) measures required for aftercare and opening the road to traffic;
- (z) protective system to steel beams (as Series 1900 paragraph 4);
- (aa) slurry sealing, surface dressing, bituminous spray, resin based treatment and tack coat forming integral parts of the pavement;
- (bb) admixtures and additives;
- (cc) retarders, brushing and other measures necessary to provide exposed aggregate textured surface including disposal of surplus mortar arising;
- (dd) saw cutting and sealing bituminous overlays;
- (ee) bond-breaker tape.
- (ff) Construction of longitudinal and transversal joints (edge rolling, joint cutting, blade cutting; hot bitumen)

Regulating Course

Units

10 The units of measurement shall be:

- (i) bituminous regulating course tonne, cubic metre, or square metre.
- (ii) cement bound regulating course tonne, cubic metre or square metre.

Measurement

11 The measurement of bituminous regulating course by tonne shall be calculated from the tonnage of material certified by the Overseeing Organisation.

The tonnage certified by the Overseeing Organisation shall be only that material included on delivery tickets which is incorporated in the Permanent Works in the locations and to the extent and thickness required by the Contract. Material in excess of the requirements of the Contract and material used for any other purpose shall not be included within the certified tonnage.

The measurement of bituminous regulating course by cubic metres or square metres shall be the volume of material or layer thickness measured to the outlines required by the Contract.

12 The measurement of cement bound regulating course shall be the volume of material measured to the outlines required by the Contract.

Itemisation

13 Separate items shall be provided for bituminous regulating courses and cement bound regulating courses in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each group or type of bituminous regulating course.
	2 Each group or type of cement bound regulating course.
II	1 Lower base course.
	2 Upper base course.
	3 Base course.
	4 Binder course.
	5 Surface course.

Bituminous and Cement Bound Regulating Course

14 The items for bituminous and cement bound regulating course shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) base, lower base, upper base, binder course, surface course and concrete slab (as this Series paragraph 9);
 - (b) weighing, tickets and copies;
 - (c) material not laid as regulating course.

Surface Treatment

Units **15** The unit of measurement shall be:

- (i) surface treatment square metre.

Measurement **16** The measurement of surface treatment shall be calculated using the width of the top surface to be treated as described in paragraph 7.

17 Surface treatment shall only be measured separately when the Contract requires a separate or additional surface treatment to be applied to the pavement. Surface treatment forming an integral part of any specified group or type of pavement shall not be separately measured. No deductions shall be made for openings of 1 square metre or less.

Itemisation **18** Separate items shall be provided for surface treatment, in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Slurry sealing.
	2 Surface dressing.
	3 Bituminous spray.
	4 Resin based surface treatment.
II	1 Different types.
III	1 Different colours.
IV	1 Different rates of spread.

Surface Treatment

19 The items for surface treatment shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) trial areas and trials;
 - (b) spreading and rolling deposited materials;
 - (c) tack coat (as this Series paragraph 24);

- (d) in the case of resin based surface treatment certification of spraying equipment and supplying copy of certificate at monthly intervals to the Overseeing Organisation;
- (e) measures required for aftercare and opening road to traffic.

Tack Coat

Units

20 The unit of measurement shall be:

- (i) tack coat square metre.

Measurement

21 For the purposes of measurement any reference to tack coat shall be deemed to include bond coats.

22 Tack coat shall only be measured separately when the Contract requires a separate or additional tack coat to be applied to an existing surface prior to the construction of the following course or treatment. Tack coat forming an integral part of any specified group or type of pavement or surface treatment shall not be separately measured.

Itemisation

23 Separate items shall be provided for tack coat in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Tack coat.
II	1 Different materials.
III	1 Different rates of spread.

Tack Coat

24 The items for tack coat shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) trial areas and trials;
- (b) making good after sampling and testing;
- (c) designing and verifying mixes;
- (d) grading, measuring, mixing and depositing materials;
- (e) making joints;
- (f) cleaning surfaces;
- (g) protection and masking and unmasking of kerbs, drainage channels, chamber covers, gully gratings, expansion joints, road studs, road markings and the like and obtaining clean markings;
- (h) cutting back, preparing and working on or up to adjacent faces, surfaces and features;
- (i) admixtures and additives.

Cold Milling (Planing)

Units	25	The unit of measurement shall be:							
	(i)	milling square metre.							
Measurement	26	The measurement of milling shall be calculated using the width stated in the Contract. No deductions shall be made for openings of 1 square metre or less.							
		Milling carried out as part of a repave recycle process shall not be separately measured.							
Itemisation	27	Separate items shall be provided for milling in accordance with Chapter II paragraphs 3 and 4 and the following:							
		<table><tr><th>Group</th><th>Feature</th></tr><tr><td>I</td><td>1 Milling.</td></tr><tr><td>II</td><td>1 Different thicknesses or depths.</td></tr></table>		Group	Feature	I	1 Milling.	II	1 Different thicknesses or depths.
Group	Feature								
I	1 Milling.								
II	1 Different thicknesses or depths.								
Milling	28	The items for milling shall in accordance with the Preambles to Bill of Quantities General Directions include for:							
Item coverage		(a)	re-shaping and rolling;						
		(b)	shaping to cambers, falls and crowns;						
		(c)	multiple handling of material;						
		(d)	loading into transport;						
		(e)	disposal of material (as Series 600 paragraph 39);						
		(f)	working around drainage channels, chamber covers, gully gratings, expansion joints and the like;						
		(g)	ramps;						
		(h)	removing road studs not required for re-use;						
		(i)	surface preparation and cleaning;						
		(j)	cutting out and removal of material by other means;						
		(k)	water supply and damping down;						
		(l)	electronic detection sweep, referencing and reports.						
		(m)	haulage and deposition in tip off site						

Insitu Recycling - The Remix and Repave Processes

- Units** **29** The unit of measurement shall be:
- (i) reshape recycle process square metre
 - (ii) repave recycle process square metre.
 - (iii) remix recycle process square metre.

Measurement **30** The measurement of insitu recycle processes shall be calculated using the width stated in the Contract. No deductions shall be made for openings of 1 square metre or less.

Itemisation **31** Separate items shall be provided for insitu recycle processes in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Reshape recycle process.
	2 Repave recycle process.
	3 Remix recycle process.
II	1 Different thicknesses or depths.

Insitu Recycling - The Remix and Repave Processes

32 The items for insitu recycle processes shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) milling (as this Series paragraph 28);
 - (b) heating and scarifying;
 - (c) base course, lower base course, upper base course, binder course, surface course and concrete slab (as this Series paragraph 9);
 - (d) make up to low areas and reprofiling;
 - (e) removal of surface dressing;
 - (f) removal of road markings;
 - (g) reports.

Reinstatement of Paved Areas

- Units** **33** The unit of measurement shall be:
- (i) reinstatement of paved area square metre.

Measurement **34** The measurement of reinstatement of paved area shall be calculated using the width of the top surface to be reinstated excluding sides and edges.

No deduction shall be made for openings of 1 square metre or less. The top surface for the following features shall be the widths or areas described below:

- (a) for drains, sewers, piped culverts, service ducts and filter drains - the width shall be the internal diameter of the pipe plus 600 mm;
- (b) for kerbs, channels, edgings, combined drainage and kerb blocks, linear drainage channel systems and the like - the width of the foundations;
- (c) for chambers, gullies, traffic signs, traffic signals, road lighting columns and the like - the horizontal area of the base slab or where no base slab is required the area of the bottom of the excavation.

Itemisation

35 Separate items shall be provided for reinstatement of paved area in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each type of paved area reinstatement.
II	1 Different thicknesses or depths.

Reinstatement of Paved Area

36 The items for reinstatement of paved area shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) determination of the extent of the reinstatement and agreement with the Overseeing Organisation;
- (b) sub-base (as this Series paragraph 5);
- (c) base course, lower base course, upper base course, binder course, surface course and concrete slab (as this Series paragraph 9);
- (d) bituminous and cement bound regulating course (as this Series paragraph 14);
- (e) surface treatment (as this Series paragraph 19);
- (f) kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems (as Series 1100 paragraph 4);
- (g) footways and paved areas (as Series 1100 paragraph 21);
- (h) scarifying;
- (i) milling (as this Series paragraph 28);
- (j) drilling holes;
- (k) tack coat (as this Series paragraph 24);
- (l) bringing to correct levels and surface regularity following settlement.

Thin Bonded Repairs and Joint Repairs to Existing Concrete Carriageway

Units

37 The units of measurement shall be:

- (i) thin bonded repairs square metre.
- (ii) joint repairs linear metre.

(iii) saw-cutting grooves linear metre.

(iv) sealing grooves linear metre.

Measurement

38 The measurement of thin bonded repairs shall be calculated using the plan area of the top surface of each repair patch excluding areas of joint sealant.

39 Thin bonded repairs and joint repairs shall only be measured separately when areas and lengths to be repaired are stated in the Contract.

40 The measurement of saw-cutting grooves shall be the summation of the lengths of saw-cutting grooves stated in the Contract.

41 The measurement of sealing grooves shall be the summation of the lengths of the sealed grooves stated in the Contract.

Itemisation

42 Separate items shall be provided for thin bonded repairs and joint repairs in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Thin bonded repairs.
	2 Joint repairs.
	3 Saw-cutting grooves.
	4 Sealing grooves.
II	1 Each type.
III	1 Individual areas not exceeding 1 square metre on plan.
	2 Individual areas exceeding 1 square metre but not exceeding 2 square metres on plan and so on in steps of 1 square metre.
	3 In individual lengths not exceeding 1 linear metre.
	4 In individual lengths exceeding 1 linear metre but not exceeding 2 linear metres and so on in steps of 1 linear metre.
IV	1 Depth of cut not exceeding 50mm.
	2 Depth of cut exceeding 50mm but not exceeding 75mm and so on in steps of 25 mm.
V	1 Different thicknesses or depths.

**Thin Bonded Repairs and
Joint Repairs**

43 The items for thin bonded repairs and joint repairs shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) determination of the area or length of the repair and agreement with the Overseeing Organisation;
- (b) base course, lower base course, upper base course, binder course, surface course and concrete slab (as this Series paragraph 9);
- (c) removal of any existing joint sealant and caulking material;
- (d) removal of unsound concrete and cutting back reinforcement within the repair area;
- (e) treatment of repair area and surrounds;
- (f) supply and application of clean water;
- (g) wetting and removal of excess water;

- (h) finishing repair material flush with the level of the surrounding concrete slab and brushing and applying surface texture to match existing;
- (i) reinstatement of sub-base;
- (j) disposal of material (as Series 600 paragraph 39).

Saw-cutting Grooves and Sealing Grooves

44 The items for saw-cutting grooves and sealing grooves shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparing;
- (b) cleaning;
- (c) drying;
- (d) bond-breaker tape;
- (e) recording details;
- (f) disposal of material (as Series 600 paragraph 39).

Full Depth Repairs and Bay Replacement Repairs to Existing Concrete Carriageway

Units

45 The units of measurement shall be:

- (i) full depth repairs, bay replacement repairs square metre.
- (ii) reinstatement of sub-base cubic metre, tonne or square metre.

Measurement

46 The measurement of full depth repairs and bay replacement repairs shall be the summation of the individual areas to be repaired as stated in the Contract.

Itemisation

47 Separate items shall be provided for full depth repairs and bay replacement repairs to existing concrete carriageway in accordance with Chapter II Paragraph 3 and 4 and the following:

Group	Feature	
I	1	Full depth repairs.
	2	Bay replacement repairs.
	3	Reinstatement of sub-base.
II	1	In unreinforced slabs.
	2	In reinforced slabs.
III	1	Different thicknesses of slabs.

Full Depth Repairs and Bay Replacement Repairs to Existing Concrete Carriageway

48 The items for full depth repairs and bay replacement repairs to existing concrete carriageway shall in accordance with the Preambles to Bills of Quantities General Directions include for:

Item coverage	<ul style="list-style-type: none"> (a) saw cutting and drilling to full depth; (b) excavation of acceptable material (as Series 600 paragraph 18); (c) excavation of unacceptable material (as Series 600 paragraph 19); (d) excavation in hard material (as Series 600 paragraph 23); (e) disposal of material (as Series 600 paragraph 39); (f) completion of formation (as Series 600 paragraph 88); (g) dowel bars and tie bars including drilling and supports, cleaning, plugging with resin mortar and de-bonding and compressive discs; (h) sub-base (as this Series paragraph 5); (i) separation layer; (j) joint filler board; (k) joint groove forming strip; (l) concrete slab (as this Series paragraph 9).
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Saw Cutting, Cracking and Seating Existing Jointed Reinforced Concrete Pavements

Units	<p>49 The units of measurement shall be:</p> <ul style="list-style-type: none"> (i) removal of existing bituminous overlay square metre. (ii) main trial item. (iii) re-assessment trial number. (iv) saw cutting existing pavement square metre. (v) cracking existing pavement square metre. (vi) seating existing pavement square metre.
Measurement	<p>50 The main trial shall be measured once only for the main trial area stated in the Contract.</p> <p>51 The re-assessment trial shall be measured once only for each time that the defined circumstances in the Contract require that such a trial be carried out as stated in the Contract.</p> <p>52 The measurement of cracking and seating shall be the areas stated in the Contract to be cracked and seated. No deductions shall be made for openings of 1 square metre or less.</p>
Itemisation	<p>53 Separate items shall be provided for saw-cutting, cracking and seating existing jointed reinforced concrete pavements in accordance with Chapter II paragraphs 3 and 4 and the following:</p>

Group	Feature	
I	1	Removal of existing bituminous overlay.
	2	Main trial.
	3	Re-assessment trial.
	4	Saw-cutting existing pavement.
	5	Cracking existing pavement.
	6	Seating existing pavement.
II	1	Saw-cuts exceeding 50mm but not exceeding 70mm in depth.
	2	Saw-cuts exceeding 70mm but not exceeding 90mm in depth.
	3	Saw-cuts exceeding 90mm but not exceeding 110mm in depth, and so on in steps of 20mm.
III	1	Thickness not exceeding 50mm.
	2	Thickness exceeding 50mm but not exceeding 100mm.
	3	Thickness exceeding 100mm but not exceeding 150mm, and so on in steps of 50mm.

Note 1: Group II Features shall be applied only to Feature 4 of Group I.

Note 2: Group III Features shall be applied only to Features 5 and 6 of Group I.

Removal of Existing Bituminous Overlay

54 The items for removal of existing bituminous overlay shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 Paragraph 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) excavation in hard material (as Series 600 paragraph 23);
- (d) disposal of material (as Series 600 paragraph 39);
- (e) milling (as Series 700 paragraph 28).

Main Trial

55 The items for main trial shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) saw-cutting (as this Series paragraph 57);
- (b) cracking and seating existing pavements (as this Series paragraphs 58 and 59);
- (c) checking cracking;
- (d) checking saw cuts.

Re-assessment Trial

56 The items for re-assessment trial shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) main trial (as this Series paragraph 55);
- (b) lost time, standing time and disruption caused by re-assessment trials.

Saw-cutting

57 The items for saw-cutting shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) locating existing joints;
- (b) water supply;
- (c) monitoring and adjusting plant and equipment;
- (d) removal of loose material and debris;
- (e) disposal of material (as Series 600 paragraph 39);
- (f) taking measurements and calculations;
- (g) observations and examinations;
- (h) coring, reinstatement and compaction;
- (i) marking reference chainages and grid;
- (j) giving of notices, keeping records, completing and supplying reports and certificates;
- (k) lighting for core inspection.

Cracking

58 The items for cracking shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) supply and application of clean water;
- (b) monitoring and adjusting plant and equipment;
- (c) removal of loose material and debris;
- (d) disposal of material (as Series 600 paragraph 39);
- (e) taking measurements and calculations;
- (f) observations and examinations;
- (g) cleaning;
- (h) coring, reinstatement and compaction;
- (i) marking reference chainages and grid;
- (j) giving of notices, keeping records, completing and supplying reports and certificates;
- (k) providing and maintaining side restraint;
- (l) lighting for core inspection.

Seating

59 The items for seating shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) monitoring and adjusting plant and equipment;
- (b) removal of loose material and debris;
- (c) disposal of material (as Series 600 paragraph 39);
- (d) taking measurements and calculations;
- (e) observations and examinations;
- (f) rolling;
- (g) measures to rectify unstable seating;
- (h) giving of notices, keeping records, completing and supplying reports and certificates;
- (i) providing and maintaining side restraint;

Cracking and Seating Existing Jointed Unreinforced Concrete Pavements and CBM Bases

Units

60 The units of measurement shall be:

- (i) removal of existing bituminous overlay square metre.
- (ii) main trialitem.
- (iii) re-assessment trial..... number.
- (iv) crackingsquare metre.
- (v) seatingsquare metre.

Measurement

61 The main trial shall be measured once only for the stated area.

62 The re-assessment trial shall be measured once only for each time that the defined circumstances in the Contract require that such a trial be carried out as stated in the Contract.

63 The measurement of cracking and seating shall be the areas stated in the Contract to be cracked and seated. No deductions shall be made for openings of 1 square metre or less.

Itemisation

64 Separate items shall be provided for cracking and seating existing jointed unreinforced concrete pavements and CBM bases in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Removal of existing bituminous overlay.
	2 Main trial.
	3 Re-assessment trial.
	4 Cracking.
	5 Seating.
II	1 Jointed unreinforced concrete pavements.
	2 CBM bases.
III	1 Thickness not exceeding 50mm.
	2 Thickness exceeding 50mm but not exceeding 100mm.
	3 Thickness exceeding 100mm but not exceeding 150mm, and so on in steps of 50mm.
IV	1 Transverse cracks exceeding 1.00m but not exceeding 2.00m centres.
	2 Transverse cracks exceeding 2.00m but not exceeding 3.00m centres.
	3 Transverse cracks exceeding 3.00m but not exceeding 4.00m centres.
	4 Transverse cracks exceeding 4.00m but not exceeding 6.00m centres, and so on in steps of 2.00m.

Note 1: Group III Features shall be applied only to Features 4 and 5 of Group I.

Note 2: Group IV Features shall be applied only to Feature 4 of Group I.

Removal of Existing Bituminous Overlay

65 The items for removal of existing bituminous overlay shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation of acceptable material (as Series 600 paragraph 18);
 - (b) excavation of unacceptable material (as Series 600 paragraph 19);
 - (c) excavation in hard material (as Series 600 paragraph 23);
 - (d) disposal of material (as Series 600 paragraph 39);
 - (e) milling (as this Series paragraph 28).

Main Trial

66 The items for main trial shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) main trial (as this Series paragraph 55).

Re-assessment Trial

67 The items for re-assessment trial shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) re-assessment trial (as this Series paragraph 56).

Cracking

68 The items for cracking shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) cracking (as this Series paragraph 58).

Seating **69** The items for seating shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) seating (as this Series paragraph 59).

Overbanding and Inlaid Crack Sealing Repair Systems

Units **70** The units of measurement shall be:

- (i) simple overbanding repair system linear metre.
- (ii) fill and overbanding repair system linear metre.
- (iii) inlaid sealing repair system linear metre.

Measurement **71** The measurement of simple overbanding repair system, fill and overbanding repair system and inlaid sealing repair system shall be the summation of the lengths stated in the Contract and shall be for the complete system.

Itemisation **72** Separate items shall be provided for simple overbanding repair system, fill and overbanding repair system and inlaid sealing repair system in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Simple overbanding repair system.
	2 Fill and overbanding repair system.
	3 Inlaid sealing repair system.
II	1 Different stated materials.
III	1 Crack exceeding 5mm but not exceeding 10mm wide.
	2 Crack exceeding 10mm but not exceeding 15mm wide.
	3 Crack exceeding 15mm but not exceeding 20mm wide.
IV	1 Stated width of crack.

Note: Group III Features shall be applied only to Group I Feature 2.

Note: Group IV Feature shall be applied only to Group 1 Feature 3.

Overbanding and Inlaid Crack Sealing Repair Systems

73 The items for overbanding and inlaid crack sealing repair systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) cleaning;
 - (b) drying;
 - (c) disposal of material (as Series 600 paragraph 39);
 - (d) priming;
 - (e) bond-breaker tape;
 - (f) recording details.

Maintenance of Arrester Beds

Units

74 The unit of measurement shall be:

- (i) maintenance of arrester bed item.

Itemisation

75 Separate items shall be provided for maintenance of arrester beds in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Maintenance of arrester bed.
II	1	Stated location.

Maintenance of Arrester Beds

76 The items for maintenance of arrester beds shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item Coverage

- (a) clearance of debris, litter and weed growth from granular material;
- (b) disposal of material (as Series 600 paragraph 39);
- (c) sweeping;
- (d) re-placing material on bed;
- (e) raking and levelling.

Repairs and Patching

Units

77 The units of measurement shall be:

- (i) repairs to potholes, repairs to depressionskilogramme.
- (ii) patching square metre.

Measurement

78 The measurement of repairs to potholes and repairs to depressions shall be the mass of specified material placed in the voids.

79 The measurement of patching shall be the area of the top surface of the patch.

Itemisation

80 Separate items shall be provided for repairs and patching in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Repairs to potholes.
	2	Repairs to depressions.
	3	Patching.
II	1	Different thicknesses.
III	1	Stated repair materials or system.
IV	1	In areas not exceeding 5 square metres.
	2	In areas exceeding 5 square metres but not exceeding 10 square metres.
	3	In areas exceeding 10 square metres but not exceeding 15 square metres and so on in steps of 5 square metres.

Note: Groups II & IV features shall be applied only to Group I feature 3.

Repairs and Patching 81

The items for repairs and patching shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraph 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) excavation of hard material (as Series 600 paragraph 23);
- (d) disposal of material (as Series 600 paragraph 39);
- (e) milling (as this Series paragraph 28);
- (f) removing loose material and water;
- (g) tack coat (as this Series paragraph 24);
- (h) compaction and shaping;
- (i) forming joints and sealing.

Series 800 is not taken up

Series 900 is not taken up

Series 1000 is not taken up

Series 1100: Kerbs, Footways and Paved Areas

Kerbs, Channels, Edgings, Combined Drainage and Kerb Blocks and Linear Drainage Channel Systems

Units	1	The unit of measurement shall be:
	(i)	kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems linear metre.
Measurement	2	The measurement of kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall be the lengths required by the Contract. No deduction shall be made for gaps of 1 linear metre or less.
Itemisation	3	Separate items shall be provided for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I	1	Kerbs.
	2	Channels.
	3	Edgings.
	4	Combined drainage and kerb blocks.
	5	Linear drainage channel systems.
II	1	Permitted alternative materials and designs.
	2	Different materials and designs.
	3	Group reference.
III	1	Straight or curved exceeding 12 metres radius.
	2	Curved not exceeding 12 metres radius.

Kerbs, Channels, Edgings, Combined Drainage and Kerb Blocks and Linear Drainage Channel Systems

Item coverage	4	The items for kerbs, channels, edgings, and combined drainage and kerb blocks and linear drainage channel systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:
	(a)	trial mixes;
	(b)	making good after sampling and testing;
	(c)	excavation of acceptable material (as Series 600 paragraphs 17 and 18);
	(d)	excavation of unacceptable material (as Series 600 paragraph 19);
	(e)	excavation in Hard Material (as Series 600 paragraph 23);

- (f) disposal of material (as Series 600 paragraph 39);
- (g) concrete (as Series 1700 paragraphs 5 and 10);
- (h) formwork (as Series 1700 paragraph 15);
- (i) reinforcement (as Series 1700 paragraph 26);
- (j) mixing materials and extruding kerbs;
- (k) bedding, bonding, jointing, including movement joints, filling and sealing of joints;
- (l) keying of surfaces and tack coats;
- (m) surface finishing, curing and protecting;
- (n) gratings, frames, bedding and seatings;
- (o) tie bars;
- (p) drainage holes or pipes through concrete;
- (q) quadrants, dropper kerbs and other special kerb units;
- (r) edge support;
- (s) preservation of timber;
- (t) cutting;
- u) drainage layer;
- (v) additional pavement material below channels;
- (w) backfilling and compaction;
- (x) special units and fittings;
- (y) connections to chambers;
- (z) in the case of combined drainage and kerb blocks and linear drainage channel systems - design, certificates, provision of data and drawings, resubmissions, modifications and amendments to the Works.
- (aa) in the case of combined drainage and kerb blocks and linear drainage channel systems - internal checking and cleaning;
- (bb) reinstatement of surfaces.

Additional Concrete for Kerbs, Channels, Edgings, Combined Drainage and Kerb Blocks and Linear Drainage Channel Systems

Units

5 The unit of measurement shall be:

- (i) additional concrete for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems
..... cubic metre.

Measurement 6 The measurement of additional concrete for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall be the volume required by the Contract in excess of the standard requirements of the Contract for each type of kerb, channel, edging, combined drainage and kerb block or linear drainage channel system.

Itemisation 7 Separate items shall be provided for additional concrete for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Additional concrete of different mixes, classes or grades.
II	1 To kerbs. 2 To channels. 3 To edgings. 4 To combined drainage and kerb blocks. 5 To linear drainage channel systems.

**Additional Concrete for
Kerbs, Channels, Edgings,
Combined Drainage and Kerb
Channel Systems**

8 The items for additional concrete for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
 - (b) excavation of unacceptable material (as Series 600 paragraph 19);
 - (c) excavation in Hard Material (as Series 600 paragraph 23);
 - (d) in situ concrete (as Series 1700 paragraph 5);
 - (e) formwork (as Series 1700 paragraph 15);
 - (f) reinforcement (as Series 1700 paragraph 26);
 - (g) forming, filling and sealing joints;
 - (h) surface finishing, curing and protecting;
 - (i) movement joints;
 - (j) drainage holes or pipes through concrete;
 - (k) disposal of material (as Series 600 paragraph 39).

**Remove from Store and Relay Kerbs, Channels, Edgings,
Combined Drainage and Kerb Blocks and Linear Drainage
Channel Systems**

Units	9	The unit of measurement shall be: (i) remove from store and relay kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems linear metre.
Measurement	10	The measurement for remove from store and relay kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall be the length required by the Contract. No deduction shall be made for gaps of 1 linear metre or less.
Itemisation	11	Separate items shall be provided for remove from store and relay kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	<ol style="list-style-type: none"> 1 Remove from store and relay kerbs. 2 Remove from store and relay channels. 3 Remove from store and relay edgings. 4 Remove from store and relay combined drainage and kerb blocks. 5 Remove from store and relay linear drainage channel systems.
II	<ol style="list-style-type: none"> 1 Different materials and designs.
III	<ol style="list-style-type: none"> 1 Straight or curved exceeding 12 metres radius. 2 Curved not exceeding 12 metres radius.

Remove from Store and Relay Kerbs, Channels, Edgings, Combined Drainage Kerb Blocks and Linear Drainage Channel Systems	12	The items for remove from store and relay kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:
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Item coverage	<ol style="list-style-type: none"> (a) loading, transporting from store, unloading and positioning for relaying; (b) replacing items damaged during the foregoing operations; (c) modification and new materials; (d) kerbs, channels, edgings, combined drainage and kerb blocks and
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linear drainage channel systems (as this Series paragraph 4).

Footways and Paved Areas

Units	13	The units of measurement shall be: (i) footways and paved areas square metre. (ii) bituminous regulating course tonne. (iii) cement bound regulating course cubic metre.
Measurement	14	The measurement of footways and paved areas shall be calculated using the width of the top surface stated in the Contract.
	15	In the case of flexible construction where a Group reference is given for the whole construction, the total thickness of the combined sub-base, binder course, surface course and/or surface dressing shall be stated.
	16	In all other cases of flexible construction the thickness of each course shall be stated in the item description except that where a surface dressing is an integral part of any course then the combined thickness of the course and surface dressing shall be stated.
	17	In the cases of in situ and precast concrete, stone, slab and block paving the thickness of the sub-base, bedding and paving shall be separately stated in the item description.
	18	The measurement of bituminous regulating course shall be the tonnage certified by the Overseeing Organisation, being only that material included on delivery tickets which is incorporated in the Permanent Works in the locations and to the extent and thickness required by the Contract. The measurement of cement bound regulating course shall be the volume of material measured to the outlines stated in the Contract.
	19	No deduction shall be made for openings of 1 square metre or less.
Itemisation	20	Separate items shall be provided for footways and paved areas in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I	1	Footways.
	2	Paved areas.
II	1	Different types of construction.
III	1	Different thicknesses.

IV	1	Different sizes, groups or types.
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V	1	Surfaces sloping at 10o or less to the horizontal.
	2	Surfaces sloping at more than 10o to the horizontal.

VI	1	Regulating course of different groups or types.
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Footways and Paved Areas

Item coverage

21 The items for footways and paved areas shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- (a) sub-base (as Series 700 paragraph 5);
- (b) edge support;
- (c) concrete (as Series 1700 paragraphs 5 and 10);
- (d) formwork (as Series 1700 paragraph 15);
- (e) void formers (as Series 1700 paragraph 16);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) joint filler and sealant (as Series 2300 paragraphs 9 and 10);
- (h) trial mixes;
- (i) laying to levels and falls;
- (j) bedding, jointing and pointing;
- (k) straight, circular and radial cutting and fitting;
- (l) rough and fair cutting and fitting;
- (m) base, lower base, upper base, binder course, surface course and concrete slab (as Series 700 paragraph 9);
- (n) compacting;
- (o) membrane;
- (p) topsoiling (as Series 600 paragraph 80);
- (q) grass seeding (as Series 3000 paragraph 9).

Bituminous and Cement Bound Regulating Course

Item coverage

22 The items for bituminous and cement bound regulating course shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- (a) bituminous and cement bound regulating course (as Series 700 paragraph 14).

Remove from Store and Relay Paving Flags, Slabs and Blocks

Units	23	The unit of measurement shall be:													
		(i) remove from store and relay paving flags, slabs and blocks square metre.													
Measurement	24	The measurement of remove from store and relay paving flags, slabs and blocks shall be the area of the top surface of the work stated in the Contract.													
		No deduction shall be made for openings of 1 square metre or less.													
Itemisation	25	Separate items shall be provided for remove from store and relay paving flags, slabs and blocks in accordance with Chapter II paragraphs 3 and 4 and the following:													
		<table><tr><th>Group</th><th>Feature</th></tr><tr><td>I</td><td>1 Remove from store and relay paving in footways. 2 Remove from store and relay paving in paved areas.</td></tr><tr><td>II</td><td>1 Different types of construction.</td></tr><tr><td>III</td><td>1 Different thicknesses.</td></tr><tr><td>IV</td><td>1 Different sizes groups or types.</td></tr><tr><td>V</td><td>1 Surfaces sloping at 10o or less to the horizontal. 2 Surfaces sloping at more than 10° to the horizontal.</td></tr></table>		Group	Feature	I	1 Remove from store and relay paving in footways. 2 Remove from store and relay paving in paved areas.	II	1 Different types of construction.	III	1 Different thicknesses.	IV	1 Different sizes groups or types.	V	1 Surfaces sloping at 10o or less to the horizontal. 2 Surfaces sloping at more than 10° to the horizontal.
Group	Feature														
I	1 Remove from store and relay paving in footways. 2 Remove from store and relay paving in paved areas.														
II	1 Different types of construction.														
III	1 Different thicknesses.														
IV	1 Different sizes groups or types.														
V	1 Surfaces sloping at 10o or less to the horizontal. 2 Surfaces sloping at more than 10° to the horizontal.														
Remove from Store and Relay Paving Flags, Slabs and Blocks	26	The items for remove from store and relay paving flags, slabs and blocks shall in accordance with the Preambles to Bill of Quantities General Directions include for:													
Item coverage		(a) loading, transporting from store unloading and positioning for relaying;													
		(b) replacing items damaged during the foregoing operations;													
		(c) modification and new materials;													
		(d) footways and paved areas (as this Series paragraph 21).													

Steps

- | | | |
|-------------|-----------|--|
| | 27 | The unit of measurement shall be:

(i) flights of steps number. |
| Measurement | 28 | The measurement of steps shall be the complete flight including landings. |
| Itemisation | 29 | Separate items shall be provided for steps in accordance with Chapter II paragraphs 3 and 4 and the following: |

Group Feature

- | | | | |
|---------------|-----------|--|----------------------|
| | I | 1 | Flight of steps. |
| | II | 1 | Different locations. |
| Steps | 30 | The items for steps shall in accordance with the Preambles to Bill of Quantities General Directions include for: | |
| Item coverage | | <p>(a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);</p> <p>(b) excavation of unacceptable material (as Series 600 paragraph 19);</p> <p>(c) excavation in Hard Material (as Series 600 paragraph 23);</p> <p>(d) backfilling, compaction and reinstatement;</p> <p>(e) disposal of material (as Series 600 paragraph 39);</p> <p>(f) completion of formation (as Series 600 paragraph 85)</p> <p>(g) brickwork, blockwork and stonework (as Series 2400 paragraphs 4 and 8);</p> <p>(h) kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems (as this Series paragraph 4);</p> <p>(i) footways and paved areas (as this Series paragraph 21);</p> <p>(j) surface finishing and non-slip treatment;</p> <p>(k) tread nosings;</p> <p>(l) pedestrian guardrails and handrails (as Series 400 paragraph 46);</p> <p>(m) fencing (as Series 300 paragraph 4);</p> <p>(n) concrete foundation to timber posts (as Series 300 paragraph 5);</p> <p>(o) gates and stiles (as Series 300 paragraph 6);</p> <p>(p) reinstatement of surfaces.</p> | |

Series 1200: Traffic Signs and Road Markings

Traffic Signs

Units	1	The unit of measurement shall be: (i) traffic signs number.
Measurement	2	The measurement of traffic signs shall be the complete Installation except for earth electrodes which shall be measured separately under Series 1400 (paragraphs 24 to 27).
Itemisation	3	Separate items shall be provided for traffic signs in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
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I	1	Permanent traffic signs.
	2	Prescribed temporary traffic signs.

II	1	Particular sign reference.
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III	1	Retroreflective.
	2	Non-retroreflective.
	2	Enhanced retroreflective.

IV	1	Lit Sign Units.
	2	Non Lit Sign Units.

V 1 Different types.

VI 1 Different sizes.

VII 1 Different posts or supports.

Permanent Traffic Signs

	4	The items for permanent traffic signs shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		(a) excavation of acceptable material (as Series 600 paragraphs 17 and 18); (b) excavation of unacceptable material (as Series 600 paragraph 19); (c) excavation in hard material (as Series 600 paragraph 23); (d) backfilling and compaction; (e) in situ concrete (as Series 1700 paragraph 5);

- (f) formwork (as Series 1700 paragraph 15);
- (g) reinforcement (as Series 1700 paragraph 26);
- (h) ducts in bases;
- (i) reinstatement of surfaces;
- (j) covering and removal of covering of signs;
- (k) disposal of material (as Series 600 paragraph 39);
- (l) doors, locks and keys;
- (m) location lettering and marking;
- (n) drilling or forming holes and pockets in structures, lighting columns or foundations and casting in bolts, sockets, base plates and anchorage assemblies;
- (o) bedding and grouting;
- (p) protective system (as Series 1900 paragraph 4);
- (q) rivets, bolts, nuts and the like;
- (r) electrical equipment, wiring, and connections, excluding supply and control cabling;
- (s) conduit including screwed and threaded connections, bends, tees, and the like and draw wires;
- (t) threading cable through ducts, sleeves, conduit and the like;
- (u) backboard, fixings, protective caps, sealing, grommets, spacers, mounting plates and strips;
- (v) complying with wiring regulations, earthing (other than earth electrodes), and inspection;
- (w) protective treatment;
- (x) notices and recording;
- (y) preparation and supply of record drawings;
- (z) light spill screens;
- (aa) fixing to structures and foundations including attachment systems.

Prescribed Temporary 5 The items for prescribed temporary traffic signs shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) permanent traffic signs (as this Series paragraph 4);
- (b) take up or down and set aside for reuse or remove to store off Site (as Series 200 paragraph 11);
- (c) maintaining and servicing equipment.

Remove from Store and Re-erect Traffic Signs

Units	6	The unit of measurement shall be:	
		(i) remove from store and re-erect traffic signs number.	
Itemisation	7	Separate items shall be provided for remove from store and re-erect traffic signs in accordance with Chapter II paragraphs 3 and 4 and the following:	
<hr/>			
	Group	Feature	
<hr/>			
	I	1	Remove from store and re-erect traffic signs.
<hr/>			
	II	1	Retroreflective.
		2	Non-retroreflective.
		3	Enhanced retroreflective.
<hr/>			
	III	1	Lit Sign Units.
		2	Non Lit Sign Units.
<hr/>			
	IV 1 Different types.		
<hr/>			
	V 1 Different sizes.		
<hr/>			
	VI 1 Different posts or supports.		
<hr/>			
Remove from Store Re-erect Traffic Signs	8	The items for remove from store and re-erect traffic signs shall in accordance with the Preambles to Bill of Quantities General Directions include for:	
Item coverage		(a) loading, transporting from store, unloading and positioning for reerection;	
		(b) replacing items damaged during the foregoing operations;	
		(c) modification and new materials;	
		(d) painting existing painted items;	
		(e) permanent traffic signs (as this Series paragraph 4).	

Road Markings

Units	9	The units of measurement shall be: (i) marking and removal of solid areas square metre. (ii) marking and removal of lines linear metre. (iii) marking and removal of triangles, circles with enclosing arrows, arrows, kerb markings, symbols, letters and numerals number. (The diagram number from the Traffic Signs Regulations and General Directions to be stated.)
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Measurement	10	<p>The removal of road markings shall only be measured where Specifically required by the Contract.</p> <p>The marking and removal of solid areas shall only be measured for the solid infilling between converging lines, the enclosing lines themselves shall be measured as lines.</p> <p>Road markings which form part of a traffic signal installation or a controlled or uncontrolled crossing shall not be separately measured.</p> <p>Road markings which require enhanced reflectorised marking materials for 'wet-night' conditions stated in Appendix 12/3 shall be identified and measured separately.</p>
	11	<p>Road markings other than those measured under sub-paragraphs 9(i) and (iii) above shall be measured as lines and shall be grouped together according to width.</p> <p>In the case of intermittent lines the measurement shall be of the marks only but the length of the mark and gap shall be stated. Double lines shall be measured as two single lines.</p> <p>Diagonal lines between double lines and short transverse lines at the ends of any longitudinal lines shall be measured with the lines of which they form part.</p> <p>Ancillary lines shall include lines forming hatched areas, chevrons, zigzag lines, boxed areas and lines enclosing boxed areas. In the case of hatched areas and chevrons the enclosing lines shall be measured as the longitudinal line of which they form part. The measurement of zigzag lines shall include any transverse or longitudinal lines at their ends.</p>
	12	The measurement of circles with enclosing arrows (mini roundabouts) shall be for the complete marking, the external diameter of the circle being stated. Distinction shall be made for all other arrows between straight, curved, turning or double headed.
	13	Kerb markings shall be measured as a single item irrespective of the number of lines forming any one marking.
	14	Each letter or numeral shall be separately measured with all letters or numerals grouped together according to height.
	15	Symbols shall be measured separately and grouped together according to size.
Itemisation	16	Separate items shall be provided for marking and removal of road markings in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Removal of road markings.
	2	Road markings.
II	1	Solid areas.
	2	Continuous lines.
	3	Intermittent lines.
	4	Ancillary lines.
	5	Raised rib lines.
	6	Triangles.
	7	Circle with enclosing arrows.
	8	Arrows.
	9	Kerb markings.

	10	Letters and numerals.
	11	Symbols.
III	1	Different materials.
IV	1	Different widths of lines.
	2	Different sizes of circles with enclosing arrows.
	3	Different lengths of arrows.
	4	Different lengths of kerb markings.
	5	Different heights of letters and numerals.
	2	Different sizes of symbols.
V	1	Different lengths of mark and gap for intermittent lines.
	2	Different diagram numbers for arrows, kerb markings and symbols.
VI	1	Different types.
VII	1	Different colours.
VIII	1	Reflectorised.
IX	1	Different rib spacings.

Removal of Road Markings 17 The items for the removal of road markings shall in accordance with **Markings** the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) disposal of material (as Series 600 paragraph 39);
 - (b) reinstatement;
 - (c) apostrophes in the case of letters and numerals;
 - (e) markings down the face of kerbs;

Road Markings 18 The items for road markings shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item Coverage
- (a) cleaning, brushing and drying surfaces;
 - (b) application of the marking materials including the incorporation of specified reflecting medium;
 - (c) thinners, primers and tack coats;
 - (d) apostrophes in the case of letters and numerals;
 - (e) markings down the face of kerbs;

(f) adhesives;

Road Studs

Units	19	The unit of measurement shall be: (i) road studs number.
Measurement	20	The measurement of road studs shall be the complete installation. Road studs which form part of a traffic signals installation or a pedestrian crossing shall not be separately measured.
Itemisation	21	Separate items shall be provided for road studs in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Road studs.

II 1 Different sizes.

III 1 Different types.

IV 1 Different coloured reflectors.

Road Studs	22	The items for road studs shall in accordance with the Preambles to Bill of Quantities General Directions include for:
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Item coverage	(a) cutting or forming holes;
	(b) milling;
	(c) adhesives and grout;
	(d) reinstatement of surfaces;
	(e) disposal of material (as Series 600 paragraph 39).

Remove from Store and Re-install Road Studs

Units	23	The unit of measurement shall be: (i) remove from store and re-install road studs number.
Itemisation	24	Separate items shall be provided for remove from store and reinstall road studs in accordance with Chapter II paragraphs 3 and 4 and the following:

	Group	Feature
	I	1 Remove from store and re-install road studs.
	II	1 Different sizes.
	III	1 Different types.
Remove from Store and Re-install Road Studs	25	The items for remove from store and re-install road studs shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		(a) loading, transporting from store, unloading and positioning for re-installation; (b) replacing items damaged during the foregoing operations; (c) new materials; (d) road studs (as this Series paragraph 22).

Traffic Signal Installations

Definitions	26	For the purposes of measurement of Traffic Signal Installations the network is defined as all cabling emanating from either an outstation transmission unit (O.T.U), an outstation monitoring unit (O.M.U.) or an outstation monitoring and control unit (O.M.C.U.) and terminating at a location outside the limits of the site.
Units	27	The unit of measurement shall be: (i) traffic signal installations item.
Measurement	28	The measurement of traffic signal installations shall be the complete installations except for earth electrodes which shall be measured separately under Series 1400 (paragraphs 24 to 27).
Itemisation	29	Separate items shall be provided for traffic signal installations in accordance with Chapter II paragraphs 3 and 4 and the following:
<hr/>		
Group Feature		
<hr/>		
	I	1 Permanent traffic signal installations. 2 Prescribed temporary traffic signal installations.
<hr/>		
	II	1 Different locations.

Permanent Traffic Signal Installations	30	The items for permanent traffic signal installations shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		<ul style="list-style-type: none"> (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18); (b) excavation of unacceptable material (as Series 600 paragraph 19); (c) excavation in hard material (as Series 600 paragraph 23); (d) in situ concrete (as Series 1700 paragraph 5); (e) backfilling and compaction; (f) disposal of material (as Series 600 paragraph 39); (g) detectors; (h) detector loops (as Series 1500 paragraph 31); (i) detector feeders; (j) trench for cable (as Series 1400 paragraph 8) excluding network cabling; (k) cable (as Series 1400 paragraph 13) excluding network cabling; (l) control equipment; (m) electrical equipment, wiring, and connections, excluding network cabling; (n) marking out, cutting or forming slots, drying, damming, backfilling, cleaning and sealing; (o) road markings (as this Series paragraph 18); (p) notices and recording; (q) numbering and lettering; (r) complying with wiring regulations and earthing (other than earth electrodes); (s) reinstatement of surfaces; (t) preparation and supply of record drawings; (u) road studs; (v) ducts; (w) chambers (as Series 500 paragraph 37); (x) protective system (as Series 1900 paragraph 4).
Prescribed Temporary	31	The items for prescribed temporary traffic signal installations shall

Signal Installations

in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) permanent traffic signal installations (as this Series paragraph 30);
- (b) take up or down and set aside for reuse or remove to store off Site (as Series 200 paragraph 11);
- (c) removal of road markings (as this Series paragraph 17);
- (a) maintaining and servicing equipment.

Controlled and Uncontrolled Crossings

Units

32

The unit of measurement shall be:

- (i) controlled crossings item.
- (ii) uncontrolled crossings item.

Measurement

33

The measurement of controlled and uncontrolled crossings shall be the complete installation.

Itemisation

34

Separate items shall be provided for prescribed, controlled and uncontrolled crossings in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I

1
2
3
4

- Permanent controlled crossings.
- Permanent uncontrolled crossings.
- Prescribed temporary controlled crossings.
- Prescribed temporary uncontrolled crossings.

II

1

Different locations.

**Permanent Controlled 35
and Uncontrolled
Crossings**

The items for permanent controlled and uncontrolled crossings shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) permanent traffic signal installations (as this Series paragraph 30);
- (b) road studs;
- (c) kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems (as Series 1100 paragraph 4);
- (d) footways and paved areas (as Series 1100 paragraph 21);
- (e) flashing beacons and additional lighting.

**Prescribed Temporary 36
Controlled and
Uncontrolled Crossings**

The items for prescribed temporary controlled and uncontrolled crossings shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) permanent controlled and uncontrolled crossings (as this Series paragraph 35);
 - (b) take up or down and set aside for reuse or remove to store off Site (as Series 200 paragraph 11);
 - (c) removal of road markings (as this Series paragraph 17);
 - (d) maintaining and servicing equipment.

Marker Posts

- Units **37** The unit of measurement shall be:
(i) marker posts number.

- Itemisation **38** Separate items shall be provided for marker posts in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Marker posts.
II	1 Different types.

- Marker Posts** **39** The items for marker posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) protective system (as Series 1900 paragraph 4);
 - (b) numerals, symbols and reflectorised strips or discs including adhesive;
 - (c) driving or excavating in any material (as Series 600 paragraphs 17, 18, 19 and 23);
 - (d) backfilling and compaction;
 - (e) sockets;
 - (f) galvanized fixings and fittings;
 - (g) preservation of timber;
 - (h) disposal of material (as Series 600 paragraph 39);
 - (i) in-situ concrete (as Series 1700 paragraph 5);
 - (j) formwork (as Series 1700 paragraph 15);
 - (k) reinforcement (as Series 1700 paragraph 26);
 - (l) reinstatement of surfaces.

Permanent Bollards

Units	40	The unit of measurement shall be:	
		(i) permanent bollards number.	
Itemisation	41	Separate items shall be provided for permanent bollards in accordance with Chapter II paragraphs 3 and 4 and the following:	
		Group	Feature
		I	1 Permanent bollards.
		II	1 Internally illuminated. 2 Non-illuminated.
		III	1 Different types.
		IV	1 Different sizes.
Permanent Bollards	42	The items for permanent bollards shall in accordance with the Preambles to Bill of Quantities General Directions include for:	
Item coverage		(a) permanent traffic signs (as this Series paragraph 4); (b) preservation of timber.	
		Node Markers	
Units	43	The unit of measurement shall be:	
		(i) node markers number.	
Itemisation	44	Separate items shall be provided for node markers in accordance with Chapter II paragraphs 3 and 4 and the following:	
		Group	Feature
		I	1 Node markers.
		II	1 Different types.
		III	1 Different sizes.
Node Markers	45	The items for node markers shall in accordance with the Preambles to Bill of Quantities General Directions include for:	
Item coverage		(a) coring pockets in carriageway; (b) cleaning and drying pockets; (c) disposal of material (as Series 600 paragraph 39);	

(d) incorporation of solid glass beads.

**Series 1300: Road Lighting Columns, Brackets and CCTV
Masts**

**Road Lighting Columns, Brackets, Wall Mountings and CCTV
Masts**

Units	1	The unit of measurement shall be:
		(i) road lighting columns, brackets, wall mountings, CCTV masts.....
Measurement	2	The measurement of road lighting columns, brackets, wall mountings and CCTV masts shall be the complete installation except for earth electrodes which shall be measured separately (under Series 1400 paragraphs 24 to 27).
Itemisation	3	Separate items shall be provided for road lighting columns, brackets, wall mountings and CCTV masts in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I	1	Road lighting columns and brackets.
	2	Wall mountings.
	3	CCTV masts.

II	1	Different height of lighting columns.
	2	Different height of CCTV masts.

III 1 Different projection of brackets.

IV 1 Different luminaires.

V 1 Different types.

**Road Lighting Columns 4
Brackets, Wall
Mountings and
CCTV Masts**

The items for road lighting columns, brackets, wall mountings and CCTV masts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage	(a) design;
	(b) certificates;
	(c) provision of data and drawings;
	(d) resubmissions and modifications;
	(e) amendments to the Works;
	(f) obtaining aesthetic approval;
	(g) excavation of acceptable material (as Series 600 paragraphs 17 and 18);

- (h) excavation of unacceptable material (as Series 600 paragraph 19);
- (i) excavation in Hard Material (as Series 600 paragraph 23);
- (j) rivets, nuts, bolts, shims, washers, welds, clamps and the like;
- (k) blinding concrete and paving slab;
- (l) in situ concrete (as Series 1700 paragraph 5);
- (m) formwork (as Series 1700 paragraph 15);
- (n) reinforcement (as Series 1700 paragraph 26);
- (o) drilling or forming holes and pockets in structures or foundations, and casting in bolts, sockets, base plates and anchorage assemblies;
- (p) bedding, grouting and filling;
- (q) backfilling and compaction;
- (r) protective system (as Series 1900 paragraph 4);
- (s) marking and lettering;
- (t) electrical equipment, wiring and making connections, excluding supply and control cabling;
- (u) disposal of material (as Series 600 paragraph 39);
- (v) reinstatement of surfaces;
- (w) plugging cable entry slots;
- (x) doors, locks and keys;
- (y) ducts in bases;
- (z) conduit including screwed and threaded connections, bends, tees and the like and draw wires;
- (aa) threading cable through ducts, sleeves, conduit and the like;
- (bb) backboards, fixings, protective caps, sealing, grommets, spacers, mounting plates and strips;
- (cc) complying with wiring regulations and earthing (other than earth electrodes);
- (dd) protective treatment;
- (ee) notices, recording and preparation and supply of record drawings;
- (ff) fixing to structures and foundations including attachment systems.

**Remove from Store and Re-erect Road Lighting Columns,
Brackets, and Wall Mountings**

Units	5	The unit of measurement shall be:	
		(i) remove from store and re-erect road lighting columns, brackets and wall mountings number.	
Itemisation	6	Separate items shall be provided for remove from store and re-erect road lighting columns, brackets and wall mountings in accordance with Chapter II paragraphs 3 and 4 and the following:	
		Group	Feature
		I	1 Remove from store and re-erect road lighting columns and brackets.
			2 Remove from store and re-erect wall mountings.
		II	1 Different height of columns.
		III	1 Different projections of brackets.
		IV	1 Different luminaires.
		V	1 Different types.
Remove from Store and Re-erect Road Lighting Columns, Brackets and Wall Mountings	7	The items for remove from store and re-erect road lighting columns, brackets and wall mountings shall in accordance with the Preambles to Bill of Quantities General Directions include for:	
Item coverage		(a) loading, transporting from store, unloading and positioning for re-erection;	
		(b) replacing items damaged during the foregoing operations;	
		(c) modification and new materials;	
		(d) painting existing painted items;	
		(e) road lighting columns, brackets and wall mountings (as this Series paragraph 4).	

Series 1700: Structural Concrete

1 Surface impregnation of concrete shall be measured under Series 2000: Waterproofing for Structures.

In Situ Concrete

Units

2 The unit of measurement shall be:

- (i) in situ concrete cubic metre.

Measurement

3 No deduction shall be made for:

- (a) holes, ducts, pockets, sockets, mortices and the like not exceeding 0.15 cubic metres each in volume;
- (b) reinforcement;
- (c) individual chamfers, splays, rebates, recesses, drips, grooves and the like of 100 mm total girth or less when measured overall the faces of the individual feature formed in the concrete;
- (d) in the case of concrete with a patterned profile face, any indentations of 100 mm total girth or less when measured overall the faces of the indentations formed in the concrete;
- (e) cast in components not exceeding 0.15 cubic metres each in volume.

Itemisation

4 Separate items shall be provided for in situ concrete in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I	1	In situ concrete.
II	1	Different design mixes.
	2	Different classes or grades.
III	1	Blinding concrete 75 mm or less in thickness.

In Situ Concrete

5 The items for in situ concrete shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) mix design;
- (b) trial mixes;
- (c) mixing, placing in or against any surface, including soil faces, compaction, finishing and unformed surface finishes;
- (d) curing and protection;
- (e) formwork (as this Series paragraph 15) to upper surfaces inclined at an angle of less than 15° to the horizontal;

- (f) trial panels;
- (g) falls, cambers, and shaped profiles;
- (h) construction joints, (whether or not shown on the Drawings) water bars and stops including formwork (as this Series paragraph 15);
- (i) weep pipes, pipe sleeves and the like;
- (j) holes, ducts, pockets, sockets, mortices and the like not exceeding 0.15 cubic metres each in volume including formwork (as this Series paragraph 15);
- (k) formwork (as this Series paragraph 15) to edges of blinding concrete 75 mm or less in thickness;
- (l) filling to overbreak and working space;
- (m) measures to control alkali - silica reaction;
- (n) air entrainment;
- (o) facilities and assistance for the Overseeing Organisation's cover meter survey;
- (p) admixtures and additives.

Precast Concrete

Definition

6 The term "precast" applies to a concrete unit cast on Site but not in its final position, and to concrete units manufactured off the Site.

Units

7 The units of measurement shall be:

- (i) precast members, slabs, segmental units, hinges, specially moulded blocks number.
- (ii) precast copings, capping units, plinths and the like of uniform cross section, culverts (excluding piped culverts measured under Series 500: Drainage) linear metre.
- (iii) precast facing units square metre.

Measurement

8 The measurement of precast facing units shall be the flat undeveloped area.

The measurements of culverts (excluding piped culvert measured under Series 500: Drainage) shall be the length measured at the invert level, along the centre line.

The measurement of precast copings, capping units, plinths and the like shall be the measurement along the centre line.

Itemisation

9 Separate items shall be provided for precast concrete in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Precast members, slabs, segmental units, hinges, specially moulded blocks.
	2	Precast copings, capping units and plinths and culverts.
	3	Precast facing units.
II	1	Different types.
III	1	Different sizes.
IV	1	Curved.

Precast Members, Slabs, Segmental Units, Hinges, Specially Moulded Blocks, Copings, Plinths, Capping Units and Facing Units

10 The items for precast members, slabs, segmental units, hinges, specially moulded blocks, copings, capping units, plinths and facing units shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) mix design;
- (b) trial mixes;
- (c) reinforcement (as this Series paragraph 26);
- (d) formwork (as this Series paragraphs 15, 16 and 21);
- (e) mixing, placing in or against any surface; including soil faces, compaction finishing and unformed surface finishes;
- (f) curing and protection;
- (g) individual chamfers, splays, rebates, recesses, drips, grooves, and the like;
- (h) holes, ducts, pockets, sockets, mortices and the like;
- (i) matching members;
- (j) marking members for identification and delivery in matching sequence;
- (k) lifting devices including removal and bearing plates;
- (l) temporary bracing or stays to prevent displacement;
- (m) trial panels;
- (n) bedding, jointing and pointing including cramps, dowels or other fixing devices;
- (o) caulking and sealing between and under units and members;
- (p) infilling to joints between adjacent units and members where the maximum width of the joint is less than 150 mm including surface finish and formwork;
- (q) cutting and trimming;
- (r) in the case of precast prestressed members and the like, and in the case

of precast and precast prestressed members and the like for incorporation in in situ post-tensioned prestressed construction, tendons (as this Series paragraph 37) and stressing (including partially stressing) and grouting internal tendons (as this Series paragraph 38);

- (s) in the case of facing units, units for top, bottom, ends, changes in direction, battering, waterproofing, weep pipes, pipe sleeves and the like;
- (t) air entrainment;
- (u) admixtures and additives;
- (v) measures to control alkali-silica reaction;
- (w) facilities and assistance for the Overseeing Organisation's cover meter survey.
- (x) awaiting Overseeing Organisation's approval of trial panels.

Surface Finish of Concrete - Formwork

Units

11 The units of measurement shall be:

- (i) formwork square metre.
- (ii) void formers linear metre.

Measurement

12 The measurement shall be the area of formwork which is in contact with the finished concrete but measured over the face of openings of 1 square metre or less and features described in (c) below.

Formwork shall not be measured to:

- (a) construction joints whether or not shown on the Drawings;
- (b) holes, ducts, pockets, sockets, mortices and the like, not exceeding 0.15 cubic metres each in volume;
- (c) individual fillets, chamfers, splays, drips, rebates, recesses, grooves and the like of 100 mm total girth or less when measured overall the faces in contact with the concrete;
- (d) edges of blinding concrete 75 mm or less in thickness;
- (e) upper surfaces of concrete inclined at an angle of less than 15o to the horizontal;
- (f) unformed surfaces.

Where concrete, other than blinding concrete 75 mm or less in thickness, is placed in structural foundations, formwork shall be measured to the sides of

such concrete foundations regardless of whether or not any formwork is used, except where it is expressly stated on the Drawings that the concrete is to be cast against the soil face.

For measurement of formwork:

- (i) “horizontal” shall include formwork horizontal or inclined at any angle up to and including 5o to the horizontal.
- (ii) “inclined” shall include formwork inclined at any angle more than 5o up to and including 85o to the horizontal.
- (iii) “vertical” shall include formwork inclined at any angle more than 85o up to and including 90o to the horizontal.
- (iv) “at any inclination” shall include formwork horizontal or inclined at any angle up to and including 90o to the horizontal.

13 The measurement of void formers shall be the length measured along the centre line of the void former, and shall be measured whether of a permanent or temporary nature.

Itemisation

14 Separate items shall be provided for formwork in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Formwork.
	2	Void formers.
II	1	Horizontal more than 300 mm wide.
	2	Inclined more than 300 mm wide.
	3	Vertical more than 300 mm wide.
	4	300 mm wide or less at any inclination.
	5	Curved of both girth and width more than 300 mm at any inclination.
	6	Curved of girth or width of 300 mm or less at any inclination.
	7	Domed.
	8	Void formers of different cross section.
III	1	Different classes of surface finish.
	2	Permanent formwork of different types.
	3	Void formers of different types.

Formwork

15 The items for formwork shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) trial panels;
- (b) falsework, centering, fabricating, assembling, cutting, fitting, and fixing in position and taking measures to produce the required shapes of concrete;

- (c) forming cambers and falls;
- (d) linings and taking measures to produce the required finish to the surfaces of the concrete;
- (e) cutting and fitting around projecting members, pipes, reinforcement and the like;
- (f) individual fillets, chamfers, splays, drips, rebates, recesses, grooves and the like of 100 mm total girth or less when measured overall the faces in contact with the concrete;
- (g) maintaining in place until striking and allowing for any variation from the minimum period for striking arising from prevailing weather conditions;
- (h) striking, taking down and removing;
- (i) concrete provided in lieu of formwork to fill overbreak and working space.

Void Formers

16 The items for void formers shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) fixing to avoid displacement during concreting operations;
- (b) capping or blocking off ends;
- (c) sealing ends and joints;
- (d) proving holes.

Surface Finish of Concrete - Patterned Profile Formwork

Definition

17 The term “patterned profile formwork” shall be formwork designed to produce a concrete face with a specified patterned profile comprising ribs, corrugations, troughs or other patterns in relief.

Formwork with a specified regular pattern of formwork joints shall not be classified as patterned profile formwork.

Units

18 The unit of measurement shall be:

- (i) patterned profile formwork square metre.

Measurement

19 The measurement shall be the flat undeveloped area of the patterned concrete required by the Contract and measured over the face of openings of 1 square metre or less and features described in (c) below. Patterned profile formwork shall not be measured to:

- (a) construction joints whether or not shown on the Drawings;
- (b) holes, ducts, pockets, sockets, mortices and the like, not exceeding 0.15 cubic metres each in volume;

- (c) individual fillets, chamfers, splays, drips, rebates, recesses, grooves and the like, not forming part of the pattern and of 100 mm total girth or less when measured overall the faces in contact with the concrete;
- (d) edge of blinding concrete 75 mm or less in thickness;
- (e) upper surfaces of concrete inclined at an angle of less than 15° to the horizontal.

For measurement of patterned profile formwork:

- (i) “horizontal” shall include patterned profile formwork horizontal or inclined at any angle up to and including 5° to the horizontal.
- (ii) “inclined” shall include patterned profile formwork inclined at any angle more than 5° up to and including 85° to the horizontal.
- (iii) “vertical” shall include patterned profile formwork inclined at any angle more than 85° up to and including 90° to the horizontal.
- (iv) “at any inclination” shall include patterned profile formwork horizontal or inclined at any angle up to and including 90° to the horizontal.

Itemisation

20 Separate items shall be provided for patterned profile formwork in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Patterned profile formwork.
II	1	Horizontal.
	2	Inclined.
	3	Vertical.
	4	Curved at any inclination.
III	1	Different types.

Patterned Profile Formwork

21 The items for patterned profile formwork shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) formwork (as this Series paragraph 15).

Steel Reinforcement for Structures

Units

22 The units of measurement shall be:

- (i) bar and helical reinforcement tonne.
- (ii) fabric reinforcement square metre.
- (iii) dowels number.

Measurement

23 The mass of plain bar reinforcement shall be calculated on the basis that the nominal density of steel is 0.00785 kilogrammes per square millimetre of cross sectional area per linear metre; the mass of deformed bar

reinforcement shall be calculated as the nominal rolling mass of the reinforcement. Steel bar supports to reinforcement where described in the Contract shall be measured as reinforcement.

No allowance shall be made for the mass of welds and mechanical connections.

24 Fabric reinforcement shall be measured as the area of work covered, the BS reference being stated.

Itemisation

25 Separate items shall be provided for steel reinforcement for structures in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Bar reinforcement.
	2	Fabric reinforcement of different BS references.
	3	Helical reinforcement.
	4	Dowels of different diameters and lengths.
II	1	Nominal size 16 millimetres and under.
	2	Nominal size 20 millimetres and over.
III	1	Different types and grades of steel.
IV	1	Bars not exceeding 12 metres in length.
	2	Bars exceeding 12 metres in length but not exceeding 13.5 metres and so on in steps of 1.5 metres.
V	1	Bars threaded through holes in members.
VI	1	Different types of deformed bars.

Reinforcement

26 The items for reinforcement shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) cleaning, cutting and bending;
- (b) binding with wire or other material;
- (c) supports, cover blocks and spacers (except for steel bar supports to reinforcement where shown on the Drawings);
- (d) extra fabric reinforcement at laps;
- (e) welding;
- (f) mechanical connections.

Dowels

27 The items for dowels shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) drilling or forming holes and pockets, casting in and grouting;
- (b) protective caps, sleeves and wrappings.

Reinforcement for Reinforced and Anchored Earth Structures

Units

28 The units of measurement shall be:

- (i) vertical rods, strip and bar reinforcing elements linear

- metre.
(ii) sheet, grid, mesh reinforcing elements square metre.

Measurement

29 The measurement of vertical rods shall be the length from the top surface of the strip footing to the top of the facing unit or the top of the rod whichever is the higher.

The measurement of strip and bar reinforcing elements shall be the overall length including connections and, where applicable, the turn down for end anchorages. Provided that where a strip element comprises more than one leg measurement shall be of all legs, the number of legs measured being stated in the item description.

Measurement of sheet, grid or mesh reinforcing elements shall be the summation of the areas of each layer.

Itemisation

30 Separate items shall be provided for reinforcement for reinforced and anchored earth structures in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Vertical rods of nominal size 16 millimetres and under.
	2	Vertical rods of nominal size 20 millimetres and over.
	3	Strip and bar reinforcing elements of different cross-sections or load carrying capacity.
	4	Sheet, grid, mesh reinforcing elements of different references.
II	1	Different materials.
III	1	Vertical rods of different lengths.
	2	Strip and bar reinforcing elements of different lengths.

Vertical Rods

31 The items for vertical rods shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) cleaning and cutting;
- (b) measures to prevent displacement including adjustments and removal;
- (c) protective treatment including tubes and grouting.

Strip, Bar, Sheet, Grid or Mesh Reinforcing Elements

32 The items for strip, bar, sheet, grid or mesh reinforcing elements shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) examining and checking steel for segregation, laminations, cracks and surface flaws;
- (b) cutting, marking off, drilling, notching, machining, bending, connection within the length and preparing for connection to vertical rod facing unit or capping unit;
- (c) marking elements for identification;

- (d) protective system (as Series 1900 paragraph 4);
- (e) extra sheeting, grid or mesh at laps;
- (f) bolts, nuts, washers and connecting to facing units;
- (g) threading over of fixing to vertical rods;
- (h) casting in ends to in situ capping units.

In Situ Post-tensioned Prestressing for Structures

Units

33 The unit of measurement shall be:

- (i) tendons, stressing and grouting, protective covering to external tendons number.

Definition

34 For the purpose of this Series a tendon is defined as all the permanent components of a system which imparts a compressive load to a concrete member through a single anchorage or bearing plate at each end of the system.

Measurement

35 Lengths of tendons shall be measured along the line of the tendon between the outside faces of those parts of the anchorage units cast into the concrete. Tendons shall be grouped so that no member of the group differs in length from the stated length by more than 5%.

Itemisation

36 Separate items shall be provided for in situ post-tensioned prestressing for structures in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Tendons.
	2	Stressing and grouting internal tendons.
	3	Stressing external tendons.
	4	Final stressing and grouting tendons of members supplied partially prestressed.
II	1	Tendons for in situ concrete construction.
	2	Tendons for segmental construction.
III	1	Tendons of different types.
IV	1	Tendons of different stated lengths.
V	1	Protective covering of different types or size to external tendons.

Tendons

37 The items for tendons shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) forming, installing and sealing tendon ducts, sheaths and duct formers to profile supporting or between precast segmental units;
- (b) steel bars, cables, wires or strands with couplers, tagging, binders, spacers and proving that tendons are free to move between anchorages in ducts;
- (c) tendon anchorages, bearing plates, reinforcing helices, grout inlets, vents and other components except where these are supplied complete

with precast members or segments;

- (d) electrical bonding and proving electrical continuity of structure;
- (e) forming recesses in the concrete for anchorages and jack seatings;
- (f) allowing for variations of length in tendons contained in the same bill item;
- (g) cutting;
- (h) cleaning ducts;
- (i) marking, labelling, grouting and vent points with tendon identification.
- (j) photographing and anchorage on removal of end caps;
- (k) replacement and sealing of end caps against ingress of contamination

**Stressing and Grouting
Internal Tendons, Stressing
External Tendons and Final
Stressing and Grouting
Tendons of Members
Supplied Partially
Prestressed**

38 The items for stressing and grouting internal tendons, stressing external tendons and final stressing and grouting tendons of members supplied partially prestressed shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) checking the accuracy of load measuring equipment and adjusting;
- (b) applying prestress in one or more stages;
- (c) gripping and trimming tendons;
- (d) taking observations and compiling a record of stressing and grouting operations and supplying one copy to the Overseeing Organisation;
- (e) in the case of internal tendons, grouting trials, grouting, sealing vent holes and end anchorages, treating ends of tendons and filling anchorages and jack seating recesses with in situ concrete (as this Series paragraph 5);
- (f) in the case of external tendons, tying or binding to main structure and sealing at joints;
- (g) accommodating and adjusting for differences between tendons included in the same bill item;
- (h) calculation in respect of the required jacking force and extension;
- (i) releasing tension and re-tensioning where pull-in is greater than that agreed by the Overseeing Organisation;
- (j) flushing-out of grout.

**Protective covering to
External Tendons**

(39) The items for protective covering to external tendon shall in accordance with the Preambles to Bill of Quantities General Directions include for

- (a) tying or bonding to main structure;
- (b) sealing at joints

Grouting Trials

(40) The items for grouting trials shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item Coverage

- (a) excavation in any material (as series 600 paragraphs 17,18,19 and 23);
- (b) concrete (as this Series paragraph 5 and 10);
- (c) formwork (as this Series paragraph 15);
- (d) reinforcement (as this Series paragraph 26);
- (e) tendons (as this Series paragraph 37)
- (f) Stressing and grouting (as this Series paragraph 38);
- (g) Protective covering to external tendons (as this Series paragraph 39);
- (h) Pressure testing of systems;
- (i) Cutting and sectioning of member;
- (j) Reporting of results to Engineer and photographs
- (k) Retrials as instructed by Engineer
- (l) Breaking up and disposal;

Series 2000: Waterproofing for Structures

Waterproofing

Units	1	The unit of measurement shall be:																		
	(i)	waterproofing square metre.																		
Measurement	2	The measurement shall be the area of surface covered by the waterproofing. No deduction shall be made for openings of 1 square metre or less.																		
Itemisation	3	Separate items shall be provided for waterproofing for structures in accordance with Chapter II paragraphs 3 and 4 and the following:																		
<table border="1"> <thead> <tr> <th>Group</th><th colspan="2">Feature</th></tr> </thead> <tbody> <tr> <td>I</td><td>1</td><td>Waterproofing.</td></tr> <tr> <td>II</td><td>1</td><td>Different types.</td></tr> <tr> <td rowspan="4">III</td><td>1</td><td>More than 300 mm wide horizontal or at any inclination up to and including 30° to the horizontal.</td></tr> <tr> <td>2</td><td>More than 300 mm wide at any inclination more than 30° up to and including 90° to the horizontal.</td></tr> <tr> <td>3</td><td>300 mm wide or less at any inclination.</td></tr> <tr> <td>4</td><td>Domed.</td></tr> </tbody> </table>			Group	Feature		I	1	Waterproofing.	II	1	Different types.	III	1	More than 300 mm wide horizontal or at any inclination up to and including 30° to the horizontal.	2	More than 300 mm wide at any inclination more than 30° up to and including 90° to the horizontal.	3	300 mm wide or less at any inclination.	4	Domed.
Group	Feature																			
I	1	Waterproofing.																		
II	1	Different types.																		
III	1	More than 300 mm wide horizontal or at any inclination up to and including 30° to the horizontal.																		
	2	More than 300 mm wide at any inclination more than 30° up to and including 90° to the horizontal.																		
	3	300 mm wide or less at any inclination.																		
	4	Domed.																		
Waterproofing	4	The items for waterproofing shall in accordance with the Preambles to Bill of Quantities General Directions include for:																		
Item coverage	(a)	preparing, cleaning and drying;																		
	(b)	priming and bonding agents;																		
	(c)	laying to cambers, falls and crowns;																		
	(d)	protective layers;																		
	(e)	additional protection;																		
	(f)	levelling courses;																		
	(g)	formwork (as Series 1700 paragraph 15);																		
	(h)	additional base or binder course required as a result of the Contractor's choice of waterproofing;																		
	(i)	nibs, angle fillets, external angles, mitres, stops and the like;																		
	(j)	sealing and making good at edges and chases, around interruptions and projections and up to abutting surfaces including cleaning and priming;																		
	(k)	cutting out and rectifying imperfections;																		
	(l)	joints and laps;																		

- (m) preparing surfaces at gullies and the like;
- (n) masking and other measures to protect adjacent untreated areas;
- (o) complying with any special requirements in respect of ambient conditions and for intervals between successive operations and applications.

Surface Impregnation of Concrete

Units

5 The unit of measurement shall be:

- (i) surface impregnation of concrete square metre.
- (ii) Surface impregnation and coatings of concretesquare metre

Measurement

6 The measurement shall be the area of the surface to be impregnated of any width or at any inclination. No deduction shall be made for openings of 1 square metre or less. For plain surfaces the measurement shall be the area over the face of individual fillets, chamfers, splays, drips, rebates, recesses, grooves and the like of 100mm total girth or less when measured overall the faces of the concrete. For patterned surfaces the measurement shall be the flat undeveloped area and measured over the face of individual fillets, chamfers, splays, drips, rebates, recesses, grooves and the like, not forming part of the pattern and of 100 mm total girth or less when measured overall the faces in contact with the concrete. Surfaces shall be measured once only, irrespective of the number of applications specified in the treatment.

Itemisation

7 Separate items shall be provided for surface impregnation of concrete in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Surface impregnation.
	2	Surface impregnation and coatings of concrete
II	1	Patterned surfaces.
	2	Plain surfaces.
III	1	Different types of systems.

Surface Impregnation of Concrete and surface Impregnation and coatings of Concrete

8 The items for surface impregnation of concrete shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparing, cleaning and drying;
- (b) protection from precipitation and spray;
- (c) masking and other measures to protect adjacent untreated materials;
- (d) disposal of material (as Series 600 paragraph 39);
- (e) facilities and assistance for the Overseeing Organisation's inspection;
- (f) complying with any special requirements in respect of ambient conditions and for intervals between successive operations and

applications;

- (g) preparation and supply of data sheets;
- (h) trial control panels;
- (i) removal of graffiti.
- (j) obtaining the correct dry film thickness of coatings
- (k) complying fully with the manufacturer's recommendations

Removal of Existing Waterproofing

Units

9 The unit of measurement shall be:

- (i) removal of existing waterproofingsquare metre

Measurement

10 The measurement of removal of existing waterproofing shall be the area of surface covered by the existing waterproofing.

No deduction shall be made for openings of 1 square metre or less.

Itemisation

11 Separate items shall be provided for removal of existing waterproofing in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Removal of existing waterproofing.
II	1	More than 300mm wide horizontal or at any inclination up to and including 30o to the horizontal.
	2	More than 300mm wide at any inclination more than 30o up to and including 90o to the horizontal.
	3	300mm wide or less at any inclination.
	4	Domed.

Removal of Existing Waterproofing

12 The items for removal of existing waterproofing shall in accordance with the Preamble to Bill of Quantities General Directions include for:

Item coverage

- (a) marking out the areas of waterproofing to be removed;
- (b) removal of protective layer;
- (c) removal of primer;
- (d) preparation of existing surfaces to receive new waterproofing;
- (e) disposal of materials (as Series 600 paragraph 39);
- (f) trials and approval tests;

- (g) measures to prevent damage to existing surfaces;

Series 2400: Brickwork, Blockwork and Stonework

Brickwork

Units	1	The units of measurement shall be:																																				
	(i)	brickwork square metre.																																				
	(ii)	copings, string courses and the like linear metre.																																				
Measurement	2	<p>The measurement shall be the superficial area of brickwork required by the Contract. No deduction shall be made for openings of 0.10 square metre or less.</p> <p>The measurement of copings, string courses and the like shall be the length of the work required by the Contract.</p> <p>Facings shall be measured as extra over brickwork except where brickwork is built entirely of facings.</p>																																				
Itemisation	3	<p>Separate items shall be provided for brickwork in accordance with Chapter II paragraphs 3 and 4 and the following:</p> <table border="1"> <thead> <tr> <th colspan="3">Group Feature</th></tr> </thead> <tbody> <tr> <td>I</td><td>1</td><td>Brickwork.</td></tr> <tr> <td>II</td><td>1</td><td>Copings, string courses and the like of different sizes.</td></tr> <tr> <td>III</td><td>1</td><td>Different types of bricks.</td></tr> <tr> <td>IV</td><td>1</td><td>Different thicknesses.</td></tr> <tr> <td>V</td><td>1</td><td>Different bonds.</td></tr> <tr> <td>VI</td><td>1</td><td>Different types of mortar.</td></tr> <tr> <td>VII</td><td>1</td><td>Curved on plan.</td></tr> <tr> <td>VIII</td><td>1</td><td>With a battered face.</td></tr> <tr> <td rowspan="4">IX</td><td>1</td><td>In walls.</td></tr> <tr> <td>2</td><td>In facework to concrete.</td></tr> <tr> <td>3</td><td>In arches.</td></tr> <tr> <td>4</td><td>In alteration work.</td></tr> </tbody> </table>	Group Feature			I	1	Brickwork.	II	1	Copings, string courses and the like of different sizes.	III	1	Different types of bricks.	IV	1	Different thicknesses.	V	1	Different bonds.	VI	1	Different types of mortar.	VII	1	Curved on plan.	VIII	1	With a battered face.	IX	1	In walls.	2	In facework to concrete.	3	In arches.	4	In alteration work.
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	2	In facework to concrete.																																				
	3	In arches.																																				
	4	In alteration work.																																				
Brickwork, Copings, String Courses and the Like	4	The items for brickwork, copings, string courses and the like shall in accordance with the Preambles to Bill of Quantities General Directions include for:																																				
Item coverage	(a)	bedding, jointing, pointing, raking out, wetting and fair-faced work, including rough and fair cutting;																																				
	(b)	plinths, corbels, bull-noses, chases, rebates, quoins and the like, grouting;																																				
	(c)	ties, dowels, cramps, joggles and the like, including sinkings, mortices and running in;																																				
	(d)	bonding into existing work;																																				
	(e)	forming cavity;																																				
	(f)	reinforcement (as Series 1700 paragraph 26);																																				
	(g)	cavity filling between the brickwork and the backing;																																				

- (h) building in pipes, holdfasts, bolts and the like and forming small openings;
- (i) sample panels;
- (j) damp proof courses and membranes;
- (k) removing loose material from the backing and washing clean;
- (l) curing and protection;
- (m) admixtures and additives.

Blockwork and Stonework

Units

5 The units of measurement shall be:

- (i) blockwork and stonework cubic metre.
- (ii) copings, string courses and the like linear metre.
- (iii) individual blocks, features or stones number.

Measurement

6 The measurement of blockwork and stonework shall be the volume of the work excluding the volume of the cavity and associated filling.

The measurement of copings, string courses and the like shall be the length of the work required by the Contract.

No deduction shall be made from the measurement for holes or voids of 0.15 cubic metre or less.

Itemisation

7 Separate items shall be provided for blockwork and stonework in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Blockwork.
	2	Stonework.
II	1	Copings, string courses and the like of different sizes.
	2	Individual blocks, features or stones of different sizes and shape.
III	1	Different types of construction.
IV	1	Different materials.
V	1	Different types of mortar.
VI	1	Curved on plan.
VII	1	With a battered face.
VIII	1	In walls.
	2	In facework to concrete.
	3	In arches.
	4	In alteration work.
IX	1	Plastering and finishes

Blockwork, Stonework, Copings, String Courses and the Like, Individual Blocks, Features or Stones

Item coverage

8 The items for blockwork, stonework, copings, string courses and the like, individual blocks, features or stones shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- (a) dressing including in situ dressing;

- (b) setting, bedding, jointing, coursing, raking out, quoins, grouting, pointing, wetting and fair-faced work including rough and fair cutting;
- (c) bonding into existing work;
- (d) ties, dowels, cramps, joggles and the like including sinkings, mortices and running in;
- (e) forming cavity;
- (f) cavity filling between the blockwork or stonework and the backing;
- (g) building in pipes, holdfasts, bolts and the like and forming small openings;
- (h) sample panels;
- (i) damp-proof courses and membranes;
- (j) removing loose material from the backing and washing clean;
- (k) reinforcement (as Series 1700 paragraph 26);
- (l) grooves, rebates, recesses, stoolings and weatherings;
- (m) marking for identification and delivery in any matching sequence;
- (n) manufacturer's certificate and supplying a copy to the Overseeing Organisation;
- (o) curing and protection;
- (p) admixtures and additives.
- (q) plastering and finishes

Remove from Store and Relay Brickwork, Blockwork and Stonework

Units

- 9** The units of measurement shall be:
- (i) remove from store and relay blockwork and stonework cubic metre.
 - (ii) remove from store and relay brickwork square metre.
 - (iii) remove from store and relay copings, string courses and the like..... linear metre.
 - (iv) remove from store and relay individual blocks, features or stones number.

Measurement

- 10** The measurement of remove from store and relay blockwork and stonework shall be the volume of the work required by the Contract. No deduction shall be made for holes or voids of 0.15 cubic metre or less.

The measurement of remove from store and relay brickwork shall be the superficial area of re-used brickwork required by the Contract. No deductions shall be made for openings of 0.1 square metre or less.

The measurement of remove from store and relay copings, string courses and the like shall be the length of the work required by the Contract.

Brick facings shall be measured as extra over remove from store and relay brickwork except where the brickwork is built entirely of facings. Itemisation

11 Separate items shall be provided for remove from store and relay brickwork, blockwork and stonework in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Remove from store and relay brickwork.
	2	Remove from store and relay blockwork.
	3	Remove from store and relay stonework.
II	1	Copings, string courses and the like of different sizes.
	2	Individual blocks, features or stones of different sizes and shape.
III	1	Different types of construction.
	2	Different types of bond.
IV	1	Different types of bricks.
	2	Different materials.
V	1	Different thicknesses.
VI	1	Different types of mortar.
VII	1	Curved on plan.
VIII	1	With a battered face.
IX	1	In walls.
	2	In facework to concrete.
	3	In arches.
	4	In alteration work.

**Remove from Store and
Brickwork, Blockwork
or Stonework**

Item coverage

12 The items for remove from store and relay brickwork, blockwork **Relay** and stonework shall in accordance with the Preambles to Bill of Quantities 1 General Directions include for:

- (a) loading, transporting from store unloading and positioning for relaying;
- (b) replacing items damaged during the foregoing operation;
- (c) modifications and new materials;
- (d) brickwork, copings, string courses and the like (as this Series paragraph 4);
- (e) blockwork, stonework, copings, string courses and the like, individual blocks, features or stones (as this Series paragraph 8).

Series 2600 is not taken up

Series 2700 is not taken up

Series 200: Site Clearance

<i>Item</i>	<i>Root Narrative</i>	<i>Unit</i>
Site Clearance		
1	General site clearance	ha
2	General site clearance area 1*	ha
3	Demolition of building or structure 1*	item
4	Demolition of group of buildings or structures 1*	item
5	Partial demolition of individual structures 1*	item

Take Up or Down and Set Aside for Re-use or Remove to Store or Tip off Site

6	Take up or down 2*3*4*	m ³
7	Take up or down 2*5* paving 6*	m ²
8	Take up or down 2*4* brickwork 6*	m ²
9	Take up or down 2*7*19*	m
10	Take up or down 2*8*9* safety fencing 11*	m
11	Take up or down 2*10*4*13*	m
12	Take up or down 2*12* fence 13*	m
13	Take up or down 2*14*4*19*	m
14	Take up or down 2*15*16*	m
15	Take up or down 2*17*18*19*	no
16	Take up or down 2*20*	no

<i>Group</i>	<i>Variables</i>
1*	(i) etc =[stated reference]
2*	(i) =and set aside for reuse (ii) =and remove to store off Site (iii) =and remove to tip off Site
3*	(i) =blockwork (ii) =stonework
4*	(i) etc =[stated Type]
5*	(i) =precast concrete slab (ii) =stone flag (iii) =brick (iv) =cobble

	(v)	=granite sett
	(vi)	=block
	(vii) etc	=[stated Type]
6*	(i) etc	=[stated depth or thickness]
7*	(i)	=precast concrete kerbs
	(ii)	=granite kerbs
	(iii)	=precast concrete channels
	(iv)	=precast concrete edgings
	(v)	=combined drainage and kerb blocks
	(vi)	=linear drainage channel systems
	(vii) etc	=[stated Type and feature]
8*	(i)	=untensioned single sided
	(ii)	=untensioned double sided
	(iii)	=tensioned single sided
	(iv)	=tensioned double sided
9*	(i)	=corrugated beam
	(ii)	=open box beam
	(iii)	=rectangular hollow section beam
10*	(i)	=safety barriers
	(ii)	=pedestrian guardrails
11*	(i)	=on timber posts
	(ii)	=on steel posts
	(iii)	=attached to structures
12*	(i)	=post and rail
	(ii)	=cleft chestnut
	(iii)	=chain link
	(iv) etc	=[stated Type]
13*	(o)	=No entry
	(i)	=300 mm high
	(ii)	=375 mm high
	(iii)	=450 mm high
	(iv) etc	=525 mm high (and so on in steps of 75 mm)
14*	(i)	=copings
	(ii)	=string courses
	(iii) etc	=[stated named feature]
15*	(i)	=power cable
	(ii)	=communications cable
16*	(i)	=laid singly
	(ii)	=laid as a pair
	(iii) etc	=[stated number]
17*	(i)	=bench seat
	(ii)	=cattle trough
	(iii) etc	=permanent bollard [stated type]
	(iv)	=parking meter
	(v)	=pedestrian crossing lights
	(vi)	=lighting column including bracket arm and lantern
	(vii)	=wall mounting including bracket arm and lantern
	(viii)	=traffic sign

	(ix)	=traffic sign including posts
	(x)	=internally illuminated traffic sign
	(xi)	=internally illuminated traffic sign including posts
	(xii)	=externally illuminated traffic sign
	(xiii)	=externally illuminated traffic sign including posts
	(xiv)	=timber gate
	(xv)	=metal gate
	(xvi)	=stile
	(xvii)	=road stud
	(xviii)	=individual blocks
	(xix)	=individual masonry features
	(xx)	=individual stones
	(xxi)	=chamber cover and frame
	(xxii)	=gully grating and frame
	(xxiii)	=feeder pillars
	(xxiv)etc	=[stated named feature]
18*	(o)	=No entry
	(i) etc	=[stated Type]
19*	(o)	=No entry
	(i) etc	=[stated Size]
20*	(i) etc	=[stated Type of signal]
	(ii) etc	=[stated Type of motorwarn assembly]
	(iii) etc	=[stated Type of emergency telephone]
	(iv)	=camera pole
	(v) etc	=[stated Type of cabinet]
	(vi) etc	=[stated Type of equipment]

Series 300: Fencing

Fencing, Gates and Stiles

Units	<p>1 The units of measurement shall be:</p> <ul style="list-style-type: none"> (i) fencing linear metre. (ii) concrete foundation to timber posts number. (iii) gates, stiles number. (iv) wire, wire mesh to existing fencing, gates and the like linear metre. (v) fenced tree guards number. 															
Measurement	<p>2 Where a particular type of temporary fencing is specified in Appendix 3/1 by the Overseeing Organisation and shown on the drawings it shall be measured. All other temporary fencing shall not be measured. The measurement of fencing shall be the developed length along the centre line of the fence. The measurement of height of fencing shall be that stated in the Contract for the type of fence.</p> <p>The measurement of wire and wire mesh shall only be separately measurable where it is required by the Contract to be fixed to existing fencing, gates and the like, and shall be the developed length along the centre line of the fence.</p> <p>The measurement of width of gates shall be the distance between the outer edges of the stiles; the outer edges of hanging stiles in the case of double gates.</p> <p>The measurement of height of gates shall be the distance between the upper surface of the top rail and the underside of the bottom rail.</p> <p>Concrete foundation to timber posts shall only be measured for those locations stated in Appendices 1/15 or 3/1 of the Specification.</p>															
Itemisation	<p>3 Separate items shall be provided for fencing in accordance with Chapter II paragraphs 3 and 4 and the following:</p> <table border="1"> <thead> <tr> <th>Group</th><th>Feature</th></tr> </thead> <tbody> <tr> <td rowspan="7">I</td><td>1 Each type of fencing.</td></tr> <tr> <td>2 Concrete foundation to each type of timber post for each type of fencing.</td></tr> <tr> <td>3 Each type of gate.</td></tr> <tr> <td>4 Each type of stile.</td></tr> <tr> <td>5 Each type of wire to existing fencing, gates and the like.</td></tr> <tr> <td>6 Each type of wire mesh to existing fencing, gates and the like.</td></tr> <tr> <td>7 Each type of fenced tree guard.</td></tr> <tr> <td rowspan="2">II</td><td>1 Fencing of different heights.</td></tr> <tr> <td>2 Gates of different heights and widths.</td></tr> <tr> <td>III</td><td>1 Painted fencing, gates or stiles.</td></tr> </tbody> </table>	Group	Feature	I	1 Each type of fencing.	2 Concrete foundation to each type of timber post for each type of fencing.	3 Each type of gate.	4 Each type of stile.	5 Each type of wire to existing fencing, gates and the like.	6 Each type of wire mesh to existing fencing, gates and the like.	7 Each type of fenced tree guard.	II	1 Fencing of different heights.	2 Gates of different heights and widths.	III	1 Painted fencing, gates or stiles.
Group	Feature															
I	1 Each type of fencing.															
	2 Concrete foundation to each type of timber post for each type of fencing.															
	3 Each type of gate.															
	4 Each type of stile.															
	5 Each type of wire to existing fencing, gates and the like.															
	6 Each type of wire mesh to existing fencing, gates and the like.															
	7 Each type of fenced tree guard.															
II	1 Fencing of different heights.															
	2 Gates of different heights and widths.															
III	1 Painted fencing, gates or stiles.															
Fencing	<p>4 The items for fencing shall in accordance with the Preambles to Bill of Quantities General Directions include for:</p>															
Item coverage	<p>(a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);</p>															

- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) trimming ground on the line of the fencing;
- (d) concrete (as Series 1700 paragraphs 5 and 10);
- (e) formwork (as Series 1700 paragraph 15);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) backfilling and compaction;
- (h) disposal of material (as Series 600 paragraph 39);
- (i) preservation of timber;
- (j) adjustment of fencing to a flowing alignment including additional length posts;
- (k) fixings and fittings;
- (l) joining to existing fencing, gates, hedges and walls;
- (m) protective system (as Series 1900 paragraph 4);
- (n) inspection and maintenance of fencing and gates;
- (o) erection and removal of temporary fencing and gates;
- (p) additional posts and rails over ditches;
- (q) maintenance of access for owners, tenants and occupiers of adjoining land and patrolling gaps or openings;
- (r) epoxy resin compound and mastic filler to posts fixed in socket;
- (s) additional posts at junctions and changes in direction or adjacent to gates, stiles and other obstacles;
- (t) additional posts, stakes and ground anchors;
- (u) inspection of existing fencing and reports;
- (v) pegging, bending, turning and cutting mesh;
- (w) cutting turves and turfing (as Series 3000 paragraph 9);
- (x) patrolling.

**Concrete Foundation 5
to Timber Posts**

The items for concrete foundation to timber posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- | | |
|---------------|---|
| Item coverage | (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18); |
| | (b) excavation of unacceptable material (as Series 600 paragraph 19); |
| | (c) in situ concrete (as Series 1700 paragraph 5); |

- (d) formwork (as Series 1700 paragraph 15);
- (e) reinforcement (as Series 1700 paragraph 26);
- (f) backfilling and compaction;
- (g) disposal of material (as Series 600 paragraph 39).

Gates and Stiles

6 The items for gates and stiles shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) trimming ground at entrance;
- (d) in situ concrete (as Series 1700 paragraph 5);
- (e) formwork (as Series 1700 paragraph 15);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) backfilling and compaction;
- (h) disposal of material (as Series 600 paragraph 39);
- (i) preservation of timber;
- (j) protective system (as Series 1900 paragraph 4);
- (k) posts, fittings and furniture;
- (l) joining to existing fencing, hedges and walls;
- (m) in the case of new gates and stiles in existing fencing, hedges or walls, forming openings and making good;
- (n) stock-proofing.

Remove from Store and Re-erect Fencing, Gates and Stiles

Units

7 The units of measurement shall be:

- (i) remove from store and re-erect fencing linear metre.
- (ii) concrete foundation to timber posts number.
- (iii) remove from store and re-erect gates and stiles number.

Measurement

8 The measurement of re-erected fencing shall be the developed length along the centre line of the re-erected fencing. The measurement of height of fencing shall be that stated in the Contract for the type of fence.

The measurement of width of gates shall be the distance between the outer edges of the stiles; the outer edges of hanging stiles in the case of double gates.

Concrete foundation to timber posts shall only be measured for those locations stated in Appendices 1/15 or 3/1 of the Specification.

Group	Feature	
I	1	Each type of re-erected fencing.
	2	Concrete foundation to each type of timber post for each type of re-erected fencing.
	3	Each type of re-erected gate.
	4	Each type of re-erected stile.
II	1	Re-erected fencing of different heights.
	2	Re-erected gates of different heights and widths.
III	1	Re-erected painted fencing, gates or stiles.

Item coverage	(a)	loading, transporting from store, unloading and positioning for re-erection;
	(b)	replacing items damaged during the foregoing operations;
	(c)	modification and new materials;
	(d)	painting existing painted items;
	(e)	fencing (as this Series paragraph 4).

Item coverage (a) concrete foundation to timber posts (as this Series paragraph 5).

Item coverage	<ul style="list-style-type: none"> (a) loading, transporting from store, unloading and positioning for re-erection; (b) replacing items damaged during the foregoing operations; (c) modification and new materials; (d) painting existing painted items; (e) gates and stiles (as this Series paragraph 6).
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Units **13** The unit of measurement shall be:

- (i) extra over excavation for excavation in Hard Material in fencing works
..... cubic metre.

Measurement **14** The measurement of extra over excavation for excavation in Hard Material in fencing works shall be the plan area of the minimum size of the particular foundation required by the Contract multiplied by the depth of Hard Material removed.

Itemisation **15** Separate items shall be provided for extra over excavation for excavation in Hard Material in fencing works in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Extra over excavation for excavation in Hard Material in fencing works.

Extra Over Excavation for Excavation in Hard Material **16** The items for extra over excavation for excavation in Hard Material in fencing works shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item Coverage** (a) excavation in Hard Material (as Series 600 paragraph 23).

Series 400: Safety Fences, Safety Barriers and Pedestrian Guardrails

Definition

1 The term “beam” shall mean a longitudinal member spanning posts and mounting brackets within the limits defined in paragraph 4 below. The term “mounting bracket” shall be deemed to include the term “bridge pier or concrete parapet mounting connection”.

2 The term “wire rope” shall mean the complete rope system for the wire rope safety fence comprising upper and lower ropes together with inherent component ropes of all types and tail ropes but excluding safety check ropes.

Beam Safety Fences

Units

3 The units of measurement shall be:

- (i) beams linear metre.
- (ii) posts, mounting brackets, terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets, connection pieces, concrete foundations and socketed foundations to posts number.

Measurement

4 The measurement of beams shall be the developed length along the center line of the beams or in the case of double sided fences and double rail fences, measured once only along the centre line of the posts, between the following points:

- (a) the end of each beam type at a connection to bridge parapet or within a connection piece assembly;
- (b) the connection of beams to terminal sections, full height anchorages and expansion joint anchorages.

5 The measurement of terminal sections, full height anchorages, expansion joint anchorages and connections to bridge parapets shall be the complete installation. Mounting brackets and all other posts required between those points defined in paragraph 4 shall be measured. Concrete foundations and socketed foundation to posts, between those points defined in paragraph 4, shall only be measured for those locations stated in the Contract.

6 The measurement of connection pieces shall be the complete installation.

7 The measurement of expansion joint anchorages shall be for each anchorage on each side of the expansion joint.

Itemisation

8 Separate items shall be provided for beam safety fences in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each type of beam.
	2 Each type of post.
	3 Each type of mounting bracket.
	4 Each type of terminal section.
	5 Each type of full height anchorage.
	6 Each type of expansion joint anchorage.
	7 Each type of connection to bridge parapet.
	8 Each type of connection piece.
	9 Each type of concrete foundation to post.
	10 Each type of socketed foundation to post.
II	1 Straight or curved exceeding 120 metres radius.

	2	Curved exceeding 50 metres radius but not exceeding 120 metres radius.
	3	Curved not exceeding 50 metres radius.
III	1	Double rail.
IV	1	Double sided.

Beams

9 The items for beams shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) fabrication (as Series 1800 paragraph 6);
- (b) protective system (as Series 1900 paragraph 4);
- (c) attachments, adjuster assemblies, expansion assemblies, fixings, closure pieces and stiffeners;
- (d) adjustment of beams to flowing alignment;
- (e) tensioning or retensioning;
- (f) flaring;
- (g) painting.

Posts

10 The items for posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) fabrication (as Series 1800 paragraph 6);
- (b) protective system (as Series 1900 paragraph 4);
- (c) driving in any material;
- (d) fixing to structures including attachment systems;
- (e) fixing to beam including spacers;
- (f) drilling or forming holes and pockets and casting in bolts, base plates and anchorage assemblies;
- (g) bedding;
- (h) filling.

Mounting Brackets

11 The items for mounting brackets shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) fabrication (as Series 1800 paragraph 6);
- (b) protective system (as Series 1900 paragraph 4);
- (c) fixing to structures including adaptor platforms;
- (d) fixing to beam;
- (e) drilling or forming holes and pockets and casting in bolts, base plates and anchorage assemblies.

Terminal Sections, Full Height Anchorages, Expansion Joint Anchorages,

12 The items for terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets and connection pieces shall in accordance with the Preambles to Bill of Quantities General Directions include

**Connections to Bridge
Parapets and Connection
Pieces**

for:

Item coverage

- (a) posts (as this Series paragraph 10);
- (b) beams (as this Series paragraph 9);
- (c) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
- (d) concrete (as Series 1700 paragraphs 5 and 10);
- (e) formwork (as Series 1700 paragraph 15);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) disposal of material (as Series 600 paragraph 39);
- (h) fixing to or setting in concrete;
- (i) terminal end shoes;
- (j) precast concrete fairings;
- (k) in the case of terminal sections to untensioned corrugated beam, acceptable material, ramp, backfilling and compaction;
- (l) casings and plastic sheeting;
- (m) sockets, socket covers and filling.

**Concrete Foundations to
Posts**

13 The items for concrete foundations to posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
- (b) disposal of material (as Series 600 paragraph 39);
- (c) concrete (as Series 1700 paragraphs 5 and 10);
- (d) formwork (as Series 1700 paragraph 15);
- (e) reinforcement (as Series 1700 paragraph 26);
- (f) plastic sheeting;
- (g) casings.

**Socketed Foundations
to Posts**

14 The items for socketed foundations to posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) fabrication (as Series 1800 paragraph 6);
- (b) protective system (as Series 1900 paragraph 4);
- (c) concrete foundations to posts (as this Series paragraph 13);
- (d) socket covers and filling.

Remove from Store and Re-erect Beam Safety Fences

Units	15	The units of measurement shall be:
	(i)	remove from store and re-erect beams linear metre.
	(ii)	remove from store and re-erect posts, mounting brackets, terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets, connection pieces number.
	(iii)	concrete foundations and socketed foundations to re-erected posts.... number.

Measurement	16	The measurement of re-erected beam safety fences shall be in accordance with paragraphs 4, 5, 6 and 7 of this Series.
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Itemisation	17	Separate items shall be provided for remove from store and re-erect beam safety fences in accordance with Chapter II paragraphs 3 and 4 and the following:
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Group	Feature
I	1 Each type of re-erected beam.
	2 Each type of re-erected post.
	3 Each type of re-erected mounting bracket.
	4 Each type of re-erected terminal section.
	5 Each type of re-erected full height anchorage.
	6 Each type of re-erected expansion joint anchorage.
	7 Each type of re-erected connection to bridge parapet.
	8 Each type of re-erected connection piece.
	9 Each type of concrete foundation to re-erected post.
	10 Each type of socketed foundation to re-erected post.
II	1 Straight or curved exceeding 120 metres radius.
	2 Curved exceeding 50 metres radius but not exceeding 120 metres radius.
	3 Curved not exceeding 50 metres radius.

Remove from Store and Re-erect Beams	18	The items for remove from store and re-erect beams shall in accordance with the Preambles to Bill of Quantities General Directions include for:
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Item coverage	(a)	loading, transporting from store, unloading and positioning for re-erection;
	(b)	replacing items damaged during the foregoing operations;
	(c)	modification and new materials;
	(d)	beams (as this Series paragraph 9);
	(e)	making good to protective system.

Remove from Store and Re-erect Posts	19	The items for remove from store and re-erect posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:
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Item coverage	(a)	loading, transporting from store, unloading and positioning for re-erection;
	(b)	replacing items damaged during the foregoing operations;

- (c) modification and new materials;
- (d) posts (as this Series paragraph 10);
- (e) making good to protective system.

Remove from Store and Re-erect Mounting Brackets **20** The items for remove from store and re-erect mounting brackets shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) loading, transporting from store, unloading and positioning for re-erection;
 - (b) replacing items damaged during the foregoing operations;
 - (c) modification and new materials;
 - (d) mounting brackets (as this Series paragraph 11);
 - (e) making good to protective system.

Remove from Store and Re-erect Terminal Sections Full Height Anchorages Expansion Joint Anchorages Connections to Bridge parapets and Connection Pieces **21** The items for remove from store and re-erect terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets and connection pieces shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) loading, transporting from store, unloading and positioning for re-erection;
 - (b) replacing items damaged during the foregoing operations;
 - (c) modification and new materials;
 - (d) terminal sections, full height anchorages, expansion joint anchorages, connections to bridge parapets and connection pieces (as this Series paragraph 12);
 - (e) making good to protective system.

Concrete Foundations and Socketed Foundations to Re-erected Posts **22** The items for concrete foundations and socketed foundations to re-erected posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) concrete foundations to posts (as this Series paragraph 13);
 - (b) socketed foundations to posts (as this Series paragraph 14).

Post Extension Units

Units **23** The unit of measurement shall be:

- (i) post extension units number.

Itemisation **24** Separate items shall be provided for post extension units in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each type of post extension unit.

Post Extension Units **25** The items for post extension units shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) fabrication (as Series 1800 paragraph 6);
 - (b) protective system (as Series 1900 paragraph 4);
 - (c) drilling existing posts;
 - (d) fixing to existing posts.

Raising Existing Sockets

Units **26** The unit of measurement shall be:

(i) raising existing sockets number.

Itemisation **27** Separate items shall be provided for raising existing sockets in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Raising each type of existing socket.

Raising Existing Sockets 28 The items for raising existing sockets shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) removing existing posts and setting aside for re-use;
 - (b) cleaning out sockets;
 - (c) in situ concrete (as Series 1700 paragraph 5);
 - (d) formwork (as Series 1700 paragraph 15);
 - (e) loading, transporting from store, unloading and positioning for re-erection;
 - (f) removing from store and re-erecting posts (as this Series paragraph 19);
 - (g) replacing items damaged during the foregoing operations;
 - (h) making good to protective systems.

Wire Rope Safety Fence

Units **29** The units of measurement shall be:

(i) wire rope linear metre.

- (ii) posts, intermediate anchorages, end anchorages, concrete foundations and socketed foundations to posts number.

Measurement **30** The measurement of wire rope shall be the undeveloped length measured once only along the centre line of the fence on plan from midway between the anchor blocks at one end to midway between the anchor blocks at the other end.

31 The measurement of intermediate anchorages and end anchorages shall be the complete installation.

Concrete foundations and socketed foundations shall only be measured for those locations stated in the Contract.

temisation **32** Separate items shall be provided for wire rope safety fences in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Wire rope.
	2 Each type of post.
	3 Each type of intermediate anchorage.
	4 Each type of end anchorage.
	5 Each type of concrete foundation to post.
	6 Each type of socketed foundation to posts.

Wire rope **33** The items for wire rope shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) fabrication (as Series 1800 paragraph 6);
 - (b) protective system (as Series 1900 paragraph 4);
 - (c) rigging screws, threaded terminals, attachments, fittings and fixings;
 - (d) adjustments and tensioning;
 - (e) threading ropes into and around posts.

Posts **34** The items for posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) fabrication (as Series 1800 paragraph 6);
 - (b) protective system (as Series 1900 paragraph 4);
 - (c) driving in any material;
 - (d) fixing to structures including attachment systems;
 - (e) post caps, excluders, hooks and fittings;
 - (f) drilling or forming holes and pockets and casting in bolts, base plates, sockets and anchorage assemblies;
 - (g) bedding;
 - (h) filling.

Intermediate Anchorages and End Anchorages **35** The items for intermediate anchorages and end anchorages shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage		<ul style="list-style-type: none"> (a) fabrication (as Series 1800 paragraph 6); (b) protective system (as Series 1900 paragraph 4); (c) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23); (d) concrete (as Series 1700 paragraphs 5 and 10); (e) formwork (as Series 1700 paragraph 15); (f) reinforcement (as Series 1700 paragraph 26); (g) disposal of material (as Series 600 paragraph 39); (h) safety check ropes, fork terminals, pins, thimbles, ferrules, attachments, fixings and fittings; (i) anchor frames, surface mounted anchors and sockets; (j) fixing to anchor block including attachment systems; (k) drilling or forming holes and pockets and casting in bolts, base plates, sockets and anchorage assemblies.
Concrete Foundations To Posts	36	The items for concrete foundations to posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		<ul style="list-style-type: none"> (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23); (b) disposal of material (as Series 600 paragraph 39); (c) concrete (as Series 1700 paragraphs 5 and 10); (d) formwork (as Series 1700 paragraph 15); (e) reinforcement (as Series 1700 paragraph 26); (f) plastic sheeting; (g) casings.
Socketed Foundations to Posts	37	The items for socketed foundations to posts shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		<ul style="list-style-type: none"> (a) fabrication (as Series 1800 paragraph 6); (b) protective system (as Series 1900 paragraph 4); (c) concrete foundations to posts (as this Series paragraph 36); (d) socket covers and filling.
Concrete Safety Barriers		
Units	38	The units of measurement shall be: <ul style="list-style-type: none"> (i) concrete safety barriers linear metre. (ii) concrete safety barrier terminations, transitions number.
Measurement	39	The measurement of concrete safety barriers shall be the developed length along the centre line of the barriers between terminations.

Itemisation **40** Separate items shall be provided for concrete safety barriers in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each type of barrier.
	2 Each type of termination.
	3 Each type of transition.
II	1 Straight or curved exceeding 50 metres radius.
	2 Curved not exceeding 50 metres radius.

Concrete Safety Barriers 41 The items for concrete safety barriers shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
 - (b) disposal of material (as Series 600 paragraph 39);
 - (c) concrete (as Series 1700 paragraph 5 and 10);
 - (d) formwork (as Series 1700 paragraph 15);
 - (e) reinforcement (as Series 1700 paragraph 26);
 - (f) joints and gaskets including movement joints;
 - (g) foundations and bases;
 - (h) filling;
 - (i) attachment systems and fixings;
 - (j) adjustment to flowing alignment;
 - (k) fabrication (as Series 1800 paragraph 6);
 - (l) protective system (as Series 1900 paragraph 4);
 - (m) cast-in sockets, bolts, nuts, washers;
 - (n) make-up units;
 - (o) dowel bars;
 - (p) treatment at lighting columns and the like including cover plates, sub-frames, plates and fixings.

Concrete Safety Barrier Terminations and Transitions 42 The items for concrete safety barrier terminations and transitions shall in accordance with the Preambles to Bill of Quantities General Directions included for:

- Item coverage
- (a) concrete safety barriers (as this Series paragraph 41);
 - (b) fixing to or setting in concrete;
 - (c) attachment systems and connectors for fixing to beam safety fences.

Pedestrian Guardrails and Handrails

Units	43	The unit of measurement shall be:	
	(i)	pedestrian guardrails, handrails linear metre.	
Measurement	44	The measurement of pedestrian guardrails and handrails shall be the developed length along the centre line. The height of pedestrian guardrails shall be the height between the top of the top rail and the finished level of the surface directly beneath the guardrail.	
Itemisation	45	Separate items shall be provided for pedestrian guardrails and handrails in accordance with Chapter II paragraphs 3 and 4 and the following:	
		Group	Feature
		I	1 Each type of pedestrian guardrail.
			2 Each type of handrail.
		II	1 Different heights.
		III	1 Elements curved in plan to different radii.
Pedestrian Guardrails and Handrails	46	The items for pedestrian guardrails and handrails shall in accordance with the Preambles to Bill of Quantities General Directions include for:	
Item coverage		(a)	excavation in any material (as Series 600 paragraphs 17, 18, 19 and 23);
		(b)	disposal of material (as Series 600 paragraph 39);
		(c)	in situ concrete (as Series 1700 paragraph 5);
		(d)	formwork (as Series 1700 paragraph 15);
		(e)	reinforcement (as Series 1700 paragraph 26);
		(f)	backfilling and compaction;
		(g)	metal parapets (as Series 2200 paragraph 5);
		(h)	gates (as Series 300 paragraph 6);
		(j)	rivets, nuts, bolts, shims, washers, welds, clamps and the like.

Loading Tests on Post Foundations

Units

47

The unit of measurement for loading test on post foundation shall be:

(i)

loading test on post foundation carried out by Contractor, loading test on post foundation carried out by Overseeing Organisation number.

Itemisation

48

Separate items shall be provided for loading test on post foundation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Loading test on post foundation carried out by Contractor.
	2 Loading test on post foundation carried out by Overseeing Organisation.
II	1 Different types of safety fence posts.
III	1 Different sizes of safety fence posts.

Loading Test on Post Foundation Carried Out by Contractor

49

The items for loading test on post foundation carried out by Contractor shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) posts (as this Series paragraph 10);
 - (b) concrete foundations to posts (as this Series paragraph 13);
 - (c) socketed foundations to posts (as this Series paragraph 14);
 - (d) provision, maintenance and subsequent removal of test equipment;
 - (e) provision, maintenance and subsequent removal of reaction vehicle;
 - (f) preparation and submission of results to the Overseeing Organisation;
 - (g) removal of test posts and foundations;
 - (h) disposal of material (as Series 600 paragraph 39);
 - (i) reinstatement and making good;
 - (j) traffic safety and management (as Series 100 paragraph 26).

Loading Test on Post Foundation Carried Out by Overseeing Organisation

50 The items for loading test on post foundation carried out by Overseeing Organisation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) posts (as this Series paragraph 10);
 - (b) concrete foundations to posts (as this Series paragraph 13);
 - (c) socketed foundations to posts (as this Series paragraph 14);
 - (d) provision, maintenance and subsequent removal of reaction vehicle;
 - (e) removal of test posts and foundations;
 - (f) disposal of material (as Series 600 paragraph 39);
 - (g) reinstatement and making good;
 - (h) traffic safety and management (as Series 100 paragraph 26).

Series 500: Drainage and Service Ducts

Definitions

- 1 Any reference to 'drain' shall be deemed to include sewers and piped culverts.
- 2 Drains exceeding 900 mm internal diameter, box culverts, piped culverts and all associated chambers, headwalls, outfall works and concrete bagwork shall be measured in accordance with Series 2500 Special Structures.
- 3 Trenches and ducts in connection with electrical work for road lighting and traffic signs cabling shall be measured in accordance with Series 1400.
- 4 Trenches and ducts in connection with motorway communications cabling shall be measured in accordance with Series 1500.
- 5 The Earthworks Outline is defined in Series 600 Earthworks paragraphs 1 to 6 inclusive and shall apply equally to this Series.
- 6 Where the ground level has been subjected to treatment, under the Contract, in respect of ground improvement, mine workings, swallow holes and the like, for the purposes of this Series Existing Ground Level shall be the level obtained upon completion of any such treatment of the areas affected.
- 7 Sub-soil Level is defined as the level of the ground after the removal of topsoil required by the Contract.
- 8 Surcharge is defined as material placed on embankments for the purpose of loading the embankment for the periods stated in the Contract.

Drains and Service Ducts (Excluding Filter Drains, Narrow Filter Drains and Fin Drains)

Unit

- 9 The unit of measurement for drains and service ducts shall be:
 - (i) drains, service ducts linear metre.

Measurement

- 10 The measurement of drains and service ducts shall be the summation of their individual lengths measured along the centre lines of the pipes between any of the following:
 - (a) the internal faces of chambers;
 - (b) the external faces of headwalls;
 - (c) the intersections of the centre lines at pipe junctions;
 - (d) the centre of gully gratings (or where no grating is provided, the centre of the gully);
 - (e) the position of terminations shown in the Contract;
 - (f) the point of change of stage depth.
- 11 The depth of drains and service ducts shall be the vertical measurement between the invert and the following:
 - (a) where the invert is below the Existing Ground Level - the Existing Ground Level except that where the Earthworks Outline is below the Existing Ground Level the measurement shall be taken to the Earthworks Outline;
 - (b) where the invert is at or above the Existing Ground Level - the

datum stated in the Contract, or where none is stated, the Earthworks Outline.

Notwithstanding the foregoing, where in the Contract a commencing level or a minimum level of cover is stated from which excavation shall commence, then the depth shall be taken to that stated level.

12 The average depth to invert shall be the calculated arithmetic mean of the depths taken at intervals of 10 metres along the pipelines starting from the outfall end. For terminal lengths and pipelines less than 10 metres long the measurement of depths shall be taken at their ends.

13 The measurement of service ducts shall be for the complete construction irrespective of the number of ducts contained within any one trench.

Where more than one duct is laid in a trench then the number of ducts shall be stated in the item description.

14 Drains and service ducts required to be designed by the Contractor shall be measured in accordance with Series 2500.

Itemisation

15 Separate items shall be provided for drains and service ducts (excluding filter drains, narrow filter drains and fin drains) in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Drains.
	2	Service ducts.
II	1	Different internal diameters.
III	1	Depths to invert not exceeding 2 metres. The average depth to invert to be stated to the nearest 25 mm.
	2	Depths to invert exceeding 2 metres but not exceeding 4 metres and so on in steps of 2 metres. The average depth to invert to be stated to the nearest 25 mm.
IV	1	Specified design groups.
	2	Particular designs stated in the Contract
V	1	Construction in trench.
	2	Construction in heading.
	3	Construction by jacking or thrust boring.
	4	Suspended on discrete supports.
VI	1	In side slopes of cuttings or side slopes of embankments.

Note: For each item which includes Group III Feature 1 or 2, an associated item shall be provided for adjustment of the rate for each 25 mm of difference in excess of 150 mm where the average depth to invert calculated from site measurement varies from that stated in the Bill of Quantities. The foregoing shall apply to both increases and decreases of average in excess of 150 mm, and will result in

either a positive or negative adjustment of the rate.

Drains and Service Ducts

- 16** The items for drains and service ducts shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage
- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
 - (b) excavation of unacceptable material (as Series 600 paragraph 19);
 - (c) access shafts to headings and their subsequent reinstatement;
 - (d) thrust pits and thrust blocks for pipe jacking and their removal on completion;
 - (e) articulated pipes and fittings;
 - (f) cutting, laying, jointing and bedding;
 - (g) building in pipes to headwalls and outfall works;
 - (h) hangers, stools and discrete supports;
 - (i) bedding, haunching and surrounding;
 - (j) formwork (as Series 1700 paragraph 15);
 - (k) backfilling and compaction;
 - (l) disposal of material (as Series 600 paragraph 39);
 - (m) movement joints to beds, surrounds and the like;
 - (n) reinstatement of unpaved areas;
 - (o) checking and cleaning;
 - (p) recording, staking and labelling;
 - (q) in the case of ducts, fixing draw ropes, removable stoppers, marker blocks and posts;
 - (r) pipe schedules;
 - (s) lubricants, packing, grouting and caulking;
 - (t) surveys and recordings;
 - (u) protective system (as Series 1900 paragraph 4).

Filter Drains

- Units**
- 17** The units of measurement for filter drains shall be:
- (i) filter drains linear metre.
 - (ii) filter material contiguous with filter drains cubic metre.
 - (iii) sub-base material cubic metre.

		(iv) lightweight aggregate infill cubic metre.
		(v) excavate and replace filter material cubic metre.
Measurement	18	<p>The measurement of filter drains, excluding narrow filter drains, shall be the summation of their individual lengths measured along the center lines of the pipe (or trench where no pipe is provided), between any of the following:</p> <p>(a) the internal faces of chambers;</p> <p>(b) the external faces of headwalls;</p> <p>(c) the intersection of centre lines at junctions;</p> <p>(d) the centre of gully gratings (or where no grating is provided the centre of the gully);</p> <p>(e) the position of terminations shown in the Contract;</p> <p>(f) the point of change of stage depth.</p>
	19	<p>The depth of filter drains shall be the vertical measurement between the invert (or the centre line of the trench bottom where no pipe is provided) and the following:</p> <p>(a) where the invert is below the Existing Ground Level - the Existing Ground Level or the Earthworks Outline whichever is the lower, except that where the finished level of the filter material is above the Existing Ground Level the measurement shall be taken to the finished level of the filter material;</p> <p>(b) where the invert is at or above the Existing Ground Level - the datum stated in the Contract, or where none is stated, the finished level of the filter material.</p> <p>The calculation of average depth to invert of filter drains shall be as paragraph 12 of this Series taken along the centre line of the filter drain.</p> <p>Narrow filter drains shall be measured in accordance with paragraphs 25 to 28 of this Series.</p>
	20	<p>The measurement of contiguous filter material shall be the volume of the material occupying the void between the filter drain and the adjacent carriageway, hardshoulder and hardstrip. The side of the contiguous filter material next to the filter drain shall be taken as the vertical extension of the trench side above capping or where no capping is provided above subgrade level.</p> <p>The measurement of sub-base material shall be the volume of the sub-base material within non-pavement verge or central reserve adjacent to the carriageway, hardshoulder and hardstrip filled to the outline stated in the Contract.</p> <p>The measurement of lightweight aggregate infill shall be the volume of the lightweight aggregate infill above the filter drain filled to the outline stated in the Contract.</p> <p>The measurement of excavate and replace filter material shall be the product of the lengths, widths and depths instructed by the Overseeing Organisation with no deduction for pipes, ducts or chambers. Lengths and widths shall be taken as the lengths and widths at the level of the drain invert or, in the case that partial excavation is instructed, at the depth to which excavation is instructed by the Overseeing Organisation.</p>
Itemisation	21	<p>Separate items shall be provided for filter drains in accordance with Chapter II paragraphs 3 and 4 and the following:</p>

Group	Feature	
I	1	Filter drains.
	2	Filter material contiguous with filter drains.
	3	Sub-base material.
	4	Lightweight aggregate infill.
	5	Excavate and replace filter material.
II	1	Different internal diameters.
	2	Different types of filter material.
	3	Different types of sub-base material.
	4	Different types of lightweight aggregate infill.
III	1	Depths to invert not exceeding 2 metres. The average depth to invert to be stated to the nearest 25 mm.
	2	Depths to invert exceeding 2 metres but not exceeding 4 metres and so on in steps of 2 metres. The average depth to invert to be stated to the nearest 25 mm.
IV	1	Specified design groups.
	2	Particular designs stated in the Contract.
V	1	In side slopes of cuttings or side slopes of embankments.

Note: For each item which includes Group III Feature 1 or 2 an associated item shall be provided for adjustment of the rate for each 25 mm of difference in excess of 150 mm where the average depth to invert calculated from site measurement varies from that stated in the Bill of Quantities. The foregoing shall apply to both increases and decreases of average in excess of 150 mm, and will result in either a positive or negative adjustment of the rate.

Filter Drains

22 The items for filter drains shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) disposal of material (as Series 600 paragraph 39);
- (d) articulated pipes, and fittings;
- (e) cutting, laying, jointing and bedding;
- (f) bedding, haunching and surrounding;
- (g) formwork (as Series 1700 paragraph 15);
- (h) filter material and compaction;
- (i) reinstatement of unpaved areas;

- (j) checking and cleaning;
- (k) recording, staking and labelling;
- (l) geotextiles;
- (m) topsoiling, seeding and turfing;
- (n) mesh;
- (o) pipe schedules;
- (p) protective system (as Series 1900 paragraph 4).

Filter Material Contiguous with Filter Drains, Sub-base Material and Lightweight **23** The items for filter material contiguous with filter drains, sub-base material and lightweight aggregate infill shall in accordance with the Preambles to Bill of Quantities General **Aggregate Infill**
Directions include for:

- Item coverage
- (a) compaction;
 - (b) formwork (as Series 1700 paragraph 15);
 - (c) geotextiles;
 - (d) mesh.

Excavate and Replace Filter Material **24** The items for excavate and replace filter material shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation (as Series 600 paragraphs 18 and 19);
 - (b) disposal of material (as Series 600 paragraph 39);
 - (c) compaction of fill (as Series 600 paragraph 52);
 - (d) geotextiles.

Fin Drains and Narrow Filter Drains

Units **25** The unit of measurement shall be:

- (i) fin drains linear metre.
- (ii) narrow filter drains linear metre.

Measurement **26** The measurement of fin drains and narrow filter drains shall be the summation of their individual lengths measured along their centre lines between any of the following:

- (a) the internal faces of chambers;
- (b) the position of terminations shown in the Contract;

(c) the external faces of headwalls.

The depth of the fin drain or narrow filter drain shall be the vertical measurement between the invert and the Earthworks Outline.

Itemisation

27 Separate items shall be provided for fin drains and narrow filter drains in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Fin drains. 2 Narrow filter drains.
II	1 Specified design group. 2 Particular designs stated in the Contract.
III	1 Depth not exceeding 1.5 metres.

Fin Drains and Narrow Filter Drains

Item coverage

28 The items for fin drains and narrow filter drains shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- (a) geotextiles and cores;
- (b) backfilling and compaction;
- (c) filter drains (as this Series paragraph 22);
- (d) protection from ultra-violet light;
- (e) marker tapes;
- (f) lapping and jointing;
- (g) connections, attachments and fittings;
- (h) treatment at chambers, gullies, pipelines and the like.

Connections

Units

29 The unit of measurement for connections shall be:

- (i) connection to existing drain, existing piped culvert, existing chamber, permanently severed land or mole drain number.

Measurement

30 Connections shall only be separately measured for connection to existing drains, existing piped culverts or existing chambers, and permanently severed land or mole drains.

Itemisation

31 Separate items shall be provided for connections in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Connection to existing drain and existing piped culvert.
	2 Connection to existing chamber.
	3 Connection to permanently severed land or mole drain.
II	1 Different diameters.
III	1 Depths to invert not exceeding 2 metres.
	2 Depths to invert exceeding 2 metres but not exceeding 4 metres and so on in steps of 2 metres.

Connections to Existing Drains, Existing Piped Culverts, Existing Chambers, Permanently Severed Land or Mole Drains

Item coverage

The items for connection to existing drains, existing piped culverts, existing chambers, permanently severed land or mole drains shall in accordance with the Preambles to Bill of Quantities General for:

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) locating and making entry;
- (d) backfilling and compaction;
- (e) disposal of material (as Series 600 paragraph 39);
- (f) making entry into chambers, concrete benching and channels, and making good the benching, channels and walls;
- (g) locating severed ends of land and mole drains;
- (h) pipes, fittings and saddles;
- (i) bedding, haunching and surrounding, and filter material;
- (j) formwork (as Series 1700 paragraph 15);
- (k) sealing off disused ends;
- (l) re-laying existing pipes disturbed.

Chambers and Gullies

Units	33	The unit of measurement shall be:
		(i) chambers, gullies number.
Measurement	34	The measurement shall be of the complete chamber or gully.
	35	Depths of chambers shall be the distance between the top surface of the cover and the invert of the main channel, or where no channel is required by the Contract, the uppermost surface of the base slab. Where no base slab is required the depth shall be taken to the bottom of the excavation.

Itemisation

36 Separate items shall be provided for chambers and gullies in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Chambers.
	2	Gullies.
II	1	Specified design groups.
	2	Particular designs stated in the Contract.
III	1	Depths not exceeding 1 metre.
	2	Depths exceeding 1 metre but not exceeding 2 metres
	3	and so on in steps of 1 metre
IV	1	Different types of covers or gratings.

Chambers

37 The items for chambers shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) locating existing drains;
- (d) breaking into existing drains;
- (e) connecting and re-connecting existing drains;
- (f) construction of bases, walls, roof and cover slabs and shafts, surrounds and corbelling for cover;
- (g) channels, fittings, benchings, building in pipes and fin drain connections;
- (h) cleaning;
- (i) steps, safety chains, ladders, handholds and the like;
- (j) covers, frames, seatings and bedding;
- (k) lifting keys;
- (l) concrete (as Series 1700 paragraphs 5 and 10);
- (m) formwork (as Series 1700 paragraph 15);
- (n) reinforcement (as Series 1700 paragraph 26);
- (o) backfilling and compaction;
- (p) disposal of material (as Series 600 paragraph 39);

- (q) filling;
- (r) notices;
- (s) sealants (as Series 2300 paragraph 10);
- (t) brickwork (as Series 2400 paragraph 4);
- (u) re-laying existing pipes disturbed;
- (v) pipework and fittings;
- (w) penstocks and ancillary equipment.

Gullies

38

The items for gullies shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) fittings including in situ concrete (as Series 1700 paragraph 5) bed and surround and jointing to pipes;
- (d) gratings, frames, slabs, surrounds, aprons, seatings, liners and bedding;
- (e) formwork (as Series 1700 paragraph 15);
- (f) cleaning;
- (g) backfilling and compaction;
- (h) disposal of material (as Series 600 paragraph 39);
- (i) brickwork (as Series 2400 paragraph 4);
- (j) re-laying existing pipes disturbed.

Headwalls and Outfall Works

Measurement

39

Headwalls and outfall works and the like to pipes up to 900 mm internal diameter shall be measured in accordance with this Series paragraphs 40 to 42.

Headwalls and outfall works and the like to pipes exceeding 900 mm internal diameter shall be measured in accordance with Series 2500.

Headwalls and outfall works and the like constructed using concrete bagwork shall be measured in accordance with this Series paragraphs 77 to 80.

Units

40

The unit of measurement shall be:

- (i) headwalls, revetments number.

Itemisation

41

Separate items shall be provided for headwalls and revetments in accordance with Chapter II paragraphs 3 and 4 and the following:

Group

Feature

	I	1	Headwalls.
		2	Revetments
	II	1	Different types.
	III	1	Different materials
	IV	1	Pipe not exceeding 100 mm internal diameter.
		2	Pipe exceeding 100 mm but not exceeding 300 mm internal diameter.
		3	Pipe exceeding 300 mm but not exceeding 600 mm internal diameter.
		4	Pipe exceeding 600 mm but not exceeding 900 mm internal diameter.
Headwalls and Outfall Works	42	The items for headwalls and outfall works shall in accordance with the Preambles to Bill of Quantities General Directions include for:	
Item coverage		<p>(a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);</p> <p>(b) excavation of unacceptable material (as Series 600 paragraph 19);</p> <p>(c) concrete (as Series 1700 paragraphs 5 and 10);</p> <p>(d) formwork (as Series 1700 paragraph 15);</p> <p>(e) backfilling and compaction;</p> <p>(f) disposal of material (as Series 600 paragraph 39);</p> <p>(g) brickwork, copings, string courses and the like (as Series 2400 paragraph 4);</p> <p>(h) blockwork, stonework, copings, string courses, individual blocks, features or stones (as Series 2400 paragraph 8);</p> <p>(i) lining of watercourses (as Series 600 paragraph 89);</p> <p>(j) drainage channel blocks (as Series 1100 paragraph 4);</p> <p>(k) building in pipes and fin drain connections;</p> <p>(l) reinforcement (as Series 1700 paragraph 26);</p> <p>(m) miscellaneous metalwork (as Series 1800 paragraph 14);</p> <p>(n) waterproofing (as Series 2000 paragraph 4);</p> <p>(o) flap valves.</p>	
		Soft Spots and Other Voids	
Units	43	The unit of measurement shall be:	
		(i) soft spots, other voids cubic metre.	
Measurement	44	The measurement of soft spots and other voids shall be the volume	

of the void directed to be excavated or filled. For this measurement the width shall be taken for drains, service ducts and filter drains, as the internal diameter of the pipe plus 600 mm. Where no pipe is required the width shall be taken as 600 mm. For chambers, gullies and the like the measurement shall be taken as the horizontal area of the base slab or where no base slab is required the bottom of the excavation. The depths shall be measured from the underside of the thinnest permitted bed in any one group for trenches and from the underside of the base slab for chambers, gullies and the like.

Itemisation **45** Separate items shall be provided for soft spots and other voids in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Excavation of soft spots and other voids. 2 Filling of soft spots and other voids.
II	1 Different types of fill.

Excavation of Soft Spots and other Voids 46

The items for excavation of soft spots and other voids shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
(b) excavation of unacceptable material (as Series 600 paragraph 19);
(c) disposal of material (as Series 600 paragraph 39).

Filling of Soft Spots and Other Voids

47 The items for filling of soft spots and other voids shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) deposition of fill (as Series 600 paragraph 33);
(b) compaction of fill (as Series 600 paragraph 52);
(c) in situ concrete (as Series 1700 paragraph 5);
(d) formwork (as Series 1700 paragraph 15).

Supports Left in Excavation

Units **48** The unit of measurement shall be:
(i) supports left in excavation square metre.

Measurement **49** The measurement shall be the area of face required by the Contract to be left with supports in position

Itemisation **50** Separate items shall be provided for supports left in excavation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Supports.

II	1	Timber.
	2	Steel
III	1	Different types.
IV	1	Construction in trench.
	2	Construction in pits.
	3	Construction in heading.

Supports Left in Excavation

51 The items for supports left in excavation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) struts, walings and the like and working around them.

Drainage and Service Ducts in Structures (Including Reinforced Earth Structures and Anchored Earth Structures)

Units **52** The unit of measurement shall be:

(i) drainage and service ducts in structures item.

Measurement **53** The components comprising the items of drainage and service ducts in structures shall be identified and scheduled in the Contract.

Itemisation **54** Separate items shall be provided for drainage and service ducts in structures in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Drainage.
	2 Service ducts

II	1	Substructure - end supports.
	2	Substructure - intermediate supports.
	3	Superstructure.
	4	Reinforced earth structure.
	5	Anchored earth structure.

Drainage and Service Ducts in Structures **55** The items for drainage and service ducts in structures shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) drains, service ducts, filter drains, fin drains and narrow filter drains and connections (as this Series paragraphs 16,22, 28 and 32);
- (b) chambers (as this Series paragraph 37);
- (c) gullies (as this Series paragraph 38);
- (d) pipework, gullies, downpipes, fittings and the like including brackets, hangers and straps, fixing to or building into the structure;
- (e) making good protective system, waterproofing;
- (f) permeable backing including compaction and supports;

(g) channels.

Filling to Pipe Bays and Verges on Bridges

Units	56	The unit of measurement shall be:
	(i)	filling to pipe bays and verges on bridges cubic metre.
Measurement	57	The measurement shall be the volume of the void stated in the Contract to be filled except that no deduction shall be made for drains, service ducts, services, supplies and the like and their supports.
Itemisation	58	Separate items shall be provided for filling to pipe bays and verges on bridges in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Filling to pipe bays and verges on bridges.
II	1 Different types.

Filling to Pipe Bays and Verges on Bridges	59	The items for filling to pipe bays and verges on bridges shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage	(a)	deposition;
	(b)	complying with any restrictions on the placing and compacting of materials;
	(c)	compaction around drains, service ducts, services, supplies, supports and the like.

Replacement, Raising or Lowering of Covers and Gratings on Existing Chambers and Gullies

Definition	60	For the purpose of paragraphs 61 to 64 of this Series any reference to covers and gratings shall be deemed to include associated frames.
Units	61	The units of measurement shall be:
	(i)	replacement of covers and gratings on existing chambers and gullies number.
	(ii)	raising or lowering of covers and gratings on existing chambers and gullies number.
Measurement	62	When an existing cover or grating is to be raised/lowered and replaced, separate items shall be measured for raising/lowering and replacement.
Itemisation	63	Separate items shall be provided for replacement, raising or lowering of covers and gratings on existing chambers and gullies in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Replacement.
	2	Raising the level.
	3	Lowering the level.
II	1	Different sizes of cover.
	2	Different sizes of grating.
III	1	Different types of cover.
	2	Different types of grating.
IV	1	Different sizes of chamber.
	2	Different sizes of gully.
V	1	Different construction of chamber.
	2	Different construction of gully.
VI	1	Not exceeding 150 mm.
	2	Exceeding 150 mm but not exceeding 300 mm and so on in steps of 150 mm.

**Replacement, Raising
or Lowering of Covers
Existing the Preambles to
Chambers and Gullies**

Item coverage

64 The items for replacement, raising or lowering of covers and gratings on existing chambers and gullies shall in accordance with **and gratings on** Bill of Quantities General Directions include for:

- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) excavation of Hard Material (as Series 600 paragraph 23);
- (d) take up existing cover or grating including frame and clean and set aside for re-use;
- (e) demolition and preparation to receive new construction;
- (f) construction of walls, roof and cover slabs and shafts, surrounds and corbelling for cover and making good;
- (g) steps, safety chains, ladders, handholds, lifting keys and the like;
- (h) bedding cover or grating including frame;
- (i) concrete (as Series 1700 paragraphs 5 and 10);
- (j) formwork (as Series 1700 paragraph 15);
- (k) reinforcement (as Series 1700 paragraph 26);

- (l) backfilling and compaction;
- (m) disposal of material (as Series 600 paragraph 39);
- (n) taking precautions to avoid damage to drains;
- (o) cleaning;
- (p) reinstatement of adjacent surfaces;
- (q) brickwork (as Series 2400 paragraph 4);
- (r) sealants (as Series 2300 paragraph 10);
- (s) modification and new materials;
- (t) replacing items damaged during the foregoing operations.

**Remove from Store and Reinstall Chamber Covers and Frames,
and Gully Gratings and Frames**

Units	65	The unit of measurement shall be: (i) remove from store and reinstall chamber covers and frames, and gully gratings and frames number.
Measurement	66	The measurement of remove from store and reinstall chamber covers and frames and gully gratings and frames shall be the complete installation.
Itemisation	67	Separate items shall be provided for remove from store and reinstall chamber covers and frames and gully gratings and frames in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Remove from store and reinstall different types of chamber covers and frames.
	2	Remove from store and reinstall different types of Gully gratings and frames.
II	1	Different sizes.

Remove from Store and Reinstall Chamber and Frames and Gully Gratings and Frames Item coverage	68	The items for remove from store and reinstall chamber covers and frames and gully gratings and frames shall in accordance with the Preambles to Bill of Quantities General Directions include for: (a) loading, transporting from store, unloading and positioning for reinstallation; (b) replacing items damaged during the foregoing operations; (c) modification and new materials; (d) replacement, raising or lowering of covers and gratings on existing chambers and gullies (as this Series paragraph 64).
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Grouting Up of Existing Drains and Service Ducts

Units	69	The unit of measurement shall be: (i) grouting up of existing drains and service ducts linear metre.
Measurement	70	The measurement of grouting up of existing drains and service ducts shall be the length to be grouted as stated in the Contract.
Itemisation	71	Separate items shall be provided for grouting up of existing drains and service ducts in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Grouting up of existing drains and service ducts.
II	1 Different diameters.
III	1 Different types of grout.

Grouting Up of Existing Drains and Service Ducts

	72	The items for grouting up of existing drains and service ducts shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		(a) excavation of acceptable material (as Series 600 paragraphs 17 and 18); (b) excavation of unacceptable material (as Series 600 paragraph 19); (c) breaking into drain or service duct and cleaning; (d) mixing and placing grout; (e) in situ concrete (as Series 1700 paragraph 5); (f) formwork (as Series 1700 paragraph 15); (g) backfilling and compaction; (h) disposal of material (as Series 600 paragraph 39).

Excavation in Hard Material

Units	73	The unit of measurement shall be: (i) extra over excavation for excavation in Hard Material in drainage cubic metre.
Measurement	74	The measurement shall be the volume of the voids formed by the removal of the Hard Material. For the measurement of: (a) drains, service ducts and filter drains (except fin drains and narrow filter drains), the width shall be taken as the internal diameter of the pipe plus 600 mm. Where no

pipe is required the width shall be taken as 600 mm;

(b) fin drains and narrow filter drains the width shall be taken as 300mm

(c) chambers, gullies and the like the area shall be taken as the horizontal area of the base slab or where no base slab is required the area of the bottom of the excavation;

(d) Excavation in hard material shall not be measured separately in connection with replacement and raising or lowering of covers and gratings on existing chambers and gullies.

Itemisation **75** Separate items shall be provided for extra over excavation for excavation in Hard Material in drainage in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
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I	1	Extra over excavation for excavation in Hard Material in drainage.
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Extra Over Excavation for Excavation in Hard Material

76 The items for extra over excavation for excavation in Hard Material in drainage shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) excavation in Hard Material (as Series 600 paragraph 23).

Concrete Bagwork

Units **77** The unit of measurement shall be:

(i) Concrete bagworkcubic metre.

Measurement **78** No deduction shall be made for holes, ducts, pockets, sockets, mortices and the like not exceeding 0.15 cubic metres each in volume.

Itemisation **79** Separate items shall be provided for concrete bagwork in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
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I	1	Concrete bagwork.
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II	1	In headwalls.
	2	Other stated location.

III	1	With battered face.
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Concrete Bagwork

80 The items for concrete bagwork shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item Coverage	<ul style="list-style-type: none"> (a) excavation (as Series 600 paragraphs 18 and 19); (b) disposal of material (as Series 600 paragraph 39); (c) trials and trial panels; (d) deposition, fill and compaction (as Series 600 paragraphs 33, 45 and 52); (e) filling bags with concrete and tucking in ends of bags; (f) shaping bags and soaking; (g) dowel bars (as Series 1700 paragraph 27); (h) building in pipes; (i) tying into existing work; (j) construction of bagwork in more than one lift; (k) in situ concrete (as Series 1700 paragraph 5); (l) formwork (as Series 1700 paragraph 15); (m) reinforcement (as Series 1700 paragraph 26); (n) geotextiles (as Series 600 paragraph 60); (o) water supply.
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Cleaning Existing Drainage Systems

Units	<p>81 The units of measurement shall be:</p> <ul style="list-style-type: none"> (i) cleaning of piped drainage systems, drainage channels, linear drainage channel systems, combined drainage and kerb systems.....linear metre. (ii) cleaning of bridge drainage systemitem. (iii) cleaning of chambers, gulliesnumber.
Measurement	<p>82 The measurement of cleaning piped drainage systems, drainage channels, linear drainage channel systems and combined drainage and kerb systems shall be the individual lengths measured along the centre lines between any of the following:</p> <ul style="list-style-type: none"> (a) the internal faces of chambers; (b) the external faces of headwalls; (c) the intersections of the centre lines at pipe junctions; (d) the centre of gully gratings (or where no grating is provided, the centre of the gully); (e) the position of terminations shown in the Contract.

The measurement of cleaning drainage channels, linear drainage channel systems, combined drainage and kerb systems and bridge drainage systems shall be deemed to include associated chambers, sumps and the like.

Itemisation **83** Separate items shall be provided for cleaning existing drainage systems in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Cleaning.
II	1 Piped drainage system. 2 Drainage channels. 3 Linear drainage channel system. 4 Combined drainage and kerb system. 5 Bridge drainage system. 6 Chambers. 7 Gullies.
III	1 Different stated sizes.
IV	1 Different stated locations.

Cleaning Existing Drainage Systems

84 The items for cleaning existing drainage systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item Coverage
- (a) marking;
 - (b) lifting chamber covers, replacement and bedding;
 - (c) rodding;
 - (d) flushing;
 - (e) water supply;
 - (f) mandrelling;
 - (g) disposal of material (as Series 600 paragraph 39);
 - (h) recording and reporting;
 - (i) greasing;
 - (j) cleaning covers, gratings and frames, offlets and the like;
 - (k) filling with water;
 - (l) vacuum/air suction;
 - (m) locating obstructions and the like;
 - (n) contamination prevention measures;
 - (o) locating chambers and gullies.

Series 600: Earthworks

Definitions

1 The Earthworks Outline, unless expressly stated otherwise, is defined as the finished earthworks levels and dimensions (prior to topsoiling) required by the Contract for the construction, where specified, of:

- (a) carriageway, hard shoulder, hard strip, footway, paved area, central reserve, verge, side slope;
- (b) sub-base;
- (c) fill on sub-base material, base and capping;
- (d) contiguous filter material, lightweight aggregate infill;
- (e) surface water channels;
- (f) landscape areas, screening mounds, environmental bunds.

In all cases of filter drains, except narrow filter drains, the Earthworks Outline shall be the top of the filter material.

2 Where capping or stabilisation to form capping is required by the Contract in cutting or on embankment, the Earthworks Outline shall be as defined in paragraph 1 of this Series i.e. as the top of capping.

3 Where an embankment is required by the Contract to be surcharged, the Earthworks Outline shall be as defined in paragraph 1 of this Series and exclude the surcharge.

4 Where permanent storage or stockpiling of topsoil is required by the Contract, the Earthworks Outline shall be as defined in paragraph 1 of this Series and exclude stored topsoil.

5 Where the bottom of a structural foundation for an earth retaining structure (other than for reinforced earth and an anchored earth structure) is below Existing Ground Level, the Earthworks Outline shall be the permanently exposed face of the structure below Existing Ground Level.

6 Where the bottom of the facing foundation for a reinforced earth structure or an anchored earth structure is below Existing Ground Level, the Earthworks Outline shall be the inside face of the facing above Existing Ground Level to the underside of the capping unit, or where no capping unit is required, to the finished earthworks level prior to topsoiling.

7 Where the ground has been subjected to treatment under the Contract in respect of ground improvement, mine workings, swallow holes and the like, for the purpose of this Series Existing Ground Level shall be the level obtained upon completion of any such treatment of the areas affected.

8 Sub-soil Level is defined as the level of the ground after the removal of topsoil required by the Contract.

9 Surcharge is defined as material placed on embankments for the purpose of loading the embankment for the periods stated in the Contract.

Measurement General

10 For the purposes of this Series it shall be assumed that one cubic metre of material excavated forms one cubic metre of compacted fill. No allowance shall be made in the measurement for bulking and shrinkage of any material.

11 Earthworks within Designated Outlines shall not be measured in this Series.

12 For the purpose of this Series no account shall be taken of excavated material arising from the Works measured in accordance with Series 100 to 500 and 700 to 3000 hereof.

13 Where deposition and compaction of an embankment has been carried out in accordance with the Contract and settlement occurs:

- (a) subsequent to the Earthworks Outline having been reached, or in the case of a surcharged embankment subsequent to the removal of the surcharge; or
- (b) from settlement of or penetration into the ground beneath the embankment;

then the additional fill, deposition and compaction required shall be measured immediately prior to the preparation of formation, provided that the first 75 mm of settlement or penetration shall not be measured.

In the case of landscape areas, screening mounds, environmental bunds and other areas of fill where settlement or penetration occurs, the additional fill, deposition and compaction required shall not be measured.

Excavation

Units

14 The unit of excavation shall be:

- (i) excavation cubic metre.

Measurement

15 The measurement of excavation shall be, for:

- (a) Topsoil Class 5A - the volume of the void formed by the excavation of material designated topsoil Class 5A.
- (b) Cutting and other excavation:
 - (i) cutting and bulk excavation - the volume of the void formed by the excavation of material from Existing Ground Level down to the Earthworks Outline, together with the volume of the void formed by the excavation of material below that Outline; or
 - (ii) under embankments and other areas of fill - the volume of the void formed by the excavation of material below Existing Ground Level;

less in each case the volume of topsoil Class 5A in the void included in the measurement under paragraph 15(a). The volume of excavation of soft spots measured under paragraph 62 of this Series shall not be included.

- (c) Removal of surcharge - the volume of material remaining as

surcharge to be removed down to the datum stated in the Contract, or if none is stated, to the Earthworks Outline.

- (d) Structural foundations - the volume of the void to accommodate the structural foundation calculated on the basis of the horizontal area of the bottom of the foundation with the depth being measured from the bottom of the foundation (including blinding concrete) to:

- (i) where the bottom of the foundation is below Existing Ground Level - the Existing Ground Level; provided that where the Earthworks Outline is below Existing Ground Level the depth shall be measured to the Earthworks Outline;
- (ii) where the bottom of the foundation is at or above Existing Ground Level - the datum stated in the Contract, or where none is stated to the Earthworks Outline;

less in each case the volume of topsoil Class 5A in the void included in the measurement under paragraph 15(a). The volume of excavation of soft spots measured under paragraph 62 of this Series shall not be included.

The classification of stage depths for the excavation of structural foundations shall be the maximum depth of excavation obtained in accordance with this sub-paragraph.

- (e) Foundations for corrugated steel buried structures and the like – the volume of the void to accommodate the structure, bedding and surround down to the outline stated in the Contract from:

- (i) where the bottom of the bedding is below Existing Ground Level - Existing Ground Level;
- (ii) where the bottom of the bedding is at or above Existing Ground Level - the datum stated in the Contract or where none is stated - Earthworks Outline;

less in each case the volume of topsoil Class 5A in the void included in the measurement under paragraph 15(a). The volume of excavation of soft spots measured under paragraph 62 of this Series shall not be included.

The classification of stage depths for the excavation of the foundation shall be the maximum depth of excavation obtained in accordance with this sub-paragraph.

- (f) New and enlarged watercourses, intercepting ditches - the volume of the void formed from Existing Ground Level down to the outline stated in the Contract less the volume of topsoil Class 5A in the void included in the measurement under paragraph 15(a) of this Series.
- (g) Clearing abandoned watercourses - the volume of the void formed from Existing Ground Level down to the outline stated in the Contract.
- (h) Gabion walling, mattresses and crib walling - as for structural foundations sub-paragraph (d) of this paragraph.

- (i) Caps to mine working, well, swallow hole and the like – the volume of the voids formed to accommodate the caps.

Itemisation

16 Separate items shall be provided for excavation in accordance with Chapter II paragraphs 3 and 4, and the following:

Group Feature		
I	1	Excavation.
II	1	Acceptable material Class 5A.
	2	Acceptable material excluding Class 5A.
	3	Unacceptable material Class U1.
	4	Unacceptable material Class U2.
III	1	Cutting and other excavation.
	2	Structural foundations.
	3	Foundations for corrugated steel buried structures and the like.
	4	New watercourses.
	5	Enlarged watercourses.
	6	Intercepting ditches.
	7	Clearing abandoned watercourses.
	8	Removal of surcharge.
	9	Gabion walling and mattresses.
	10	Crib walling.
	11	Caps to mine working, well, swallow hole and the like.
IV	1	0 metres to 3 metres in depth.
	2	0 metres to 6 metres in depth and so on in steps of 3 metres.

Note 1: Acceptable material Class 5A shall not be separately identified by any Group III or IV feature.

Note 2: Group IV features shall be applied only to Features 2, 3, 9, 10 and 11 of Group III.

Excavation of Acceptable Material Class 5A

17 The items for excavation of acceptable material Class 5A shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) selection and separation of materials;
- (b) loading into transport;
- (c) multiple handling of material;
- (d) keeping earthworks free of water;
- (e) haulage and deposition in temporary stockpiles including the provision of sites for stockpiles;
- (f) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like;
- (g) grading beds and trimming side slopes of watercourses and the like;
- (h) replacing acceptable material rendered unacceptable.
- (i) facilitating Archaeologist

**Excavation of Acceptable
Material Excluding Class 5A**

18 The items for excavation of acceptable material excluding Class 5A shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) loosening or breaking up material before or in the process of excavation;
- (b) upholding the sides;
- (c) working around and between piles;
- (d) overbreak and making good;
- (e) keeping earthworks free of water;
- (f) selection and separation of materials;
- (g) forming and trimming side slopes, benchings and berms;
- (h) trimming the bottom and sides of foundations;
- (i) grading beds and trimming sides of watercourses and the like;
- (j) protection of subgrade;
- (k) additional excavation the Contractor may require for working space, timbering, formwork or other temporary works and its subsequent backfilling with approved materials and compaction;
- (l) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like;
- (m) treatment of faces of cuttings which are not to receive topsoil;
- (n) loading into transport;
- (o) multiple handling of material;
- (p) disposal of surcharge material (as this Series paragraph 39)
- (q) disposal of surcharge material rendered unacceptable (as this Series paragraph 39);
- (r) haulage, deposition and compaction in temporary stockpiles including provision of sites for stockpiles;
- (s) replacing acceptable material rendered unacceptable;
- (t) breaking down and processing material necessary to comply with the requirements of fill;
- (u) complying with special requirements for materials requiring special treatments.
- (v) excavation difficulties due to the presence of traffic on public road
- (w) facilitating installation of permanent drainage before excavation reaches 300mm before formation.

Excavation of Unacceptable Material Classes U1 and U2

19 The items for excavation of unacceptable material U1 and U2 shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation (as this Series paragraph 18);
- (b) special measures for dealing with Class U2 material.

Excavation in Hard Material

Units

20 The unit of measurement shall be:

- (i) extra over excavation for excavation in Hard Material cubic metre.

Measurement

21 The measurement of extra over excavation for excavation in Hard Material shall be the volume of Hard Material within the void measured under paragraph 15 of this Series.

Itemisation

22 Separate items shall be provided for extra over excavation for excavation in Hard Material in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Extra over excavation for excavation in Hard Material.
II	1	Cutting and other excavation.
	2	Structural foundations.
	3	Foundations for corrugated steel buried structures and the like.
	4	New watercourses.
	5	Enlarged watercourses.
	6	Intercepting ditches.
	7	Clearing abandoned watercourses.
	8	Gabion walling and mattresses.
	9	Crib walling.
	10	Caps to mine working, well, swallow hole and the like.

Extra Over Excavation for Excavation in Hard Material

23 The items for extra over excavation for excavation in Hard Material shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preliminary site trials of blasting;
- (b) blasting, splitting, breaking and the like;
- (c) cutting through reinforcement;
- (d) saw cutting and trimming;
- (e) removal of existing paved areas by course or layer, cleaning surfaces, milling or planing, stepping out and treatment to bottoms of foundations.

Processing of Unacceptable Material Class U1

Definition

24 The term 'processing' shall refer to treatment whereby material arising from the Site is rendered acceptable for a particular use in the Works by mechanical, chemical, hydraulic or other means.

- Units **25** The unit of measurement shall be:
- (i) processing of unacceptable material Class U1 cubic metre.
- Measurement **26** The processing of unacceptable material Class U1 shall be measured only when the Contract specifically requires particular material to be obtained for use in the Works by processing. Other processing carried out by the Contractor shall not be measured. The measurement of processing of unacceptable material Class U1 shall be the volume of the void required to be filled with the processed material.
- Itemisation **27** Separate items shall be provided for processing of unacceptable material Class U1 in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Processing of unacceptable material Class U1.
II	1 Different locations.
III	1 Into different classes of acceptable material.

Processing of Unacceptable Material Class U1

28 The items for processing of unacceptable material Class U1 shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) selection and separation of materials;
 - (b) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like;
 - (c) loading into transport;
 - (d) multiple handling of material;
 - (e) replacing acceptable material rendered unacceptable;
 - (f) haulage, deposition and compaction in temporary stockpiles including provision of sites for stockpiles;
 - (g) crushing, screening, mixing, grading, drying, wetting and sieving;
 - (h) mechanical, chemical, hydraulic and other methods;
 - (i) producing the required classification of material from Site-won materials;
 - (j) obtaining permissions and approvals.

Deposition of Fill

- Units **29** The unit of measurement shall be:
- (i) deposition of fill cubic metre.
- Measurement **30** The measurement of deposition of fill shall be the volume of compacted fill, calculated in accordance with paragraphs 47, 48 and 49 of this Series, less the volume of imported fill calculated in accordance with paragraphs 41 and 42 of this Series.
- 31** Deposition of Class 1C and 6B materials shall be separately measured only where Class 1C or 6B material is specifically stated by the Contract to be required

to be placed in a particular location.

Itemisation

32 Separate items shall be provided for deposition of fill in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Deposition.
II	1 Acceptable material. 2 Acceptable material Class 1C. 3 Acceptable material Class 6B.
III	1 Embankments and other areas of fill. 2 Strengthened embankments. 3 Reinforced earth structures. 4 Anchored earth structures. 5 Landscape areas. 6 Environmental bunds. 7 Fill to structures. 8 Fill above structural concrete foundations. 9 Fill on sub-base material, base and capping. 10 Fill on bridges (under footways, verges and central reserves). 11 Upper bedding to corrugated steel buried structures and the like. 12 Lower bedding to corrugated steel buried structures and the like. 13 Surround to corrugated steel buried structures and the like. 14 Fill above corrugated steel buried structures and the like.

Deposition of Fill

33 The items for deposition of fill shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) protection of subgrade;
- (b) multiple handling of material;
- (c) keeping earthworks free of water;
- (d) complying with requirements and constraints on the sequence, timing and rate of deposition and filling, and equalisation of earth pressures;
- (e) complying with the special requirements for materials requiring special treatments;
- (f) complying with the particular requirements and constraints with regard to soil stabilisation, reinforced earth structures, strengthened embankments, anchored earth structures, corrugated steel buried structures and the like;
- (g) taking precautions to avoid damage to property, structures, sewers, drains, services, instrumentation and the like;
- (h) haulage;
- (i) replacing acceptable material rendered unacceptable;
- (j) selection of material of stated Classes and layering or depositing in locations stated in the Contract;
- (k) depositing fill to slope away from vertical drainage layers and measures to prevent surface water entering such layers;

- (l) treatment of soil as the Contractor may require to facilitate the use of particular plant;
- (m) trimming and shaping to levels and contours;
- (n) deposition of fill resulting from settlement and penetration of landscape areas, environmental bunds and other areas of fill, and from the first 75 mm of settlement and penetration of embankments.

Disposal of Material

Units

34 The unit of measurement shall be:

- (i) disposal of material cubic metre.

Measurement

35 The measurement of disposal of acceptable material shall be, for:

- (a) acceptable material excluding Class 5A - the volume excavated from within the Site measured in this Series less the volume of compacted fill calculated in accordance with paragraphs 47, 48 and 49 of this Series, after deduction from the latter of the volume of imported fill calculated in accordance with paragraphs 41 and 42 of this Series.
- (b) acceptable material Class 5A - the volume excavated from within the Site measured in accordance with paragraph 15(a) of this Series less the volume of topsoil to be permanently stored and the volume of topsoil calculated from the areas and thicknesses to be topsoiled in accordance with paragraph 78 of this Series.

36 The measurement of disposal of unacceptable material Class U1 shall be the volume of unacceptable material Class U1 excavated from within the Site and measured under this Series less the volume of processed unacceptable material Class U1 calculated in accordance with paragraph 26 of this Series.

37 The measurement of disposal of unacceptable material Class U2 shall be the volume of unacceptable material Class U2 excavated from within the Site and measured under this Series.

Itemisation

38 Separate items shall be provided for disposal of material in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Disposal.
II	1	Acceptable material excluding Class 5A.
	2	Acceptable material Class 5A.
	3	Unacceptable material Class U1.
	4	Unacceptable material Class U2.

Disposal of Material

39 The items for disposal of material shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) haulage and deposition in tips off Site provide by the Contractor;
- (b) multiple handling of material;
- (c) special measures for dealing with Class U2 material;

- (d) allowing for deposition in lieu of disposal of acceptable fill resulting from settlement and penetration of landscape areas, environmental bunds and other areas of fill, and from the first 75 mm of settlement and penetration of embankments.

Imported Fill

Units

40 The unit of measurement shall be:

- (i) imported fill cubic metre.

Measurement

41 The measurement of imported acceptable fill shall be the volume of compacted fill, calculated in accordance with paragraphs 47, 48 and 49 of this Series less the volumes of:

- (a) acceptable material (including that measured in accordance with this Series paragraph 26), excluding topsoil Class 5A and acceptable material of a particular Class being both surplus to the requirements of the Contract for that Class of material and which does not meet the requirements for acceptability for use elsewhere within the measured volume of compacted fill, excavated from within the Site and measured in this Series;
- (b) other stated classes of imported acceptable fill excluding topsoil Class 5B.

42 The measurement of other stated classes of imported acceptable fill, other than topsoil Class 5B, shall be the volume of the void filled with the stated class of imported acceptable fill to the outline stated in the Contract.

43 The measurement of imported topsoil Class 5B shall be the volume of topsoil calculated from the areas and thicknesses to be topsoiled less the volume of topsoil Class 5A excavated from within the Site and measured in accordance with paragraph 15(a) of this Series. Notwithstanding paragraph 45(j) and (k) of this Series, when an item for imported topsoil is measured, corresponding items for placing shall be measured under paragraphs 77 to 81 inclusive of this Series for Topsoiling and Storage of Topsoil.

Itemisation

44 Separate items shall be provided for imported acceptable fill in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Imported acceptable material.
	2 Other stated classes of imported acceptable fill.
	3 Imported topsoil Class 5B
II	1 Embankments and other areas of fill.
	2 Strengthened embankments.
	3 Reinforced earth structures.
	4 Anchored earth structures.
	5 Landscape areas.
	6 Environmental bunds.
	7 Fill to structures.
	8 Fill above structural concrete foundations.
	9 Fill on sub-base material, base and capping.
	10 Fill on bridges (under footways, verges, and central reserves).
	11 Upper bedding to corrugated steel buried structures and the like.
	12 Lower bedding to corrugated steel buried structures and the like.

- | | |
|----|--|
| 13 | Surround to corrugated steel buried structures and the like. |
| 14 | Fill above corrugated steel buried structures and the like. |

Note: Group I Feature 3 imported topsoil Class 5B shall not be separately identified by any Group II feature.

Imported Fill

45 The items for imported fill shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) protection of subgrade;
- (b) multiple handling of material;
- (c) keeping earthworks free of water;
- (d) complying with requirements and constraints on the sequence, timing and rate of deposition and filling, and equalisation of earth pressures;
- (e) complying with the special requirements for materials requiring special treatments;
- (f) complying with the particular requirements and constraints with regard to soil stabilisation, reinforced earth structures, strengthened embankments, anchored earth structures, corrugated steel buried structures and the like;
- (g) taking precautions to avoid damage to property, structures, sewers, drains, services, instrumentation and the like;
- (h) fill provided by the Contractor from sources outside the Site;
- (i) replacing acceptable material rendered unacceptable;
- (j) selection of material of stated Classes and layering or depositing in locations stated in the Contract;
- (k) depositing fill to slope away from vertical drainage layers and measures to prevent surface water entering such layers;
- (l) trimming and shaping to levels and contours;
- (m) imported fill resulting from settlement and penetration of landscape areas, environmental bunds and other areas of fill, and from the first 75 mm of settlement and penetration of embankments;
- (n) reports.

Compaction of Fill

Units

46 The unit of measurement shall be:

- (i) compaction of fill cubic metre.

Measurement

47 The measurement of compaction of fill in embankments and other areas of fill, in strengthened embankments, in reinforced earth structures, in anchored earth structures, in landscape areas and in environmental bunds shall be the volume of the embankment or void filled from Existing Ground Level up to the Earthworks

Outline plus, where required by the Contract, the volume of:

- (a) the void formed by the removal of topsoil Class 5A beneath the fill in question, and included in the measurement under paragraph 15(a) of this Series;
- (b) the void formed by excavation for the fill in question:
 - (i) below the Earthworks Outline included in the measurement under paragraph 15(b)(i) of this Series; and
 - (ii) below Existing Ground Level included in the measurement under paragraph 15(b) (ii) of this Series;
- (c) surcharge, being the void filled from the Earthworks Outline up to the profile stated in the Contract to which the surcharge is required to be constructed;

less in each case the volume of any compaction of fill to structures, and bedding and surround to corrugated steel buried structures and the like included in the volume so obtained and which is measured separately under paragraph 49 of this Series.

48 The measurement of compaction of fill above structural concrete foundations shall be the volume of the void measured in accordance with paragraph 15(d) of this Series less the volume of the structural foundation and structure within that void.

49 The measurement of compaction of:

- (a) fill to structures;
- (b) fill on sub-base material, base course and capping;
- (c) fill on bridges (under footways, verges and central reserves);
- (d) bedding to corrugated steel buried structures and the like;
- (e) surround to corrugated steel buried structures and the like;

in each case, shall be the volume of the voids filled to the outline stated in the Contract less the volume of corrugated steel buried structures and the like within that void.

50 Compaction of Class 1C and 6B materials shall be separately measured only where Class 1C or 6B material as such is specifically stated by the Contract to be required to be placed in a particular location.

Itemisation

51 Separate items shall be provided for compaction of fill in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Compaction.
II	1 Acceptable material.
	2 Acceptable material Class 1C.
	3 Acceptable material Class 6B.
III	1 Embankments and other areas of fill.
	2 Strengthened embankments.
	3 Reinforced earth structures.

- 4 Anchored earth structures.
- 5 Landscape areas.
- 6 Environmental bunds.
- 7 Fill to structures.
- 8 Fill above structural concrete foundations.
- 9 Fill on sub-base material, base course and capping.
- 10 Fill on bridges (under footways, verges and central reserves).
- 11 Upper bedding to corrugated steel buried structures and the like.
- 12 Lower bedding to corrugated steel buried structures and the like.
- 13 Surround to corrugated steel buried structures and the like.
- 14 Fill above corrugated steel buried structures and the like.

Compaction of Fill

52 The items for compaction of fill shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) protection of subgrade;
- (b) multiple handling of material;
- (c) keeping earthworks free of water;
- (d) complying with requirements and constraints on the sequence, timing and rate of deposition and filling, and equalisation of earth pressures;
- (e) complying with the requirements for materials requiring special treatment;
- (f) complying with the particular requirements and constraints with regard to soil stabilisation, reinforced earth structures, strengthened embankments, anchored earth structures, corrugated steel buried structures and the like;
- (g) taking precautions to avoid damage to property, structures, sewers, drains, services, instrumentation and the like;
- (h) spreading and levelling;
- (i) trial areas, trials and demonstrations;
- (j) making good after sampling and testing;
- (k) forming and trimming side slopes, benchings and berms;
- (l) treatment of side slopes and berms;
- (m) compaction of fill resulting from settlement and penetration of landscape areas, environmental bunds and other areas of fill, and from the first 75 mm of settlement and penetration of embankments;
- (n) blinding.

Soil Stabilisation

Units

53 The unit of measurement shall be:

- (i) soil stabilisation cubic metre.

Measurement

54 The measurement of soil stabilisation shall be the volume of the material to be stabilised measured to the outlines stated in the Contract irrespective of the number of layers or thicknesses, methods or sequences of operations involved in stabilising the material to the depth required.

Note: Soil stabilisation means the process of stabilisation whether the material is intact and undisturbed or deposited and compacted prior to stabilisation.

Excavation, fill, import, disposal, deposition and compaction required to expose or produce the layer to be stabilised, as appropriate, shall be included under the measurement of earthworks elsewhere in this Series.

Excavation, deposition and compaction involved in the process of stabilization itself shall not be measured.

Itemisation

55 Separate items shall be provided for soil stabilisation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Soil stabilisation.
II	1 Capping.
III	1 Cement.
	2 Lime.

Soil Stabilisation with Cement, Soil Stabilisation with Lime

56 The items for soil stabilisation shall in accordance with the Peambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);
- (b) deposition (as this Series paragraph 33);
- (c) compaction of fill (as this Series paragraph 52);
- (d) pulverising, measuring and mixing;
- (e) laps and joints;
- (f) curing, protection and sealing;
- (g) shaping to cambers, falls and crowns;
- (h) edge supports;
- (i) additional fill, deposition, compaction or disposal resulting from the process of stabilisation;
- (j) additional fill and stabilisation resulting from the first 75 mm of settlement and penetration of embankments.

Geotextiles

- Units** **57** The unit of measurement shall be:
- (i) geotextile square metre.
- Measurement** **58** The measurement of geotextile shall be the developed area of the geotextile measured to the limits stated in the Contract.
- Itemisation** **59** Separate items shall be provided for geotextile in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Geotextile.
II	1	Different types.
III	1	Different grades.

- Geotextile** **60** The items for geotextile shall in accordance with the Preambles to Bill of Quantities General Directions include for:
- Item coverage** (a) cleaning, trimming, regulating and preparing surfaces;
- (b) laps;
- (c) measures to protect material;
- (d) cutting, jointing, sealing and fixing;
- (e) securing material in place;
- (f) complying with the requirements of strengthened earthworks.
- (g) turn ups and overlaps at edges

Soft Spots and Other Voids

- Units** **61** The unit of measurement shall be:
- (i) soft spots, other voids cubic metre.
- Measurement** **62** The measurement of soft spots and other voids shall be the volume of the voids directed to be excavated or filled. Soft spots and other voids shall be measured separately from the main excavation or filling where the volume:
- (a) below structural foundations, foundations for corrugated steel buried structures or in side slopes of cuttings is less than 1 cubic metre;
- (b) elsewhere is less than 25 cubic metres.
- Itemisation** **63** Separate items shall be provided for soft spots and other voids in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Excavation of soft spots and other voids.
	2	Filling of soft spots and other voids.
II	1	Below cuttings or under embankments.

	2	In side slopes.
	3	Below structural foundations and foundations for corrugated steel buried structures.
	III	1 Different types of fill.
Excavation of Soft Spots and Other Voids	64	The items for excavation of soft spots and other voids shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage	(a)	excavation of acceptable material (as this Series paragraphs 17 and 18);
	(b)	excavation of unacceptable material (as this Series paragraph 19);
	(c)	disposal of material (as this Series paragraph 39);
	(d)	trimming back cutting faces.
Filling of Soft Spots and Other Voids	65	The items for filling of soft spots and other voids shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage	(a)	deposition of fill (as this Series paragraph 33);
	(b)	compaction of fill (as this Series paragraph 52);
	(c)	formwork (as Series 1700 paragraph 15);
	(d)	treatment of cutting faces;
	(e)	in situ concrete (as Series 1700 paragraph 5).
		Disused Sewers, Drains, Cables, Ducts, Pipelines and the Like Occurring at Formation or Sub-formation Level; Disused Basements, Cellars and the Like and Gullies
Definition	66	The term 'services' in paragraphs 67 to 72 inclusive shall be deemed to include sewers, drains, cables, ducts, pipelines and the like, together with associated chambers, fittings etc. Units
	67	The units of measurement shall be:
	(i)	removal of disused services linear metre.
	(ii)	backfilling disused services cubic metre.
	(iii)	backfilling disused basement, cellar and the like cubic metre.
	(iv)	backfilling disused gullies number.
Measurement	68	The measurement of removal of disused services shall be applied only to those existing services occurring at or below formation or sub-formation level in cutting and/or which are specifically stated in the Contract to be removed. The measurement shall be the distance along the centre line of the route of the services and, unless stated otherwise in the Contract no deduction shall be made for chambers and the like.
		The measurement of backfilling disused services shall be applied only to those

existing services occurring at or below formation or sub-formation level in cutting and/or which are specifically stated in the Contract to be backfilled. The measurement shall be the volume of the void directed to be filled, and unless stated otherwise in the Contract shall include chambers and the like. The removal or backfilling of other disused services occurring elsewhere in the Works shall not qualify for separate measurement under this paragraph.

69 The measurement of backfilling disused basements, cellars and the like shall be the volume of the void directed to be filled. The measurement of backfilling disused gullies shall be the complete operation.

Itemisation

70 Separate items shall be provided for removal, backfilling disused services, backfilling disused basements, cellars and the like and gullies in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Removal.
	2	Backfilling.
II	1	Different types.
III	1	Different sizes.
IV	1	Disused service with one metre or less of cover to formation level.
	2	Disused service exceeding one metre and not exceeding two metres of cover to formation level, and so on in steps of one metre.
	3	Disused basement, cellar and the like.
	4	Disused gully.
V	1	Different materials.

Note: Group IV Features 3 and 4 shall not be applied to Group I Feature 1.

Removal of Disused

71 The items for removal of disused services shall be in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);
- (b) excavation of unacceptable material (as this Series paragraph 19);
- (c) breaking up beds, haunches and surrounds;
- (d) disposal of material (as this Series paragraph 39);
- (e) sealing ends of services;
- (f) credit value of materials.

Backfilling, Disused Services, Basements, Cellars and the Like and Gullies

72 The items for backfilling disused services, basements, cellars and the like and gullies shall in accordance with the Preambles to Bill of Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) compaction (as this Series paragraph 52);
- (b) perforation of existing slabs and cleaning;
- (c) in situ concrete (as Series 1700 paragraph 5);
- (d) reinforcement (as Series 1700 paragraph 26);

- (e) formwork (as Series 1700 paragraph 15);
- (f) sealing ends of services;
- (g) grouting.

Supports Left in Excavation

- Units** **73** The unit of measurement shall be:
- (i) supports left in excavation square metre.
- Measurement** **74** The measurement of supports left in excavation shall be the area of face directed to be left with supports in position.
- Itemisation** **75** Separate items shall be provided for supports left in excavation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Supports.
II	1	Timber.
	2	Steel.
III	1	Different types.

- Supports Left in Excavation** **76** The items for supports left in excavation shall in accordance with the Preambles to Bill of Quantities General Directions include for:
- Item coverage** (a) struts, wallings and the like and working around them.

Topsoiling and Storage of Topsoil

- Units** **77** The units of measurement shall be:
- (i) topsoiling..... square metre.
- (ii) permanent storage of topsoil cubic metre.
- Measurement** **78** The measurement of the topsoiling shall be the area of the surface to be topsoiled and shall include topsoil Class 5A excavated from within the site and imported topsoil Class 5B. The measurement of the permanent storage of topsoil shall be the volume of topsoil Class 5A excavated from within the Site and measured in accordance with paragraph 15(a) of this Series less the volume of topsoil calculated from the areas and thicknesses to be topsoiled.
- Itemisation** **79** Separate items shall be provided for topsoiling in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Topsoiling of different thicknesses.
	2	Permanent storage of topsoil.
II	1	Surfaces sloping at 10o or less to the horizontal.
	2	Surfaces sloping at more than 10o to the horizontal.

Note: Group I feature 2 shall not be identified by any Group II feature.

Topsoiling

80 The items for topsoiling shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) the removal of debris;
- (b) taking delivery of imported topsoil;
- (c) excavation from stockpile;
- (d) loading into transport;
- (e) haulage, deposition, spreading, levelling and compaction;
- (f) trimming and shaping to levels and contours;
- (g) herbicide treatment.

Permanent Storage of Topsoil

81 The items for permanent storage of topsoil shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation from stockpile;
- (b) loading into transport;
- (c) hauling, deposition, spreading, levelling and compaction in permanent storage area;
- (d) trimming and shaping to levels and contours;
- (e) multiple handling of material.

Grass seeding and Turfing

Units

82 Unit of measurement shall be:

- (i) grass seeding, turfing square metre

Itemisation

83 Separate items shall be provided for grass seeding and turfing in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Grass Seeding
	2	Turfing
	3	Hydraulic mulch grass seeding
II	1	Surfaces sloping at 10 °C or less to the horizontal
	2	Surface slopping at more than 10 °C to the horizontal
III	1	Turfing in two layers
IV	1	Different mixture

Grass seeding and Turfing

84 The item for grass seeding and turfing topsoil shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item Coverage

- (a) freeing surfaces of areas to be grassed or turfed from stones and other debris and reducing the soil to a tilth immediately prior to grassing;
- (b) fertilising including additional plant nutrients
- (c) mowing and clearance of grass cuttings;

- (d) pegging and wiring of turfs;
- (e) raking, watering, retaining agent and herbicide treatment;
- (f) additives;

Completion of Formation and Sub-formation

Units

85 The unit of measurement shall be:

- (i) completion of formation, sub-formation square metre.

Measurement

86 The measurement of completion of formation shall be the area of the surface immediately beneath the sub-base except that where capping is required the measurement shall be the area of the surface of the capping excluding sloping sides and edges.

The measurement of completion of sub-formation shall be the area of the surface immediately beneath capping.

Completion of formation and sub-formation on Classes 1C and 6B materials shall be measured separately only when the Contract states specifically that those materials are to be provided at formation or sub-formation level.

Itemisation

87 Separate items shall be provided for completion of formation and sub-formation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Completion of sub-formation.
	2	Completion of formation.
II	1	On material other than Class 1C, 6B or rock in cuttings.
	2	On Class 1C material.
	3	On Class 6B material.
	4	On rock in cuttings.

Completion of Formation and Sub-formation

88 The items for completion of formation and sub-formation shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) removal of protective layer, mud and slurry;
- (b) compaction;
- (c) cleaning, trimming, regulating, making good and rolling;
- (d) cement bound materials;
- (e) excavation, processing, compaction of naturally occurring Hard Material;
- (f) measures to protect formation and sub-formation against deterioration or degradation.

Lining of Watercourses

Units

89 The unit of measurement shall be:

- (i) lining of watercourses square metre.

Measurement **90** The measurement of lining of watercourses shall be the permanently exposed face area of the work.

The measurement of bagwork shall be the flat undeveloped area of the work.

Itemisation **91** Separate items shall be provided for lining of watercourses in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Lining of new watercourse.
	2	Lining of enlarged watercourse.
	3	Lining of intercepting ditches.
II	1	To inverts.
	2	To side slopes.
III	1	Different types.
IV	1	Different thicknesses.

Lining of Watercourses **92** The items for lining of watercourses shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) bedding and compaction;
 - (b) laying, setting, bedding, jointing, wedging, cutting and pointing;
 - (c) building in pipes;
 - (d) concrete (as Series 1700 paragraphs 5 and 10);
 - (e) formwork (as Series 1700 paragraph 15);
 - (f) reinforcement (as Series 1700 paragraph 26);
 - (g) bags, filling, staking and securing.
 - (h) blinding concrete (as series 1720 Paragraph 4)

Clearing of Existing Ditches

Units **93** The unit of measurement shall be:

- (i) clearing of existing ditches linear metre.

Measurement **94** The measurement of clearing of existing ditches shall be the length along the centre line of the ditch.

Itemisation **95** Separate items shall be provided for clearing of existing ditches in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Clearing of existing ditches.
II	1	Different locations.

Clearing of Existing Ditches **96** The items for clearing of existing ditches shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);

- (b) excavation of unacceptable material (as this Series paragraph19);
- (c) disposal of material (as this Series paragraph39);
- (d) clearing debris and vegetable growth;
- (e) trimming side slopes and grading bottoms;
- (f) maintaining existing outfalls.

Ground Improvement - Establishment of Plant

Units

97 The unit of measurement shall be:

- (i) establishment of ground improvement plant item.

Measurement

98 The establishment of ground improvement plant shall be measured once only to each separate location for each method of ground improvement on the Site. Any additional establishment of plant to suit the Contractor's method of working shall not be measured.

Itemisation

99 Separate items shall be provided for establishment of ground improvement plant in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Establishment of dynamic compaction plant.
	2	Establishment of vibrated stone columns plant.
II	1	Different locations.

Establishment of Ground Improvement Plant

100 The items for establishment of ground improvement plant shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) bringing plant and equipment to the location of the ground improvement;
- (b) erecting and setting up plant and equipment including site preparation, levelling, and access ramps;
- (c) moving and setting up plant and equipment at each position including site preparation, levelling and access ramps;
- (d) dismantling and removing plant and equipment from the Site on completion.

Ground Improvement - Dynamic Compaction

Units

101 The units of measurement shall be:

- (i) dynamic compaction linear metre.
- (ii) dynamic compaction plant standing time hour.
- (iii) granular blanket tonne.

Measurement

102 The measurement of dynamic compaction shall be the sum of the distances through which the pounder is required to fall. The distance for each drop shall be the vertical measurement from the underside of the pounder immediately prior to release, to the level of the ground beneath the pounder immediately prior to the first drop at that point.

103 The measurement of dynamic compaction plant standing time shall be for the period or periods of standing time ordered by the Overseeing Organisation. Periods of less than half an hour shall not be measured. Any other standing time due to the Contractor's method of working, necessitated by the process of ground improvement provided for in the Contract or other than that ordered by the Overseeing Organisation shall not be measured.

104 The measurement of granular blanket shall be the tonnage of material certified by the Overseeing Organisation, being only that material included on delivery tickets which is incorporated within the Permanent Works in the locations to the extent and thicknesses stated in the Contract or ordered by the Overseeing Organisation.

Itemisation

105 Separate items shall be provided for dynamic compaction, dynamic compaction plant standing time, and granular blanket in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Dynamic compaction.
	2	Dynamic compaction plant standing time.
	3	Granular blanket.
II	1	Trial compaction.
	2	Main compaction.
III	1	Different weight of pounder.
IV	1	Different materials.

Note: Group II and III features shall be applied only to Group I Feature 1.

Dynamic Compaction

106 The items for dynamic compaction shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparation and levelling prior to placing the granular blanket;
- (b) pounding;
- (c) filling craters with adjacent material and compaction;
- (d) keeping earthworks free of water;
- (e) compaction of surface after the final pass;
- (f) complying with particular requirements and constraints;
- (g) keeping records;
- (h) extracting buried pounder.

Dynamic Compaction Plant Standing Time

107 The items for dynamic compaction plant standing time shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) ancillary plant;
- (b) equipment and operatives;
- (c) periods of less than half an hour.

Granular Blanket

108 The items for granular blanket shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- (a) deposition of fill (as this Series paragraph 33);
- (b) compaction of fill (as this Series paragraph 52).

Ground Improvement - Vibrated Stone Columns

Units

109 The units of measurement shall be:

- (i) vibrated stone columns linear metre.
- (ii) vibrated stone column plant standing time hour.

Measurement

110 The measurement of vibrated stone columns shall be the length measured along the axis of the stone column from the maximum depth of the vibrator tip to the specified finished level.

111 The measurement of vibrated stone column plant standing time shall be for the period or periods of standing time ordered by the Overseeing Organisation. Periods of less than half an hour shall not be measured. Any other standing time due to the Contractor's method of working, necessitated by the process of ground improvement provided for in the Contract or other than that ordered by the Overseeing Organisation shall not be measured.

Itemisation

112 Separate items shall be provided for vibrated stone columns and vibrated stone columns plant standing time in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Vibrated stone columns.
	2	Vibrated stone columns plant standing time.
II	1	Different minimum diameters.
III	1	Different methods of installation.
IV	1	Columns not exceeding 5 metres in length.
	2	Columns exceeding 5 metres in length but not exceeding 10 metres and so on in steps of 5 metres.

Note: Group II, III and IV features shall be applied only to Group I Feature 1.

Vibrated Stone Columns

113 The items for vibrated stone columns shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) complying with design criteria;
- (b) certificates;
- (c) provision of data and drawings;
- (d) resubmissions and modifications;
- (e) amendments to the Works;
- (f) air or water supply;
- (g) effluent/slurry disposal;

- (h) precautions to prevent ingress of surface water or foreign matter;
- (i) preliminary treatment areas;
- (j) trial areas;
- (k) demonstrations;
- (l) site control, observations, records and reports;
- (m) additional stone required due to penetration into surrounding ground.

**Vibrated Stone Columns
Plant Standing Time**

114 The items for vibrated stone columns plant standing time shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) ancillary plant;
- (b) equipment and operatives;
- (c) periods of less than half an hour.

Gabion Walling and Mattresses

Units

115 The unit of measurement shall be:

- (i) gabion walling, mattresses cubic metre.

Measurement

116 The measurement of gabion walling and mattresses shall be the volume contained within the outline of the gabions or mattresses as stated in the Contract.

Itemisation

117 Separate items shall be provided for gabion walling and mattresses in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Gabion walling.
	2	Mattresses.
II	1	Different mesh materials.
III	1	Different mesh size.
IV	1	Different types of fill.
V	1	Mattresses installed at 10o or less to the horizontal.
	2	Mattresses installed at more than 10o to the horizontal.
VI	1	In environmental bunds.

**Gabion Walling and
Mattresses**

118 The items for gabion walling and mattresses shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) assembling, tying, fixing, staking and tensioning;
- (b) fill, compaction and finishes;
- (c) mesh including cutting and folding to form special units and shapes;
- (d) bracing and wiring lids.

Crib Walling

- Units** **119** The unit of measurement shall be:
- (i) crib walling square metre.
- Measurement** **120** The measurement shall be the flat undeveloped area of crib walling. No deduction shall be made for openings within the wall which are part of the modular system, nor for other openings of one square metre or less.
- Itemisation** **121** Separate items shall be provided for crib walling in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Crib walling.
II	1	Different types.
III	1	Curved on plan.
IV	1	With a battered face.
V	1	Different finishes.
VI	1	Different infill.

- Crib Walling** **122** The items for crib walling shall in accordance with the Preamble to Bill of Quantities General Directions include for:

- Item coverage** (a) bedding and jointing;
- (b) dowels and pins;
- (c) granular infill and compaction;
- (d) special units and forming ends and corners;
- (e) obtaining manufacturer's certificate and supplying copy to the
Overseeing Organisation;
- (f) building in pipes and forming small openings.

Filling and Caps to Mine Working, Well, Swallow Hole and the Like

- Units** **123** The units of measurement shall be:
- (i) filling to mine working, well, swallow hole and the like
tonne.
- (ii) caps to mine working, well, swallow hole and the like cubic
metre.

- Measurement** **124** The measurement of filling to mine working, well, swallow hole and the like shall be calculated from the tonnage of material certified by the Overseeing Organisation, being only that material, included on delivery tickets, which is incorporated in the Permanent Works in the locations and to the extent and thickness required by the Contract. Material in excess of the requirements of the Contract and material used for any other purpose shall not be included within the certified tonnage.

- 125** The measurement of caps to mine working, well, swallow hole and the like shall be the volume of concrete forming the caps.

Itemisation

126 Separate items shall be provided for filling and caps to mine working, well, swallow hole and the like in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Filling.
	2	Caps.
II	1	Mine working.
	2	Well.
	3	Swallow hole and the like.
III	1	Different materials.

Filling and Caps to Mine Working, Well, Swallow Hole and the Like

127 The items for filling and caps to mine working, well, swallow hole and the like shall in accordance with the Preambles to Bill of Quantities and the like. Directions include for:

Item coverage

- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);
- (b) excavation of unacceptable material (as this Series paragraph 19);
- (c) backfilling and compaction;
- (d) concrete (as Series 1700 paragraphs 5 and 10);
- (e) formwork including permanent formwork (as Series 1700 paragraph 15);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) flushing;
- (h) disposal of material (as this Series paragraph 39);
- (i) investigation and monitoring;
- (j) material not used as filling.

Ground Anchorages - Ground Anchorage Plant

Units

128 The unit of measurement shall be:

- (i) establishment of ground anchorage plant item.

Measurement

129 The establishment of ground anchorage plant shall be measured once only to each separate location of ground anchorages on the Site. Any additional establishment of ground anchorage plant to suit the Contractor's method of working shall not be measured.

Itemisation

130 Separate items shall be provided for ground anchorage plant in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Establishment of ground anchorage plant.
II	1	Different locations.

Establishment of Ground Anchorage Plant

131 The items for establishment of ground anchorage plant shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) bringing plant and equipment to the location of ground anchorages;
 - (b) erecting and setting up plant and equipment including site preparation, levelling and access ramps;
 - (c) moving and setting up plant and equipment at each position including site preparation, levelling and access ramps;
 - (d) dismantling and removing plant and equipment from Site on completion.

Ground Anchorages

Units **132** The unit of measurement shall be:

- (i) ground anchorages linear metre.

Measurement **133** The measurement of ground anchorages shall be for the complete anchorage assembly and shall be the length from the bottom of the fixed anchorage to the bearing face.

Itemisation **134** Separate items shall be provided for ground anchorages in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Ground anchorages.
II	1	Different types.
III	1	Different capacities.
IV	1	Not exceeding 5 metres in length.
	2	Exceeding 5 metres in length but not exceeding 10 metres in length and so on in steps of 5 metres.
V	1	Trial anchorages.
	2	Main anchorages.

Ground Anchorages **135** The items for ground anchorages shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) design;
 - (b) provision of data and drawings;
 - (c) certificates;
 - (d) resubmissions and modifications;
 - (e) amendments to the Works;
 - (f) boring, augering, lining, under-reaming, removing and disposing of material;
 - (g) cables, wires or strands with couplers, binders and spacers;
 - (h) anchorages, bearing plates, reinforcing helices, grout inlets, vents and the like;
 - (i) applying water under pressure and proving watertightness of boreholes;

- (j) flushing borehole, cleaning and preparation;
- (k) protective system (as Series 1900 paragraph 4);
- (l) grouting ground anchorages including fixed length and free stressing length;
- (m) applying prestress in one or more stages;
- (n) checking the accuracy of load measuring equipment and adjusting;
- (o) taking observations and compiling a record of stressing and grouting operations and supplying one copy to the Overseeing Organisation;
- (p) measures to prove anchorage suitability.
- (q) proof loading
- (r) facilities for Engineers's poof loading;

Ground Anchorages - Waterproofing Anchorage Boreholes

Units

136 The unit of measurement shall be:

- (i) waterproofing of boreholes linear metre.

Measurement

137 The measurement of waterproofing of boreholes shall be the total length of waterproofing operation instructed by the Overseeing Organisation.

Itemisation

138 Separate items shall be provided for waterproofing of boreholes in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Waterproofing of boreholes.
II	1	Standard grouting.
	2	Pressure grouting.

Waterproofing of Boreholes

139 The items for waterproofing of boreholes shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) pre-grouting;
- (b) re-drilling and applying water under pressure and proving watertightness of borehole.

Instrumentation and Monitoring - Boring Plant

Units

140 The unit of measurement shall be:

- (i) establishment of boring plant item.

Measurement

141 The establishment of boring plant shall be measured once only to each separate location of boring on the Site. Any additional establishment of boring plant to suit the Contractor's method of working shall not be measured.

Itemisation

142 Separate items shall be provided for boring plant in accordance with

Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Establishment of boring plant.
II	1	Different locations.

Establishment of Boring Plant

143 The items for establishment of boring plant shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) bringing plant and equipment to the location of boring;
- (b) erecting and setting up plant and equipment including site preparation, levelling and access ramps;
- (c) moving and setting up plant at each position including site preparation, levelling, and access ramps;
- (d) dismantling and removing plant and equipment from Site on completion.

Instrumentation and Monitoring - Boring Holes

Units

144 The unit of measurement shall be:

- (i) boring holes linear metre.

Measurement

145 The measurement of boring holes shall be the linear distance along the axis of the borehole between the instrument base and the level stated in the Contract.

Itemisation

146 Separate items shall be provided for boring holes in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Boring holes.
II	1	Vertical.
	2	Raking.
III	1	Depth not exceeding 10 metres.
	2	Depth exceeding 10 metres but not exceeding 20 metres and so on in steps of 10 metres.

Boring Holes

147 The items for boring holes shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) boring holes in any material, including changing bits and tools;
- (b) disposal of material (as this Series paragraph 39);
- (c) taking measures to deal with the presence of water in the boreholes;
- (d) drilling fluid;
- (e) standing time including ancillary plant, equipment and operatives.

Instrumentation and Monitoring - Instrumentation

Units

148 The units of measurement shall be:

- (i) installation of instruments number.
- (ii) installation of tubing, cabling and the like linear metre.
- (iii) grouting linear metre.

Measurement

149 The measurement of installation of instruments shall be the complete installation.

The measurement of tubing and the like shall be the length measured from the instrument to the underside of the screw cap, plug or the like, along the centre line of the trench or borehole.

The measurement of cabling and the like shall be the length measured from the instrument to the base of the instrument hut or cabinet along the centre line of the trench or borehole.

The measurement of grouting shall be the distance from the top of the seal to either the bottom of the trench or to the underside of the screw cap plug or the like whichever is the lower.

Itemisation

150 Separate items shall be provided for instrumentation in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Installation.
II	1	Different types of instruments.
	2	Different types of tubing or cabling.
	3	Different types of grouting.
III	1	Length or depth not exceeding 10 metres.
	2	Length or depth exceeding 10 metres but not exceeding 50 metres, and so on in steps of 50 metres.

Installation of Instruments

151 The items for installation of instruments shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) recording water levels;
- (b) cleaning and keeping hole free of deleterious materials;
- (c) connections and joints;
- (d) keeping items clean during installation;
- (e) sand filters including allowing time for settlement;
- (f) removing contaminated water;
- (g) recording data and supplying one copy to the Overseeing Organisation;
- (h) proving correct functioning;
- (i) bedding and surround.

Installation of Tubing and Cabling

152 The items for installation of tubing and cabling shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) standpipes;
- (b) cutting and jointing tubing including fittings and screw caps;
- (c) connections and joints;
- (d) excavation in any material (as this Series paragraphs 17, 18, 19 and 23);
- (e) bedding and surround to cable or tube;
- (f) backfilling and compaction;
- (g) marking tape or cable covers;
- (h) extra length of cable for connection to monitoring equipment;
- (i) twisting and snaking;
- (j) incremental installation;
- (k) ducts (as Series 500 paragraph 16).

Grouting

153 The items for grouting shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) mixing and placing;
- (b) in situ concrete (as Series 1700 paragraph 5);
- (c) formwork (as Series 1700 paragraph 15);
- (d) backfilling and compaction;
- (g) disposal of material (as this Series paragraph 39);
- (h) covers, frames, seatings and bedding;
- (i) locks and keys.

Instrumentation and Monitoring - Instrument Hut or Cabinet

Units

154 The unit of measurement shall be:

- (i) erection, servicing, dismantling of instrument hut or cabinet .
..... item.

Itemisation

155 Separate items shall be provided for instrument hut or cabinet in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

- | | | |
|---|---|--------------|
| I | 1 | Erection. |
| | 2 | Servicing. |
| | 3 | Dismantling. |

II	1	Instrument hut for the Overseeing Organisation.
	2	Instrument cabinet for the Overseeing Organisation.
III	1	Until completion of the works.
	2	After completion of the works.

Erection of Instrument Hut

156 The items for erection of instrument hut shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparation of site;
- (b) foundations, bases and hardstandings;
- (c) heating, power, water and lighting services;
- (d) security fence and lockable gates;
- (e) furnishings and fittings;
- (f) locks and keys.

Servicing Instrument Hut

157 The items for servicing instrument hut shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) depreciation and maintenance of building, services and fences;
- (b) depreciation and maintenance of furnishings, fittings and supplies.

Dismantling Instrument Hut

158 The items for dismantling instrument hut shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) receiving back from the Overseeing Organisation and removing furnishings and fittings;
- (b) disconnecting, removing and sealing off disused services;
- (c) demolishing and removing including hardstandings, fences and gates;
- (d) disposal of material (as this Series paragraph 39);
- (e) reinstatement of the site.

Erection of Instrument Cabinet

159 The items for erection of instrument cabinet shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparation of site;
- (b) foundations and bases;
- (c) power and water services;
- (d) locks and keys.

Servicing of Instrument Cabinet

160 The items for servicing of instrument cabinet shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) depreciation and maintenance of cabinet and services;
- (b) depreciation and maintenance of fittings and supplies;

(c) servicing.

Dismantling of Instrument Cabinet

161 The items for dismantling of instrument cabinet shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) disconnecting, removing, and sealing off disused services;
- (b) removing instrument cabinet off Site;
- (c) breaking up and removal of foundations, and bases, and disposal of surplus material;
- (d) disposal of material (as this Series paragraph 39);
- (e) reinstatement of the site.

Instrumentation and Monitoring - Monitoring Equipment

Units

162 The unit of measurement shall be:

- (i) monitoring equipment item.

Itemisation

163 Separate items shall be provided for monitoring equipment in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Monitoring equipment.
II	1	Different types.

Monitoring Equipment

164 The items for monitoring equipment shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) installing, commissioning, calibrating and maintaining monitoring equipment in instrument hut or cabinet;
- (b) installing, commissioning, calibrating and maintaining monitoring equipment in vehicles for the Overseeing Organisation;
- (c) copies of reports and results and supplying to the Overseeing Organisation;
- (d) instructing the Overseeing Organisation's staff in the operation and maintenance of the instrumentation;
- (e) attendance during measurement carried out by the Overseeing Organisation;
- (f) removing on completion.

Ground Water Lowering

Units

165 The unit of measurement shall be:

- (i) ground water lowering item.

Measurement

166 The measurement of ground water lowering shall be the complete installation. Ground water lowering shall be separately measured only where ground water lowering is specifically required in the Contract.

Itemisation

167 Separate items shall be provided for ground water lowering in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Ground water lowering.
II	1	Different locations.

Ground Water Lowering

168 The items for ground water lowering shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparing, amending and submitting proposals to the Overseeing Organisation;
- (b) installation, operation, maintenance and removal of plant;
- (c) making arrangements with owners and occupiers of land temporarily acquired, and cost arising therefrom;
- (d) diversion of rivers and the like;
- (e) soakaways, lagoons and the like;
- (f) measures to safeguard water supplies including liaising with water companies.

Trial Pits

Units

169 The unit of measurement shall be:

- (j) trial pits cubic metre.

Measurement

170 The measurement of trial pits shall be the volume of the void, calculated on the basis of the horizontal area of the bottom of the excavation with the depth being measured from the bottom of the excavation to the level at which excavation is directed to be commenced.

Itemisation

171 Separate items shall be provided for trial pits in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Trial pits.
II	1	0 metres to 3 metres in depth.
	2	0 metres to 6 metres in depth, and so on in steps of 3 metres.

Trial Pits

172 The items for trial pits shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as this Series paragraphs 17 and 18);
- (b) excavation of unacceptable material (as this Series paragraph 19);
- (c) excavation in Hard Material (as this Series paragraph 23);
- (d) locating, working around and supporting pipes, cables, services, apparatus and the like;

- (e) attendance on the Overseeing Organisation and others for inspection and investigation purposes;
- (f) disposal of material (as this Series paragraph 39);
- (g) backfilling and compaction;
- (h) reinstatement of surfaces.

Breaking Up and Perforation of Redundant Pavements

Units

173 The unit of measurement shall be:

- (i) breaking up of redundant pavements, perforation of redundant pavements square metre.

Measurement

174 The measurement of breaking up and perforation of redundant pavements shall be the areas stated in the Contract to be broken up or perforated and left in place. The depth of the pavement shall be the depth from the existing surface of the pavement to the underside of bituminous or cementitious material.

Itemisation

175 Separate items shall be provided for breaking up and perforation of redundant pavements in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Breaking up of redundant pavements.
	2	Perforation of redundant pavements.
II	1	Different types of pavement.
III	1	Depth not exceeding 100 mm.
	2	Depth exceeding 100 mm but not exceeding 200 mm, and so on in steps of 100 mm.

Breaking up and Perforation of Redundant Pavements

176 The items for breaking up and perforation of redundant pavements shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation in Hard Material (as this Series paragraph 23);
- (b) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like.

Perforation of Redundant Slabs, Basements and the Like

Units

177 The unit of measurement shall be:

- (i) perforation of redundant slabs, basements and the like square metre.

Measurement

178 The measurement of perforation of redundant slabs, basements and the like shall be the areas stated in the Contract to be perforated and left in place.

Itemisation

179 Separate items shall be provided for perforation of redundant slabs, basements and the like in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Perforation of redundant slabs, basements and the like.
II	1	Different types of slabs, basements and the like.
III	1	Thickness not exceeding 100 mm.
	2	Thickness exceeding 100 mm but not exceeding 200 mm, and so on in steps of 100 mm.

**Perforation of Redundant
Slabs, Basements and the
Like**

180 The items for perforation of redundant slabs, basements and the like shall in accordance with the Preambles to Bill of Quantities General
Directions include for:

Item coverage

- (a) excavation in Hard Material (as this Series paragraph 23);
- (b) taking precautions to avoid damage to property, structures, drains, sewers, services, instrumentation and the like.

Series 700: Pavements

Sub-base (Foundation Course CBM)

Units	1	The unit of measurement shall be:													
	(i)	sub-base square metre.													
Measurement	2	The measurement of sub-base shall be calculated using the width and thickness required by the contractor.													
		Note: See note paragraph 7													
	3	No deduction shall be made for openings of 1 square metre or less.													
Itemisation	4	Separate items shall be provided for sub-base in accordance with Chapter II paragraphs 3 and 4 and the following:													
	<table> <tr> <th>Group</th><th colspan="2">Feature</th></tr> <tr> <td>I</td><td>1</td><td>Each group or type of sub-base.</td></tr> <tr> <td rowspan="3">II</td><td>1</td><td>In carriageway, hardshoulder and hardstrip.</td></tr> <tr> <td>2</td><td>In emergency crossing.</td></tr> <tr> <td>3</td><td>In lay-by and bus bay.</td></tr> </table>		Group	Feature		I	1	Each group or type of sub-base.	II	1	In carriageway, hardshoulder and hardstrip.	2	In emergency crossing.	3	In lay-by and bus bay.
Group	Feature														
I	1	Each group or type of sub-base.													
II	1	In carriageway, hardshoulder and hardstrip.													
	2	In emergency crossing.													
	3	In lay-by and bus bay.													
Sub-base	5	The items for sub-base shall in accordance with the Preambles to Bill of Quantities General Directions include for:													
Item coverage	(a)	trial areas and trials;													
	(b)	making good after sampling and testing;													
	(c)	protection of material in transit and while awaiting tipping;													
	(d)	designing and verifying mixes													
	(e)	grading, measuring, mixing and depositing materials;													
	(f)	spreading and compaction;													
	(g)	cleaning, preparing and working on or up to existing surfaces and features;													
	(h)	curing and protection;													
	(i)	edge support;													
	(j)	maintenance of surface;													
	(k)	induced cracking;													
	(l)	taking measures to protect the subgrade and sub-base from deterioration due to the ingress of water and the use of constructional plant;													

- (m) taking measures to improve the sub-base to protect the sub-base and subgrade from damage due to the Contractor's method of construction and choice of constructional plant;
- (n) shaping to cambers, falls and crowns;
- (o) provision of soundness test certificate.

Note: As the pavement according to the Directive for the standardization of Pavements for Traffic Areas' includes also the foundation course and the CBM layer, this paragraph 5 may also need items of paragraph 9 of this series.

Pavement

Units

6 The unit of measurement shall be:

- (i) base course, lower base course (unbound material), upper base course (asphalt), binder course, surface course, concrete slab square metre.

Measurement

7 The measurement of base course, lower base course, upper base course, binder course, surface course and concrete slab shall be calculated using the width of the top surface of the course or slab and the required thickness.

Note: The width of the "top surface" of the course or slab shall be the width required by the Contract and shall exclude sloping sides or edges.

No deductions shall be made for openings of 1 square metre or less.

Itemisation

8 Separate items shall be provided for base course, lower base course, upper base course, binder course, surface course and concrete slab in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Pavement.
II	1 Base Course.
	2 Lower base Course.
	3 Upper base Course.
	4 Binder course.
	5 Surface course.
	6 Concrete slab.
III	1 Each group or type.
IV	1 Different thicknesses.
V	1 Reinforced.
VI	1 In carriageway, hardshoulder and hardstrip.
	2 In emergency crossing.
	3 In lay-by and bus bay.
VII	1 In overlay.

Base Course, Lower Base Course Upper Base course, Binder Course, Surface Course and Concrete Slab

9 The items for base course, lower base course, upper base course, surface course and concrete slab shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage	<ul style="list-style-type: none">(a) trial areas and trials;(b) making good after sampling and testing;(c) protection of material in transit and while awaiting tipping;(d) designing and verifying mixes;(e) grading, measuring, reclaiming, mixing and depositing materials;(f) air entrainment;(g) spreading and compaction;(h) cutting back, saw cutting, cleaning, preparing and working on or up to existing surfaces and features;(i) edge support;(j) reinforcement (as Series 1700 paragraph 26);(k) waterproof and separation membranes;(l) chippings;(m) surface texturing;(n) formwork (as Series 1700 paragraph 15);(o) making joints;(p) forming or sawing grooves, cleaning, grit blasting, priming, caulking, temporary and permanent sealing of joints;(q) longitudinal, expansion, contraction, warping and construction joint assemblies, including joint filler and crack inducers, tie and dowel bars, dowel bar cradles, caps and sheaths and inspection of dowel bars and corrosion protection to tie bars and coating to transverse reinforcement;(r) shaping to cambers, falls and crowns;(s) forming sockets, recesses, openings, and bays;(t) curing and protection;(u) protection and masking and unmasking of kerbs, drainage channels, chamber covers, gully gratings, expansion joints, and the like;(v) maintenance of surface;(w) taking measures to protect and maintain the pavement from deterioration by the use of constructional plant and the ingress of water and other materials;
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- (x) anchorages including excavation and disposal, steel beams, ground beams and thickening of slab;
- (y) measures required for aftercare and opening the road to traffic;
- (z) protective system to steel beams (as Series 1900 paragraph 4);
- (aa) slurry sealing, surface dressing, bituminous spray, resin based treatment and tack coat forming integral parts of the pavement;
- (bb) admixtures and additives;
- (cc) retarders, brushing and other measures necessary to provide exposed aggregate textured surface including disposal of surplus mortar arising;
- (dd) saw cutting and sealing bituminous overlays;
- (ee) bond-breaker tape.
- (ff) Construction of longitudinal and transversal joints (edge rolling, joint cutting, blade cutting; hot bitumen)

Regulating Course

Units

10 The units of measurement shall be:

- (i) bituminous regulating course tonne, cubic metre, or square metre.
- (ii) cement bound regulating course tonne, cubic metre or square metre.

Measurement

11 The measurement of bituminous regulating course by tonne shall be calculated from the tonnage of material certified by the Overseeing Organisation.

The tonnage certified by the Overseeing Organisation shall be only that material included on delivery tickets which is incorporated in the Permanent Works in the locations and to the extent and thickness required by the Contract. Material in excess of the requirements of the Contract and material used for any other purpose shall not be included within the certified tonnage.

The measurement of bituminous regulating course by cubic metres or square metres shall be the volume of material or layer thickness measured to the outlines required by the Contract.

12 The measurement of cement bound regulating course shall be the volume of material measured to the outlines required by the Contract.

Itemisation

13 Separate items shall be provided for bituminous regulating courses and cement bound regulating courses in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each group or type of bituminous regulating course.
	2 Each group or type of cement bound regulating course.
II	1 Lower base course.
	2 Upper base course.
	3 Base course.
	4 Binder course.
	5 Surface course.

Bituminous and Cement Bound Regulating Course

14 The items for bituminous and cement bound regulating course shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) base, lower base, upper base, binder course, surface course and concrete slab (as this Series paragraph 9);
 - (b) weighing, tickets and copies;
 - (c) material not laid as regulating course.

Surface Treatment

Units **15** The unit of measurement shall be:

- (i) surface treatment square metre.

Measurement **16** The measurement of surface treatment shall be calculated using the width of the top surface to be treated as described in paragraph 7.

17 Surface treatment shall only be measured separately when the Contract requires a separate or additional surface treatment to be applied to the pavement. Surface treatment forming an integral part of any specified group or type of pavement shall not be separately measured. No deductions shall be made for openings of 1 square metre or less.

Itemisation **18** Separate items shall be provided for surface treatment, in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Slurry sealing.
	2 Surface dressing.
	3 Bituminous spray.
	4 Resin based surface treatment.
II	1 Different types.
III	1 Different colours.
IV	1 Different rates of spread.

Surface Treatment

19 The items for surface treatment shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) trial areas and trials;
 - (b) spreading and rolling deposited materials;
 - (c) tack coat (as this Series paragraph 24);

- (d) in the case of resin based surface treatment certification of spraying equipment and supplying copy of certificate at monthly intervals to the Overseeing Organisation;
- (e) measures required for aftercare and opening road to traffic.

Tack Coat

Units

20 The unit of measurement shall be:

- (i) tack coat square metre.

Measurement

21 For the purposes of measurement any reference to tack coat shall be deemed to include bond coats.

22 Tack coat shall only be measured separately when the Contract requires a separate or additional tack coat to be applied to an existing surface prior to the construction of the following course or treatment. Tack coat forming an integral part of any specified group or type of pavement or surface treatment shall not be separately measured.

Itemisation

23 Separate items shall be provided for tack coat in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Tack coat.
II	1 Different materials.
III	1 Different rates of spread.

Tack Coat

24 The items for tack coat shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) trial areas and trials;
- (b) making good after sampling and testing;
- (c) designing and verifying mixes;
- (d) grading, measuring, mixing and depositing materials;
- (e) making joints;
- (f) cleaning surfaces;
- (g) protection and masking and unmasking of kerbs, drainage channels, chamber covers, gully gratings, expansion joints, road studs, road markings and the like and obtaining clean markings;
- (h) cutting back, preparing and working on or up to adjacent faces, surfaces and features;
- (i) admixtures and additives.

Cold Milling (Planing)

Units	25	The unit of measurement shall be:							
	(i)	milling square metre.							
Measurement	26	The measurement of milling shall be calculated using the width stated in the Contract. No deductions shall be made for openings of 1 square metre or less.							
		Milling carried out as part of a repave recycle process shall not be separately measured.							
Itemisation	27	Separate items shall be provided for milling in accordance with Chapter II paragraphs 3 and 4 and the following:							
		<table><tr><th>Group</th><th>Feature</th></tr><tr><td>I</td><td>1 Milling.</td></tr><tr><td>II</td><td>1 Different thicknesses or depths.</td></tr></table>		Group	Feature	I	1 Milling.	II	1 Different thicknesses or depths.
Group	Feature								
I	1 Milling.								
II	1 Different thicknesses or depths.								
Milling	28	The items for milling shall in accordance with the Preambles to Bill of Quantities General Directions include for:							
Item coverage	(a)	re-shaping and rolling;							
	(b)	shaping to cambers, falls and crowns;							
	(c)	multiple handling of material;							
	(d)	loading into transport;							
	(e)	disposal of material (as Series 600 paragraph 39);							
	(f)	working around drainage channels, chamber covers, gully gratings, expansion joints and the like;							
	(g)	ramps;							
	(h)	removing road studs not required for re-use;							
	(i)	surface preparation and cleaning;							
	(j)	cutting out and removal of material by other means;							
	(k)	water supply and damping down;							
	(l)	electronic detection sweep, referencing and reports.							
	(m)	haulage and deposition in tip off site							

Insitu Recycling - The Remix and Repave Processes

- Units** **29** The unit of measurement shall be:
- (i) reshape recycle process square metre
 - (ii) repave recycle process square metre.
 - (iii) remix recycle process square metre.

Measurement **30** The measurement of insitu recycle processes shall be calculated using the width stated in the Contract. No deductions shall be made for openings of 1 square metre or less.

Itemisation **31** Separate items shall be provided for insitu recycle processes in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Reshape recycle process.
	2 Repave recycle process.
	3 Remix recycle process.
II	1 Different thicknesses or depths.

Insitu Recycling - The Remix and Repave Processes

32 The items for insitu recycle processes shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage**
- (a) milling (as this Series paragraph 28);
 - (b) heating and scarifying;
 - (c) base course, lower base course, upper base course, binder course, surface course and concrete slab (as this Series paragraph 9);
 - (d) make up to low areas and reprofiling;
 - (e) removal of surface dressing;
 - (f) removal of road markings;
 - (g) reports.

Reinstatement of Paved Areas

- Units** **33** The unit of measurement shall be:
- (i) reinstatement of paved area square metre.

Measurement **34** The measurement of reinstatement of paved area shall be calculated using the width of the top surface to be reinstated excluding sides and edges.

No deduction shall be made for openings of 1 square metre or less. The top surface for the following features shall be the widths or areas described below:

- (a) for drains, sewers, piped culverts, service ducts and filter drains - the width shall be the internal diameter of the pipe plus 600 mm;
- (b) for kerbs, channels, edgings, combined drainage and kerb blocks, linear drainage channel systems and the like - the width of the foundations;
- (c) for chambers, gullies, traffic signs, traffic signals, road lighting columns and the like - the horizontal area of the base slab or where no base slab is required the area of the bottom of the excavation.

Itemisation

35 Separate items shall be provided for reinstatement of paved area in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Each type of paved area reinstatement.
II	1 Different thicknesses or depths.

Reinstatement of Paved Area

36 The items for reinstatement of paved area shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) determination of the extent of the reinstatement and agreement with the Overseeing Organisation;
- (b) sub-base (as this Series paragraph 5);
- (c) base course, lower base course, upper base course, binder course, surface course and concrete slab (as this Series paragraph 9);
- (d) bituminous and cement bound regulating course (as this Series paragraph 14);
- (e) surface treatment (as this Series paragraph 19);
- (f) kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems (as Series 1100 paragraph 4);
- (g) footways and paved areas (as Series 1100 paragraph 21);
- (h) scarifying;
- (i) milling (as this Series paragraph 28);
- (j) drilling holes;
- (k) tack coat (as this Series paragraph 24);
- (l) bringing to correct levels and surface regularity following settlement.

Thin Bonded Repairs and Joint Repairs to Existing Concrete Carriageway

Units

37 The units of measurement shall be:

- (i) thin bonded repairs square metre.
- (ii) joint repairs linear metre.

(iii) saw-cutting grooves linear metre.

(iv) sealing grooves linear metre.

Measurement

38 The measurement of thin bonded repairs shall be calculated using the plan area of the top surface of each repair patch excluding areas of joint sealant.

39 Thin bonded repairs and joint repairs shall only be measured separately when areas and lengths to be repaired are stated in the Contract.

40 The measurement of saw-cutting grooves shall be the summation of the lengths of saw-cutting grooves stated in the Contract.

41 The measurement of sealing grooves shall be the summation of the lengths of the sealed grooves stated in the Contract.

Itemisation

42 Separate items shall be provided for thin bonded repairs and joint repairs in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Thin bonded repairs.
	2 Joint repairs.
	3 Saw-cutting grooves.
	4 Sealing grooves.
II	1 Each type.
III	1 Individual areas not exceeding 1 square metre on plan.
	2 Individual areas exceeding 1 square metre but not exceeding 2 square metres on plan and so on in steps of 1 square metre.
	3 In individual lengths not exceeding 1 linear metre.
	4 In individual lengths exceeding 1 linear metre but not exceeding 2 linear metres and so on in steps of 1 linear metre.
IV	1 Depth of cut not exceeding 50mm.
	2 Depth of cut exceeding 50mm but not exceeding 75mm and so on in steps of 25 mm.
V	1 Different thicknesses or depths.

**Thin Bonded Repairs and
Joint Repairs**

43 The items for thin bonded repairs and joint repairs shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) determination of the area or length of the repair and agreement with the Overseeing Organisation;
- (b) base course, lower base course, upper base course, binder course, surface course and concrete slab (as this Series paragraph 9);
- (c) removal of any existing joint sealant and caulking material;
- (d) removal of unsound concrete and cutting back reinforcement within the repair area;
- (e) treatment of repair area and surrounds;
- (f) supply and application of clean water;
- (g) wetting and removal of excess water;

- (h) finishing repair material flush with the level of the surrounding concrete slab and brushing and applying surface texture to match existing;
- (i) reinstatement of sub-base;
- (j) disposal of material (as Series 600 paragraph 39).

Saw-cutting Grooves and Sealing Grooves

44 The items for saw-cutting grooves and sealing grooves shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) preparing;
- (b) cleaning;
- (c) drying;
- (d) bond-breaker tape;
- (e) recording details;
- (f) disposal of material (as Series 600 paragraph 39).

Full Depth Repairs and Bay Replacement Repairs to Existing Concrete Carriageway

Units

45 The units of measurement shall be:

- (i) full depth repairs, bay replacement repairs square metre.
- (ii) reinstatement of sub-base cubic metre, tonne or square metre.

Measurement

46 The measurement of full depth repairs and bay replacement repairs shall be the summation of the individual areas to be repaired as stated in the Contract.

Itemisation

47 Separate items shall be provided for full depth repairs and bay replacement repairs to existing concrete carriageway in accordance with Chapter II Paragraph 3 and 4 and the following:

Group	Feature	
I	1	Full depth repairs.
	2	Bay replacement repairs.
	3	Reinstatement of sub-base.
II	1	In unreinforced slabs.
	2	In reinforced slabs.
III	1	Different thicknesses of slabs.

Full Depth Repairs and Bay Replacement Repairs to Existing Concrete Carriageway

48 The items for full depth repairs and bay replacement repairs to existing concrete carriageway shall in accordance with the Preambles to Bills of Quantities General Directions include for:

Item coverage	<ul style="list-style-type: none"> (a) saw cutting and drilling to full depth; (b) excavation of acceptable material (as Series 600 paragraph 18); (c) excavation of unacceptable material (as Series 600 paragraph 19); (d) excavation in hard material (as Series 600 paragraph 23); (e) disposal of material (as Series 600 paragraph 39); (f) completion of formation (as Series 600 paragraph 88); (g) dowel bars and tie bars including drilling and supports, cleaning, plugging with resin mortar and de-bonding and compressive discs; (h) sub-base (as this Series paragraph 5); (i) separation layer; (j) joint filler board; (k) joint groove forming strip; (l) concrete slab (as this Series paragraph 9).
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Saw Cutting, Cracking and Seating Existing Jointed Reinforced Concrete Pavements

Units	<p>49 The units of measurement shall be:</p> <ul style="list-style-type: none"> (i) removal of existing bituminous overlay square metre. (ii) main trial item. (iii) re-assessment trial number. (iv) saw cutting existing pavement square metre. (v) cracking existing pavement square metre. (vi) seating existing pavement square metre.
Measurement	<p>50 The main trial shall be measured once only for the main trial area stated in the Contract.</p> <p>51 The re-assessment trial shall be measured once only for each time that the defined circumstances in the Contract require that such a trial be carried out as stated in the Contract.</p> <p>52 The measurement of cracking and seating shall be the areas stated in the Contract to be cracked and seated. No deductions shall be made for openings of 1 square metre or less.</p>
Itemisation	<p>53 Separate items shall be provided for saw-cutting, cracking and seating existing jointed reinforced concrete pavements in accordance with Chapter II paragraphs 3 and 4 and the following:</p>

Group	Feature	
I	1	Removal of existing bituminous overlay.
	2	Main trial.
	3	Re-assessment trial.
	4	Saw-cutting existing pavement.
	5	Cracking existing pavement.
	6	Seating existing pavement.
II	1	Saw-cuts exceeding 50mm but not exceeding 70mm in depth.
	2	Saw-cuts exceeding 70mm but not exceeding 90mm in depth.
	3	Saw-cuts exceeding 90mm but not exceeding 110mm in depth, and so on in steps of 20mm.
III	1	Thickness not exceeding 50mm.
	2	Thickness exceeding 50mm but not exceeding 100mm.
	3	Thickness exceeding 100mm but not exceeding 150mm, and so on in steps of 50mm.

Note 1: Group II Features shall be applied only to Feature 4 of Group I.

Note 2: Group III Features shall be applied only to Features 5 and 6 of Group I.

Removal of Existing Bituminous Overlay

54 The items for removal of existing bituminous overlay shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 Paragraph 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) excavation in hard material (as Series 600 paragraph 23);
- (d) disposal of material (as Series 600 paragraph 39);
- (e) milling (as Series 700 paragraph 28).

Main Trial

55 The items for main trial shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) saw-cutting (as this Series paragraph 57);
- (b) cracking and seating existing pavements (as this Series paragraphs 58 and 59);
- (c) checking cracking;
- (d) checking saw cuts.

Re-assessment Trial

56 The items for re-assessment trial shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) main trial (as this Series paragraph 55);
- (b) lost time, standing time and disruption caused by re-assessment trials.

Saw-cutting

57 The items for saw-cutting shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) locating existing joints;
- (b) water supply;
- (c) monitoring and adjusting plant and equipment;
- (d) removal of loose material and debris;
- (e) disposal of material (as Series 600 paragraph 39);
- (f) taking measurements and calculations;
- (g) observations and examinations;
- (h) coring, reinstatement and compaction;
- (i) marking reference chainages and grid;
- (j) giving of notices, keeping records, completing and supplying reports and certificates;
- (k) lighting for core inspection.

Cracking

58 The items for cracking shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) supply and application of clean water;
- (b) monitoring and adjusting plant and equipment;
- (c) removal of loose material and debris;
- (d) disposal of material (as Series 600 paragraph 39);
- (e) taking measurements and calculations;
- (f) observations and examinations;
- (g) cleaning;
- (h) coring, reinstatement and compaction;
- (i) marking reference chainages and grid;
- (j) giving of notices, keeping records, completing and supplying reports and certificates;
- (k) providing and maintaining side restraint;
- (l) lighting for core inspection.

Seating

59 The items for seating shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) monitoring and adjusting plant and equipment;
- (b) removal of loose material and debris;
- (c) disposal of material (as Series 600 paragraph 39);
- (d) taking measurements and calculations;
- (e) observations and examinations;
- (f) rolling;
- (g) measures to rectify unstable seating;
- (h) giving of notices, keeping records, completing and supplying reports and certificates;
- (i) providing and maintaining side restraint;

Cracking and Seating Existing Jointed Unreinforced Concrete Pavements and CBM Bases

Units

60 The units of measurement shall be:

- (i) removal of existing bituminous overlay square metre.
- (ii) main trialitem.
- (iii) re-assessment trial..... number.
- (iv) crackingsquare metre.
- (v) seatingsquare metre.

Measurement

61 The main trial shall be measured once only for the stated area.

62 The re-assessment trial shall be measured once only for each time that the defined circumstances in the Contract require that such a trial be carried out as stated in the Contract.

63 The measurement of cracking and seating shall be the areas stated in the Contract to be cracked and seated. No deductions shall be made for openings of 1 square metre or less.

Itemisation

64 Separate items shall be provided for cracking and seating existing jointed unreinforced concrete pavements and CBM bases in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Removal of existing bituminous overlay.
	2 Main trial.
	3 Re-assessment trial.
	4 Cracking.
	5 Seating.
II	1 Jointed unreinforced concrete pavements.
	2 CBM bases.
III	1 Thickness not exceeding 50mm.
	2 Thickness exceeding 50mm but not exceeding 100mm.
	3 Thickness exceeding 100mm but not exceeding 150mm, and so on in steps of 50mm.
IV	1 Transverse cracks exceeding 1.00m but not exceeding 2.00m centres.
	2 Transverse cracks exceeding 2.00m but not exceeding 3.00m centres.
	3 Transverse cracks exceeding 3.00m but not exceeding 4.00m centres.
	4 Transverse cracks exceeding 4.00m but not exceeding 6.00m centres, and so on in steps of 2.00m.

Note 1: Group III Features shall be applied only to Features 4 and 5 of Group I.

Note 2: Group IV Features shall be applied only to Feature 4 of Group I.

Removal of Existing Bituminous Overlay

65 The items for removal of existing bituminous overlay shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation of acceptable material (as Series 600 paragraph 18);
 - (b) excavation of unacceptable material (as Series 600 paragraph 19);
 - (c) excavation in hard material (as Series 600 paragraph 23);
 - (d) disposal of material (as Series 600 paragraph 39);
 - (e) milling (as this Series paragraph 28).

Main Trial

66 The items for main trial shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) main trial (as this Series paragraph 55).

Re-assessment Trial

67 The items for re-assessment trial shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) re-assessment trial (as this Series paragraph 56).

Cracking

68 The items for cracking shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) cracking (as this Series paragraph 58).

Seating **69** The items for seating shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage (a) seating (as this Series paragraph 59).

Overbanding and Inlaid Crack Sealing Repair Systems

Units **70** The units of measurement shall be:

- (i) simple overbanding repair system linear metre.
- (ii) fill and overbanding repair system linear metre.
- (iii) inlaid sealing repair system linear metre.

Measurement **71** The measurement of simple overbanding repair system, fill and overbanding repair system and inlaid sealing repair system shall be the summation of the lengths stated in the Contract and shall be for the complete system.

Itemisation **72** Separate items shall be provided for simple overbanding repair system, fill and overbanding repair system and inlaid sealing repair system in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Simple overbanding repair system.
	2 Fill and overbanding repair system.
	3 Inlaid sealing repair system.
II	1 Different stated materials.
III	1 Crack exceeding 5mm but not exceeding 10mm wide.
	2 Crack exceeding 10mm but not exceeding 15mm wide.
	3 Crack exceeding 15mm but not exceeding 20mm wide.
IV	1 Stated width of crack.

Note: Group III Features shall be applied only to Group I Feature 2.

Note: Group IV Feature shall be applied only to Group 1 Feature 3.

Overbanding and Inlaid Crack Sealing Repair Systems

73 The items for overbanding and inlaid crack sealing repair systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) cleaning;
 - (b) drying;
 - (c) disposal of material (as Series 600 paragraph 39);
 - (d) priming;
 - (e) bond-breaker tape;
 - (f) recording details.

Maintenance of Arrester Beds

- Units** **74** The unit of measurement shall be:
- (i) maintenance of arrester bed item.
- Itemisation** **75** Separate items shall be provided for maintenance of arrester beds in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature		
I	1	Maintenance of arrester bed.
II	1	Stated location.

Maintenance of Arrester Beds

76 The items for maintenance of arrester beds shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item Coverage**
- (a) clearance of debris, litter and weed growth from granular material;
- (b) disposal of material (as Series 600 paragraph 39);
- (c) sweeping;
- (d) re-placing material on bed;
- (e) raking and levelling.

Repairs and Patching

- Units** **77** The units of measurement shall be:
- (i) repairs to potholes, repairs to depressionskilogramme.
- (ii) patching square metre.
- Measurement** **78** The measurement of repairs to potholes and repairs to depressions shall be the mass of specified material placed in the voids.
- 79** The measurement of patching shall be the area of the top surface of the patch.
- Itemisation** **80** Separate items shall be provided for repairs and patching in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature	
I	1	Repairs to potholes.
	2	Repairs to depressions.
	3	Patching.
II	1	Different thicknesses.
III	1	Stated repair materials or system.
IV	1	In areas not exceeding 5 square metres.
	2	In areas exceeding 5 square metres but not exceeding 10 square metres.
	3	In areas exceeding 10 square metres but not exceeding 15 square metres and so on in steps of 5 square metres.

Note: Groups II & IV features shall be applied only to Group I feature 3.

Repairs and Patching 81

The items for repairs and patching shall in accordance with the Preambles to Bill of Quantities General Directions include for:

Item coverage

- (a) excavation of acceptable material (as Series 600 paragraph 18);
- (b) excavation of unacceptable material (as Series 600 paragraph 19);
- (c) excavation of hard material (as Series 600 paragraph 23);
- (d) disposal of material (as Series 600 paragraph 39);
- (e) milling (as this Series paragraph 28);
- (f) removing loose material and water;
- (g) tack coat (as this Series paragraph 24);
- (h) compaction and shaping;
- (i) forming joints and sealing.

ROAD PAVEMENTS - UNBOUND, HYDRAULICALLY BOUND AND OTHER MATERIALS.

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ROAD PAVEMENTS - UNBOUND, HYDRAULICALLY BOUND AND OTHER MATERIALS.

801 General Requirements for Unbound, Hydraulically Bound and Other Materials

1 Sub-bases (foundation course) and unbound base courses shall be made and constructed using materials described in the following Clauses. The permitted alternatives for each part of the Works shall be as described in Appendix 7/1.

2 Where recycled coarse aggregate or recycled concrete aggregate is used in accordance with this Series, it shall have been tested in accordance with Clause 710.

Transporting

3 Plant-mixed material shall, when mixed, be removed at once from the mixer, transported to the point where it is to be laid and protected from weather both during transit from the mixer to the laying site and whilst awaiting tipping.

Laying

4 Materials shall not be laid on any surface that is frozen or covered with ice.

5 All material shall be placed and spread evenly. Spreading shall be undertaken either concurrently with placing or without delay. Unbound and hydraulically bound base course material shall be spread using a paving machine or a suitable spreader box and operated with a mechanism that levels off the material to an even depth. Mixtures are to be laid at a water content which is favourable for compaction.

6 Except where otherwise stated in Appendix 7/1, material shall be spread so that after compaction the total thickness is at least as follows:

- Aggregate mixture 0/37.5mm: 15cm
- Aggregate mixture 0/50mm: 18cm

Laying of several layers is possible if the minimum laying thickness is observed. Where the layers of unbound material are of unequal thickness the lowest layer shall be the thickest layer.

Compaction

7 Compaction should be completed as soon as possible after the material has been spread and in accordance with the requirements for the individual materials.

8 Full compaction shall be obtained over the full area including in the vicinity of both longitudinal and transverse joints.

9 Compaction of unbound materials may be carried out by a method specified in Table 8/1. Independently of these recommendations the following requirements have to be achieved:

- (i) Compaction degree based on the Standard Proctor Test according to BS 1377: Part 4 shall not fall below $D_{pr} = 103\%$. In residential areas where laying is hindered by manholes etc., a compaction degree of $D_{pr} = 100\%$ may be required to be included in the tender documents.
- (ii) The reaction modulus E_{v2} according to ASTM-D-1194 and Clause 642, Sub-Clause 4 required in chart 1, chart 2, chart 3 and chart 5 of the “Directives for the Standardization of Pavements for Traffic Areas” has to be achieved. The relation E_{v2}/E_{v1} shall not exceed 2.2. Higher relations than 2.2 are permissible if the value E_{v1} is at least 60% of the required E_{v2} value.

The following tolerances are permissible in production control and control testing:

- Less than five test values: all values have to be above the minimum value.
- Five or more test values: one value may fall below the required value by 10%.

The Site Engineer of the Overseeing Organization decides to which extent the compaction control will be carried out based only on the relation E_{v2}/E_{v1} .

10 The surface of any layer of material shall on completion of compaction and immediately before overlaying, be well closed, free from movement

under construction plant and from ridges, cracks, loose material, pot holes, ruts or other defects. All loose, segregated or otherwise defective areas shall be removed to the full thickness of the layer, and new material laid and compacted.

11 For the purposes of Table 8/1 the following shall apply:

- (i) The number of passes is the 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, in the case of power rammers).
- (ii) The compaction plant in Table 8/1 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.
- (iii) 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 spacing between the wheel tracks provided that each spacing does not exceed 230mm. Where the spacing exceed 230mm, the effective width shall be the sum of the widths of the individual wheel tracks only.
- (iv) Vibratory rollers are self-propelled or towed smooth-wheeled rollers having means of applying mechanical vibration to one or more rolls:
 - (a) The requirements for vibratory rollers are based on the use of the lowest gear on a self-propelled machine with mechanical transmission and a speed of 1.5-2.5 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.
 - (b) Where the mechanical vibration is applied to two rolls in tandem, the minimum number of passes shall be half the number given in Table 8/1 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 smaller 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.
- (c) Vibratory rollers operating without vibration shall be classified as smooth wheeled rollers.
- (d) Vibratory rollers shall be operated with their vibratory mechanism operating at the frequency of vibration recommended by the manufacturer. All such 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.
- (v) Vibrating-plate compactors are machines having a base-plate to which a source of vibration consisting of one or two eccentrically weighted shafts is attached:
 - (a) The mass per square metre of 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.
 - (b) Vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturer. 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.
- (vi) 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.
- (vii) Power rammers are machines, which are actuated by explosions in an internal combustion cylinder. The operator controls

each of these explosions manually. One pass of a power rammer is considered as the instance when the compacting shoe has made one strike on the area in question.

- (viii) Combinations of different types of plant or different categories of the same plant will be

permitted; in which case the number of passes for each shall be such proportion of the appropriate number in Table 8/1 as will together produce the same total compactive effort as any one operated singly, in accordance with Table 8/1.

TABLE 8/1: Compaction Requirements for Granular Sub-base Material Types 1 and 2

Type of compaction plant	Category	Number of passes for layers not exceeding the following compacted thickness		
		110 mm	150 mm	225 mm
Smooth-wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll:			
	over 2700 kg up to 5400 kg	16	unsuitable	unsuitable
	over 5400 kg	8	16	unsuitable
Pneumatic-tyred roller	Mass per wheel:			
	over 4000 kg up to 6000 kg	12	unsuitable	unsuitable
	over 6000 kg up to 8000 kg	12	unsuitable	unsuitable
	over 8000 kg up to 12000 kg	10	16	unsuitable
	over 12000 kg	8	12	unsuitable
Vibratory roller	Mass per metre width of vibrating roll:			
	over 700 kg up to 1300 kg	16	unsuitable	unsuitable
	over 1300 kg up to 1800 kg	6	16	unsuitable
	over 1800 kg up to 2300 kg	4	6	10
	over 2300 kg up to 2900 kg	3	5	9
	over 2900 kg up to 3600 kg	3	5	8
	over 3600 kg up to 4300 kg	2	4	7
	over 4300 kg up to 5000 kg	2	4	6
	over 5000 kg	2	3	5
Vibrating-plate compactor	Mass per square metre of base plate:			
	over 1400 kg/m ² up to 1800 kg/m ²	8	unsuitable	unsuitable
	over 1800 kg/m ² up to 2100 kg/m ²	5	8	unsuitable
	over 2100 kg/m ²	3	6	10
Vibro-tamper	Mass:			
	over 50 kg up to 65 kg	4	8	unsuitable
	over 65 kg up to 75 kg	3	6	10
	over 75 kg	2	4	8
Power rammer	Mass:			
	100 kg-500 kg	5	8	unsuitable
	over 500 kg	5	8	12

Use of Surfaces by Traffic and Construction Plant

12 Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the subgrade or the pavement courses already constructed. The wheels or tracks of plant moving

over the various pavement courses shall be kept free from deleterious materials.

13 Where the Contractor proposes to use the sub-base or base course layers for construction plant he shall improve the sub-base or roadbase layers where necessary, to accommodate the method of construction and the type of plant and vehicles which he proposes to use, in order to avoid damage

to the base course, sub-base, any capping and the subgrade. Any permanent thickening shall be across the whole width of the pavement. Temporary thickening shall not impede drainage of the sub-base or the subgrade.

802 Not used

803 Granular Material Type 1

1 Type 1 granular material (e.g. for base courses) shall be crushed rock or crushed concrete. The material shall lie within the grading envelope of Table 8/2, and not be gap graded.

2 The material passing the 425 micron BS sieve shall be non-plastic as defined by BS 1377: Part 2 and tested in compliance therewith.

3 The material shall be transported, laid and compacted without drying out or segregation.

4 The material shall have a ten per cent fines value of 50kN or more when tested in compliance with BS 812: Part 111. The test sample shall be in a soaked condition at the time of test.

5 The aggregate will be considered suitable if:

(i) aggregate from the source, when tested in accordance with BS 812 : Part 121, has a soundness value greater than 65;

or

(ii) evidence can be provided to the Overseeing Organisation of satisfactory use of aggregate from the source.

The water absorption of the coarse aggregate from the source determined in accordance with BS 812: Part 2 shall also be declared.

TABLE 8/2: Granular Material Type 1 Range of Grading

ASTM sieve size	Percentage by mass passing
50.0 mm	100
37.5 mm	70 – 100
25.0 mm	60 – 80
12.5 mm	40 – 65
4.75 mm	22 – 47
2.36 mm	15 – 40
0.30 mm	5 - 20
0.075 mm	0 – 5
The particle size shall be determined by the washing and sieving method of BS 812: Part 103	

804 Granular Material Type 2

1 Type 2 granular material (e.g. for foundation courses) shall be natural sands, gravels, and crushed rock, crushed concrete, or recycled aggregate. The material shall lie within the grading envelope of Table 8/3 and not be gap graded. The other materials content of recycled coarse aggregate and recycled concrete aggregate shall be determined in accordance with Clause 710. Foreign materials including wood, glass, plastic and metal shall not exceed 1%.

2 The material passing the 425 micron BS sieve when tested in compliance with BS 1377: Part 2 shall have a plasticity index of less than 6.

3 The material shall satisfy the minimum CBR requirement in Appendix 7/1 when tested in accordance with BS 1377: Part 4, with surcharge discs. The material shall be tested at the density and moisture content likely to develop in equilibrium pavement conditions, which shall be taken as being the density relating to a uniform air voids content of 5% and the optimum moisture content determined in compliance with BS 5835.

4 The material shall be transported, laid and compacted at a moisture content within the range 1% above to 2% below the optimum moisture content determined in compliance with BS 5835 and without drying out or segregation.

5 The material shall have a ten per cent fines value of 50 kN or more when tested in compliance with BS 812: Part 111. The test sample shall be in a soaked condition at the time of test.

6 The aggregate will be considered suitable if:

(i) aggregate from the source, when tested in accordance with BS 812: Part 121, has a soundness value greater than 65;

or

(ii) evidence can be provided to the Overseeing Organisation of satisfactory use of aggregate from the source.

The water absorption of the coarse aggregate from the source determined in accordance with BS 812: Part 2 shall also be declared.

TABLE 8/3: Granular Material Type 2 Range of Grading

ASTM sieve size	Percentage by mass passing
50.0 mm	100
37.5 mm	70 – 100
25.0 mm	60 – 100
12.5 mm	40 – 80
4.75mm	22 – 62
2.36 mm	15 – 50
0.30 mm	5 – 25
0.075 mm	0 – 10
The particle size shall be determined by the washing and sieving method of BS 812: Part 103	

805 Not used

806 Granular Material Type 4

1 Type 4 granular sub-base material (e.g. for foundation courses) shall be derived from asphalt **arising**s. The asphalt **arising**s shall be either asphalt road planings or granulated asphalt, but excluding materials containing tar or tar-bitumen binders.

Asphalt planings are defined as materials derived from the asphalt layers of the pavement using a mobile machine fitted with milling cutters.

Granulated asphalt is defined as asphalt bound material recycled from roads under reconstruction or surplus asphalt material destined for bound pavement layers, but unused, which has been granulated. It may be used up to an amount of 30%.

2 Type 4 granular sub-base material shall have an upper limit on recovered bitumen content of 10% when tested in accordance with BS 598: Part 102.

3 Type 4 granular sub-base material shall, at the time of placing, lie within the lump size-grading envelope of Table 8/4 and not be gap graded.

4 The material shall be transported, laid and compacted at a moisture content within the range optimum moisture content to 2% below the optimum moisture content determined in compliance with BS 5835 and without drying out or segregation.

Measurement of moisture content both for control purposes and for OMC determination shall be according to BS 812: Part 109 using a conventional oven on a reduced temperature setting of 45 to 50°C.

TABLE 8/4: Type 4 Granular Sub-base Material Range of Lump-size Grading

ASTM sieve size	Percentage by mass passing
50.0 mm	100
37.5 mm	70 – 100
25.0 mm	60 – 100
12.5 mm	40 – 80
4.75mm	22 – 62
2.36 mm	15 – 50
0.30 mm	5 – 25
0.075 mm	0 – 10
The lump size distribution shall be determined either by the washing and sieving method or by the dry sieving method of BS 812: Part 103:1985 (see Note 1).	
Note 1: The planings should be oven dried (prior to sieving) at a temperature of 45 to 50°C. Sieving shall be carried out at 20 ± 5°C to reduce the tendency of the bitumen to soften and particles to adhere to each other.	

5 When required by Appendix 7/1, the Contractor shall undertake a Trafficking Trial incorporating the Type 4 granular sub-base material proposed for use in the Works. A trial area shall be constructed, trafficked and assessed in accordance with the procedure described in sub-Clauses 6 to 11 of this Clause. The mean vertical deformation after 1000 equivalent standard axles shall be less than 30 mm when measured in accordance with the procedure stated in sub-clause 10 of this clause.

Proposals for sub-base trials shall be submitted to the Overseeing Organisation 5 days in advance of construction.

Trial Procedure

6 The trial area shall be located on a formation prepared in accordance with the Specification. The trial area may be located so that it can be incorporated within the Permanent Works if the resistance to wheel track rutting is demonstrated to comply with sub-Clause 5 of this Clause.

7 The trial area shall be at least 60 m long, and of sufficient width that when trafficked, the wheel

paths of the test vehicle shall be at least 1 m from either edge of the top of the sub-base layer. The sub-base shall be compacted to the thickness specified in Appendix 7/1. The formation shall extend for a further 1 m either side of the sub-base layer.

8 A sufficient run off/run on area shall be constructed at each end of the trial area, the same width, and compacted to the same level, as the trial area, to ensure correct tracking by the test vehicle and minimise dynamic effects of the vehicle bouncing on its springs. Suitable guidance shall be given to assist the driver in maintaining the same track on each pass and to achieve channelled trafficking. Examples of suitable guides would be a string or painted line.

Materials

9 The sub-base used in the trial shall be transported, laid and compacted using the equipment proposed for use in the Works.

10 Maximum vertical deformation shall be measured in both wheel tracks using optical or laser levels at predetermined monitoring points on five transverse lines spaced equally along the length of the trial bay. The transverse lines at the ends of the trial area shall be at least 5 m from the run off/run on areas. The average vertical deformation of the two wheel tracks after 1000 standard axles shall be recorded.

Reporting

11 The Contractor shall provide the Overseeing Organisation with a report on the Trafficking Trial. For Type 4 sub-base to be approved for use in the Works the report shall set out the results of the trial, stating how they validate the use of the material.

ROAD PAVEMENTS – BITUMINOUS BOUND MATERIALS

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ROAD PAVEMENTS – BITUMINOUS BOUND MATERIALS

901 Bituminous Courses

General

1 Bituminous pavement courses shall be made using the materials described in Appendix 7/1.

Aggregates for Bituminous Materials

2 Natural, recovered unbound and artificial aggregates shall be clean, hard and durable. Aggregates must not contain organic and swelling material of damaging quantity. They have to be of angular shape and have to be resistant to wear, to weathering and to heat. The type of rock decay 'Sonnenbrand' must not be present in basalt.

Where recycled coarse aggregate or recycled concrete aggregate is used in this Series it shall have been tested in accordance with Clause 710 and the content of all foreign materials (including wood, plastic and metal) shall not exceed 1% by mass.

Hardness

Unless otherwise stated in Appendix 7/1, coarse aggregates for bituminous materials shall have the following properties:

- (i) A Los Angeles coefficient not greater than 35 per cent for crushed aggregate when tested in a dry condition in accordance with ASTM C131. A Los Angeles coefficient not greater than 20 per cent when tested in accordance with MSA-EN 1097-2 for crushed aggregate of wearing courses.
- (ii) Recovered unbound aggregates shall be natural and artificial aggregates recovered from a previous use in an unbound form and which meet the requirements of this Clause.

Durability

When required in Appendix 1/5, the aggregate source shall be tested in accordance with BS812: Part 121 and shall have a soundness value greater than 75, or such lower value as may be required in Appendix 7/1.

For routine testing, the water absorption value of the coarse aggregate shall be determined as in BS 812: Part 2. The water absorption value of the coarse aggregate shall be less than 4%.

Cleanliness

Unless otherwise stated in Appendix 7/1, the fraction of material passing 75 micron, for coarse and fine aggregates for bituminous materials, shall not exceed the limits stated in BS 594: Part 1 and BS 4987: Part 1, when tested in accordance with the washing and sieving method of BS 812: Part 103.

Polishing

Polished stone value according to BS 812: Part 3 is required for wearing courses only.

- Construction classes IV to VI :PSV \geq 45
- Construction classes HD and I to III :PSV \geq 53
- Open porous asphalt :PSV \geq 55

Transporting

3 Hot bituminous materials shall be transported continuously according to the progress of construction works in clean insulated vehicles, unless otherwise agreed by the Overseeing Organization, and shall be covered while in transit or a waiting tipping. To facilitate discharge of the mixed materials, dust, coated dust, water or the minimum of liquid soap, vegetable oil, or other non-solvent solutions may be used on the interior of the vehicles. When a fluid coating is used then, prior to loading, the body shall be tipped to its fillets extent with the tailboard open to ensure drainage of any excess. The floor of the vehicle shall be free from adherent bituminous materials or other contaminants.

Laying

4 Wherever practicable, bituminous materials shall be spread, levelled and tamped by a self-propelled paving machine, which may be equipped with an averaging beam. As soon as possible after arrival at site the materials shall be supplied continuously to the paver and laid without delay. The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously and it shall be so operated whenever practicable.

5 The travel rate of the paver, and its method of operation, shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, so that the material is free from dragging, tearing and segregation of the material.

6 Hot bituminous materials shall be laid in accordance with the requirements and recommendations for laying in BS 4987: Part 2 or BS 594: Part 2, as appropriate. Where there is no British Standard for the particular material it shall be laid in accordance with the requirements and recommendations of BS 594: Part 2, subject also to the requirements of sub-Clauses 7 to 29 of this Clause.

The minimum thickness of material laid in each paver pass shall be in accordance with BS 4987: Part 2 or BS 594: Part 2, as appropriate, or the full course thickness, where this is less than the specified minimum in BS 4987: Part 2 or BS 594: Part 2. The ratio layer thickness/maximum grain size of 3 to 4 (maximum 5) may be assumed to be a general rule.

7 When laying bituminous courses the paver shall be taken out of use when approaching an expansion joint of a structure. In laying the remainder of the pavement up to the joint, and the corresponding area beyond it by hand, the joint or joint cavity shall be kept clear of surfacing material.

8 With the exception of sand asphalt carpet, bituminous materials with a temperature greater than 125°C shall not be deposited on a bridge deck waterproofing system unless adequate precautions are taken to avoid heat damage in accordance with a good industrial practice. A maximum temperature of 145°C is permitted for sand asphalt carpet.

9 Hand placing of bituminous materials shall only be permitted in the following circumstances:

- (i) For laying regulating courses of irregular shape and varying thickness.
- (ii) In confined spaces where it is impracticable for a paver to operate.
- (iii) For footways although laying by paver is preferred.
- (iv) At the approaches to expansion joints at bridges, viaducts or other structures.
- (v) For laying mastic asphalt in accordance with BS 1447

10 Hand-raking of wearing course material or the addition of such material by hand spreading to the paved area, for adjustment of level, shall only be permitted in the following circumstances:

- (i) At the edges of the layers of material and at gullies and manholes.
- (ii) At the approaches to expansion joints at bridges, viaducts or other structures.

11 Hand laid work shall conform to the requirements of this Clause.

12 Bituminous materials shall be laid and compacted in layers, which enable the specified thickness, surface level, regularity requirements and compaction to be achieved.

13 Compaction of bituminous materials shall commence as soon as the uncompacted material will bear the effects of the rollers without undue displacement or surface cracking. Compaction shall be substantially completed before the temperature falls below the minimum rolling temperatures stated in BS 594: Part 2 or BS 4987: Part 2. Rolling shall continue until all roller marks have been removed from the surface.

14 Except where otherwise specified, compaction may be carried out preferably using 8-10 tonnes deadweight smooth wheeled rollers having a width of roll not less than 450 mm, or by multi-wheeled pneumatic-tyred rollers of equivalent mass, or by vibratory rollers or a combination of these rollers. All courses shall be surface finished with a smooth-wheeled roller, which may be a deadweight roller or a vibratory roller in non-vibrating mode. Vibratory rollers shall not be used in vibrating mode on bridge decks nor are they to be used at mixture temperatures below 100°C.

15 Vibratory rollers may be used if they are capable of achieving at least the standard of compaction of an 8-tonnes deadweight roller. They shall be equipped or provided with devices, indicating the frequency at which the mechanism is operating and the travel speed, which can be read from the ground. The performance of vibratory rollers proposed for use may be assessed as follows:

- (i) by means of site trials in accordance with BS 598: Part 109; or

- (ii) by the Contractor producing evidence of independent trials.

Where compaction is to be determined in accordance with Clause 927, the requirements to prove the performance of rollers shall not apply. In such cases the Contractor may use any plant to achieve the specified level of compaction and finish at temperatures above the minimum specified rolling temperature.

16 Bituminous materials shall be rolled in a longitudinal direction, with the driven rolls nearest the paver. The roller shall first compact material adjacent to joints and then work from the lower to the upper side of the layer, overlapping on successive passes by at least half the width of the rear roll or, in the case of a pneumatic tyred roller at least the nominal width of one tyre.

17 Rollers shall not be permitted to park or stand on warm compacted materials.

18 Unless otherwise specified in Appendix 7/1, the design, compaction assessment and compliance requirements for bituminous courses shall be in accordance with Clause 927. For the compaction degree determined in accordance with clause 927, a value of $\geq 96\%$ is required for base/wearing courses and of $\geq 97\%$ for all other courses

Chippings

19 In order to increase skid resistance, it may be necessary to apply uncoated or slightly coated chippings or sand to wearing courses mechanically. Addition of chippings by hand operation shall only be permitted in the following circumstances:

- (i) In confined spaces, where it is impracticable for a chipping spreader to operate.
- (ii) As a temporary expedient, when adjustments have to be made to the spreader distribution mechanism.
- (iii) When hand laying of the wearing course is permitted.
- (iv) To correct uneven distribution of chippings.

20 Chippings shall be applied uniformly at time and

rolled into the hot wearing course surface so they are effectively held and provide the necessary skid resistance. Recommended amount are as follows:

- (i) Crushed sand/chippings 1/3mm:
0.5 to 1.0 kg/m²
- (ii) Chippings 2/5mm:
1.0 to 2.0 kg/m²

Loose material has to be removed after application:

Joints

21 Except where otherwise specified in this Series, where joints are made in any courses, the material shall be fully compacted and the joint made flush in one of the following ways;

- (i) By using two or more pavers operating in echelon, where this is practicable, and in sufficient proximity for adjacent widths to be fully compacted by continuous rolling.
- (ii) By cutting back (e.g. with edge roller, blade, joint cutter) the exposed joint for a distance equal to the specified layer thickness to a vertical face, discarding all loosened material and coating the vertical face completely with a suitable hot bitumen (200g/m per 4 cm thickness), before the adjacent width is laid. A polymer modified adhesive bitumen strip with a minimum thickness of 2 mm may also be used. Bitumen emulsion is not suitable.

22 All joints shall be offset at least 300 mm from parallel joints in the layer beneath. Joints in the wearing course shall coincide with either the lane edge or the lane marking, whichever is appropriate. No joints shall be formed between a hardstrip and the edge of the carriageway, nor within a hard strip. Longitudinal joints in materials subject to Percentage Impact Compactor Density (PCD) testing procedures shall not be situated in wheel-track zones.

General

23 If necessary the application of a bituminous tack coat spray, complying with Clause 920, to the surface on which laying is to take place will be required in order to achieve sufficient layer bond.

24 Bituminous material shall be kept clean and uncontaminated. The only traffic permitted to run

on bituminous material to be overlaid shall be that engaged in laying and compacting the next course. Should any bituminous material become contaminated the Contractor shall make it good by cleaning it and, if this proves impracticable, by rectification in compliance with Clause 702.

25 Binder courses or base courses below wearing courses should not remain uncovered by the wearing course for more than three consecutive days after being laid. With prior agreement with the Overseeing Organization this period may be extended by the minimum amount of time necessary to allow for adverse weather conditions or for other reasons.

Regulating Course

26 Regulating course materials shall be made and laid in accordance with the requirements of Clause 907.

Use of Surfaces by Traffic and Construction Plant

27 All temporary running surfaces shall be thoroughly cleaned and a tack or bond coat applied prior to laying the succeeding course. Where trafficking has been of a very short duration, the tack coat may be omitted when so directed by the Overseeing Organization (e.g. sufficient bitumen film on the lower layer surface).

28 Tack coat shall be bitumen emulsion as described in Appendix 7/4 and shall be applied at a uniform rate of spread. The bitumen emulsion shall not be permitted to collect in any hollows and shall be allowed to break before the next layer is placed.

29 Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the subgrade or the pavement courses already constructed. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

902 Reclaimed Bituminous Materials

1 Reclaimed bituminous materials may also be used in the production of bituminous courses. The

maximum amount of reclaimed bituminous material permitted shall be 10% in wearing courses, 30% in binder courses and 50% in base courses. Other materials for recycling in bituminous mixtures shall only be used with the approval of the Overseeing Organization. The mixed material shall comply with the requirements of this Series (e.g. technological properties).

2 When the amount of reclaimed bituminous material comprises 10% by mass or less, requirements to the feed stock are only those of Clause 4 of EN 13108-8 (Reclaimed asphalt).

Reclaimed Feedstock

3 All reclaimed material shall be pre-treated before use such that it is homogeneously mixed and the maximum particle size does not exceed 37.5mm

Properties of Recovered Binder

4 The binder shall be recovered from the reclaimed asphalt in accordance with the requirements of BS 2000: Part 397 and tested in accordance with BS 2000: Part 49. The penetration value and the softening point of the binder recovered shall comply with the requirements of EN13108.

Suitability has to be demonstrated if these requirements are not met (e.g. compactability, void content).

Softening point of the Bitumen recovered from the resulting mixture: $\leq 70^{\circ}\text{C}$.

Compliance and Frequency of Testing

5 Compliance shall be monitored either:

- (i) by sampling and testing from the permanent works at a frequency approved by the Overseeing Organization or
- (ii) by periodic trials at a frequency approved by the Overseeing Organization.

Trial areas in which the mixed material complies with the requirements of this Series may form part of the permanent works.

903 Asphalt Concrete for Base Courses

1 Unless otherwise specified in Appendix 7/1, base course mixtures shall comply with sub-Clauses 2 and 3 of this Clause. Tolerances from Mix-Design are those of ASTM D 3515.

Aggregate

2 Grading of total aggregate complies with table 1, dense mixtures and nominal maximum size of aggregate 25mm of ASTM D 3515. The content of aggregate 19mm to 25mm is at least 10%.

Binder

3 The binder shall be petroleum bitumen complying with EN 12591. The penetration of the bitumen shall be 50/70 penetration as described in Appendix 7/1. The maximum temperature of the bitumen at any stage shall be 180°C when penetration bitumen is used.

The bitumen content by weight of total mixture shall be within the limits of 4.8% to 6.3%. It is recommended that the percentage voids filled with bitumen (VFB) is within the range of 65% to 78%.

Technological Properties

4 The technological properties of the Marshall specimen compacted at a temperature of $150 \pm 5^\circ\text{C}$ by 50 blows from each side are as follows:

- Stability: $\geq 6.7 \text{ KN}$
- Flow: 2mm to 4mm
- Void content: 4 % to 7 %

904 Asphalt Concrete for Binder Courses

1 Unless otherwise specified in Appendix 7/1, binder course mixtures comply with sub-Clauses 2 and 3 of this clause. Tolerances from Mix-Design are those of ASTM D3515.

Aggregate

2 Grading of total aggregate complies with table 1, dense mixtures and nominal maximum size of aggregate 19mm of ASTM D3515. The content of aggregate greater 12.5 mm is at least 20%.

Binder

2. Binder shall comply with EN 12591 and have the penetration grade 50/70. Maximum temperature of Bitumen: Clause 903 sub-Clause 3.

The bitumen content by weight of total mixture shall be within the limits of 5.0% to 6.9%. It is recommended that the percentage voids filled with bitumen (VFB) is within the range of 65% to 78%.

Technological Properties

3 The technological properties of the Marshall Specimen compacted at a temperature of $150 \pm 5^\circ\text{C}$ by 50 blows from each side are according to Clause 903, Sub-Clause 4 except void content; 4% to 6%.

905 Asphalt Concrete for combined Base-Wearing Courses

1. Unless otherwise specified in Appendix 7/1, combined base-wearing course mixtures comply with sub-clauses 2 and 3 of this clause. Tolerances from Mix-Design are those of ASTM D3515

Aggregate

2 Grading of total aggregate complies with table 9/1.

Table 9/1: Aggregate Grading

Sieve Size (mm)	Percentage Passing (%)
25.00	100
19.00	95-100
12.50	82-92
9.50	73-86
4.75	49-67
2.36	33-53
0.60	14-36
0.30	11-28
0.075	6-11

Binder

3. Binder shall comply with EN12591 and have the penetration grade 50/70. Maximum temperature of bitumen: Clause 903, sub Clause 3.

The bitumen content by weight of total mixture shall be within the limits of 7.1% to 7.8%. It is recommended that the percentage voids filled with bitumen (VFB) is within the range of 82% to 90%.

Technological Properties

4 The technological properties of Marshall-Specimen compacted at a temperature of $135 \pm 5^\circ\text{C}$ by 50 blows from each side are as follows:

- Stability: $\geq 8\text{KN}$
- Flow: 2mm to 5mm
- Void content: 1% to 3%

Void content of laid materials after compaction shall be below 7%

906 Asphalt Concrete for Wearing Courses

1 Unless otherwise specified in Appendix 7/1, wearing course mixtures shall comply with sub-clauses 2 and 3 of this clause. Tolerances from Mix-Design are those of ASTM D3515.

Aggregate

2. Grading of total aggregate complies to table 1, dense mixture and nominal maximum size of aggregate 12.5mm of ASTM D3515.

Binder

3. The binder shall be petroleum bitumen complying with EN12591. The penetration of the Bitumen shall be the grade as specified in Appendix 7/1. The maximum temperature of bitumen at any stage shall be 180°C when 50/70 penetration bitumen is used.

The bitumen content by weight of total mixture shall be within the limits of 5.8% to 7.2%. It is recommended that the percentage voids filled with bitumen (VFB) is within the range of 65% to 78%.

Technological Properties

4 The technological properties of the Marshall specimen compacted at a temperature of $150 \pm 5^\circ\text{C}$ by 50 blows from each side are according to Clauses 903, sub-Clause 4 except void content: 3% to 5%.

907 Regulating Courses

1 Regulating courses shall be in accordance with sub-Clauses 2 and 3 of this Clause and the

requirements of Appendix 7/1. Bituminous materials for regulating courses shall meet the requirements for the appropriate material as specified in Clause 903 to Clause 906. The regulating course shall have at least the same technological properties of the asphalt layer which is being adjusted by the regulating layer.

2 Regulating courses, which may consist of one or more layers of a bituminous material, shall have their finished surfaces laid to achieve the appropriate tolerances for horizontal alignments, surface levels and surface regularity, for pavement layers, in accordance with Clause 702.

3. Minimum and maximum layer thicknesses acc. to Clause 901, sub-Clause 6 have to be respected. Minimum layer thickness for regulating courses has to be at least $2.5 \times$ maximum grain size (e.g. for binder course 0/19mm at least 4.8cm). If the minimum thickness cannot be achieved, scarifying will be necessary. Binder course material 0/12.5mm allows minimum thickness of 3.0cm.

Table 9/2: Aggregate grading for regulating courses 0/12.5mm

Sieve Size (mm)	Percentage Passing (%)
16.00	100
12.50	90-100
9.50	65-85
4.75	45-65
2.36	30-50
0.60	15-40
0.30	9-30
0.075	3-9

4 Compaction degree of $\geq 96\%$ may be accepted for regulating courses.

908 Not used

909 Not Used

910 Not Used

911 Mix Design for Asphalt Concrete

1 Asphalt concrete shall be designed in accordance with the Marshall method of Mix Design according to the Asphalt Institute Manual Series No.2 (MS-2).

The design mixture selected by the Contractor must be approved by the Roads Directorate prior to its use in any Works.

Constituent Material

2. Mix Design have to be carried out with the constituent materials, which will be used for the mixture production. Constituent materials are aggregates, binder, reclaimed asphalt and additives.

Grading of Total Aggregate

3 Grain size distribution has to be chosen within the limits of Clauses 903 to Clause 906 so that the required technological properties are achieved. It must not be necessarily in the middle of the grading envelope.

Verification

4 Verification of the design proposal shall be carried out using materials obtained from the plant before manufacture of the courses commences. Technological properties shall be determined at the proposed target binder content recommended by the Roads Directorate.

The binder content determined on verification shall be not less than the recommended bitumen content under consideration of the tolerance.

Composition

5 When determined in accordance with the procedures, of ASTM D2172, C136, D1559, D2041 and D2726, the composition and technological properties of the plant mixture shall comply with the requirements for the course design mix. The nature and source of the coarse and fine aggregate may be changed only if the mix is redesigned and agreed by the Roads Directorate prior to its use in the works. With the agreement of the Roads Directorate the source of the filler may be varied provided its characteristics remain essentially the same.

913 Not Used

914 Not Used

915 Not Used

916 Not Used

917 Cold-milling (Planing) of Bituminous Bound Flexible Pavement

1 Where milling of bituminous bound flexible pavement is required, the area of carriageway to be milled shall be removed to the specified depth by a milling machine approved by the Engineer. The process shall be carried out so as not to produce excessive quantities of either fumes of smoke. Damping with water sprays will minimise dust. The use of machines which employ direct flame heating, shall not be permitted.

2 The cut edges shall be left neat, vertical and in straight lines. The contractor shall brush and sweep the milled surface by mechanical means, to produce a clean and regular running surface with a groove depth not greater than 10mm, with a uniform texture, to the satisfaction of the Engineer.

3 Carriageways shall be milled to the tolerance of surface levels specified in clause 702 namely, a milling of a wearing course $\leq 6\text{mm}$ and milling of binder and wearing course together $\leq 10\text{mm}$. In awkward spaces (e.g. Kerbs, junctions, manholes) tolerances $\leq 10\text{mm}$ are allowed. If the tolerance in this Clause is exceeded, the full extent of the area which does not comply, shall be rectified by further milling or by regulating with materials in accordance with Clause 907.

4 Existing ironwork shall not be disturbed by the milling action. When necessary, surfacing in the vicinity of ironwork shall be removed by pneumatic tools or other suitable methods.

5 Where milling is carried out on a carriageway open to traffic, temporary ramping to ensure the safe passage of vehicles shall be provided to the approval of the Engineer.

6 If the milled surface profile varies by more than the permissible tolerance when measured transversely or longitudinally by a 4-metre straight edge, adjustments or replacements shall be made to

the cutting teeth on the milling drum before work continues. Any discontinuity between adjacent milling passes exceeding 6 or 10mm, when measured transversely by a 4-metre straight edge, shall be rectified by further milling or regulating before placing bituminous materials.

7 Where milling is required over extensive areas, the contractor shall programme the work to allow removal of full length widths. If this is impracticable, the proposed programme of milling shall be submitted to the Engineer for approval.

8 Immediately after milling, surplus material shall be removed by a machine of suitable and efficient design and the milled surface swept to remove all dust and loose debris.

9 No stockpiling shall be allowed on Site unless permitted by the Engineer.

10 Carriageways, which are closed to traffic, shall be resurfaced after milling prior to reopening the carriageway to traffic unless otherwise agreed by the Engineer.

11 48 hours prior to cold-milling the contractor shall carry out a sweep of the area(s) by electronic detection equipment to locate any buried metalwork within the layer to be cold-milled.

918 Slurry Sealing

1 Slurry sealing shall comply with BS434: Part 1 and Part 2, and with Sub-Clauses 2 to 17 of this Clause. It is preferred that slurry seals be delivered as finished product to the site.

Aggregate

2 Occurring sand free from silt, clay or other fine material. The aggregate, whether a mixture or not, shall have a smooth grading within the limits of Table 9/3

Table 9/3: Aggregate Grading

BS Sieve Size	Percentage by mass of total aggregate and additive passing	
	3mm Finished thickness	1.5mm Finished thickness
5mm	100	100
3.35mm	80-100	100

2.36mm	75-100	95-100
1.18mm	55-90	70-95
600µm	35-70	55-75
300µm	20-45	30-50
150µm	10-25	10-30
75µm	5-15	5-15

Additive

3 The additive shall be Portland cement complying with MSA EN 197-1, or hydrated lime complying with BS 890. At least 75% shall pass the 75µm BS sieve.

Bitumen Emulsion

4 The slurry seal bitumen emulsion shall comply with BS434: Part 1 and shall be either:

- (i) Class A4 Rapid Setting or Class K3 capable of producing a slurry which on laying develops early resistance to traffic and rain and is sufficiently stable to permit mixing with the specified aggregate, without breaking during the mixing and laying processes, or
- (ii) Class A4 Slow Setting

Tack Coat

5 Where required, or described in Appendix 7/3, tack coat shall be cationic bitumen emulsion complying with BS 434: Part 1.

Composition of Mixed Material

6 The mixed material shall comprise aggregate, bitumen emulsion and, where necessary, additive complying with sub-Clause 3 of this Clause. The amount of emulsion used shall be between 180 litres/ tonne and 250 litres/ tonne of dry aggregate; the precise proportions of each constituent being selected after laboratory tests and trials using the same plant intended to be used in the Works. When additive complying with sub-Clause 3 of this Clause is used, the proportion shall not normally exceed 2% by mass of aggregate.

The following requirements are in general to be met:

- Bitumen Content: >14%
- Water content: >20%

- Aggregate and Additive: >55%

Mixings

7 The materials shall be measured into a mechanical mixer and mixed such that the aggregate is completely and uniformly coated with bitumen emulsion and a slurry is produced of consistency that can be satisfactorily laid as described in sub-Clauses 12 to 14 of this Clause. When required, an additive complying with sub-Clause 3 of this Clause, shall be used to control consistency, mix, segregation and setting rate.

Preparation of Site

8 Before applying tack coat, or spreading slurry, any necessary patching of the road surface shall be completed. Immediately before application of bituminous materials, loose material, dust and vegetation shall be cleaned from the existing surface by sweeping, supplemented if necessary by air jet (Water pressure 80 to 150 bar) and removed from the site. All ironwork, road studs and where directed by the Engineer, road markings, shall be masked. At junctions with surfaces not to be treated, clean lines shall be defined by masking, or other suitable means.

Laying

9 If required, a tack coat shall be applied in accordance with BS 434: Part 2 before spreading the slurry seal.

10 The rate of spread of tack coat shall depend on the surface to be treated. For bituminous surfaces the rate shall be 0.15-0.30 l/m² and for concrete surfaces it shall be 0.4-0.6 l/m²

11 Slurry shall be spread evenly by mechanical means such that the aggregate cover (dry mass equivalent) is 4-6 kg/m² for 3mm finished thickness and 2-4 kg/m² for 1.5 mm finished thickness.

12 All voids, cracks and surface irregularities shall be completely filled. Spreading shall not be undertaken when the ground temperature falls below 5°C or when standing water is present on the surface. In warm dry weather the surfacing, immediately ahead of the spreading, shall be slightly damped by mist water spray applied mechanically unless the Engineer agrees otherwise.

13 The slurry may be rolled by a self-propelled or towed multi-wheeled smooth tread rubber-tyred roller, having an individual wheel load between 0.75 and 1.5 tonnes, making at least six passes, unless the Contractor demonstrates to the satisfaction of the Engineer that rolling is unnecessary or that a fewer passes are sufficient for a particular process. Rolling shall commence as soon as the slurry has set sufficiently to ensure rutting or excessive movement will not occur

14 The finished slurry shall have uniform surface texture and colour throughout the work, without variations of texture within the lane width, or from lane to lane, due to segregation of aggregates or colour, due to variations in the emulsion/water content of the mixture. It must be possible to open the carriageway to traffic 30 minutes after laying.

15 The finished surface shall be free from blowholes and surface irregularities which may be due to scraping, scabbing, dragging, droppings, excess overlapping or badly aligned longitudinal or transverse Joints, damage by rain or other defects. Slurry sealing which does not comply with this Clause or is non-uniform in surface texture or colour 24 hours after laying, shall be rectified by removal and replacement with fresh material rolled in compliance with the Specification. If this is impracticable, fresh material superimposed and rolled in compliance with the Specification. Areas so treated shall lie not less than 5 m long and not less than one lane wide. All areas being worked on shall be kept free of traffic until permitted by the Engineer.

Preliminary Slurry Mixture Design and Trial Areas

16 Using the same plant proposed for the works the Contractor may make trial mixes of the slurry, varying the bitumen emulsion/aggregate ratio to produce a slurry or creamy consistency which, whilst the screed box is travelling at the laying speed, will flow ahead of the screeding blade across the whole width of the spread at all times. At least three trial mixes should be made, each sufficient to spread a trial area of 40 square meters, to the specified finished thickness. The preparation of the existing surface for the trials, the tack coat spreading and the rolling methods shall comply in all respects with this Clause. Trial Areas which achieve the required spreading consistency will be examined after 24 hours, for surface texture and

adhesion.

17 Mix design will be carried out according to MS-2 at a compaction temperature of $135 \pm 5^\circ\text{C}$. The mixture will be produced in three steps:

- (i) Mixing of aggregates and additives,
- (ii) Mixing after addition of water,
- (iii) Mixing after addition of emulsion.

The mixture has to be tried for four hours at a temperature of 150°C before producing the Marshall Specimen. Stability and flow are not determined.

18 When a produced mix has been approved variations shall not be made in mixing time, mix proportion or in the type, size, grading or source of any of the constituents without the agreement of the Engineer who may require further tests to be made.

919 Surface Dressing – SD

General

1 Surface dressing consists of a bitumen containing binder applied directly to the base or to a base which had chippings previously applied to it and of the spreading of coated or uncoated chippings in one or two layers. The three types of application and the amount of binder and aggregate are to be found in table 9/5.

Use

2 Surface dressings are mainly used for roads of construction classes IV to VI as well as unclassified roads and other traffic areas. They are used primarily to improve the skid resistance and for the substance preservation.

Surface dressings protect the traffic areas

essentially from destruction by water ingress and other climatic influences (e.g. ageing of bitumen). Depending on the aggregate used they may also improve the visibility at night and during wet road surface conditions.

Type and condition of base, traffic loading, speed and also climatic and local conditions have to be considered when they are applied.

Type of surface dressing should be chosen in accordance with table 9/4.

Table 9/4: Type of surface dressing according to the condition of base.

Condition of Base	SD with single chippings spreading	SD with double chippings spreading	SD to previously applied chippings
Bleeding	-	-	+
Polished grains	+	+	+
Mortar loss	+	+	-
Crocodiling	+	+	-

Explanation:

- + Suitable
- Not suitable

Irregularities of the surface cannot be eliminated by surface dressing.

Repeated use of surface dressing may have disadvantages e.g. bitumen increase in the wheel passes or increase of irregularities.

Materials, type of surface dressing

3 Type of surface dressing and the materials to be used have to be indicated in the bill of quantities. Table 9/5 has to be observed.

Table 9/5: Type of application and materials for Surface Dressing

Type of Binder	Layer respectively course	Amount of binder (Kg/m^2)	Amount of chippings (Kg/m^2) for grain range		
			8/11	5/8	2/5
1. Surface dressings with single chippings spreading					
Unstable bitumen emulsion K1-70 , Polymermodified unstable bitumen		1.5 to 2.0	-	11 to 17	-
		1.2 to 1.6	-	-	9 to 14

emulsion					
Polymermodified hot bitumen		1.0 to 1.4	-	9 to 15	-
		0.9 to 1.1	-	-	8 to 12
2. Surface dressing with double chippings spreading					
Unstable bitumen emulsion K1-70,	1.layer	1.6 to 2.2	10 to 13	-	-
	2.layer	-	-	-	3 to 6
Polymermodified unstable bitumen emulsion	1.layer	1.4 to 1.8	-	10 to 12	-
	2.layer	-	-	-	3 to 6
Polymermodified hot bitumen	1.layer	1.2 to 1.3	10 to 13	-	-
	2.layer	-	-	-	2 to 5
	1.layer	1.1 to 1.2	-	9 to 12	-
	2.layer	-	-	-	2 to 5
3. Surface dressing to previously applied chippings.					
Polymermodified unstable bitumen emulsion	1.course	-	10 to 13	-	-
	2.course	1.8 to 2.3	-	(10 to 15)*	10 to 13
	1.course	-	-	9 to 12	-
	2.course	1.7 to 2.1	-	-	10 to 13
Polymermodified hot bitumen	1.course	-	10 to 13	-	-
	2.course	1.3 to 1.6	-	(10 to 12)*	10 to 13
	1.course	-	-	9 to 12	-
	2.course	1.2 to 1.5	-	-	10 to 13

Explanation:

- Not suitable

*) Alternatively possible

Bitumen emulsions comply with BS 434: Part 1, type K1-70. For polymermodified bitumen the Contractor provides a Binder Data Sheet giving details of the properties of the binder proposed

is to be found in table 9/6.

Chippings shall have a Los Angeles coefficient of below 20. A PSV-value of at least 53 is recommended if surface dressing is applied to improve the skid resistance. Aggregates which are not coated must not have a fines content of greater 0.3% for the sieve size 0.075 mm. Coated chippings are not to be used with bitumen emulsion as setting would be hindered.

The amount of chippings and binder has to be established for each project, as well as for partial sections of the road. Binder amount as well as grain size and amount of chippings are to be chosen according to the base, traffic loading and climate conditions. The amount of binder has to be chosen such that the chippings are sufficiently embedded (up to the shoulder) but no bitumen exceeds the grain tips. Trial areas might be necessary to establish the final mix composition.

Advice for the consideration of the various influence factors to the necessary bitumen content

Table 9/6: Influence factors for binder determination based on bitumen content.

Amount of Bitumen	Influence factors
Higher	Base with high void content and rough surface (e.g. mortar loss)
	Rigid surface (e.g. concrete)
	Low traffic volume
	Shady and/or moist situation of the road
	Rough grain surface of chippings
Lower	Low void content of base
	Soft surface (e.g. too high Bitumen content)

	Fine-grained and/or closed surface of base
	High traffic loading
	Sunny situation of road

Execution

4. Surface dressing should be carried out in the dry season, i.e. middle of April to middle of September so that a sufficient period is available where the road is under traffic at favourable climate conditions.

Temperature of the binders has to be chosen in such a way that would ensure easy spraying, overheating has to be excluded. Application temperature of K1-70 for example is generally between 30°C and 75°C and must be controllable. The truck binder sprayer shall be capable of uniform application at the designed rate of spread over a variable or fixed width to allow a full lane width to be dressed in a single pass. Only in awkward spaces should hand spraying be allowed.

The chipping spreader shall have controlled metering and be capable of variable or fixed width application to match the binder sprayer. For surface dressing with single and double chippings spreading, the chippings have to be applied immediately after spraying of the binder and to be pressed on by rolling; local chippings decrease or increase has to be eliminated before rolling. For surface dressing to previously applied chippings, the chippings are regularly to be spread onto the cleaned base; afterwards the binder is sprayed and immediately hereafter the second chipping layer is spread and pressed on by rolling.

Surface dressings produced with bitumen emulsion have to be closed to traffic until setting has been fully attained. Traffic speed has to be limited to 40Km/h until the surface dressing is stable and loosened grains have been removed. Surplus chippings have to be removed before opening the road to restricted traffic.

5 Any defects arising from deficiencies in the materials, workmanship and aftercare which are apparent during or at the end of the maintenance period shall be rectified by the Contractor at his own expense.

As Built Manual

6 Not more than 30 days after completion of the work, the Contractor shall provide a record of the progress of the work in the form of an As Built Manual incorporating all relevant information, including all test results; variations to the design and those necessitated by localized site conditions; weather information; unforeseen problems and a list of complaints, if any, from the general public or road users, and any such other information that the Overseeing Organization may reasonably require should also to be included.

920 Tack Coats and other Bituminous Sprays

1 This Clause shall not apply to bond and tack coats for proprietary thin surface course systems

Tack Coats

2 Tack coats shall be bitumen emulsions complying with BS 434: Part 1. Tack coats for hot rolled asphalt and coated macadam shall be in accordance with BS 594: Part 2 and BS 4987: Part 2, respectively.

Modified Bituminous products may also be used, a certificate has to be presented to the Overseeing Organization.

Bituminous Sprays

3 Bituminous sprays used to facilitate sealing and curing shall consist of either bitumen emulsion to BS 434: Part 1; cutback bitumen or bitumen to BS 3690; or modified bituminous products with a Certificate.

Manufacture and Product Data

4 Bond coats, tack coats and bituminous sprays shall be manufactured in plants operating under a system conforming to the requirements of BS EN ISO 9002: 1994. The Contractor shall complete the binder data sheet specified in Appendix 7/4 and supply a copy to the Overseeing Organization prior to the application of the product.

Preparation

5 Any limitations on area availability and timing or other constraints relating to the execution of works shall be as specified in Appendix 1/13. Before spraying is commenced, the surface shall be free of all loose material and standing water. Surface

preparation shall be carried out in accordance with BS 594: Part 2, or BS 4987: Part 2 as appropriate, and shall comply with any requirements specified in Appendix 7/4. When specified in Appendix 7/4, street furniture, ironwork and drop-kerbs shall be masked using self-adhesive masking material before application starts and removed prior to the completion of the works.

Application

6 Application shall be by metered mechanical spraying equipment, spray tanker or spraying device integral with the paving machine. The spraying equipment used shall not cause permanent deformation to the surface. Tack coats shall be sprayed onto an existing surface prior to overlay in accordance with Clause 901. For small or inaccessible areas, application may be by hand held sprayer with the agreement of the Overseeing Organization.

Rate of Spread

7 Unmodified bituminous emulsions shall be sprayed at the rate of spread specified in BS 434: Part 2 or as otherwise specified in Appendix 7/4. The rate of spread of bitumen and cutback bitumen shall be as specified in Appendix 7/4.

Accuracy of Application

8 Spray application shall be uniform. Before spraying begins, the Contractor shall provide the Overseeing Organization with a test certificate showing the results for rate of spread and accuracy of spread. The certificate shall demonstrate that the spraying device has been tested, using the product to be used in the Contract, not more than six weeks before commencement of the work. These tests shall be carried out in accordance with prEN 12272-1 either by a laboratory, or by the Contractor. Not more than six weeks prior commencement of work, the certificate showing that the spraying device has been tested, using the product to be used in the Contract, must be presented. The tolerance on the specified rate of spread shall not exceed $\pm 20\%$ and the coefficient of variation of the transverse distribution shall not exceed 15%. During the works the Contractor shall repeat the tests for rate of spread and accuracy of application. The results shall be reported verbally to the Overseeing Organization within 24 hours of carrying out a test and in writing within 7 days.

Where application is by hand held sprayer, the rate of spread shall be measured by calculating the volume applied per square meter and evenness shall be visually assessed.

Overlaying Concrete Surfaces

9 The Contractor shall submit evidence of the suitability of tack coat he intends to use when overlaying concrete surfaces to the Overseeing Organization prior to the commencement of the work.

Blinding Material

10 When specified in Appendix 7/4, blinding material shall consist of hard clean crushed rock or sand containing not more than 15% retained on a 6.3 mm sieve. It shall be spread over the sprayed area and left unrolled. The rate of application shall ensure that the coverage is essentially complete. When blinding material is used on cementitious materials it shall be light in colour to minimize solar gain. All loose material on a sprayed surface including non-adhered blinding material shall be removed prior to the application of an overlay.

Bond Testing

11 Application rate and quality of tack coats have to be chosen in such a way that upon core testing on 15cm diameter cores, by the shear apparatus according to Leutner, the following results are achieved:

- (a) Wearing coarse to binder course or base course:
minimum load $\geq 14\text{KN}$,
shear way : 2-5mm;
- (b) Binder course to base course:
minimum load: $\geq 10\text{KN}$,
shear way: 1-4.5mm.

921 Surface Texture of Asphalt Concrete Wearing Courses

1 The surface of the finished wearing course must have sufficient roughness. The Skid Resistance of the road surface for the construction classes HD and I to VI measured by the measuring proceedings SCRIM must not fall by more than 0.03 below the following limit values for the single value of a 100m section:

- Acceptance of construction works

- at 80 km/h $\mu\text{SCRIM} = 0.46$
- at 60 km/h $\mu\text{SCRIM} = 0.53$
- at 40 km/h $\mu\text{SCRIM} = 0.60$

- Up to the end of a service time of four years

- at 80 km/h $\mu\text{SCRIM} = 0.43$
- at 60 km/h $\mu\text{SCRIM} = 0.50$
- at 40 km/h $\mu\text{SCRIM} = 0.56$

2 Correlations between SCRIM and the Skid Resistance Value measured by the Skid Resistance Tester according to RRL Road Note No 27,1969 (See also MSA-EN 1436) may be found in the specification 'Arbeitsanweisung für kombinierte Griffigkeits-und Rauheitsmessungen mit dem Pendelgerät und dem Ausflussmesser' of the Road and Transportation Research Association (FGSV). According to this specification the relations for a speed of 40km/h are as follows:

- $\mu\text{SCRIM} = 0.60$: SRT-Value = 64
- $\mu\text{SCRIM} = 0.56$: SRT-Value = 60

These relations are taken from the lower confidence limit of Fig.10 of the specification mentioned above.

3. The requirement to Skid Resistance is not applied for residential areas, or parking areas or pedestrian areas.

922 Not Used

923 Not Used

924 High Friction Surfaces

1 High friction surfacing systems shall have current International or British Board of Agreement HAPAS Roads and Bridges Certificates. If the supplier of the system is not from Great Britain a certificate of a comparable Board or a governmental approved Testing Institute is required.

2 A high friction surfacing system with a current International or British Board of Agreement HAPAS Roads and Bridges Certificate shall only be installed by a Contractor who is familiar with the

system.

3 The high friction surfacing system required for each location shall be as specified in Appendix 7/1.

Aggregate

4 Aggregate used in high friction surfacing systems shall have the minimum polished stone value, determined in accordance with BS 812: Part 114, as specified in Appendix 7/1.

Installation and Quality Control Procedures

5 The installation and quality control procedures shall be in accordance with the International or British Board of Agreement Roads and Bridges Certificate for each system and the current method statement agreed by the BBA or by a comparable board. The results of all quality control checks carried out on site by the Contractor and quality assurance information compiled in accordance with the requirements of the Certificate, shall be made available to the Overseeing Organization on request.

System Coverage

6 For each location where high friction surfacing is applied, the total quantities of each system component used, the measured area of the surface treated and the calculated coverage rate in kg/m² shall be reported to the Overseeing Organization within three days of completion at that location. For systems in which aggregate is broadcast over a film of binder applied to the surface, the calculated coverage rate shall be that of the binder film and shall not include the mass of the aggregate.

After care

7 During the specified curing period no disturbance or trafficking of the treated surface will be permitted.

Guarantee

8 The Contractor shall guarantee the high friction surfacing materials and workmanship for a period of two years from the date of opening the surfacing to traffic. This guarantee shall exclude defects arising from damage caused by settlement, subsidence or failure of the carriageway on which the surfacing has been applied, but shall cover failure to meet the minimum requirements set out in

Table 4 of the BBA/HAPAS 'Guidelines Document for the Assessment and Certification of High Friction Surfaces for Highways', or a comparable international document.

925 Testing of Bituminous Mixtures and Their Component Materials

1 The sampling, testing and analysis of bituminous mixtures shall comply with BS 598: Parts 100 to 103 except where specified otherwise in this Series.

2 Production control is carried out by the contractor to ensure that the completed construction works are according to the requirements of the contract. The frequency shown in table 9/7 is only a minimum requirement. The test results have to be presented to the Overseeing Organization on request. Deviations from the contractual requirements have to be reported to the Overseeing Organization and any shortcomings are to be rectified without delay.

Table 9/7: Type and Frequency of testing

Construction Materials Type of Test	Specification	Asphalt Concrete	Gussasphalt	Cold Asphalt	Slurry Sealing	Surface Dressing
1. Aggregate¹⁾		-	-	-	-	x
2. Mixture^{2) 5)}						
2.1 Grain size distribution	ASTM C136	x	x	x	x	-
2.2 Bitumen content	ASTM D2172	x	x	x	x	-
2.3 Softening point of recovered bitumen	EN 1427	x	x	x	-	-
2.4 Density and void content of specimen	ASTM D2041, ASTM D2726	x	x ³⁾	x	-	-
2.5 Stability and flow (Marshall)	ASTM D1559	x	-	x	-	-
2.6 Penetration depth after 30min and 60min	DIN-1996 Part 3	-	x	-	-	-
3. Layer properties						
3.1 Compaction degree ²⁾	ASTM D1559, ASTM D2726	x	-	x	-	-
3.2 Layer bond ²⁾	ALPA StB: Part 4	x	-	-	-	-
3.3 Levels (transversal slope)	String method	x	x	x	-	-
3.4 Regularity	4m straight edge	x	x	x	-	-

3.5 Thickness respectively mass/m ²		x	x	x	x	x
3.6 Void content ⁴⁾		x	-	-	-	-

- 1) See also Clause 925,- Sub Clause 7
- 2) Each layer and per each started 3000m² or per day one sample; number of samples may be increased according to necessity (e.g. urban roads, bridge courses)
- 3) Only density for cubes
- 4) Only for wearing course and base/wearing course
- 5) Eventually also additives

3 Control testing is to be carried out by the Overseeing Organization. Type and frequency of testing is described in table 9/7. The results are the base for the acceptance of the construction works. Sampling, and testing at site is carried out by the Overseeing Organization in the presence of the contractor. They may also be carried out in the absence of the contractor if he has been informed in good time and is absent.

4 The contractor may require additional control testing if there is contended that the result of sub-Clause 3 is not characteristic for the area in question. Sampling places and their assigned partial areas are determined in presence of the contractor. The partial area assigned to the initial test result shall not be less than 20% of the initial area.

The Overseeing Organization may carry out additional control testing at it's own discretion. The results of the initial and the additional control tests assigned to the partial areas are decisive for the acceptance of the construction works. Costs of additional tests required by the contractor are to be met by the contractor.

5 Arbitrary testing may be carried out if there are doubts of the Overseeing Organization or the contractor that the control testing has not been carried out correctly. It will be carried out by a laboratory which has not carried out the control testing and will be chosen by the Overseeing Organization and the contractor. Both parties may be present when the tests are carried out.

The result of the arbitrary test replaces the initial test result. Testing costs are to be covered by the party to which the result is not in favour.

6 Interpretation of the test results is based on the tolerances of ASTM D3515 and the reproducibility and repeatability of the specification in question (e.g. ASTM D2726, paragraph 12).

For the void content of the Marshall specimen the following tolerances are applied to the minimum and maximum values according to the specification (clause 903 to clause 906):

- Wearing course: 1.5%
- Binder course, base course, and base wearing course: 2.0%

7 Within the framework of control testing also samples of aggregate and bitumen are to be taken if there are doubts that the requirements are met.

8 The softening point ring and ball of the recovered bitumen must no exceed the upper limit of the bitumen used by more than 8°C, i.e. for grade 50/70 bitumen the softening point ring and ball must not exceed 62°C.

Price Reduction Formulas

9 The Overseeing Organization may carry out price reductions in 20% of all cases per contractor per year for the thickness, the bitumen content, the compaction degree and the regularity according to established formulas. If there are several defects in one project, the reductions are added.

10 Thickness - If the required thickness is not achieved the unit price (Lm/m²) will be corrected accordingly. An additional price reduction will be calculated according to the following formula:

$$\begin{aligned}
 A &= p/100 \times 3.75 \times UP \times \text{Area} \\
 &= A' \times UP \times \text{Area} \\
 A &= \text{price reduction} \\
 P &= \text{percentage exceeding the tolerance} \\
 UP &= \text{corrected unit price} \\
 \text{Area} &= \text{area concerned}
 \end{aligned}$$

Higher thickness of an upper layer is used to

compensate the thickness of the layer below.

11 Bitumen content - If the bitumen content does not fall into the tolerance of $\pm 0.5\%$ compared with the mix design a price reduction is carried out according to the formulas (1) to (3):

- (1) Out of the tolerance for a single value or for the mean value of 2 to 4 samples and $p \leq 0.3\%$

$$\begin{aligned} A &= P/100 \times 30 \times UP \times \text{Area} \\ &= A' \times UP \times \text{Area} \end{aligned}$$

- (2) Out of the tolerance for a single value or for the mean value of 2 to 4 samples and $p > 0.3\%$:

$$\begin{aligned} A &= 1/100 \times (p \times 130 - 30) \times UP \times \text{Area} \\ &= A' \times UP \times \text{Area} \end{aligned}$$

- (3) Out of the tolerance for the mean value of 5 and more samples:

$$\begin{aligned} A &= P/100 \times 100 \times UP \times \text{Area} \\ &= A' \times UP \times \text{Area} \end{aligned}$$

12 Compaction degree - If the compaction degree falls below the required value a price reduction is carried out according to the following formula:

$$\begin{aligned} A &= p^2/100 \times 3 \times UP \times \text{Area} \\ &= A' \times UP \times \text{Area} \end{aligned}$$

13 Regularity of the wearing course - If the regularity exceeds the required value, a price reduction is carried out according to the following formula:

$$A = 0.6 \times UP \times B \times \sum p_i^2$$

B: road width at measuring point

P_i: regularity above required value

926 Not Used

927 The Percentage Impact Compactor Density Test (PCD-Test)

The compaction degree K of asphalt concrete is the quotient of the sample density of the compacted material δ_A and the density δ'_A of the specimen prepared according to ASTM D1559:

$$K = \delta_A / \delta'_A \times 100 (\%).$$

928 Not Used

929 Not Used

930 Not Used

931 Not Used

932 Not Used

933 Not Used

934 Not Used

935 Not Used

936 Not Used

937 Not Used

938 Not Used

939 Not Used

940 Gussasphalt

General

1 Gussasphalt is a dense mixture consisting of chippings, sand, filler and bitumen whose aggregate mixture has a low void content. The bitumen content is designed in that way that the voids of the aggregate mixture are completely filled with bitumen or that there is a small bitumen surplus so that durable and safe wearing courses can be produced. Gussasphalt is in hot condition pourable and easy to spread and doesn't need compaction after laying. The surface has to be roughened immediately after laying.

Application

2 Gussasphalt can be used on wearing course for all kind of traffic areas. Gussasphalt of 0/4.75mm will only be used be exception for carriageways. It is suitable for bicycle lanes and footpaths.

Construction materials

3 The requirements of table 9/8 are applied.

In special cases Trinidad Epure or polymer modified bitumen may be used. Natural asphalt improves the workability. Polymermodified bitumen is sensitive to overheating and may need special laying equipment.

Table 9/8 Gussasphalt

Gussasphalt	0/12.5	0/9.5	0/4.75
1. Aggregate sieve			
Sieve Size (mm)			
12.50	90-100	100	
9.50	75-90	90-100	100
4.75	60-70	70-85	90-100
2.36	45-55	50-60	55-65
1.18	35-50	40-55	45-60
0.60	30-48	35-50	38-55
0.30	25-40	30-45	30-50
0.075	20-30	22-32	24-34
2. Bitumen	30/45 (50/70)¹⁾		
Type of bitumen			
Bitumen content (%)	6.5 to 8.0	6.8 to 8.0	7.0 to 8.5
Softening point after extraction (°C)	≤ 71 ²⁾	≤ 71	≤ 71
3. Mixture			
Penetration 5cm ² at 40°C for cubes (70mm x 70mm)			
- after 30 min (mm)	1.0 to 3.5	1.0 to 5.0	1.0 to 5.0 ³⁾
- increase after a further 30 min (mm)	≤ 0.4	≤ 0.6	≤ 0.6
4. Layer			
Thickness (including spreaded material) (cm)	3.5 to 4.0	2.5 to 3.5	2.0 to 3.0
or			
Material by weight (including spreaded material) (kg/m ²)	80 to 100	65 to 85	45 to 75
5. Spreaded Material	Chippings 2.36/4.75 mm : 5 to 8 kg/m ² Chippings 2.36mm and/or 4.75/9.5mm: 15 to 18 kg/m ² Sand: 2 to 3 kg/m ²		

1) Only in special cases

2) For Bitumen grade 20/30: ≤ 75°C

3) Bicycle lanes and footpaths: ≤ 10mm

Execution

4 Laying speed has to be regular during laying, i.e. the gussasphalt finisher should never come to standstill. The temperature of the gussasphalt should be constant for the laying cross section. These influence factors determine the regularity of the surface because of the spreading of chippings.

Special measures are necessary if the diagonal cross slope is greater than 7%, for example: reduced laying temperature, stiffer mixture or reduced amount of material before the screed.

Connections have to be constructed on joints and to be filled with sealing compound. Edge are to be vertical.

Shaping of surface

5 Surface has to be roughened in carriageways by chippings. In other areas sand may be used. Surplus material has to be taken up. It may be necessary to loosen by steel-wheel rollers material, which doesn't completely adhere.

Roughening is carried out by slightly coated chippings 2.36/4.75mm in an amount of 5 to 8 kg/m² mechanically applied to the hot surface and pressed to the gussasphalt by rolling. Application by hand can be carried out in small areas. Rolling can be carried out by smooth or profiled rollers.

Roughening can also be carried out with slightly coated chippings 2.36/4.75 or/and 4.75/9.5mm in an amount of 15 to 18Kg/m² mechanically. Chippings have to be pressed into the hot surface by rubber-tired rollers or steel-wheel rollers.

Heated or slightly coated sand is spread and rubbed into the hot surface.

941 Not Used

942 Not Used

943 Not Used

944 Not Used

945 Not Used

946 Not Used

947 Not Used

948 Not Used

949 Repairs to Potholes – Cold asphalt

1 Temporary repairs to small areas of surface courses including holes for road stud sockets shall be carried out in accordance with Appendix 7/22

Cold Asphalt

2 Cold Asphalt for repair works is designed according the Manual Series No. 14 (MS-14) of the Asphalt Institute. Requirements are as follows:

- Grading:
dense mixture 0/12.5 mm according to MS-14 Appendix C.06, Gradation 2 for mineral aggregate.
- Binder:
medium setting anionic emulsion HFMS-2 according to ASTM D977
- Void content of Marshall specimen: 8% to 12%
- As an indication:
bitumen content after curing may be between 6% to 8% with a tendency to the lower limit.

950 Depressions

1 Temporary filling to depressions shall be carried out using a proprietary material specifically formulated to treat such depressions. The depression shall be cleaned out and the surface thoroughly dried. The area to be filled shall be masked to provide straight edges and the filling material laid in accordance with the manufacturer's instructions.

2 The minimum skid resistance value of the proprietary material when laid shall be 60 measured by the Skid Resistance Pendulum Method and the surface shall have a texture at least equal to that of the existing adjacent surfacing.

3 The contractor shall obtain the Overseeing Organization's approval to the use of any proprietary material for filling depressions.

4 Permanent filling to depressions shall be carried out using material complying with Series 900.

951 Patching

1 Patching is defined as replacement of wearing course, binder course and base course where the materials are laid in small areas.

2 The existing defective surfacing and/or temporary filling of trenches and depressions shall be broken out so as to provide a cavity with straight vertical edges.

3 Joint edges shall be formed as specified in sub-Clause 901.21

4 All loose material shall be removed off Site.

5 Replacement material shall be specified in Appendix 7/1

6 A tack or bond coat shall be applied in accordance with Clause 920.

7 All construction layers shall be laid and compacted such that on completion each layer shall be at the same level as the adjacent course.

ROAD PAVEMENTS - CONCRETE AND CEMENT BOUND MATERIALS

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ROAD PAVEMENTS - CONCRETE AND CEMENT BOUND MATERIALS

1001 Grades of Concrete and Constituent Materials for Pavement Layers

1 Concrete in rigid or composite pavements shall be one of the grades given in Table 10/1, in accordance with the pavement design alternatives permitted in Appendix 7/1.

2 All concrete for use in pavements shall be designed mixes or equivalent standard mixes in accordance with the relevant clauses of BS 5328 : Parts 1, 2, 3 and 4, except where otherwise specified in this Series. Prescribed mixes may be selected for rapid construction if permitted in Appendix 7/1 or agreed with the Overseeing Organisation.

Cement

3 The general term ‘cement’ in this Series means any of the materials in (i) or the combinations in (ii) below:

- (i) Cements Complying with:
- (a) Portland cement CEM I MSA EN 197-1
 - (b) Portland slag cement CEM II/B-S and Portland blastfurnace cement (PBC) MSA EN 197-1
 - (c) Blastfurnace cement CEM III/A MSA EN 197-1
 - (d) Portland pulverised-fuel ash cements CEM II/B-V MSA EN 197-1
 - (e) Pozzolanic cement CEM IV/A MSA EN 197-1

(ii) Combinations

- (a) Portland cement CEM I MSA EN 197-1 with ground granulated blastfurnace slag (ggbs) (BS 6699) for use with Portland cement CEM I
- (b) Portland cement CEM I MSA EN 197-1 with pulverised-fuel ash (pfa) (BS 3892 Part 1) for use as a cementitious component in structural concrete Alternatively, in concrete Grades C20 and below and in Cement-bound materials specified in Clause 1035, the pfa may be in accordance with BS 3892 : Part 2
- (c) Portland cement CEM I with pozzolanic additive having a current BBA Certificate MSA EN 197-1

Generally a portland cement CEM I type 32.5R is used for the manufacturing of concrete pavement

(iii) Cement Contents

In each cubic metre of fully compacted concrete, the cement content shall be in accordance with the following:

Grade	C40	C40 In at least the top 50mm of surface slabs	C30	C20	C15	10	C7.5
Cement							
Min. Portland Cement CEM 1 BS EN 197-1 (Kg/m³)	320	320	280	(a) or 180	(a) or 160	(b) or 130	(b) or 120
Min. Other cements or combinations pennitted in Sub-clauses 3(i) and 3 (ii) (kg/m³)	340	340	340	(a) or 180	(a) or 160	(b) or 130	(b) or 120
For mixtures pre-blended or mixed on site							
Maximum proportion of ggbs (%)	50	35	65	65	65	65	65
Maximum proportion of pfa (%)F	35/15	25/15	35/15	35/15	50/-	50/-	50/-
Min. CEM 1 content (Kg/m³)	220	255	200	160	-	-	-

Note

(a) denotes maximum aggregate/cement ratio of 14:1 by mass.

(b) denotes maximum aggregate/cement ratio of 18:1 y mass.

TABLE 10/1: Pavement Layers - Grades of Concrete

Pavement Layer	BS 5328: Part 2	Standard Mix	Clauses
	Designed Mix Grade		
(i) Surface slabs: Unreinforced concrete (URC) Jointed reinforced concrete (JRC) Continuously reinforced concrete pavement (CRCP)	C40))
(ii) Continuously reinforced concrete base course (CRCR)	C40) 1034 and) 1044) 1001 to
(iii) CRCP and CRCR ground beam anchorages	C30))
(iv) Wet lean concrete 4) For bases courses or (v) Wet lean concrete 3) sub-bases (vi) Wet lean concrete 2) (vii) Wet lean concrete 1)	C20 C15 C10 ST2 C7.5 ST1	ST4 ST3)))) 1030
(viii) Cement Bound Material Category 2 (CBM2)) For) sub-bases as)) 103) to
(ix) Cement Bound Material Category 4 (CBM4)) required in) Appendix 7/1)) 1042

(iv) When used, the proportion of microsilica to CEM I shall be 10 ± 1%.

(v) In cement bound materials the maximum proportion of:

- (a) ggbs to the total cement shall not exceed 65% by mass;
- (b) pfa to the total cement shall not exceed 50% by mass.

Water

4 Water from a water company supply may be used without testing. Water from other sources may be used if it conforms with BS 3148. The water content shall be the minimum required to provide the specified workability for full compaction of the concrete to the required density, as determined by trial mixes or other means, and the maximum free water/cement ratio shall be 0.45 for Grades C40 and C30 and 0.60 for Grades C20 and C15. The requirements for standard mixes shall be in accordance with BS 5328.

(i) for surface slabs of pavements which are to be overlaid by a 30 mm minimum thickness thin surface course system complying with Clause 942, air entraining shall not be required.

5 Plasticisers or water reducing admixtures shall comply with BS 5075 : Part 1 or Part 3. Admixtures containing calcium chloride shall not be used.

Aggregate

6 Aggregates for all pavement concrete shall be natural material complying with Clause 1701, Sub-Clause 2. Crushed concrete,

which complies with the quality and grading requirements of BS 882 and Table 10/2, may also be used in all pavement concrete mixes but excluding exposed aggregate concrete surface complying with Clause 1044. Aggregates for wet lean concrete or cement bound materials shall be natural material complying with Clause 1701 Sub Clause 2, or recycled coarse aggregate or recycled concrete aggregate complying with the quality and grading requirements of Clause 1701 Sub-Clause and Table 10/2. Once the appropriate gradings have been determined they shall not be varied without the approval of the Overseeing Organisation. Irrespective of source, the aggregate will be considered suitable if:

- (i) aggregate from the source, when tested in accordance with BS 812 : Part 121, has a soundness value greater than 75;

or

- (ii) evidence can be provided to the Overseeing Organisation of satisfactory use of aggregate from the source. The water absorption of the coarse aggregate from the source determined in accordance with BS 812 : Part 2 shall also be declared. Where recycled coarse aggregate or recycled concrete aggregate is used in this Series, it shall have been tested in accordance with Clause 710.

TABLE 10/2: Limits for ‘Other Materials’ and Limiting Concrete Mixes for Recycled Coarse Aggregate and Recycled Concrete Aggregate

Aggregate Type	Recycled Concrete	Recycled Course Aggregate and
----------------	-------------------	-------------------------------

	Aggregate	Recycled Concrete Aggregate
Maximum Permitted concrete grade	C30 or greater	C20 or less
Permitted standard mixes	All	ST1 – ST3
Other Materials	Maximum % by Mass	Maximum % by Mass
Fines content	5	3
Masonry	5	100
Ultra lightweight material (<1000 kg/m ³)	0.4	1
Asphalt	5	10
Foreign materials	1	1

7 The nominal size of coarse aggregate shall not exceed 40 mm. When the spacing between longitudinal reinforcement is less than 90 mm, the nominal size of coarse aggregate shall not exceed 20 mm.

8 Sand (i.e. fine aggregate) containing more than 25% by mass of acid-soluble material as determined in accordance with BS 812 : Part 119, in either the fraction retained on, or the fraction passing the 600 micron BS sieve, shall not be used in the top 50 mm of surface slabs. This requirement will not apply for pavements with an exposed aggregate concrete surface constructed to Clause 1044 or if it can be shown that the sand (ie fine aggregate) retained on, or the fraction passing the 600 micron BS sieve, contains less than 25 per cent by weight of calcium carbonate.

9 The water absorption of flint coarse aggregate containing white flints for use in concrete surface slabs, when determined in accordance with BS 812 : Part 2 shall not exceed:

3.5% for any separate nominal size fraction;

2.0% for the total combination of coarse aggregates in the proportions to be used in the concrete.

Tests shall be carried out on three samples taken at random from the source prior to use.

Tests shall also be carried out during stockpiling or paving, once a week, or at a lesser rate when authorised by the Overseeing Organisation.

Source of Recycled Aggregates

10 Where recycled coarse aggregate or recycled concrete aggregate is used, only crushed concrete resulting from reclamation or processing of concrete previously used in construction which originates from appropriate identified structures with a known history of use shall be used.

11 In order to detect substances and chemicals harmful to the durability of concrete, appropriate tests based on current relevant advice shall be carried out on recycled coarse aggregate and recycled concrete aggregate, and the results reported to the Overseeing Organisation.

Chloride Content

12 The chloride ion content of the aggregate to be used in concrete with embedded metal shall be determined in accordance with BS 812 : Part 117, or in the case of recycled coarse aggregate or recycled concrete aggregate in accordance with BS 1881: Part 124, and shall be as stated in BS 5328 : Part 1.

Control of Alkali-Silica Reaction (ASR)

13 The requirements of sub-Clause 1704.6 shall apply to road pavement concrete specified in this Series.

1002 Not Used

1003 Density

1 The density of concrete Grades C40 and C30 shall be such that without air-entrainment the total air voids are not more than 3%. With air-entrainment, the total air voids shall be not more than 9.5% for 20 mm aggregate or 8.5% for 40 mm aggregate. The density of concrete Grades C20, mix ST4 or below shall be at least 95% of the theoretical maximum dry density.

2 The air voids shall be derived from the difference between the theoretical maximum dry density of the concrete calculated from the relative densities of the constituents of the mix and the average value of three direct density measurements made in accordance with BS 1881 : Part 114 on cores taken in accordance with BS 6089. Cores shall be at least 100 mm diameter and shall be 150 mm diameter for 40 mm size aggregate. Where different concrete mixes are used in separate layers, the density of each layer shall be separately determined by splitting or cutting the cores between the layers.

3 Cores shall be taken at the rate given in Clause 1028 for trial bays and at the rate of at least three per 600 m² length of pavement layer being constructed in any single width during normal working or per day. If the density of 30 consecutive cores meets the requirements of the Specification the rate of sampling may be reduced to at least three per 2000 m length. If the density of any core is below the minimum required, the concrete across the whole width of the slab constructed at the time relating to that core shall be removed. In unreinforced concrete the whole slab length between joints shall be removed. For reinforced slabs additional cores shall be taken at 5 m intervals on each side of any defective core until concrete of satisfactory density is found in order to determine the limit of the defective area of concrete which shall be removed. Defective

areas shall be made good with new material in accordance with the Specification.

4 In calculating the density, allowance shall be made for any steel in the cores.

5 Core holes shall be reinstated with compacted concrete with mix proportions of 1 part of Portland cement CEM I: 2 parts of sand: 2 parts of 10 mm nominal single sized coarse aggregate by mass.

1004 Quality Control of Concrete Strength

1 Sampling and testing for, and compliance with the specified characteristic strength of designed mixes shall be in accordance with BS 5328 : Part 4, except that it shall be at the following rates of sampling and testing and meet the following requirements:

2 Concrete cubes of the appropriate size shall be made, cured and tested in accordance with BS 1881 : Part 108, 111 and 116 respectively from concrete delivered to the paving plant, each set being from a different delivery of concrete. At least 4 cubes (Factory Production Control) and 3 cores (Control Testing) shall be tested per set for each 600 m² of concrete slab or per day for each type of mix. If the strength of 12 consecutive cubes meets the requirements of the Specification the rate of sampling may be reduced to 4 for each 1000 m² of concrete slab and not less than 4 sets of cubes shall be made each day for each type of mix satisfying the reduction. This rate of sampling and testing may be modified at the Engineer discretion.

3 For areas of 600m² or more, one cube shall be tested in compression at 7 days and the other three at 28 days after mixing. Groups of four consecutive results at 28 days

shall be used for assessing the strength for compliance with BS 5328: Part 4. For areas less than 600m², two cubes shall be tested at 7 days and two tested at 28 days and assessed as in BS 5328: Part 4.

4 The ratio R between 7 and 28 day strengths shall be established for the mix to be used in the slab by testing pairs of cubes at each age on at least six batches of the proposed mix or it shall be quoted by the supplier of the concrete. The average strength of the 7-day pair of cubes shall be divided by the average strength of the 28-day pair of cubes for each batch and the ratio R shall be the average of these six values. The ratio R shall be expressed to three decimal places.

5 If during the construction of the trial length or during normal working, the average value of any 4 consecutive 7-day test results falls below the strengths given in Table 10/3 then the cement content of the concrete shall be increased by 5% by mass. The increased cement content shall be maintained at least until the four corresponding 28-day tests have been assessed. If the cement content is increased, the concrete mix shall be adjusted to maintain the required workability.

C40	35	43 R	29
C30	27	33 R	22
C20	18	22 R	14
C15	13	17 R	11
C10	8	10 R	7
C7.5	5.5	7 R	4.5

6 The values in columns 2 and 4 of Table 10/3 may only be used when sufficient test results on trial mixes for calculating the ratio R are not available. Once sufficient results are available from normal working the ratio R shall be calculated from the results available on Site.

7 To assess the time for use of a concrete slab by traffic, the strength development rate may be predetermined by trial mixes. Alternatively pairs of cubes shall be made for each 600 m² or less and stored alongside the pavement in containers or in such a way

that their sides are well insulated. If thermal insulation is used for accelerated curing the cubes shall be similarly insulated. Pairs of cubes shall be tested at the intervals specified in Appendix 7/1. Tests for compliance with the specified strength shall be made in the normal way.

1005 Workability

1 The workability of the concrete at the point of placing shall enable the concrete to be fully compacted and finished without undue flow. The optimum workability for the mix to suit the paving plant being used shall be determined by the Contractor and approved by the Engineer.

2 The workability shall be determined by the Compacting Factor test in accordance with BS 1881 : Part 103, or the Vebe test in accordance with BS EN 12350-3 or alternatively for concrete grade C20 or below, by the slump test in accordance with BS EN 12350-1, at the minimum rate of one determination per 300 m² of slab laid or 6 times per day, whichever is the greater. For areas less than 300 m² the rate shall be at least one determination to each 20 m length

TABLE 10/3: 7 Day Cube Strengths

Grade of Concrete	PC mixes, R not available	All mixes R available	Pfa o ggbs mixes, R not available
	N/mm ²		N/mm ²

of slab or at least 3 times per day. Tests for workability shall also be carried out in accordance with BS EN 12350-4 for degree of compactability. Within 7 days, copies of the test sheets and results for compaction factor and degree of compactability shall be supplied to the Overseeing Organisation, presented so that correlation of the results of both tests can be examined. No limits are specified for degree of compactability. Tests for workability shall be carried out at the point of placing, in conjunction with tests for strength and any tests for air content. The workability shall be maintained at the optimum within the following tolerances:

Compacting Factor (CF)	±0.03
Slump	±20 mm
Vebe	±3 seconds or as found satisfactory as a result of trial mixes.

3 If any determination of workability gives a result outside the tolerance, a further test shall be made immediately on the next available load of concrete. The average of the two consecutive results and the difference between them shall be calculated. If the average is not within the tolerance or the difference is greater than 0.06 for CF or 20 mm for slump, or 6 seconds for Vebe, subsequent samples shall be taken from the delivery vehicles, which shall not be allowed to discharge into the Works until compliance with the Specification has been established.

1006 Trial Mixes

1 For concrete grades C15 and above the Contractor shall carry out laboratory trials of designed mixes with the materials from all sources to be used in the Works, in

accordance with BS 5328 : Part 3, unless recent data relating entirely to the proposed mix satisfies the requirements of the Specification. The trial mixes shall be repeated if necessary until the proportions of ingredients are determined which will produce a concrete which complies in all respects with the Specification.

2 Apart from minor adjustments to the mix as permitted by BS 5328 : Part 3 any changes in sources of materials or mix proportions that are proposed by the Contractor during the course of the Works shall be assessed by making laboratory trial mixes and the construction of a further trial length, unless approved by the Overseeing Organisation.

1007 Separation and Waterproof Membranes

1 A separation membrane shall be used between jointed reinforced concrete surface slabs or unreinforced concrete surface slabs and the sub-base.

2 Separation membranes shall be impermeable plastic sheeting 125 microns thick laid flat without creases. Where an overlap of plastic sheets is necessary, this shall be at least 300 mm. There shall be no standing water on or under the membrane when the concrete is placed upon it.

3 Under CRCP and CRCR a waterproof membrane shall be provided, which shall be a bituminous spray in accordance with Clause 920 before concreting. Where a bituminous spray has been used to cure cement-bound material or wet lean concrete then only those areas, which have been damaged, shall be resprayed after making good.

1008 Steel Reinforcement General

1 Reinforcement is normally installed only in the end slabs or in special cases e.g. if the slab length is greater than 25 times the slab thickness respectively 30 times for square slabs or if irregular settlements of the subgrade may arrive. Amount of steel: 3kg/m² for the construction classes HD to III and 2kg/m² for the other construction classes. The distance of the longitudinal steel bars must not exceed 150mm and of the transversal steel bars must not exceed 300mm.

Reinforcement shall comply with any of the following standards and be in prefabricated sheets or cages, or bars assembled on site and shall be free from oil, dirt, loose rust and scale:

- (i) (Carbon steel bars for the reinforcement of concrete) BS 4449.
- (ii) (Cold-reduced steel wire for the reinforcement of concrete) BS 4482.
- (iii) (Steel fabric for the reinforcement of concrete) BS 4483.

2 When deformed bars are used they shall conform to Type 2 bond classification of BS 4449.

3 Spacing of bars shall not be less than twice the maximum size of aggregate used. Laps in longitudinal bars shall be not less than 35 bar diameters or 450 mm whichever is greater. In continuously reinforced concrete slabs (CRCP or CRCR), only one third of the laps may be in any one transverse section, except in single bay width construction where half the laps may be in any one transverse section. There shall be a minimum of 1.2 m longitudinally between

groups of transverse laps or laps in prefabricated reinforcement sheets. Alternatively the reinforcement may be butt welded in accordance with Clause 1717.

4 Laps in any transverse reinforcement shall be a minimum of 300 mm. Where prefabricated reinforcement sheets are used and longitudinal and transverse laps would coincide, no lap is required in the transverse bars within the lap of the longitudinal reinforcement. These transverse bars may be cropped or fabricated shorter so that the requirements for cover are met. Alternatively, prefabricated sheets incorporating splices (i.e. flying ends) may be used to provide nesting of reinforcement in both directions at lap positions. The lengths of the laps shall be the minimum values previously stated.

5 If the reinforcement is positioned prior to concreting, it shall be fixed on metal supports and retained in position at the required depth below the finished surface and distance from the edge of the slab so as to ensure that the required cover is achieved. Reinforcement assembled on site shall be tied, or firmly fixed, at sufficient intersections to provide sufficient rigidity to ensure that the reinforcement remains in the correct position during construction of the slab.

6 Alternatively, when a reinforced concrete slab (JRC, CRCP or CRCR) is constructed in two layers, the reinforcement in the form of prefabricated sheets may be placed on or into the bottom layer which shall be spread and compacted to such a level that it will support the reinforcement without distortion at the required position in the slab. The sheets shall be tied together at overlaps and after the second layer has been spread and compacted, the reinforcement shall have the required cover.

7 When a reinforced concrete slab is constructed at maximum width as in Clause 1010 the transverse reinforcement in the centre of each slab width shall be a minimum of 12 mm nominal diameter bars at 600 mm centres. This reinforcement shall be at least 600 mm longer than one third of the width of the slab and be lapped to other transverse reinforcement bars or sheets, or be continuous across the whole width of each slab.

Jointed Reinforced Concrete Slabs

8 The reinforcement shall be so placed that after compaction of the concrete, the cover below the finished surface of the slab is 50 ± 10 mm for slabs less than 200 mm thick, 60 ± 10 mm for slabs 200 mm or more but less than 270 mm thick, 70 ± 20 mm for slabs 270 mm thick or more. The negative vertical tolerance shall not be permitted beneath road stud recesses. Where traffic signal detector loops are to be installed, the minimum cover to the reinforcement from the surface shall be 100 mm. The vertical cover between any longitudinal joint groove forming strip and any reinforcement or tie bars shall be a minimum of 30 mm. Any transverse bars shall be at right angles to the longitudinal axis of the carriageway. Any transverse reinforcement shall terminate at 125 ± 25 mm from the edges of the slab and longitudinal joints, where tie bars as in Clause 1012 are used. No longitudinal bars shall lie within 100 mm of a longitudinal joint. The reinforcement shall terminate $300 \text{ mm} \pm 50 \text{ mm}$ from any transverse joint, excluding emergency construction joints.

Anchoring

9 See Clause NG 1008 Sub-Clause 4

Continuously Reinforced Concrete Slabs (CRCP or CRCR)

10 The reinforcement shall be Grade 460 deformed steel bars with the diameters and spacings as described in Appendix 7/1.

11 The reinforcement shall consist of bars assembled on site, or of prefabricated sheets. Except where otherwise shown on the Drawings the longitudinal bars shall be parallel to the centre-line of the road.

12 The reinforcement shall be positioned so that, after compaction of the concrete, it shall be at the mid depth of the specified thickness of the slab ± 25 mm. No longitudinal bar shall lie within 100 mm of a longitudinal joint. In reinforcement assembled on site, longitudinal bars shall be placed immediately above any transverse bars, which shall be at right angles to the longitudinal axis of the carriageway. Any transverse reinforcement shall terminate 125 ± 25 mm from the edges of the slab and longitudinal joints where tie bars as in Clause 1012 are used.

1009 Transverse Joints General

1 Transverse joints shall be provided in unreinforced and jointed reinforced concrete slabs and shall be contraction, expansion or warping joints at the spacings described in Appendix 7/1, such that for unreinforced concrete slabs the length/width ratio shall be not greater than 2.0. The spacings may be increased by 20% if limestone coarse aggregate is used throughout the depth of the slab.

2 Joints in the surface slab and sub-base shall be staggered so that they are not coincident vertically and are at least 1 m apart.

3 Transverse joints shall be straight within the following tolerances along the intended line of the joint, which is the straight line transverse to the longitudinal axis of the carriageway, except at road junctions or roundabouts where the positions shall be as shown on the Drawings.

- (i) deviations of the filler board or bottom crack inducer from the intended line of the joint shall be not greater than ± 10 mm;
- (ii) the best fit straight line through the joint groove as constructed shall be not more than 25 mm from the intended line of the joint;
- (iii) deviations of the joint groove from the best fit straight line of the joint shall be not greater than 10 mm.

4 Transverse joints on each side of a longitudinal joint shall be in line with each other and of the same type and width. The position of the joints relative to manholes and gullies shall be in accordance with Clause 1018.

5 Concrete pavement layers shall be isolated from fixed structures by expansion joints, or earthworks or a granular layer over the structure, or by bridge-type expansion joints, or by lengths of fully flexible pavement construction. End of pavement surface slabs shall have a transition bay as shown on the Drawings, leading into the fully flexible construction.

6 Transverse joints shall have a sealing groove which shall be sealed in compliance with Clause 1016.

Contraction Joints

7 Contraction joints shall consist of:

- (i) a sawn joint groove complying with Clause 1013;
- (ii) dowel bars complying with Clause 1011;
- (iii) a sealing groove complying with Clause 1016.

Expansion Joints

8 Expansion joints shall consist of:

- (i) a joint filler board complying with Clause 1015;
- (ii) dowel bars complying with Clause 1011;
- (iii) a sealing groove complying with Clause 1016.

9 The filler board shall be positioned vertically within the prefabricated joint assemblies along the line of the joint within the tolerances given in sub-Clause 3 of this Clause, and at such depth below the surface as will not impede the passage of the finishing beams on the paving machines. The joint filler board together with the sealing groove shall provide a complete separation of adjacent slabs and any spaces around dowel bars and between the sub-base and the filler board shall be packed with a suitable compressible material after fixing the joint assembly.

Warping Joints

10 Warping joints shall consist of:

- (i) a sawn joint groove complying with Clause 1013;
- (ii) tie bars complying with Clause 1012;
- (iii) a sealing groove complying with Clause 1016.

Construction Joints

11 Construction joints made at the end of a working day in unreinforced concrete slabs and jointed reinforced concrete slabs shall be contraction joints. In the event of mechanical breakdown of the concreting machinery, or at the onset of adverse weather, emergency joints may be formed.

12 Emergency joints in unreinforced concrete slabs shall be contraction joints not less than 2.5 m from the preceding or succeeding joint position. If possible they should coincide with contraction or expansion joints.

13 Emergency joints in jointed reinforced concrete slabs shall be not less than 2.5 m from the preceding or succeeding joint position. The stop end formwork shall be sufficiently rigid to ensure that dowel bars, tie bars or reinforcement will be held in position in compliance with the specification, and placed in such a position that it permits the longitudinal reinforcement to project through the joint for a distance of at least 750 mm.

14 Construction joints in continuously reinforced concrete slabs (CRCP and CRCR) at end of day or in an emergency shall not be constructed within 1.5 m of any lap in the longitudinal reinforcement. The stop end formwork shall be sufficiently rigid to ensure that the longitudinal reinforcement

and the tie bars as required in sub-Clause 1012.7 which project through the joint are held in the correct position.

1010 Longitudinal Joints General

1 Sawn or wet-formed longitudinal joints shall be provided in surface slabs between or at the centre of traffic lanes within the allowable positions as shown on the Drawings, so that bay widths are not greater than 4.2 m (or 5.0 m with limestone aggregate) for unreinforced slabs, or 6 m (or 7.6 m with limestone aggregate) for reinforced concrete surface slabs with transverse reinforcement as in sub-Clause 1008.7. Longitudinal joints shall be provided in CRCR between lanes or at the centre of lanes, within a tolerance of ± 150 mm so that bay widths are not greater than 6 m (or 7.6 m with limestone aggregate). Joints in the surface slab, roadbase or sub-base shall be staggered so that they are not coincident vertically and are at least 300 mm apart.

2 Wet-formed longitudinal joints shall consist of wetformed joint grooves complying with Clause 1013, a bottom crack inducer complying with Clause 1014 and tie bars complying with Clause 1012, except where transverse reinforcement is permitted in lieu.

3 Longitudinal joints shall be constructed within the following tolerances:

- (i) deviations of the bottom crack inducer from the intended line of the joint, parallel to the axis of the road shall be not greater than ± 13 mm;
- (ii) the joint groove shall be located vertically above the bottom crack inducers within a horizontal tolerance of ± 25 mm;

- (iii) the best fit line along the constructed joint groove, shall be not more than 25 mm from the intended line of the joint;
- (iv) deviations of the joint groove from the best fit line of the joint shall be not greater than 10 mm.

4 Sawn longitudinal joints shall consist of joint grooves complying with Clause 1013.

5 Tie bars may be replaced by continuous transverse reinforcement across the joints in continuously reinforced concrete slabs which are constructed in more than one lane width in one operation, provided that the transverse reinforcement is a minimum of 12 mm diameter bars at 600 mm centres. The transverse reinforcement in these circumstances shall be protected by suitable bituminous paint or equivalent coating for a distance of at least 75 mm either side of the joint.

Longitudinal Construction Joints

6 Longitudinal construction joints between separate slabs shall have tie bars as in Clause 1012 with a joint groove as in Clause 1013. Alternatively, if split forms are used, the transverse reinforcement, if 12 mm diameter or more, may be continued across the joint for a minimum of 500 mm or 30 times the diameter of the transverse reinforcement bars, whichever is the greater. The transverse reinforcement in these circumstances shall be protected by suitable bituminous paint or equivalent coating for a distance of at least 75 mm either side of the joint. A joint sealing groove is not required in construction joints in continuously reinforced concrete base courses. Where the edge of the concrete slab is damaged it shall

be made good before the adjacent slab is constructed.

1011 Dowel Bars

1 Dowel bars shall be Grade 250 steel complying with BS 4449 and shall be free from oil, dirt, loose rust and scale. They shall be straight, free of burrs and other irregularities and the sliding ends sawn or cropped cleanly with no protrusions outside the normal diameter of the bar. For expansion joints, dowel bars shall be 25 mm diameter at 300 mm spacing, 600 mm long for slabs up to 239 mm thick and 32 mm diameter for slabs 240 mm thick or more. For contraction joints, dowels shall be 20 mm diameter at 300 mm spacing 400 mm long for slabs up to 239 mm thick and 25 mm diameter for slabs 240 mm thick or more.

2 Dowel bars shall be supported on cradles in prefabricated joint assemblies positioned prior to construction of the slab. For contraction joints, as an alternative to prefabricated assemblies, dowel bars may be mechanically inserted with vibration into the concrete by a method which ensures full recompaction of the concrete around the dowel bars and the surface finished by a diagonal finishing beam, or a longitudinal oscillating float travelling across the slab.

3 Dowel bars shall be positioned at mid-depth from the surface level of the slab ± 20 mm. They shall be aligned parallel to the finished surface of the slab, to the centre line of the carriageway and to each other within the following tolerances:

- (i) for bars supported on cradles prior to construction of the slab and for inserted bars in two layer construction prior to placing the top layer:

- (a) all bars in a joint shall be within ± 3 mm per 300 mm length of bar;
- (b) two thirds of the bars shall be within ± 2 mm per 300 mm length of bar;
- (c) no bar shall differ in alignment from an adjoining bar by more than 3 mm per 300 mm length of bar in either the horizontal or vertical plane;
- (ii) for all bars, after construction of the slab:
 - (a) twice the tolerances for alignment as in
- (iii) above;
 - (b) equally positioned about the intended line of the joint within a tolerance of 25 mm.

4 Cradles supporting dowel bars shall not extend across the line of the joint.

5 Dowel bars, supported on cradles in assemblies, when subjected to a load of 110 N applied at either end and in either the vertical or horizontal direction (upwards and downwards and both directions horizontally) shall not deflect more than the following limits:

- (i) two thirds of the number of bars of any assembly tested shall not deflect more than 2 mm per 300 mm length of bar;

- (ii) the remainder of the bars in that assembly shall not deflect more than 3 mm per 300 mm length of bar.

6 The assembly of dowel bars and supporting cradles, including the joint filler board in the case of expansion joints shall have the following degree of rigidity when fixed in position:

- (i) For expansion joints the deflection of the top edge of the filler board shall be not greater than 13 mm, when a load of 1.3 kN is applied perpendicular to the vertical face of the joint filler board and distributed over a length of 600 mm by means of a bar or timber packing, at mid depth and midway between individual fixings, or 300 mm from either end of any length of filler board, if a continuous fixing is used. The residual deflection after removal of the load shall be not more than 3 mm.
- (ii) The joint assembly fixings to the sub-base shall not fail under the 1.3 kN load applied for testing the rigidity of the assembly but shall fail before the load reaches 2.6 kN.
- (iii) The fixings for contraction joints shall not fail under a 1.3 kN load and shall fail before the load reaches 2.6 kN when applied over a length of 600 mm by means of a bar or timber packing placed as near to the level of the line of fixings as practicable.
- (iv) Failure of the fixings shall be deemed to be when there is displacement of the assemblies by more than 3 mm with any form of fixing, under the test load. The displacement shall be measured at

the nearest part of the assembly to the centre of the bar or timber packing.

7 Dowel bars shall be covered by a flexible polymeric corrosion resistant coating, bonded onto the previously cleaned bar. The coating shall be smooth and free of indentations. During coating, the bar shall be supported at each end. Minimum thickness shall be 0.3 mm. The coating shall also be able to withstand 250 hours immersion in a fog cabinet complying with BS 3900 : Part F12, without showing any visible crazing or corrosion of the protected bar. The coated bar shall comply with the following pull out test:

- (i) Four bars shall be taken at random from stock and without any special preparation shall be coated as required in this Clause. The dowel bars which have been coated shall be cast centrally into concrete specimens 150 x 150 x 450 mm, made of the same mix proportions to be used in the pavement, but with a maximum nominal aggregate size of 20 mm and cured in accordance with BS 1881 : Part 111. At 7 days a tensile load shall be applied to achieve a movement of the bar of at least 0.25 mm. The average bond stress to achieve this movement shall be not greater than 0.14 N/mm².

8 For expansion joints, a closely fitting cap 100 mm long consisting of waterproofed cardboard or suitable synthetic material shall be placed over one end of each dowel bar. An expansion space 10 mm greater than the construction of the slab.

thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar.

1012 Tie Bars

1 Tie bars in transverse and especially longitudinal joints shall be Grade 250 steel or Grade 460 deformed steel bars complying with BS 4449, in accordance with the requirements given below and Table 10/4. Deformed bars shall have Type 2 bond classification. Tie bars shall be free from oil, dirt, loose rust and scale. Tie bars which are to be cranked and later straightened shall be Grade 250.

2 Tie bars for use across joints shall have corrosion protection in the form of a flexible polymeric corrosion resistant coating, bonded centrally onto 150 mm of the previously cleaned centre section of the bars. Where tie bars are to be cranked for construction joints and later straightened, the coating shall be shown to be capable of being straightened through 90 degrees without cracking.

The coating for both straight and cranked bars after straightening shall be able to withstand 250 hours immersion in a fog cabinet complying with BS 3900 : Part F12, without showing any visible crazing or cracking, or corrosion of the protected part of the bar.

3 Tie bars in warping joints and wet-formed longitudinal joints shall be made up into rigid assemblies with adequate supports and fixings to remain firmly in position during

TABLE 10/4: Tie Bar Details

Joints	Diameter mm	Grade of Steel	Length mm	Spacing mm	mm
Transverse construction joints in continuously reinforced concrete	As for main reinforcement	460	1500	Twice the spacing of main reinforcement	
Emergency construction joints in 12 jointed reinforced concrete slabs other than at contraction or expansion joints	250 or	460 deformed	1000	600	600
Warping joints	12	250 or 460 deformed	1000	750	300 600
Longitudinal All joints, except where Transverse reinforcement is permitted in lieu	12 or 16 or 20	250 or 460 deformed 460 deformed 460 deformed	1000	750 600 500	600 600 600
Transition from rigid to flexible construction	20	460 deformed	1000	300	

NOTE: The transverse reinforcement may be continued across the joint in reinforced concrete if the bars are of a minimum nominal diameter of 12 mm and the bars are protected from corrosion and the cover is as required in this Clause.

4 Alternatively, tie bars at longitudinal joints may be mechanically inserted by vibration from above using a method which ensures recompaction of the concrete around the tie bars.

5 At longitudinal construction joints, tie bars may be adequately fixed to side forms or inserted into the side of the slab by a method which ensures recompaction of the concrete around the tie bars and adequate bond.

6 Tie bars in warping joints shall be positioned from the top surface of the slab within +20, -10 mm of the mid depth of the slab. Tie bars in other joints shall be positioned and remain within the middle third of the slab depth, approximately parallel to the surface and approximately perpendicular to the line of the joint, with the centre of each bar on the intended line of the joints within a tolerance of ± 50 mm, and with a minimum cover of 30 mm below any top crack inducer of joint groove for slabs

200 mm thick or more, or 20 mm for slabs up to 200 mm thick.

7 At transverse construction joints in continuously reinforced concrete, tie bars shall be 1.5 m long and of the same grade and size as the longitudinal reinforcement, and shall be fixed at twice the normal spacing midway between the longitudinal reinforcement bars so that $750 \text{ mm} \pm 50 \text{ mm}$ extends each side of the joint at the same level as the longitudinal reinforcement and be tied to the transverse reinforcement. Where paving from a construction joint is not resumed within 5 days, an extra longitudinal reinforcement bar 8 m long shall be lapped and tied to each tie bar. These extra bars may be combined with the tie bars. Where the spacing between longitudinal reinforcement and the extra 8 m long bars is less than 90 mm, the nominal size of aggregate shall be 20 mm for a sufficient number of concrete batches to complete that section of pavement.

8 Where tie bars are used in longitudinal joints in continuously reinforced concrete they shall be placed at the same level as the transverse reinforcement and tied to the longitudinal reinforcement.

1013 Joint Grooves General

1 Transverse contraction or warping joint grooves shall be sawn in the hardened concrete.

2 Transverse joint grooves which are initially constructed less than the full width of the slab shall be completed by sawing through to the edge of the slab and across longitudinal joints as soon as any forms have been removed and before an induced crack develops at the joint.

Sawn Transverse and Longitudinal Joint Grooves

3 Sawing shall be undertaken as soon as possible after the concrete has hardened sufficiently to enable a sharp edged groove to be produced without disrupting the concrete and before random cracks develop in the slab. The grooves shall be between 1/4 and 1/3 of the specified depth of the slab and of any convenient width not less than 3 mm. The sealing groove may be sawn to the required width later. Expansion joint sealing grooves shall be sealed as soon as practical after sawing.

Wet-formed Longitudinal Joint Grooves

4 When slabs are constructed in more than one lane width in one operation a joint groove shall be formed by inserting a groove former ahead of the finishing beams from dispenser. The concrete so displaced shall be recompacted by a vibrating compactor or

similar device, at least 300 mm wide operating symmetrically along the line of the joint. After finishing the concrete, the groove forming strip shall be in the correct position and alignment, within 10° of the vertical, and to sufficient depth below the surface to allow for the passage of the finishing beam within the range 0-3 mm below the finished level of the slab. Groove forming strips in wet-formed longitudinal joint grooves shall be left in place.

Construction Joint Grooves in Surface Slabs

5 The grooves shall be formed by fixing a groove-former or strip or cork seal along the top edge of the slab already constructed, before concreting the adjacent slab. Where the edge of the concrete is damaged it shall be ground or made good before fixing the groove forming strip. Alternatively the subsequent slab may be placed adjacent to the first and a sealing groove sawn later in the hardened concrete to the minimum depth required in Table 10/5 or to the manufacturer's instructions if greater, and to sufficient width to eliminate minor spalling of the joint arris, up to a maximum of 25 mm for longitudinal joints and 40 mm for transverse joints. The joint shall be sealed in compliance with Clause 1016.

1014 Groove Formers and Bottom Crack Inducers

General

1 Except where joint grooves are sawn, which is the normal construction procedure, a bottom crack inducer shall be provided at each longitudinal joint position.

2 The bottom crack inducer shall be triangular or inverted Y-shaped fillet, with a

base width not less than the height, made of timber or rigid synthetic material. It shall be firmly fixed to the sub-base so as to remain in position during the whole process of constructing the slab.

3 The combined depth of groove formers and bottom crack inducers shall be between $1/4$ and $1/3$ of the depth of the slab and the difference between the depth of the groove former and the height of the bottom crack inducer shall not be greater than 20 mm.

Longitudinal Joints

4 Groove forming sealing strips for wet-formed longitudinal joints shall be of firm compressible strips of ethylene vinyl acetate foam of minimum density 90 kg/m³, or synthetic rubber, or equivalent material. They shall have a minimum thickness of 5 mm and shall be sufficiently rigid to remain vertical and straight in the concrete without curving or stretching. They shall be inserted continuously along the joint.

1015 Joint Filler Board

1 Joint filler board for expansion joints and manhole and gully slab joints shall be 25 mm thick unless otherwise shown in the Drawings, within a tolerance of ± 1.5 mm. It shall be a self-expanding cork seal or a firm compressible material or a bonded combination of compressible and rigid materials of sufficient rigidity to resist deformation during the passage of the concrete paving plant. The depth of the joint filler board for manhole and gully slabs shall be the full depth of the slab less the depth of the sealing groove. In expansion joints, the filler board shall have a ridged top as shown on the Drawings, except where a sealing groove former is indicated on the Drawings.

Holes for dowel bars shall be accurately bored or punched out to form a sliding fit for the sheathed dowel bar.

2 The joint filler board shall meet the requirements given when tested in accordance with the procedures in the following clauses:

(i) Weathering Test

- (a) Three specimens, each 115 mm square ± 2.5 mm, shall be placed in a ventilated drying oven maintained at a temperature of $55^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 7 days, after which they shall immediately be immersed in water at room temperature of between 16°C and 21°C for 24 hours. They shall then be subjected to five cycles of freezing and thawing in the following manner.
- (b) The specimens shall be placed in a watertight weathering test pan having a ribbed bottom and a fitted slotted lid designed to hold the three specimens vertically on edge. The pan shall be filled with water to half the depth of the specimens and then frozen to 0°C , for at least four hours after the initial freezing of the water. The pan shall then be placed in a water bath maintained at 18°C to 38°C without disturbing the specimens and shall remain there for one hour after thawing has completed. The pan and specimens shall then be returned to the refrigerator and freezing and thawing shall be repeated in precisely the same manner until five cycles of the process have been completed.

The specimens shall be removed from the pan and air dried at room temperature for 48 hours before examination.

- (c) The Material shall be deemed to have passed the weathering test if the specimen show no signs of disintegration or shrinkage

(ii) Compression and Recovery Test

- (a) Two of the specimens which pass the weathering test, and two new specimens, each trimmed to 100 mm square ± 0.5 mm, maintained at room temperature and humidity for 24 hours, shall be subjected to three applications of load at 24 hour intervals in a compression test machine complying with BS 1610, with auxiliary platens 100 mm², minimum 13 mm thick. During each application of load each specimen shall be compressed to 50% of its original thickness at a rate of strain of 1.3 mm per minute. The load required to achieve this amount of compression shall be not less than 0.07 N/mm² nor more than 10 N/mm² for material to be used in pavements and not less than 0.07 N/mm² and not more than 0.4 N/mm² for material to be used in bridge joints. The load shall be released immediately the required degree of compression is reached and after the third applicable recovery period of 30 minutes shall be allowed after which the thickness of the specimen shall measured.

- (b) This thickness, expressed as a percentage of the original thickness, is the 'recovery' value of the specimen. The thicknesses shall be measured to an accuracy of 25 micron. The two new specimens shall

be weighed before and after testing. The difference in mass shall be determined with an accuracy of 0.1% and shall be expressed as a percentage of the original mass of the specimen.

- (c) The material shall be deemed to have passed the test if all four specimens have recovery values of at least 70% and the two new specimens have not suffered a reduction of mass in excess of 1%.

(iii) Extrusion Test

- (a) The third sample which passes the weathering test shall be trimmed to 100 mm square ± 0.5 mm and be subjected to the following extrusion test.
- (b) The extrusion mould shall be 100 mm x 100 mm (+ 0.5 mm, - 0) internally, of sufficient depth to test the sample as received, open on one side only and fixed rigidly to a base plate. The mould shall be provided with a closely fitting pressure plate which shall fit without binding, and with an accurate horizontal measuring dial gauge or measuring device accurate to 25 microns. The specimen shall be mounted in the extrusion mould and loaded once as described in the compression and recovery test. The extrusion at the open side of the mould shall be measured with the gauge when the specimen is compressed to 50% of its original thickness and before release of the load.
- (c) The material shall be deemed to have passed the test if the extrusion of the free edge does not exceed 6 mm.

(iv) Immersion Test for Cork Filler Board

- (a) Two specimens each 115 mm x 115 mm \pm 2.5 mm shall be prepared and the thickness of each specimen shall be determined to the nearest 25 microns before the specimens are immersed in boiling water for one hour. After removal from the water the specimens shall be allowed to cool to room temperature and after 15 minutes at this temperature their thickness shall be remeasured to the nearest 25 microns.
- (b) The material shall be deemed to have passed the test if both specimens have a thickness of not less than 140% of their thickness before immersion.

(v) Acid Test for Cork Filler Board

- (a) Two specimens each 115 mm x 115 mm \pm 2.5 mm shall be immersed in hydrochloric acid of a specific gravity of 1.18 at room temperature which is then brought to the boil and maintained thus for one hour when the specimens shall be removed and rinsed in water.
- (b) The material shall be deemed to have passed the test when, after examination, the specimens show no evidence of serious disintegration, friability or lack of resilience. Discolouration or minor swelling shall not be considered as failure.

1016 Preparation and Sealing of Joint Grooves

General

1 All transverse joints in surface slabs, except for construction joints in CRCP shall be sealed using one of the joint seals described in Clause 1017. Additionally longitudinal joints which are sawn or widened, shall be sealed.

Preparation of Joint Grooves for Sealing

2 Joint grooves shall be prepared in accordance with BS 5212 : Part 2 and sub-Clauses 3 to 8 of this Clause.

3 That part of the groove former used to form the sealing groove or any temporary seal shall be removed cleanly without damaging the joint arrises to a minimum depth of 25 mm where compression seals are used or otherwise to such depth as will provide an applied seal to the dimensions shown in Table 10/5, after allowing for any necessary caulking material described in sub-Clause 6 of this Clause. If joint grooves are not initially constructed to provide the minimum dimensions for the joint seals as given in Table 10/5, they shall be widened by sawing. Joint grooves formed by tapered formers need not be widened. The sealing grooves shall be cleaned out immediately after sawing using high pressure water jets, to remove all slurry from the joint, before the slurry hardens.

4 If rough arrises develop when grooves are made they shall be ground to provide a chamfer approximately 5 mm wide. If the groove is at an angle up to 10° from the perpendicular to the surface, the overhanging edge of the sealing groove shall be sawn or ground perpendicular. If spalling occurs or the angle of the former is greater than 10° the joint sealing groove shall be

sawn wider and perpendicular to the surface to encompass the defects up to a maximum width, including any chamfer, of 40 mm for transverse joints and 25 mm for longitudinal joints. If the spalling cannot be so eliminated then the arris shall be repaired by suitable thin bonded arris repair using cementitious materials as specified in Clause 1032.

5 For applied sealants the sides of the joint sealing groove shall be scoured by dry abrasive blasting. This shall not be carried out before the characteristic compressive strength of the concrete is expected to reach 15 N/mm². When compression seals are used, the sides of the groove may be ground or wire brushed.

6 For hot and cold applied sealants, compressible caulking material, debonding strip or tape or cord compatible with the sealant, of a suitable size to fill the width of the sealing groove, shall be firmly packed or stuck in the bottom of the sealing groove to such a depth so as to provide the correct depth of seal as described in Table 10/5 with the top of the seal at the correct depth below the surface of the concrete.

7 All grooves shall be cleaned of any dirt or loose material by air blasting with filtered, oil-free compressed air. The groove shall be clean and dry at the time of priming and sealing.

8 For applied sealants the joint grooves shall be primed with the relevant primer for the hot or cold applied sealant in accordance with the manufacturer's recommendations and with BS 5212 : Part 2, except that when necessary the joint grooves may be primed and sealed earlier than 14 days after construction, as soon as the grooves have been grit-blasted and cleaned.

TABLE 10/5: Dimensions of Applied Joint Seals

Type and Spacing of Joints (m)	Minimum Width mm	Minimum Depth of Seal (Note 1)		Impegnated Foam Compression Strips mm	Depth of Seal Below the Concrete Surface mm
		Cold Applied mm	Hot Applied mm		
Contraction					
15 and under	13 (Note 2)	13	15	30	5 + 2
Over 15 to 20	20	15	30	30	5 + 2
Over 20 to 25	30	20	25	40	5 + 2
Expansion	30	20	25	40	7 + 2
Transverse Waping	10	10	13	30	5 + 2
Longitudinal Joints (If Sealed)	10	10	13	30	0 to 5
(Gully and Manhole Slabs	20	15	20	30	0 to 3

NOTE (1): The depth of seal is that part in contact with the vertical face of the joint groove. The depth of seal below the surface shall be taken at the centre of an applied seal relative to a short straight edge, 150 mm long, placed centrally across the joint within 7 days of sealing.

NOTE (2): For cork seals other than in construction joints, grooves shall be 20 mm width, 50 mm depth.

Sealing with Applied Sealants

9 Sealing shall be carried out continuously along the full length of joint in any one rip, except for remedial areas. When hot or cold applied sealants are used the sealant shall be applied within the minimum and maximum drying times of the primer recommended by the manufacturer. Priming and sealing with applied sealants shall not be carried out when the naturally occurring temperature in the joint groove to be sealed is below 10°C except between 8°C and 10°C it may be carried out when the temperature is rising.

10 Hot-applied sealants shall be heated in and applied from a thermostatically controlled, indirectly heated dispenser with a recirculating pump. The sealant shall not be heated to a temperature higher than the safe heating temperature nor for a period longer than the safe heating period, both as specified by the manufacturer. The

dispenser shall be cleaned out at the end of each day and reheated material shall not be used.

11 The components of cold-applied sealants shall be thoroughly mixed in the correct proportions in accordance with the manufacturer's instructions using an automatic metering and mixing dispenser or, for hand application, using a power operated paddle mixer for sufficient time to produce a homogenous mix without entrapped air. As soon as possible after mixing and within the worklife of the sealant, the material shall be dispensed into the joint, or applied using a caulking gun, to the correct level below the concrete surface. The tack-free time shall be achieved within 3 hours for machine dispensed material, or within 12 hours for hand applied material.

Testing of Applied Sealants

12 Test certificates shall be supplied from a testing laboratory stating that the sealant complies with the relevant standard in Clause 1017. Site testing of cold-applied sealants shall be in accordance with BS 5212 : Part 2. Site testing of hot applied sealants shall be in accordance with BS 2499 : Part 2. Samples of hot applied sealants shall be taken and tested for initial penetration and resilience in accordance with clauses 8 and 23 respectively of BS 2499 :

Part 3 : 1993 and shall comply with the requirements of BS 2499 : Part 1.

Sealing with Compression Seals

13 When compression seals are used, the widths of the seal shall be selected in relation to the width of the sealing groove, the bay lengths and manufacturer's recommendations so that the estimated maximum width of the joint opening shall be not more than 70% of the original width of the seal, the estimated maximum width being calculated on the basis of a movement of 4 mm per 10 m run of slab. The maximum calculated width of sealing groove shall be 30 mm. The depth of groove shall be such that the contact face of the seal with the side of the groove shall be not less than 20 mm and that the top of the seal shall be a minimum of 3 mm below the surface of the concrete.

14 Compression seals shall be inserted into the grooves without prior extension or rotation and, where recommended by the manufacturer, with a lubricant adhesive which is compatible with the seal and the concrete. The adhesive shall be applied to both sides of the sealing groove or the seal, or to both. The seal shall be positioned with its axis perpendicular to the concrete surface. Excess adhesive on top of the seal shall be removed to prevent adhesion of the top faces of the seal under compression. Except when compression seals are used in longitudinal joints the transverse joint seal shall be continuous across the slab and the longitudinal joint groove forming strips shall be cut to the required depth after the concrete has hardened for the transverse seal to be inserted. If compression seals are used in longitudinal joints where the grooves have been sawn after construction of the slab they shall be continuous across transverse joints, with the transverse seals butted and fixed to the longitudinal seals with adhesive.

1017 Joint Seals

1 Joint seals shall consist of hot or cold applied sealants or compression seals or self expanding

cork seals complying with this Clause. The colour of the joint seal material shall comply with the requirements of Appendix 7/2.

Hot-applied Sealants

2 Hot-applied sealants shall be Type N1 or Type F1 complying with BS 2499.

3 For joints between concrete surface slabs and bituminous surfacing, hot applied Type N1 sealants complying with BS 2499 shall be used. Alternatively polymer modified bitumen sealing strips may be used and shall be applied in accordance with the manufacturer's instructions. Hot-applied Type N1 sealants may be used in joints in asphalt kerbs laid on concrete pavements.

Cold-applied Sealants

4 Cold-applied sealants shall be Type N complying with BS 5212 : Part 1 except that Type F shall be used for lay-bys and hardstandings.

5 For joints in kerbs and joints other than in pavements, seals may be any of the pavement sealants if they have the suitable characteristics for the application, or gunning grade cold applied plasticised bituminous rubber sealant or gunning grades of two part polysulphide-based sealants complying with BS 4254 may be used. Alternatively, polyurethane-based sealing compounds may be used provided their performance is not inferior to BS 4254 material.

Compression Seals

6 Compression seals shall be pre-compressed neoprene impregnated expanding foam sealing strip having a current BBA certificate or rubber seals made of polychloroprene elastomers complying with BS 2752 and conforming with the requirements of ASTM Standard D2628-81. Seals of butadiene-acrylonitrile or other synthetic rubbers may be used if certificates are produced to show that they conform to the performance requirements of ASTM Standard D2628-81 for oven ageing, oil and ozone resistance, low

temperature stiffening and recovery. Seals made of ethylene vinyl acetate in microcellular form and other synthetic materials may be used in longitudinal joints and in structures if test certificates are produced to show adequate resistance to fuels and heat ageing when tested in accordance with BS 4443 : Part 4, Method 10 and Method 12 respectively. The compression set of any seal shall not be greater than 15% when the specimen is subjected to a 25% compression in accordance with BS 4443 : Part 1, Method 6. When immersed in standard oils for 48 hours at 25°C in accordance with BS 903 : Part A16, the volume change shall not be greater than 5%.

7 Compression seals shall be shaped so that they will remain compressed at all times in accordance with Clause 1016 and shall have a minimum of 20 mm contact face with the sides of the sealing groove. If lubricant-adhesive is used, it shall be compatible with the seal and the concrete and shall be resistant to abrasion, oxidization, fuels and salt.

1018 Joints at Manhole and Gully Slabs

1 Manhole covers, gullies and their frames shall be isolated from the pavement slabs and be contained in separate small slabs, which shall be larger than the exterior of the manhole and gully shafts, including any concrete surround less than 150 mm below the underside of the sub-base layer. The joint around the manhole or gully slab shall be vertical and incorporate joint filler board as in Clause 1015 but without dowel bars and tie bars.

2 Gully slabs in unreinforced concrete slabs shall be adjacent to or straddle a transverse joint, extending the gully slab as necessary to a maximum of 2 m. Where this is impractical, an extra tied warping joint shall be provided adjacent to or within the gully slab and at least 2 m from the next transverse joint. If the edge of an isolator slab is within 1 m of any longitudinal joint the isolator slab shall be extended to that joint.

3 Manhole slabs in unreinforced concrete slabs shall be adjacent to or straddle transverse or longitudinal joints. If the manhole is within the middle third of the bay length a warping joint shall be constructed on one side of the manhole slab across the whole width of the bay to the nearest longitudinal joint.

4 Reinforcement as shown on the Drawings shall be placed in the main concrete slabs in the corners between the manhole and gully slabs and the transverse or longitudinal joints. Extra reinforcement as described in the Contract shall be placed in reinforced concrete slabs around the manhole or gully slabs.

5 Manhole and gully slabs shall have square corners, at all corners which are not adjacent to a transverse or longitudinal joint in the main slab.

6 Reinforcement as shown on the Drawings shall be placed in the gully or manhole slab and concrete grade C40 shall be placed by hand in the space between the main slab and the manhole frame. The concrete shall be fully compacted and finished in compliance with Clause 1025.

7 A sealing groove shall be made directly above the joint filler board and sealed in compliance with Clause 1016.

1019 Inspection of Dowel Bars

1 Compliance with Clause 1011 for the position and alignment of dowel bars at contraction and expansion joints shall be checked by measurement relative to the side form or guide wires.

2 When the slab has been constructed, the position and alignment of dowel bars and any filler board shall be measured after carefully exposing them across the whole width of the slab. When the joint is an expansion joint the top of the filler board shall first be exposed sufficiently in the plastic concrete to permit measurement of any lateral or vertical displacement of the board. During the course of normal working these measurements shall be

carried out at a rate of one joint per 1500 m length of slab or one per 5 days whichever occurs the sooner. For small areas the rate shall be one joint for up to each 100 joints or decided by the Engineer.

3 If the position or alignment of the bars in a single joint in the slab is unsatisfactory then the next two joints shall be inspected. If only the one joint of the three is defective, the rate of checking shall be increased to one joint per day until compliance is being achieved. In the event of non-compliance in two or more successive joints, the Contractor shall revert to the construction of trial lengths and make any necessary alterations to the concrete mix, paving plant or methods until the dowel bar position and alignment is satisfactory.

4 After the dowel bars have been examined, the remainder of the concrete shall be removed 500 mm on each side of the line of the joint, and reinstated to the requirements of the Specification. Alternatively if the dowels are examined in the penultimate joint of a day's work that joint shall be made a construction joint for the next day's work and the remainder of the concrete in the last slab may be discarded.

1020 Side Forms, Rails and Guide Wires

Side Forms and Rails

1 All side forms and rails shall be made of steel and be sufficiently robust and rigid to support the weight and pressure caused by the paving equipment. Side forms for use with wheeled paving machines shall incorporate metal rails firmly fixed at a constant height below the top of the forms.

2 The forms shall be secured by using not less than three pins for each 3 m length having one pin fixed at each side of every joint. Forms shall be tightly joined together by a locked joint, free from play or movement in any direction. Forms shall be cleaned and oiled immediately before each use. The rails or running surface shall be kept clean in front of the wheels of any paving

machines. The forms shall be straight within a tolerance of 3 mm in 3 m.

3 The forms shall be bedded on low moisture content cement mortar or concrete grade C7.5 and set to the pavement surface level as shown on the Drawings within a tolerance of ± 3 mm. The bedding shall not extend under the slab. There shall be no vertical step between the ends of adjacent forms greater than 3 mm. The horizontal alignment for forms shall be to the required alignment of the pavement edge as shown on the Drawings within a tolerance of ± 10 mm. The Contractor should ensure that the forms are set to the correct profile immediately prior to concreting. The mortar or concrete bedding shall be broken out after use.

4 Side forms shall not be removed earlier than 6 hours after the completion of the construction of the slab. Care shall be taken to prevent damage to the concrete and any projecting tie bars during the removal of the forms. If the removal of forms results in any damage to the concrete the period of 6 hours shall be increased to that which is necessary to avoid further damage and the Contractor shall make good the damaged areas.

Guide Wires

5 A guide wire shall be provided along each side of the slab to be constructed by slip form paving plant. Each guide wire shall be at a constant height above and parallel to the required edges of the slab as shown on the Drawings, within a vertical tolerance of ± 3 mm. Additionally one of the wires shall be at a constant horizontal distance from the required edge of the pavement as shown in the Drawings within a lateral tolerance of ± 10 mm.

6 The guide wires shall be supported from stakes not more than 8 m apart by connectors capable of fine horizontal and vertical adjustment. The guide wire shall be tensioned on the stakes so that a 500 gramme weight shall produce a deflection of not more than 20 mm when suspended at the mid-point between any pair of stakes. The ends of the guide wires shall be anchored to fixing points which shall be not

closer to the edge of the slab than the row of stakes and in no circumstances shall a guide wire be anchored to a stake.

7 The stakes shall be positioned and the connectors maintained at their correct height and alignment from 1200 hours on the day before concreting takes place until 36 hours after the concrete has been finished. The guide wire shall be erected and tensioned on the connectors at any section for at least two hours before concreting that section.

1021 Delivery, Storage and Batching of Concreting Materials

1 Cement shall be kept dry and used in the order in which it is delivered to the Site. Different types of cements shall be stored separately. Silos for storing pfa shall be equipped with aerators to ensure free flow within the silo.

2 Aggregate for roadworks shall be delivered to and stored on the Site in one of the following ways:

- (i) in separate nominal single sizes of coarse aggregate and sand (ie fine aggregate);
- (ii) as graded coarse aggregate of appropriate size and sand (ie fine aggregate);
- (iii) as mixes of coarse aggregates from separate sources blended off site and sand (ie fine aggregate);
- (iv) as all-in aggregate for grades C20 or below.

3 Aggregate brought on to the Site shall be kept free from contact with deleterious matter. Sand nominally below 5 mm sieve size shall have been deposited at the site for a time sufficient to permit the moisture content to stabilise before use.

4 Batching plant and storage for aggregate shall comply with the following requirements as appropriate to the method of delivery:

- (i) If separate gradings of aggregate are stockpiled, separate accommodation shall be provided for each nominal size of coarse aggregate or blend of sand (ie fine aggregate). The bases for stockpiles shall be suitably surfaced to prevent contamination of the aggregate. Drainage of the stockpile bases shall be provided.
- (ii) Aggregate shall be measured by mass and provision shall be made for batching each nominal size or blend of aggregate separately, to the tolerances specified in BS 5328 : Part 3.
- (iii) All-in aggregate shall be delivered and stockpiled in such a manner and to a height that avoids segregation.

1022 Mixing Concrete

1 Concrete shall be mixed on or near to the Site in a stationary batch type mixer in compliance with BS 5328 : Part 3. Ready mixed concrete may be used for small areas only.

2 The drums or blades of all mixers shall be operated at the speed used for testing, in accordance with BS 3963 for the mix proportions required, within a tolerance of ± 1 revolution per minute. The mixing blades of a pan mixer shall be maintained within the tolerances specified by the manufacturers of the mixer and the blades shall be replaced when it is no longer possible to maintain the tolerances by adjustment. All drums or pans which have been out of use for more than 30 minutes shall be cleaned before any fresh concrete is mixed in them.

3 The rated output of the batching and mixing plant shall exceed by at least a third the amount of concrete that is required at a constant rate to

enable the paving train to move forward continuously, at the planned rate of progress.

4 The temperature of the water for mixing with cement shall not exceed 60°C.

5 Ready mixed concrete shall comply with this Series and the following special requirements. The concrete shall be carried in purpose made agitators, operating continuously, or truck mixers. The concrete shall be compacted and in its final position within 2 hours of the introduction of cement to the aggregate. The time of such introduction shall be recorded on the delivery note together with the weight of the constituents of each mix. When concrete is transported in a truck mixer, water shall be added under supervision either at the site or at the central batching plant, but in no circumstances shall water be added in transit.

1023 Transport and Delivery

1 Freshly mixed concrete may be transported in tipping or ejector trucks, or truck mixers or agitators operating continuously. The mixed material shall be protected during transit and while awaiting discharge to prevent wetting by rain or evaporation of moisture. It shall be transported and delivered so that segregation or loss of the constituent materials is reduced to the minimum.

2 The number of delivery vehicles provided shall be sufficient to ensure a constant supply of concrete to enable the paving plant to proceed continuously.

1024 Construction by Machine

1 The concrete slab shall be constructed in a continuous process by either slip-form or by fixed form paving plant in accordance with this Clause or by small paving machines or hand guided methods as in Clause 1025.

2 The slab may be constructed in either one or two layers. In two layer construction the

thickness of the top layer shall be not less than 50 mm or twice the maximum size of the coarse aggregate, whichever is the greater, and shall be at least 15 mm thicker than the depth of the groove former, if used.

Construction by Fixed Form Paving Machines

3 A fixed form paving train shall consist of separate, powered machines which spread, compact and finish the concrete in a continuous operation.

4 Concrete shall be discharged without segregation into a hopper spreader which is equipped with the means of controlling its rate of deposition on to the sub-base or on to the lower layer. The concrete shall be spread in each layer without segregation and to a uniform uncompacted density over the whole area of the slab. The deposited concrete shall be struck off to the necessary level by the underside of the hopper as it is traversed across the spreading machine. The machine shall be capable of being rapidly adjusted for changes in average and differential surcharge necessitated by changes in slab thickness or crossfall. When the slab is constructed in two layers, the spreading of the concrete in the top layer shall follow the completion of the bottom layer within the times given in Table 10/6.

5 Prior to being compacted, the surface level of each loose spread layer shall be adjusted to the correct surcharge by means of rotating strike-off blades or a screw device.

6 The concrete shall be compacted by vibration or by a combination of vibration and mechanical tamping so as to comply with Clause 1003 throughout the full depth of the slab. Poker vibrators shall be used in each layer adjacent to the side forms and the edge of a previously constructed slab.

7 The initial regulation and finish to the surface of the slab shall be effected by means of a beam oscillating transversely or obliquely to the longitudinal axis of the pavement. This beam

shall be readily adjustable for both height and tilt.

8 Joint grooves shall be constructed in compliance with Clause 1013. When grooves are wet-formed, the concrete shall be re-compacted around the former by a hand held vibrating plate compactor drawn along or on each side of the joint, prior to the final regulation of the surface by a longitudinal oscillating float.

9 The regulation and finishing of the surface of the slab shall be carried out by a machine which incorporates twin oblique oscillating finishing beams which shall be readily adjustable for both height and tilt. The beams shall weigh not less than 170 kg/m, be of rectangular section and span the full width of the slab. The leading beam shall be vibrated. The beams shall be supported on a carriage, the level of which shall be controlled by the average level of not less than four points evenly spaced over at least 3.5 m of the supporting rail, beam, or slab, on each side of the slab that is being constructed. Except for CRCR slabs, the final regulation of the surface of the slab shall be provided by a longitudinal oscillating float, traveling across the slab. After the final regulation and before the texture is applied, any excess concrete on top of the joint groove former, where present, shall be removed. Additionally the longitudinal oscillating float shall complete the traverse of the slab in both directions within the length of the float and shall have a total longitudinal stroke of 200 mm to 300 mm.

10 The longitudinal oscillating float shall have a minimum length of 3 m and a minimum constant width of 250 mm with a maximum weight of 10 kg/m. The edges of the float shall be curved or chamfered.

11 A minimum length of 500 mm of longitudinal oscillating float shall be within the length of the machine tracks or wheels.

12 When a concrete slab is constructed in more than one width, flanged wheels on the paving machines shall not be run directly on the surface of any completed part of the slab. The second or subsequent slabs shall be constructed either by

supporting machines with flanged wheels on flat-bottom section rails weighing not less than 15 kg/m laid on the surface of the completed slab, or by replacing the flanged wheels on that side of the machines by smooth flangeless wheels. Before flangeless wheels or rails are used, the surface regularity of the slab over which they are to pass shall comply with Clause 702 (table 7/3, case a) and its surface shall be thoroughly cleaned and brushed to remove all extraneous matter. Flangeless wheels or rails shall be positioned sufficiently far from the edge of the slab to avoid damage to that edge.

Construction by Slip-form Paving Machine

13 A slip-form paving train shall consist of powered machines which spread, compact and finish the concrete in a continuous operation.

14 The slip-form paving machine shall compact the concrete by internal vibration and shape it between sliding side forms or over fixed side forms by means of either a conforming plate or by vibrating and oscillating finishing beams.

15 The concrete shall be deposited without segregation in front of the slip-form paver across its whole width and to a height which at all times is in excess of the required surcharge. The deposited concrete shall be struck off to the necessary average and differential surcharge by means of a strike-off plate or a screw auger device extending across the whole width of the slab. The equipment for striking off the concrete shall be capable of being rapidly adjusted for changes of the average and differential surcharge necessitated by changes in slab thickness or crossfall.

16 The level of the conforming plate and finishing beams shall be controlled automatically from the guide wires by sensors attached at the four corners of the slip form paving machine. The alignment of the paver shall be controlled automatically from the guide wire by at least one sensor attached to the paver. The alignment and level of ancillary machines for finishing, texturing and curing of the concrete shall be automatically controlled relative to the guide wire or to the surface and edge of the slab.

17 Slipform paving machines shall have vibration of variable output, with a maximum energy output of not less than 2.5 kW per metre width of slab per 300 mm depth of slab for a laying speed of up to 1.5 m per minute or pro rata for higher speeds. The machines shall be of sufficient mass to provide adequate reaction on the traction units to maintain forward movements during the placing of concrete in all situations.

18 Except for CRCR slabs, the final regulation of the surface slab shall be provided by a longitudinal oscillating float travelling across the slab. The longitudinal float shall comply with the requirements of sub-Clauses 9, 10 and 11 of this Clause. Additionally, the longitudinal float shall either be a separate machine closely following a slipform paver or alternatively it shall be attached to a slipform paver in such a manner that it functions effectively and does not adversely affect the performance of the paver or the surface of the slab.

19 Joint grooves shall be constructed in compliance with Clause 1013. Where grooves are wet-formed the concrete shall be compacted around the former by a separate vibrating plate compactor with twin plates. The groove former shall be compacted to the correct level by a vibrating pan which may be included with the transverse joint finishing beam. Final finishing shall be carried out in accordance with sub-Clause 18 of this Clause. Any excess concrete on top of the groove former shall be removed before the surface is textured.

20 Where a concrete slab is constructed in more than one width or where the edge needs to be matched for one level to another section of surface slab, and the surface levels at the edges are not achieved, the slab shall be supported by separate side forms placed before or after the paver to ensure that edge levels meet the required tolerances.

General

21 While the concrete is still plastic its surface shall be brush-textured in compliance with Clause 1026 and the surface and edges of surface slabs and CRC roadbases shall be cured in compliance with Clause 1027. Other roadbase or sub-base slabs shall be cured as in sub-Clause 1035.16.

22 The spreading, compacting and finishing of the concrete shall be carried out as rapidly as possible and the paving operation shall be so arranged as to ensure that the time between the mixing of the first batch of concrete in any transverse section of the slab and the application of the sprayed curing membrane to the surface of that section shall not exceed those given in Table 10/6.

23 Each bay in jointed concrete surface slabs shall be consecutively numbered near the verge, next to a transverse joint while the concrete is plastic. In continuously reinforced concrete pavement the slab shall be marked with the chainage at intervals not greater than 50 m apart.

1025 Construction by Small Paving Machines or Hand Guided Methods

1 As an alternative to fixed form or slip-form paving trains, the concrete slab may be constructed using parts of trains, small paving machines, truss type finishing beams or hand guided methods. Hand tamping beams may only be used for short lengths or infill bays or tapers. Reinforcement, dowel bars and tie bars shall be supported in position in accordance with Clauses 1008, 1011 and 1012 respectively, except where two layer construction is used and reinforcement is placed on the bottom layer.

TABLE 10/6: Maximum Working Times

Temperature of concrete at discharge from the delivery vehicle	Reinforced concrete slabs constructed in two layers, without retarding admixtures		All other concrete slabs	
	Mixing first layer to finishing concrete	Between layers	Mixing first layer to finishing concrete	Between layers in two layers work
Not more than 25 °C	3 hours	Half hour	3 hours	1.5 hours
Exceeding 25 °C but not exceeding 30 °C	2 hours	Half hour	2 hours	1 hour
Exceeding 30 °C	Unacceptable for paving	-	Unacceptable for paving	-

2 The concrete shall be spread uniformly without segregation or varying degrees of pre-compaction, by conveyor, chute, blade or auger. The concrete shall be struck off by a screed or auger so that the average and differential surcharge is sufficient for the surface of the slab to be at the correct levels after compaction of the concrete.

3 The concrete shall be compacted by vibrating finishing beams across the slab and with vibrating pokers adjacent to the side forms or the edge of a previously constructed slab. In addition, internal poker vibration shall be used for slabs thicker than 200 mm and may be used for lesser thicknesses. When used, the pokers shall be at points not more than 500 mm apart over the whole area of the slab, or drawn continuously across the slab in front of the finishing beams.

4 The finishing beams shall be metal with a contact face at least 50 mm wide. They shall be rigid or supported by a frame or truss without sag across the width of slab being paved. The beams shall be supported on rails or forms or an adjacent slab and shall be moved forward at a steady speed of 0.5 m to 2 m per minute whilst vibrating, to compact the concrete and to produce a smooth surface finished to the correct crossfalls, crowns and levels relative to the top of the forms or adjacent slab.

5 Joint grooves shall be constructed in compliance with Clause 1013. Any

irregularities at wet-formed joint grooves shall be rectified by means of a vibrating float at least 1.0 m wide drawn along the line of the joint. The whole area of the slab shall be regulated by two passes of a scraping straight edge not less than 1.8 m wide or by a further application of a twin vibrating finishing beam. Any excess concrete on top of the groove former shall be removed before the surface is textured.

6 The surface shall be brush-textured as described in Clause 1026.

7 The surface shall be cured in compliance with Clause 1027, within the time to completion given in Table 10/6.

1026 Finished Surface Requirements

Texture of Running Surfaces

1 The finished surface of the pavement shall comply with the requirements of Clause 702. Instead of irregularities of 4mm for construction classes HD I to III, irregularities up to 6mm are permitted for construction classes IV to VI and for hand guided methods. Where a pavement area does not comply with the Specification in any respect the full extent of the surface which does not comply shall be rectified in accordance with Clause 702.

2 After the final regulation of the surface of the slab and before the application of the

curing membrane, the surface of concrete slabs to be used as running surfaces shall be brush-textured in a direction at right angles to the longitudinal axis of the carriageway. The texture shall be applied evenly across the slab in one direction by a brush not less than 450 mm wide. The texture shall be uniform both along and across the slab.

3 The texture depth shall be determined by the sand patch test as described in Clause 1031. Tests shall be taken within 100 m of commencement of paving and thereafter at least once for each day's paving at the times after construction as given below and in the following manner: 10 individual measurements of the texture depth shall be taken at least 2 m apart anywhere along a diagonal line across a lane width between points 50 m apart along the pavement. No measurement shall be taken within 300 mm of the longitudinal edges of a concrete slab constructed in one pass.

4 Texture depths shall be as required in Table 10/7.

5 Where the required texture depth is found to be deficient the Contractor shall make good the texture across the full lane width over lengths necessary to comply with the requirements of Table 10/7, by retexturing the hardened concrete surface as described in Clause 1029. Failure to achieve a satisfactory minimum texture depth by random grooving shall result in the removal of the full thickness of the slab to the extent required to permit reconstruction of the slab in accordance with the Specification. If the texture depth is excessive the surface shall be planed or ground or otherwise treated over lengths necessary to comply with the requirements of Table 10/7. The treatment shall not affect the requirements of Clause 702 in respect of surface levels or surface regularity.

TABLE 10/7: Texture Depths

Time of Test	Required Texture Depth (mm)		
		Specified Value	Tolerance
(i) Between 24 hours and 7 days after the construction of the slabs or until the slab is first used by vehicles	An Average of 10 measurements	1.00	+ 0.25
(ii) Not later than 6 weeks before the road is opened to public transport	An average of 10 measurements	1.00	+ 0.25 - 0.25

Texture of Concrete Roadbases

6 The surface of wet-laid concrete roadbases shall be roughened before the application of any curing compound by brushing with a wire brush or stiff broom.

1027 Curing

1 Immediately after the surface treatment described in Clause 1026, the surface and exposed edges of surface slabs shall be cured for a minimum period of 7 days, (unless the Engineer agrees to a shorter period but not less than 3 days) by the application of an approved resin based aluminised curing compound, or polythene sheeting or an approved sprayed plastic film which hardens into a peelable plastic sheet and which shall be removed before road marking and opening to traffic. Curing by keeping the surface and the vertical faces continuously moist is also possible if the required strength will be achieved.

2 Resin based aluminised curing compound shall contain sufficient flake aluminium in finely divided dispersion to produce a complete coverage of the sprayed surface

with a metallic finish. The compound shall become stable and impervious to evaporation of water from the concrete surface within 60 minutes of application and shall have an efficiency index of 90% when tested as described in BS 7542.

3 The curing compound shall not react chemically with the concrete to be cured and shall not crack, peel or disintegrate within three weeks after application.

4 Prior to application, the contents of any containers shall be thoroughly agitated. The curing compound shall be mechanically applied using a fine spray on to the surface at a rate of at least 0.22 l/m^2 . For the sides of slip-formed slabs or when the side forms are removed within 24 hours and for small areas where mechanical application cannot be used, the compound shall be sprayed by hand lance at a rate of at least 0.27 l/m^2 . The rate of spread shall be checked during construction of each trial length and for each 1000 m^2 of treated slab or per day.

5 The mechanical sprayer shall incorporate an efficient mechanical device for continuous agitation and mixing of the compound in its container during spraying.

6 Continuously reinforced concrete base courses shall be cured in accordance with this Clause. Wet lean concrete base courses and sub-bases shall be cured in accordance with sub-Clause 1035.16.

7 To achieve high early strength for early use by vehicles, insulation blankets as described in Clause 1045 and clause 703 shall be used for accelerated curing.

8 During laying and for a period of 2 hours after laying the surface shall be protected from rain damage by the use of tentage.

1028 Trial Length General

1 Except in rapid construction projects and unless otherwise described in Appendix 7/1, at least three months prior to the construction of the trial length of surface slabs or CRCR the Contractor shall submit a detailed description of the proposed materials, mix proportions, plant, equipment and construction methods. No trials of new materials, plant, equipment or construction methods; nor any development of them shall be permitted either during the construction of the trial length or in any subsequent paving work, unless they form part of further satisfactory trials.

2 Unless otherwise described in Appendix 7/1, the Contractor shall demonstrate the materials, mix proportions, plant, equipment and methods of construction that are proposed for concrete paving, by first constructing a trial length of slab, at least 150 m but not more than 300 m long for 23 mechanised construction, and at least 30 m long for hand guided methods. The mix proportions decided by trial mixes may be adjusted during the trial but shall not be changed once the trial length has been satisfactorily completed unless the Contractor lays a further trial area to assess the suitability of the proposed changes.

3 The trial length shall be constructed in two parts over a period comprising at least part of two separate working days, with a minimum of 75 m constructed each day when mechanised paving plant is used and a minimum of 15 m on each day for hand guided methods. The trial length shall be constructed at a similar rate to that which is proposed for the main construction in the Permanent Works.

4 At least two transverse joints and one longitudinal joint of each type that are proposed for unreinforced concrete slabs and jointed reinforced concrete slabs in the main construction in the Permanent Works shall be constructed and assessed in the trial length. If in the trial length expansion joints are not demonstrated, the first 2 expansion joints and at least the first 150 m of longitudinal construction joint for mechanised paving, or 30 m for hand guided method of construction laid in the main construction in the Permanent Works, shall be considered the trial length for these joints. One construction joint shall be demonstrated in each trial length of CRCP or CRCR.

Assessment

5 The trial length shall comply with the Specification in all respects, with the following additions and exceptions:

Surface Levels and Irregularity

- (i) In checking for compliance with Table 7/1 the levels shall be taken at intervals of not more than 2.5 m along any line or lines parallel to the longitudinal centre line of the trial length.
- (ii) The maximum number of permitted irregularities of pavement surfaces shall comply with the requirements of Table 7/3 for 300 m lengths. Shorter trial lengths shall be assessed pro-rata based on values for a 300 m length.

Joints

- (iii) At least 3 cores of minimum diameter 100 mm shall be taken from the slab at joints to check the lateral and vertical

location of joint grooves and bottom crack inducers.

- (iv) After a minimum of 24 hours after construction the removable part of the joint groove former shall be taken out of at least three joints and the sides of the groove shall be inspected for compaction. If there are voids the size and number should be compared with a similar size section of the photograph for 3% excess voidage in BS 1881 : Part 120. If there is excess voidage, additional compaction shall be provided and further joints inspected. The joints so exposed shall be temporarily or permanently sealed.
- (v) Alignment of dowel bars shall be inspected as described in Clause 1019 in any two consecutive transverse joints. If the position or alignment of the dowel bars at one of these joints does not comply with Clause 1011 but if that joint remains the only one that does not comply after the next 3 consecutive joints of the same type have been inspected then the method of placing dowels shall be deemed to be satisfactory. In order to check sufficient joints for dowel bar alignment without extending the trial length unduly, the Contractor may construct joints at more frequent joint intervals than the normal spacing required in Appendix 7/1.
- (vi) If there are deficiencies in the first expansion joint that is constructed as a trial the next expansion joint shall be a trial joint. Should this also be deficient further trial expansion joints shall be made as part of a trial length. Deficient expansion joints shall not form part of the Permanent Works.

Density

- (vii) Density shall be assessed as described in Clause 1003 from at least 3 cores drilled from each part of the trial length.

Position of Reinforcement and Tie Bars

- (viii) Compliance with Clause 1008 for the position of steel reinforcement and Clause 1012 for the position and alignment of tie bars shall be checked by drilling additional cores from the slab unless they can be determined from cores taken for density assessment.

Completion of Trial

6 The Contractor shall not proceed with normal working unless the trial length complies with the Specification and any earlier defective trial lengths have been removed, unless they can be remedied to comply with the Specification.

7 After satisfactory completion of the trial length, the materials, mix proportions, plant, equipment and construction methods shall not thereafter be changed, except for normal adjustments and maintenance of plant, unless the Contractor lays a further trial length as described in this Clause to demonstrate that the changes will not adversely affect the Permanent Works or agrees the changes with the Overseeing Organisation.

Rejection and Further Trials

8 Trial lengths which do not comply with the Specification, with the exception of areas within the pavement surface which can be remedied in accordance with Clause 1029,

shall be removed and the Contractor shall construct a further trial length.

1029 Texturing of Hardened Concrete

1 Worn, rain damaged or inadequately textured surface slabs shall be textured by sawing grooves in the hardened concrete surface at right angles to the longitudinal axis of the pavement with machines using diamond or other abrasive cutting discs.

2 Grooves shall be irregularly spaced and shall be not less than 2 mm and not more than 5 mm wide. The sequence of distances between groove centres in mm shall be:- 40, 45, 35, 45, 35, 50, 30, 55, 35, 30, 50, 30, 45, 50, 30, 55, 50, 40, 35, 45, 50, 40, 55, 30, 40, 55, 35, 55. A tolerance of ± 3 mm shall be allowed on each of the spacings. The minimum width of grooving head shall be 500 mm and a head not providing a complete sequence of spacings shall use the number of spacings appropriate to its width commencing at the start of the sequence.

3 Groove depths shall be measured using a tyre tread depth gauge and measurements shall be taken as follows:

- (i) At 10 locations at least 2 m apart along a diagonal line across a lane width between points 50 m apart longitudinally. No measurement shall be taken within 300 mm of the longitudinal edge of a slab.
- (ii) At each of the 10 locations the depth of 10 adjacent grooves shall be measured.
- (iii) Where a grooved area is less than 50 m in length the locations where measurements are taken shall be as (i)

but the number shall be proportional to the requirements for 50 m.

- (iv) The average of each set of 10 measurements shall be not less than 3 mm, nor greater than 7 mm.

4 Slurry from the sawing process shall be prevented from flowing into joints, drains or into lanes being used by traffic, and all resultant debris from the grooving shall be removed.

1030 Wet Lean Concrete

Wet Lean Concrete is the term describing lower strength concretes which are suitable only for sub-bases if the pavement Design method takes so called sub-bases into consideration. The Directives for the standardization of pavements for Traffic Areas doesn't provide these types of pavement constructions

1031 Measurement of Texture Depth-Sand Patch Method

1 The following apparatus shall be used:

- (i) a cylindrical container 25 ml internal capacity for concrete surfaces;
- (ii) a flat wooden disc 64 mm diameter with a hard rubber disc, 1.5 mm thick, stuck to one face, the reverse face being provided with a handle;
- (iii) dry natural sand with a rounded particle shape passing a 300 micron BS sieve and retained on a 150 micron BS sieve.

Method

2 The surface to be measured shall be dried, any extraneous mortar and loose material

removed and the surface swept clean using a wire brush both at right angles and parallel to the carriageway. The cylinder shall be filled with the sand, tapping the base 3 times on the surface to ensure compaction, and striking off the sand level with the top of the cylinder. The sand shall be poured into a heap on the surface to be tested. The sand shall be spread over the surface, working the disc with its face kept flat, in a circular motion so that the sand is spread into a circular patch with the surface depressions filled with sand to the level of the peaks.

3 The diameter of the patch shall be measured to the nearest 5 mm. The texture depth of concrete surfaces shall be calculated from:

$$\frac{31000 \text{ mm}}{D^2}$$

where D is the diameter of the patch in mm.

1032 Thin Bonded Repairs Materials

1 Cement mortar shall be used for depths less than 20 mm and fine concrete for greater depths. Resin mortar may only be used for small patch repairs less than 1 metre long and less than 30 mm in depth and where insufficient time for adequate curing of a cementitious cement mortar exists.

2 The cements, aggregates, admixtures and water shall comply with Clause 1001. The sand (ie fine aggregate) for mortars or fine concrete shall be within the limits of Grades C or M of BS 882. Coarse aggregate for fine concrete shall be 10 mm single sized aggregate complying with BS 882. All aggregates shall have the same thermal properties as the aggregate in the original concrete, and match other properties as closely as possible. Filler and aggregate for resin mortars shall be repacked in the

correct proportions and mixed with the resin all in accordance with the manufacturer's instructions.

3 The proportions of cement, admixtures, additives to water and aggregates shall be sufficient to provide high early strength mortar or fine concrete or concrete complying with Clauses 1001, 1003 and 1004. For cement mortar the sand (ie fine aggregate) to cement ratio shall not be greater than 3. For resin mortar the sand content shall be in accordance with the manufacturer's requirements in the range between 7 and 11 to 1 of resin. High early strength concrete shall be able to achieve 25 N/mm² in less than 48 hours. For thin bonded repairs using high early strength concrete less than 30 mm depth, air entrainment is not required.

Procedure

4 Mark out the area to be rectified parallel and perpendicular to the axis of the road. Cut a groove around the perimeter at least 10 mm deep without overcutting into the adjacent slab. Carefully cut out the concrete to the required depth, with a vertical face without undercutting the adjacent slab.

5 If a joint is included in the area to be rectified, fix a groove former along the line of the joint by chasing out a groove. For joints on the perimeter fix the groove former by adhesive to the adjacent slab.

6 For cementitious repairs, wet the area of the patch. Keep it wet until the repair material is ready to be placed. Remove excess water, prime the surfaces with cement grout or bonding agent, spread the repair material immediately before the primed

surface is dry, with sufficient surcharge. Thoroughly compact it by vibration ensuring full compaction at the edges and corners.

7 Retexture the surface to match the surrounding concrete and cure in accordance with Clause 1027.

8 For resin mortar repairs, ensure the area is dry before application of the primer. Place the repair material within the time allowed by the manufacturer for the primer, and compact it well into the edges to the patch. Apply a brush texture to match the original.

1033 Full Depth Repairs and Reinstatements General

1 Full depth repairs shall be repairs which will require full depth reinstatement of the concrete slab in accordance with this Clause to the extent instructed by the Overseeing Organisation, which repairs may also require reinstatement of sub-base. Full width repairs shall be repairs over the full width of a bay or bays. Part width repairs shall be repairs over part of the width of a bay or bays. A bay shall be that portion of the concrete pavement bounded by adjacent longitudinal and transverse joints.

2 The area of concrete to be removed shall be marked out perpendicular to and parallel to the axis of the road.

For continuously reinforced concrete slabs (CRCP or CRCR) the edge of the repair shall be not less than 0.5 m from the nearest crack and not less than 3 m from a transverse construction joint at ground beam anchorages. Where this and the provisions of sub- Clause 3 of this Clause would otherwise require a longitudinal repair joint within 1 m of the existing longitudinal joint or edge, the

repair shall be extended to align with that longitudinal joint or edge.

Part Width Repairs

3 Providing all the following criteria are met, part width repairs may be carried out in accordance with sub-Clause 4 of this Clause:

- (i) the transverse width of the repair shall not exceed 45% of the width of the slab under repair; and
- (ii) the longitudinal joint which would be formed by the repair shall not occur within the wheeltrack; and
- (iii) the minimum transverse width of the repair shall not be less than 1.0 m.
If these criteria and those in sub-Clause 2 of this Clause cannot be met, a full-width repair shall be made in accordance with this Clause.

Full Width Repairs

4 For full width repairs the following criteria shall apply unless otherwise specified in Appendix 7/2:

- (i) Repair lengths which do not replace an existing transverse joint shall be constructed with two transverse contraction joints and the longitudinal joint shall have tie bars in repair lengths which are greater than 1 metre.
- (ii) Repair lengths which replace a single existing transverse joint shall be constructed with two transverse joints: one expansion and one contraction. The new expansion joint shall be formed at the end which will have the

shortest longitudinal distance between this joint and the joint in the adjacent lane(s). The longitudinal joint(s) between the existing joint(s) and the new expansion joint shall be constructed without tie bars and shall have 5 mm thick compressible foam within the joint for the full depth of the concrete slab. The longitudinal joint between the new contraction joint and the joint in the adjacent bay(s) shall be constructed with tie bars where the exposed length so permits.

- (iii) Repair lengths which replace more than one existing transverse joint shall be constructed with transverse joints to match expansion and contraction joints in the adjacent bay(s). Where the repair length does not replace an existing expansion joint, one end joint shall be formed as an expansion joint. Except for the end joints all transverse joints shall be formed to coincide with the existing transverse joints. Where one end joint is an expansion joint, the longitudinal joint(s) between the existing joint(s) and the new expansion joint shall be constructed without tie bars and shall have 5 mm thick compressible foam within the joint for the full depth of the concrete slab. All other longitudinal joints shall be constructed with tie bars.

Repair Work

5 A groove of 40 mm nominal depth but less than the depth of any reinforcement shall be sawn around the perimeter. For jointed slabs, the saw-cut shall be full depth to provide the face for a new joint. There shall be no over-cutting into the adjacent slab. Additional cuts within the repair area may be made to ease removal of the redundant portion of the slab. At internal corners full depth holes

across the corners at the limits of the saw cuts shall be drilled prior to breaking out.

The line of cut shall not vary by more than ± 25 mm throughout its length from the set out line. All sawn edges shall be perpendicular or parallel to the sides and surfaces of the slab.

When sawing operations have been completed, and before any other operations are commenced, the surface of the carriageway shall be thoroughly cleaned of the slurry produced by sawing and of any other detritus.

6 The concrete shall be carefully broken out without undercutting the slab or damaging adjoining slabs. If reinforcement has to be removed sufficient shall be left for a lap length, except where a dowelled joint is being made. Reinforcement shall not be bent and subsequently straightened. Slurry from sawing, slab breaking, repair materials and other debris shall be prevented from entering joints and grooves in adjacent areas.

7 When a new joint is required holes shall be drilled of the appropriate size and depth for dowels or tie bars according to the type of joint. These holes shall be thoroughly cleaned of debris and dust. This shall include but not be limited to the use of oil-free compressed air at a pressure of not less than 0.5 N/mm².

Dowels and tie bars shall comply with the requirements of Clauses 1011 and 1012 respectively. Epoxy mortar shall be to the manufacturer's recommendation for this specific application.

The holes shall be filled with epoxy mortar, the mortar being injected to the rear of the hole to avoid air entrapment. The dowel bars shall be inserted into the holes before the

initial set of the mortar. If cartridges of epoxy mortar are used they shall be inserted into each hole, the dowel bar inserted through the cartridges and rotated for 1 minute to ensure that the epoxy mortar is well mixed. After insertion the dowels and tie bars shall be within the specified tolerances for alignment.

Where repairs straddle a movement joint with an adjacent slab, tie bars shall be omitted and the joint between the slabs debonded to ensure that movement patterns are not restricted.

Where Appendix 7/1 or the drawings so require, full bay replacement shall be made and this may require an expansion joint or a contraction joint to be provided at the ends of the replaced bay.

8 Expansion joint filler shall be fixed to one of the transverse joints. In the other transverse joint, contraction joint groove forming strip seals shall be fixed to the edges of the adjacent concrete. If the repair is adjacent to another slab, bond between the two slabs shall be prevented by providing full depth 5 mm thick compressible foam strips to Clause 1014 along the longitudinal joint between them.

9 The sub-base layer and any separation membrane shall be reinstated as necessary to comply with Series 800 and Clause 1007 respectively.

Defective sub-base material shall be removed and the sub-base reinstated to the correct level with the material described in Appendix 7/2. Reinstatement of the subbase shall be completed before new dowel and tie bars are fixed at the joints.

10 New reinforcement shall be lapped and welded or tied. The length of tied laps shall

be 35 bar diameters or 450 mm whichever is the greater for longitudinal bars and 300 mm for transverse bars. Welded laps shall be 150 mm minimum length unless a butt-weld process has been permitted in Appendix 7/1.

11 The reinstated concrete shall be placed, spread, compacted and finished as specified in Clause 1025. Particular care shall be taken to ensure full compaction at the edges. The concrete shall be normal or high early strength pavement concrete, complying with Clauses 1001 to 1005 and shall achieve the required characteristic strength prior to opening to traffic.

Crack Repairs

12 Stitched crack repairs shall be either

Type 1 - Staple Tie Bar Repair
Type 2 - Diagonal Tie Bar Repair

as described in Appendix 7/2 and compliant with sub- Clauses 13 and 14 of this Clause.

The extent of crack repairs shall be determined by inspection after the surface has been cleaned.

13 For Type 1 crack repairs, slots 25 - 30 mm wide by 470 mm long at 600 mm centres and at right angles to the line of the crack shall be chased out to a depth such that, when bedded, the tie bars lie between $\frac{1}{3}$ and $\frac{1}{2}$ of the depth of the slab below the surface.

Holes of 25 mm - 30 mm diameter by 50 mm deep shall be drilled at each end of the slot and the slots cleaned out using oil free compressed air.

When in a dry state the slots shall be primed and the staple tie bars placed into beds of

epoxy mortar and covered to a minimum depth of 30 mm with the same material.

The sides of the slots shall be cleaned of loose material and the slots filled with thoroughly compacted epoxy or cementitious mortar as described in Appendix 7/2.

After curing a groove shall be sawn along the line of the crack and sealed in accordance with Clause 1016.

14 For Type 2 crack repairs drilling points shall be marked out at a distance from the crack equivalent to the depth of the slab, at 600 mm intervals along the crack with alternate points on opposite sides of the crack.

Holes of 16 mm minimum diameter shall be drilled at right angles to the crack and at approximately 26° to the surface of the slab to a depth which allows 50 mm cover at the bottom of the slab. These holes shall be thoroughly cleaned of debris and dust.

12 mm diameter grade 460 deformed steel tie bars shall be notched at a point which will ultimately be 50 mm below the slab surface when the bars are fully inserted into the hole.

Each hole shall be filled with epoxy mortar and its quantity adjusted to ensure that when the tie bar is fully inserted the level of the mortar is up to a point which is 25 mm below the notch on the tie bar. Such adjustment of the epoxy mortar and the final insertion of the tie bar shall be done rapidly to ensure its completion before the initial set of the mortar. After the epoxy mortar has set, the length of tie bar above the notch shall be broken off. Once all these bars have been broken off, the tops of all these holes shall be filled with epoxy mortar.

If cartridges of epoxy mortar are used the bars shall be inserted through the cartridges and rotated for 1 minute to ensure that the adhesive is well mixed.

Joint Grooves and Seals

15 Longitudinal joint grooves shall be recut where directed in Appendix 7/2 using the following procedure.

The longitudinal joint shall be saw cut to a nominal width of 10 mm to encompass the existing joint and to sufficient depth to remove the existing sealant approximately 25 mm deep. Where existing sealant or traces thereof cannot be removed within the 10 mm saw cuts the groove shall be widened to enable all existing sealant to be removed. The groove sides shall be vertical, and the horizontal alignment of the groove shall be straight and parallel to the edge of the slab.

The concrete and sealant shall be removed between the saw cuts without damaging the sides of the groove.

The base of the groove shall be formed to a uniform profile suitable for the application of debonding tape or caulking material.

Any residual traces of sealant or detritus shall be removed from the groove and the groove prepared for sealing in accordance with Clause 1016.

16 Transverse joint grooves shall be recut where directed in Appendix 7/2 using the following procedure.

The transverse joint shall be saw cut to form a groove to satisfy the dimension of applied joint seals as specified in Table 10/5

TABLE 10/8: Rates for Sampling and Testing Concrete for Pavement Layers

allowing for debonding tape or any necessary caulking material of at least 5 mm uncompacted depth and to encompass the existing joint.

The groove sides shall be vertical, and the horizontal alignment of the groove shall be straight and parallel to the line of the joint.

The concrete and sealant shall be removed between the saw cuts without damaging the sides of the groove.

The base of the groove shall be formed in accordance with Clause 1017.

Any residual traces of sealant or detritus shall be removed from the groove and the groove prepared for sealing in accordance with Clause 1016.

17 The joints shall be sealed in accordance with Clause 1016.

1034 Summary of Rates for Sampling and Testing Concrete for Pavement Layers

- 1** Table 10/8 summarises the minimum rates of sampling and testing of specimens for ensuring compliance with the Specification.
2 Samples for testing shall be taken at the point of placing or from the relevant pavement layer.

Clause	Test	Rate (the greater number shall be used)	
1003	Density	a) Main slab	3 Cores per 600m ² or per day
		b) Trial length	3 Cores per trial length
1004	(A) Strength of cubes	a) Main slab	1 set of 4 cubes per 600 m ² or per day One of each set tested at 7 days Three of each set tested at 28 days Groups of 4 results assessed as in BS 5328 : Part 4
		b) Slabs less than 600 m ²	4 cubes per 100 m ² Two cubes tested at 7 days Two cubes tested at 28 days and assessed as in BS 5328 : Part 4
	(B) Strength of cores		Three cores per 600m ² or per day
1005	Workability	a) Main Slab	1 per 300 m ² or 6 per day
		b) Slabs less than 300 m ²	1 per 20 m length or 3 per day
1016	Hot or cold applied joint sealants	Penetration test	One sample per 1000 m joint or at least one per day
1019	Inspection of dowel alignment	a) Main slab	1 joint per 1500m length or 1 joint per 5 days whichever is the sooner
		b) Slabs less than 1500 m in length	At a rate of one joint for up to each 100 joints
		c) Trial lengths	2 consecutive joints If one defective, inspect next 3 consecutive joints
1026	Texture depth	Each lane width	One within 100 m of commencement of paving and thereafter at least one set of 10 measurements per day's work.

1035 General Requirements for Cement Bound Materials

1 Cement-bound materials shall be made and constructed as described in the following Clauses. The permitted alternatives for each part of the Works shall be as described in Appendix 7/1.

2 Cement-bound materials shall comply with

Table 10/9 and be tested in accordance with Clause 1040.

Constituents

3 Cement shall comply with Clause 1001 sub- Clauses 3(i), 3(ii), and 3(iv). Water shall comply with sub-Clause 1001.4.

4 Granular material for use in CBM shall comply with Clause 1037 or 1038 as appropriate.

5 Cement for use in all cement-bound materials and aggregates for use in CBM2, and CBM4 shall be delivered and stored in compliance with Clause 1021.

Batching and Mixing

6 Batching shall be carried out by mass. Mixing shall be carried out by the mix-in-plant method. The materials shall be batched and mixed in compliance with BS 5328 : Part 3. Where continuous mixers are used, batching shall be carried out by mass and the continuous mixers shall comply with Table 5 of BS 1305 : 1974 when tested in accordance with BS 3963.

Transporting

7 Plant-mixed cement-bound material shall when mixed be removed at once from the mixer, transported directly to the point where it is to be laid and protected from the weather both during transit from the mixer to the laying site and whilst awaiting tipping.

Laying

8 All cement-bound material shall be placed and spread evenly in such a manner as to prevent segregation and drying. Spreading shall be undertaken either concurrently with placing or without delay. Cement-bound material shall be spread using a paving machine or a spreader box operated with a mechanism which levels off the cement bound material to an even depth.

9 Cement-bound material shall be spread in one layer so that after compaction the total thickness is as specified.

10 At longitudinal or transverse construction joints, unless vertical forms are used, the edge of compacted cement-bound material shall be cut back to a vertical face where the correct thickness of properly compacted cement-bound material has been obtained.

11 In the case of cement-bound sub-bases under a concrete surface slab or continuously reinforced concrete base course, longitudinal construction joints in the sub-base shall be staggered by at least 300 mm from the position of the longitudinal joints in the concrete surface slab or continuously reinforced concrete roadbase, and by 1 m for transverse joints.

Compacting

12 Compaction shall be carried out immediately after the cement-bound material has been spread and in such a manner as to prevent segregation.

13 Special care shall be taken to obtain full compaction in the vicinity of both longitudinal and transverse construction joints.

14 Compaction shall be carried out in compliance with Table 10/9 and be completed within 2 hours of the addition of the cement. The 2 hour period may be varied if the preliminary trial described in sub-Clause 18 of this Clause indicates that this is necessary or appropriate. After compaction has been completed, compacting equipment shall not bear on cement-bound material for the duration of the curing period.

15 The surface of any layer of cement-bound material shall on completion of compaction and immediately before overlaying, be well closed, free from movement under compaction plant and from ridges, cracks, loose material, pot holes, ruts or other

defects. All loose, segregated or otherwise defective areas shall be removed to the full thickness of the layer, and new cement-bound material laid and compacted.

Curing

16 Immediately on completion of compaction, the surface of cement-bound sub-bases shall be cured for a minimum period of 3 days by one of the following methods:

- (i) Covering with an impermeable sheeting with joints overlapping at least 300 mm and set to prohibit egress of moisture. The sheeting shall be removed at the end of the curing period.
- (ii) Bituminous spraying in compliance with Clause 920 which shall only be applied when there is no visible water. When the cement bound material is likely to be exposed to high

temperatures and solar radiation or shall be opened very early to traffic, the bituminous spray shall be blinded with light coloured material 2/5mm in accordance with sub- Clause 920.5 or with Sub-clause 901.19.

- (iii) Spraying with a curing compound in compliance with Clause 1027.
- (iv) Spraying with suitable plastic film which, when hardened, shall be removed before applying any other pavement layer.
- (v) The Cement Bound Material will be kept moist for at least 3 days.

Induced Cracks

17 Cement bound materials shall have cracks induced during construction as described in Clause 1047 and in Appendix 7/20.

TABLE 10/9: Cement Bound Materials

Field Requirements						Specimen Requirements				
Category	Clause	Mixing Plant	Method of Batching	Moisture Content	Minimum Compaction	Compaction	Curing	Compressive Strength Testing	Minimum 28 days core compressive Strength N/mm ²	
CBM2	1037	Mix-in-plant	Mass	To suit requirements for strength level, regularity and finish	95% of cube density (Note 1)	Clause 1040	BS 1924: Part 2: 1990 Clause 4.2.6	BS 1924: Part 2: 1990 clause 4.2 or BS 1881: (Part 116)	7 to 12	3.5
CBM4	1038	-	-	-	-	-	BS 1881	BS 1881 (Part 116)	> 15.0	6.0

							(Part 111)			
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NOTES:

- 1 The average in situ wet density of each group of three determinations carried out in accordance with Clause 1040 shall not be less than 95% of the average wet density of the corresponding group of three cubes made in accordance with Clause 1040.
- 2 The average strength of each group of three cores (diameter D= 150mm, height H= 125mm) within the limits one above the limit indicated.
- 3 The strength of any individual core (diameter D= 150mm, height H= 125mm) shall not be less than the strength indicated.

Preliminary Trial

18 At least 10 days before the start of the main cement-bound material works a trial area of at least 400 m² may be laid to assess the suitability of the proposed materials, mix proportions, mixing, laying, compaction plant and construction procedures. When applicable the area shall include one longitudinal and one transverse construction joint. The rate of testing for the trial area shall not be less than that required by Clause 1040. The trial area will only be accepted for main construction in the Permanent Works if it complies with the Specification. The main construction in the Permanent Works shall not start until the trial shows that compliance with the Specification is attained. The materials, mix proportions, mixing, laying, compaction plant and construction procedures shall not be changed unless the Contractor lays a further trial area to demonstrate the suitability of the proposed changes or agrees the changes with the Overseeing Organisation.

1036 Not Used

1037 Cement Bound Material Category 2 (CBM2)

1 CBM2 (Cement Stabilization) below asphalt layers shall be made from washed or processed granular material, crushed

concrete, recycled aggregate, crushed rock, all-in aggregate, or any combination of these. The material shall fall within the grading limits of Table 10/11. Minimum layer thickness after compaction must be 12 cm for a maximum grain size of 37.5mm and 15cm for a maximum grain size of 50mm.

2 The material shall have a ten per cent fines value of 50 kN or more when tested in accordance with BS 812 : Part 111 except that the specimens shall be in a soaked condition.

**TABLE 10/11: Material for CBM2 and CBM4
Range of Grading**

BS sieve size	Percentage by mass passing	
	0/50	0/37.5mm
50 mm	160	-
37.5 mm	78-95	100
25 mm	62-82	80-95
12.5 mm	40-68	50-75
4.75mm	26-55	30-60
2.36 mm	15-45	18-45
600 micron	8-32	8-32
300 micron	2-22	4-22
75 micron	0-15	0-15

NOTE:

The particle size distribution shall be determined by the washing and sieving method of BS 812 : Part 103

1038 Cement Bound Material Category 4 (CBM4)

1 CBM4 below concrete pavements shall be made from aggregates as in sub-Clause 1001.6. Alternatively recycled coarse aggregates may be used provided they comply with the requirements of sub-Clause 1001.6

2 The grading of the aggregate shall be within the limits in Table 10/11. Minimum layer thickness after compaction must be 13cm for a maximum grain size of 37.5mm and 15cm for a maximum grain size of 50cm.

1039 Coefficient of Thermal Expansion

1 To determine if the coefficient of thermal expansion of CBM4 composed of crushed rock is above or below 10×10^{-6} per °C it shall be measured in a laboratory equipped for the test.

The test procedure shall be based on the method outlined in Current Practice Sheet 3PC/06/01 “Thermal Movement of Concrete” by R D Brown, Concrete Journal; November 1972. It shall be carried out in a temperature controlled water bath on three test samples of nominal size 100 x 100 x 500 mm water cured for at least 28 days at 20°C. The change in length of the samples shall be measured as the temperature is raised in 20°C increments over the range 20°C to 60°C and the results plotted to demonstrate that a reasonably linear relationship has been achieved. The coefficient of thermal expansion of each sample shall be calculated from the linear change over the full temperature range and the mean value determined.

1040 Testing of Cement Bound Materials

Frequency of Sampling for Cube Specimens

1 Besides the testing of the compressive strength of cores according to table 10/9, samples may be provided in accordance with BS 1924 : Part 1 : 1990, clause 5 from the laid cement-bound material before compaction. One group of five samples may be provided from five locations equally spaced along a diagonal that bisects each 800 m² or part thereof laid each day. The number of samples and/or groups may be increased or reduced by the Engineer.

Making of Cubes

2 One 150 mm cube shall be made from each sample taken in accordance with sub-Clause 1 of this Clause. The cubes shall be made in accordance with BS 1924 : Part 2 : 1990, clause 4.2.5 without further mixing of the material and within 2 hours of the addition of the cement. Cubes shall be cured and tested in accordance with Table 10/9. Number of cubes must allow to test the compressive strength after 7 days and 28 days according to BS 5328 Part 4.

3 To determine the wet density of cubes the mould shall be weighed prior to making the cube and the mass recorded. Immediately after completion of compaction, the cube and mould shall be weighed and the mass recorded. These masses together with the nominal volume of the mould shall be used to derive the wet density of the cube.

In situ wet density

4 The in situ wet density of a layer of cement-bound material shall be taken as the average of the wet densities at five locations equally spaced along a diagonal that bisects each 800 m² or part thereof laid each day. The wet density at each location shall be the average of two readings obtained in accordance with Clause 1041 using a nuclear density gauge complying with BS 1377 : Part 9. The two readings shall be taken at 180° to each other using the same source rod hole. The source rod shall be lowered to within 25 mm of the bottom surface of the layer. Readings shall be taken within two hours of completing final compaction. If there is no nuclear density gauge available, wet in site density may be determined by standardized methods of soil testing.

Mix Design

5 Single Values of the compressive strength must not fall more than 2N/mm² above or below the mean value.

1041 Use of Nuclear Density Gauges with Cement Bound Materials

Standardisation of Nuclear Density Gauges

1 The operation, warming-up period, if any, and standardisation of the gauge shall be carried out in compliance with the manufacturer's recommendations. The gauge shall be calibrated in accordance with BS 1377 : Part 9.

Mode of Operation

2 The gauge shall be used in the direct transmission mode of operation.

Preliminary Checking

3 Prior to the preliminary trial and whenever the constituents of the mix are altered the cement-bound material shall be checked by the procedure given in BS 1924 : Part 2 : 1990, clause 3.7.4.

Field Density Determination

4 The determination of bulk density by direct transmission shall be in accordance with BS 1924 : Part 2 : 1990, clause 3.7.8.

1042 Special Requirements for Cement Bound Materials

1 Where required in Appendix 7/1, cement-bound roadbase in flexible composite construction shall be laid in individual widths with longitudinal construction joints in locations as detailed below:

Single All purpose	One longitudinal construction joint at the centre line marking
Dual 2 lane All-purpose	One longitudinal construction joint at the lane line marking
Dual 3 lane All-purpose	Two longitudinal construction joints, one at each of the lane line markings
Dual 2 lane Motorway	Two longitudinal construction joints, one at the lane line marking and one at the edge line marking between hard shoulder and left hand lane
Dual 2 lane Motorway	Three longitudinal construction joints, one at the lane line marking and one at edge line

markings between hard shoulder and left hand lane

Dual 4 lane Motorway Four longitudinal construction joints, one at each lane line marking and one at the edge line marking between hard shoulder and left hand lane

Longitudinal construction joints shall not be more than 150 mm from the centre of the centre line, lane line, or edge line marking, with individual widths not exceeding 4.75 m. Longitudinal construction joints shall not be located within the left hand lane of dual carriageways. At tapers and other changes in section the construction joint layout shall be as detailed on the Drawings, and where necessary joints shall also be permitted within 150 mm of the mid-point of the traffic lane.

1043 Not Used

1044 Pavements with an Exposed Aggregate Concrete Surface

General

1 Pavements with an exposed aggregate concrete surface shall comply with all the requirements of this Series except where otherwise specified in this Clause.

2 The Contractor shall complete Appendix 10/1 and submit this with his tender documents. If after acceptance the Contractor wishes to change the proposals contained in Appendix 10/1 this change shall only be with the consent of the Overseeing Organisation.

3 The concrete slab shall be laid in either a single layer or in two layers as stated in Appendix 10/1. If laid in two layers the

surface layer shall be laid monolithically with the lower layer.

4 The Contractor shall carry out trials, as specified in sub-Clauses 31 to 39 of this Clause, to demonstrate that the materials, mix proportions and methods for exposing the aggregate will meet the requirements of this Clause.

Quality of Concrete in the Slab

5 The surface layer concrete shall comply with the following requirements:-

- (i) The surface layer shall be not less than 40 mm thick. The coarse aggregate shall comply with the size requirements of Appendix 7/1.
- (ii) For 10-6 mm coarse aggregate or 8-4 mm coarse aggregate as required in Appendix 7/1, the amount of aggregate retained on the 10 mm sieve and 8 mm sieve respectively shall not exceed 3% by mass. The aggregate passing the 6 mm sieve and 4 mm sieve respectively shall not exceed 10% by mass.
- (iii) The fine aggregate grading shall comply with Classification F of Table 5 in Clause 5.2 of BS 882, except that not less than 99% of the mass of the material shall pass the 2.36 mm sieve.
- (iv) The coarse aggregate shall comprise at least 60% by mass of the oven dry constituents of the concrete.
- (v) The polished stone value (PSV) and the aggregate abrasion value (AAV) of the coarse aggregate shall be as specified in Appendix 7/1. The flakiness index of the aggregate shall not exceed 20.

- (vi) Hardness and durability of the coarse aggregate shall be as described in sub-Clause 901.2.
- (vii) The type of cement used in the concrete may be limited to Class 42.5N/42.5R Portland cement CEM I complying with MSA EN 197-1. The minimum cement content of the concrete may be 375 kg/m³ and the maximum free water/cement ratio shall be 0.40.
- (viii) The total quantity of air entrained in the concrete as a percentage of the volume of the fully compacted concrete may be $5 \pm 1.5\%$. It can be supposed however that air entrainment is not necessary for the climate condition of Malta.
- (ix) The total air voids in the fully compacted concrete shall not be greater than 8%. It air-entrained concrete should be necessary.
- (ii) The concrete surface layer shall be fed, spread, compacted, regulated and finished using equipment with elements to obtain the required uniform distribution and bonded embedment of the selected aggregate in the finished road surface.
- (iii) The spread concrete shall be compacted in such a manner that base layer concrete is not drawn into the surfacing and selected aggregate is uniformly present in the finished road surface.
- (iv) The surface layer shall be compacted and shaped to line and level by a combination of either internal vibration and fixed conforming plate or vibrating conforming plate.
- (v) The final regulation of the surface layer shall be provided by a transverse finishing screed in advance of a longitudinal oscillating float in accordance with Clause 1024, traveling across the slab before the application of retarder.

General Construction Requirements

6 The concrete paving equipment shall comply with Appendix 10/1 as completed by the Contractor and submitted at Tender stage for approval by the Overseeing Organisation before the work commences. The general construction requirements shall be in accordance with the requirements of this Series except where otherwise stated in this Clause:

- (i) The concrete carriageway paving operation shall be undertaken as not less than a single lane width of construction using either slipform paving machines or fixed form paving machines.

Finished Surface Requirements

7 The finished surface of the pavement shall comply with the requirements of Clause 702. Where a pavement area does not comply with the Specification for regularity, surface tolerance, thickness, material properties or compaction or contains surface depressions, the full extent of the surface which does not comply with the Specification shall be rectified by cutting out the full depth of the slab. It shall be replaced with a new slab complying with the procedures set out in Clause 1033 to the extent required to obtain compliance with the Specification.

Production of an Exposed Aggregate Surface

8 In order to obtain a suitable exposed aggregate surface the main requirement shall be the removal of the surface mortar from the top of the slab to produce an exposed aggregate finish. This objective may be achieved by the application of a suitable cement set retarder which is sprayed on the surface of the fresh concrete immediately after it has been levelled and finished. Retarded mortar shall be removed by wet or dry brushing as stated in Appendix 10/1, generally no sooner than 24 hours after concreting or after a suitable interval determined by trial, to achieve the requirements of sub-Clause 27 of this Clause.

Retarder

9 The composition and viscosity of the retarder shall be such that it can be spread at an adequate and uniform rate over the surface of the concrete slab in order to ensure adequate aggregate exposure during the subsequent brushing operation.

10 The retarder shall contain a pigment in sufficient quantity to give an even uniform colour after it has been sprayed on to the slab surface. The pigment shall be fully degraded by exposure to ultra-violet light without leaving any residue that is detrimental to the surface of the concrete.

11 The chemical composition of the retarder and of the curing compound shall be such that they do not react adversely following the application of the curing compound to the exposed aggregate surface.

12 The Contractor shall use the retarder which he has nominated in Appendix 10/1. This shall be of a type and composition to satisfy the requirements of this Clause.

Application of the Retarder

13 The retarder shall be spread evenly on to the surface of the wet concrete slab as soon as practicable after the surface layer has been levelled and finished, by a spray bar over the full width of the slab in one pass. To achieve this uniformity of spread, the spraying system shall consist of a spray bar, provided with nozzles, mounted on a machine spanning the slab. Temporary works materials and equipment shall be chosen in order to permit inspection to ensure adequate coverage of retarder immediately after spraying and before protection of the surface.

14 Before commencing work, the level of the spray bar, the rate of delivery of the retarder from the nozzles of the spray bar, and the forward speed of the spraying machine shall be adjusted to achieve the required rate of spread. Means shall be provided and steps shall be taken to avoid excess retarder flowing on the surface of the slab.

15 Back-up spraying equipment shall be available on the Site at all times for use in case of a breakdown of the spraying machine.

Protection of the Surface after the Application of the Retarder

16 The finished surface of the pavement concrete after application of retarder shall be protected against precipitation, moisture loss, contamination and dispersal of the retarder by air movements as stated in Appendix 10/1. This protection shall be

applied immediately after the application of the retarder.

17 Where waterproof sheeting is used it shall be laid onto the surface of the concrete immediately after the retarder has been sprayed. It shall be retained in position until immediately prior to exposing of the aggregate.

18 The protection system shall not adversely affect either the finish, the line or the level of the concrete surface or the even distribution of the retarder in any way. Where sheeting is used, any air bubbling or blistering shall be prevented.

Exposing the Aggregate Surface

19 Brushing equipment shall be used to expose the concrete surface aggregate. Where the brushing equipment runs on the slab the concrete shall have gained sufficient strength to avoid any damage to the concrete.

20 Removal of the protection system shall take place as brushing proceeds. If waterproof sheeting is used as a protection system it shall be maintained in position until immediately in advance of the brushing operation.

21 The Contractor shall complete the process of exposing the aggregate before the retarder becomes ineffective. Failure to do so shall entail the remedial measures specified in sub-Clauses 29 and 30 of this Clause.

Brushing System

22 Sufficient brushing capability shall always be maintained on Site to complete the exposure of the aggregate before the retarder becomes ineffective. An adequate

back-up brushing facility shall be available on the Site at all times for use in case of a breakdown of the brushing equipment.

23 The brushing equipment nominated by the Contractor in Appendix 10/1 shall be used to produce an even texture on the surface of the slab. Brushing shall be carried out in the longitudinal direction of the concrete slab.

24 The brushing equipment shall be capable of maintaining an adequate brush rotational speed which in conjunction with the forward working speed is sufficient to remove the surface mortar. Adequate dust suppression and collection measures shall be in operation at all times.

25 When complying with the requirements of sub-Clause 19 of this Clause, the wheels of any brushing equipment which may run on the slab shall be fitted with tyres with a shallow tread pattern and a low inflation pressure and be sufficiently wide to avoid damage to the concrete.

Protection of the Surface Layer After Exposure of the Aggregate

26 Within one hour of completing exposure of the aggregate the surface shall be dampened with water. A curing compound shall be applied to the entire exposed aggregate surface of the slab in accordance with Clause 1027. In wet weather the curing compound shall be applied as soon as practicable after the rain stops. The surface may, alternatively, be covered by hessian provided it is maintained in a wet condition at all times during the curing period of the concrete.

Surface Texture Depth and Remedial Measures

27 The texture depth of the surface of the concrete shall be measured by the sand patch method described in BS 598 : Part 105. The average texture depth of each 500m section of carriageway lane, or each carriageway lane where less than 500m, shall comply with the requirements of Appendix 7/1. Any individual result shall be neither greater than the maximum, nor be less than the minimum value of texture depth stated in Appendix 7/1. The Engineer may reduce the section length.

28 During brushing initial interim spot check measurements of the surface texture depth shall be made as soon as it is considered that the required texture depth has been reached. This shall continue until the specified texture depth has been achieved.

29 In the event that it is not possible to achieve the specified minimum texture depth by further exposure, the Contractor shall treat the surface in accordance with Clause 1029 to achieve the specified texture depth. This treatment shall not be applied until the concrete has reached an age of 28 days and shall not affect the requirements of sub-Clauses 702.2 to 702.4 and 702.5 to 702.9.

30 Failure to achieve a satisfactory minimum texture depth by mechanical means shall result in removal of the full thickness of the slab to the extent required to permit reconstruction of the slab in accordance with the Specification. Where the maximum texture depth is exceeded suitable remedial measures shall be employed.

Preliminary Trials

31 If there is no sufficient experience in concrete pavement construction, the Contractor shall carry out preliminary trials

to demonstrate to the Overseeing Organisation, not less than one month prior to the commencement of the trial length referred to in sub-Clauses 37 to 39 of this Clause, the materials, mix proportions and methods for achieving the texture depth requirements defined in Appendix 7/1.

32 Preliminary trial panels shall be constructed offline incorporating a top surface of exposed aggregate concrete similar to that specified for the permanent works. These panels shall be 20 m long and not less than 100 mm deep, and the maximum intended paving width. They shall be used to enable the Contractor to determine the required application rate of the retarder and the amount of brushing required to achieve the specified texture depth.

33 The trial panels may alternatively be constructed on-site, but in this case, they may only form part of the permanent Works if they meet all the requirements of the Specification, otherwise they shall be removed after they have served their purpose.

34 The surface texture depth shall be determined by sand patch tests at approximately 2 m spacings along a diagonal line across each trial panel, and shall follow the procedure in BS 598 : Part 105.

35 The average value of each set of 10 individual measurements shall be taken as the resulting texture depth which shall be assessed against the Specification.

36 The materials including all the aggregates, plant and equipment used in the preliminary trials shall be equivalent to that which will be used in the Trial Length.

Trial Length

37 In addition to the requirements of Clause 1028, the texture depth shall be tested for compliance in accordance with sub-Clauses 38 and 39 of this Clause.

38 Texture depth shall be assessed by the sand patch method for each 50 m length of the trial length and for each lane, and shall follow the procedure in BS 598 : Part 105.

39 During the construction of the Trial Length, spot checks shall be made as soon as it is considered that the required texture depth has been reached. Should the texture depth be found to be inadequate, further exposure of the aggregate shall be undertaken until the specified texture depth has been achieved. Where the texture depth is not achieved, and the trial was intended to form part of the running surface of the permanent works, the remedial measures described in sub-Clauses 29 and 30 of this Clause shall apply.

1045 Weather Conditions for Laying of Cementitious Materials

1 Road pavement materials in a frozen condition shall not be incorporated in the Works but may be used, if acceptable, when thawed.

2 Road pavement materials shall not be laid on any surface which is frozen or covered with ice.

3 The temperature of concrete or cement bound material in any pavement layer shall not be less than 5°C at the point of delivery. These materials shall not be laid when the air temperature falls below 3°C and laying shall not be resumed until the rising air temperature reach 3°C unless all surfaces of the concrete slabs are protected by thermal insulation blankets laid immediately after placing and finishing the concrete. The

insulation shall be placed before the temperature of the concrete surface has dropped below 2°C and shall be retained for a minimum of 3 days or until the concrete is assessed to have reached 50% of the specified characteristic compressive strength provided the air temperature is above 0°C and rising at that time. Thermal insulation blankets shall be closed cell polyethylene foam sheets, minimum 10 mm thick with a 'U' value of 4 watts/mC (or K value of 0.04 watts/m Kelvin) or suitable material with an equivalent or lower thermal conductivity. They shall be sufficiently robust and capable of being held in place against variations in wind and weather conditions for the necessary curing time.

1046 Cold Recycled Cement Bound Material

Scope

1 Recycled cement bound material shall be designed and produced to form the foundation or main structural layer of a road pavement. The primary aggregate source shall be obtained by cold pulverisation of all or part of the existing road structure. The stabilising agent shall be hydraulic cement with Portland cement CEM I as the main component. The aggregate grading may be adjusted by the addition of a filler. Lime may also be used to modify any cohesive subgrade soil incorporated in the pulverised layer.

2 Prior to commencing the pulverisation and stabilisation works, the Contractor shall demonstrate, to the satisfaction of the

Overseeing Organisation, using the results of the mix design procedures described in sub-Clauses 1046.43-1046.49 of this Clause, that the existing pavement materials in the sections of the works defined in Appendix 7/19, are capable of being recycled by pulverisation to form the primary aggregate component of a recycled cement bound material which can meet the specified end-product performance requirements.

Component Materials

Aggregates and Fillers

3 The pulverised road material when mixed with any supplementary aggregate and/or filler shall normally be granular material with not less than 5% and not more than 20% passing the BS 75 micron sieve (Zone A graded material in accordance with Table 10/13). Approval for use of pulverised granular material containing up to 35% passing the BS 75 micron sieve (Zone B graded material in accordance with Table 10/13) shall require confirmation by the Overseeing Organisation, subject to the results of the mixture design procedures described in sub-Clauses 43 to 49 of this Clause.

4 The pulverised granular material shall contain not more than 2% of organic matter as determined in accordance with BS 1377 : Part 3 : Clause 3.

TABLE 10/13: Particle Size Distribution of Granular Material for Recycling

Sieve size	Percentage by mass passing	
	Zone A Graded Material	Zone B Graded Material
50 mm	100	-
37.5 mm	94 - 100	-
20 mm	66 - 100	100
10 mm	48 - 75	75 - 100
5 mm	35 - 57	57 - 95
2.36 mm	25 - 42	42 - 77
600 micron	13 - 28	28 - 52

300 micron	10 - 24	24 - 45
75 micron	5 - 20	20 - 35

Aggregate grading should have a coefficient of uniformity (Cu) exceeding 10.

Cement, Filler and Lime

5 The constituents and required quality standards of hydraulic cement, filler and lime shall be certified by the supplier, whose manufacturing and delivery processes may be implemented using quality management systems in accordance with the ISO 9000 : 1994 series of standards and certified by an accredited body.

6 The primary binder shall be Portland cement CEM I or Portland blast furnace slag cement or Portland pfa cement in accordance with sub-Clause 1001.3.

7 PFA shall be in accordance with BS 3892 : Part 1.

8 Lime for lime stabilisation (or as a modifier for plastic fines) shall be either quicklime or hydrated lime, as stated in Appendix 7/19 , complying with sub-Clause 615.33.

Water

9 Water for moisture content control of the pulverised granular material shall normally be obtained from a water company supply and used without testing. Water from an alternative source shall comply with BS 3148 and be approved by the Overseeing Organisation.

Pulverisation and Stabilisation

10 The Contractor shall satisfy the Overseeing Organisation that the plant used for pulverisation is capable of uniformly pulverising the existing road in a single pass, to a depth specified in Appendix 7/19. The

plant used for stabilisation shall be capable of uniformly mixing controlled amounts of water and cementing agent(s) into the full depth of the pulverized layer. For either operation, the plant shall be equipped with a means of controlling the depth of processing to ± 15 mm of the required depth.

11 The plant used for stabilisation shall be equipped with a spraybar system within the mixing chamber capable of uniformly distributing water at a monitored and controlled rate. Evidence confirming the capabilities of the plant and calibration of flow meters, shall be submitted to the Overseeing Organisation prior to the stabilisation works commencing.

12 The material shall be pulverised and stabilised in a single layer if the compacted thickness is 300 mm or less. If the compacted thickness is greater than 300 mm, the material shall be pulverised and stabilised in a minimum number of layers between 150 mm and 300 mm thick. Where more than one layer is required, the Contractor shall satisfy the Overseeing Organisation that the lower layer has achieved adequate stability in accordance with sub-Clause 27 of this Clause before proceeding with the overlying layer.

Pulverisation Process

13 Pulverisation of the existing road structure shall be carried out in a systematic pattern, to the required depth, to ensure that all parts of the existing road designated in Appendix 7/19 are included in the works. An overlap of at least 150mm shall be made between adjacent passes of the machine. Any material missed along hard edges or around obstructions shall be excavated and placed in the path of subsequent passes of the machine until a uniform fully pulverized aggregate is obtained. The pulverised

material shall not be contaminated with material drawn in from the verge.

14 All longitudinal and transverse joints shall be clean cut and vertical. Where work continues adjacent to previously recycled material, transverse joints shall be reformed a minimum 0.5 m into the previously treated construction. Where a layer of material for stabilization is placed over a layer previously stabilised, the depth of pulverization / stabilisation of this layer shall be set to cut into the underlying stabilised layer by at least 20 mm.

15 Excess pulverised material shall be removed by the grader and/or excavator for use elsewhere on the site or transported to stockpile at locations given in Appendix 7/19. The surface of the layer shall be graded nominally to the required profile and provisionally compacted.

16 Moisture content of the pulverised aggregate immediately prior to stabilisation shall be measured in accordance with BS 812 : Part 109 using the high temperature method. The moisture content shall be uniform throughout the layer within the range 0% to +4% of the optimum moisture content for the unstabilised aggregate, including any designed proportion of filler, determined in accordance with Clause 2.1 of BS 1924 : Part 2 : 1990, using vibratory compaction.

17 If the moisture content of the unstabilised pulverised aggregate fails to meet the specified moisture content range, corrective action shall be taken either by aeration to reduce the moisture content or by controlled addition of water to increase the moisture content.

18 Aeration of the affected area shall be achieved by full depth passes of the

recycling machine to disturb and loosen the material and assist the evaporation of excess moisture. The material shall be kept in a loose condition until subsequent moisture content tests show that the treated material has reached the required moisture content range. The layer shall be re-graded nominally to the required profile and provisionally compacted in preparation for stabilisation.

19 An increase in the moisture content of the affected area shall be achieved by the controlled addition of water through an adjustable spray bar system in conjunction with full depth passes of the recycling machine to achieve a uniform distribution of the water throughout the layer. Water shall be added in increments and mixed in until subsequent moisture content tests show that the material has reached the required moisture content range. The layer shall be regarded nominally to the required profile and provisionally compacted in preparation for stabilisation.

Stabilisation Process

20 Stabilisation shall not be carried out during or after periods of rainfall where the duration and intensity are likely to cause the stabilised mixture to exceed the specified moisture content criteria and compromise the stability of the layer under compaction as described in Sub-Clause 27 of this Clause.

21 Prior to stabilisation, pulverised materials within 100 mm of restricted hard edges such as kerbs and channels, or around obstructions such as gullies, shall be removed and spread uniformly over the remaining full width of the pulverised material.

22 Cement binder, filler, hydrated lime or quicklime shall be spread full-width on the

surface of the layer using a mechanical spreader capable of distributing the material(s) in a uniform manner. The rate of spread of these materials shall be calculated to achieve mixture composition determined in accordance with sub- Clauses 43 to 49 of this Clause and monitored as the spreading operation proceeds in accordance with sub-Clause 31 of this Clause.

23 The stabilisation shall be carried out to the required depth in a systematic pattern similar to that used for the pulverisation process, with an overlap of at least 150 mm between adjacent passes of the machine. Where necessary, additional water shall be introduced and distributed through the spray bar system, directly into the rotor and mixing box of the stabiliser.

24 The layer of stabilised material shall be graded to level and compacted within two hours of the final pass of the stabilising plant, unless a curing or “maturing” period of aeration is required. Any furrow formed by prior excavation of edge materials shall be re-filled by grading the adjacent stabilised material into the space using a minimum amount of re-working.

25 The compaction of each layer shall be carried out until such time as the density complies with the minimum compaction field requirements in Table 10/9 and the stabilised layer provides a stable and dense surface. Any open or segregated surface area shall be re-mixed by machine during stabilisation.

26 Where specified in the Appendix 7/19 a system for inducing transverse cracks shall be installed into the fresh stabilised material in accordance with sub-Clauses 50 to 60 of this Clause. The installation shall be carried out after grading to level and application of

initial compaction, then completed by final compaction.

27 The stability of the layer under compaction shall be deemed adequate if the finished surface does not move, rut or exhibit transverse cracking under the load of subsequent construction traffic.

28 Where required by the Overseeing Organisation, the stability of a layer in any area shall be assessed after a curing period of at least 24 hours by channeled trafficking using a rigid three-axle tipper truck loaded to a gross mass of 24 tonnes (assumed equivalent to three standard axles). The vertical deformation shall be measured in all wheeltracks at monitoring points on each of 5 transverse sections set 1m apart after 5, 15, 30 and 40 passes of the truck. The mean vertical deformations at the above trafficking increments shall be plotted against the respective number of truck passes and the mean vertical deformation corresponding to 100 standard axles shall be interpolated. The layer shall be deemed acceptable if the mean vertical deformation corresponding to 100 standard axles is less than 10 mm.

29 On completion of compaction the surface shall be sealed using a sprayed membrane of Class K1-40 bitumen emulsion complying with Clause 920. The bitumen emulsion shall be sprayed at the rate stated in Appendix 7/19. Where the surface is opened to traffic, the sealing membrane shall be blinded with fine aggregate or sand applied at a rate of 5.5 to 7.0 kg/m².

Process Control

30 The sampling and testing of the recycled cement stabilised roadbase shall be carried out as required for cement bound materials (CBM) in accordance with Clauses 1040 and 1041.

31 The rate of spread of cement, filler, hydrated lime or quicklime shall be measured by weighing the amount of material retained on each of five trays or mats of known area laid in the path of the spreading machine. The trays shall be positioned approximately at points equally spaced along a diagonal bisecting the area of coverage. The mean rate of spread and percentage addition of the material shall be determined and recorded for each assessment area.

32 As directed by the Overseeing Organisation, where lime has been used to modify a cohesive soil component of the pulverised aggregate, the acceptability of the modified materials shall be tested in accordance with sub-Clause 615.13.

End Product Performance of Recycled Cement Bound Material

33 The end-product performance of the recycled cement bound material shall be assessed on the basis of measurements and tests carried out in areas of 800 m² or part thereof completed each working day, which shall match the areas defined in sub-Clause 1040.1.

34 Within 24 hours of completion, the as-installed performance of the stabilised layer shall be evaluated using a plate-bearing test equipment dynamic plate loading or penetrometer technique to determine values of elastic modulus at points on a nominal grid pattern, as described in Appendix 7/19. The elastic modulus at each point and the mean elastic modulus for the assessment area shall comply with the minimum standards stated in Appendix 7/19.

Additionally, before proceeding with construction of the overlying pavement, the evaluation process shall be repeated to demonstrate that the elastic modulus value at all points and that of the mean value have increased over the respective as-installed values by not less than the percentage values stated in Appendix 7/19. Where these criteria are not met, the full extent of the non-compliant material shall be determined and appropriate remedial measures implemented. Remedial action shall comprise either a delay in construction to allow further curing and stiffening of the layer to occur or a repeat of all or part of the recycling process, followed by re-evaluation, until a compliant material is achieved.

35 Within 270 days of completion of the surfacing works, a Benkelman Beam Deflection survey shall be carried out and analysed in general accordance with HD 29/94 (DMRB 7.3.2, 1994). In particular, the measurements shall be taken on the finished road surface in the nearside wheelpath, at a uniform and maximum spacing of 10 m. The survey shall be carried out during a period when the pavement temperature at a depth of 50 mm is within the range 15°C to 25°C. Compliance shall be achieved when the rolling mean of 10 results is not less than the figure specified in Appendix 7/19 and no individual result is less than 85% of the figure specified.

36 In the event that the requirements of sub-Clause 35 of this Clause are not met, the full extent of the non-compliant material shall be determined by further investigation involving coring and laboratory testing. For each area of noncompliance, cores shall be extracted through the full depth of the stabilised layer at locations directed by the Overseeing Organisation, at a minimum rate of one x 150 mm diameter core per 75 m².

37 The Contractor shall be responsible for extraction of the cores with the minimum of force or disruption. Air flush coring shall be allowed for materials that are disturbed by water flush coring. After extraction, each core shall be labelled and photographed and, prior to testing, shall be stored in sealed polythene bags, in a uniformly supported position, at a temperature of 20°C ± 5°C. The thickness of the recycled layer shall be measured and recorded.

38 Reinstatement of all core holes shall be completed before opening the area to traffic. All backfill materials shall comply with Clause 903.

39 If, at any of the prescribed core locations, it is not possible to extract an intact core of suitable size or condition for the end-product performance testing, using a maximum of three attempts in an area of 1.5 m radius, the material in the vicinity shall be deemed not to comply with the end-product performance specification.

40 In the laboratory, each core extracted successfully shall be trimmed to remove surfacing materials and any underlying material prior to the measurement of core density in accordance with the standards listed in Table 10/14.

41 Following the measurement of density each core shall be prepared and tested to determine the compressive strength of the core, in accordance with the procedures and standards given in Table 10/15.

42 The results obtained shall be used to judge the expected performance of the recycled stabilized material in the works in relation to the performance of standard CBM roadbase materials. The recycled stabilised material in the assessment area shall be

deemed acceptable if the compliance criteria described in Table 10/6 are met.

TABLE 10/14: Procedures and Standards to be Used to Determine the Density of Core Samples of Recycled Cement Bound Material

Procedure	Procedure Stage	Standard to be Used
Core preparation for density testing	Measurement of core dimensions and accuracy of measurement Methods of trimming core to length	MSA EN12504-1
	Test specimen type, shape and moisture condition	MSA EN12390-7
Core testing for density	Apparatus specification	MSA EN 12390-7
	Measurement of volume dimensions	
	Volume by water displacement	
	Measurement of mass Equations for density Accuracy and units of density	
	Core density as a proportion of theoretical density	Clause 1003

Testing machine specifications
Rate of loading

MSA 12390-2
or
MSA 12390-4
as appropriate

Correction for length/diameter ratio and orientation of coring
Equations for deriving equivalent cube strength

BS 1881 :
Part 120

Correction for excess voidage

BS 1881 :
Part 120

TABLE 10/15: Procedures and Standards to be Used to Determine the Compressive Strength of Core Samples of Recycled Cement Bound Material

Procedure	Procedure Stage	Standard to be Used
Core preparation for density Testing	Measurement of core dimensions and accuracy of measurement Maximum and minimum dimensions for strength testing	MSA 12504-1
	Methods of capping core	MSA 12390-2 or MSA 12390-4 as appropriate
	Suitability of core for strength testing	BS 1881 : Part 120
	Storage of cores before capping	
Core testing for strength	Type of strength test	MSA 12504
	Minimum period of testing after end-preparation	
	Method of curing core prior to testing	
	Measurement of core test specimen dimensions and accuracy	
	Equation for calculating core strength	

TABLE 10/16: Compliance Criteria for Recycled Cement Bound Material Based on Results of Tests on Cores Extracted from the Works

Property	Individual cores	Mean from cores in each surveyed area
Core density relative to refusal density	93%	95% minimum
Layer thickness [from core measurement]	+ 25 mm	+ 15 mm of specified
Equivalent cube compressive strength	*CBM equivalence	*CBM equivalence
* Compliance criteria is quoted in relation to the design 7 day cube compressive strength appropriate to the equivalent CBM classification of the recycled material.		

Mixture Design and Characterisation

43 Mixture design characterisation of recycled cement bound material for each site, or section of site, including details of the cementing agent and/or stabilising

agent(s) and their quantities, shall be submitted to the Overseeing Organisation at least one week prior to commencement of the recycling works. Where the site investigation has identified significant variation of existing pavement materials between different sections of the site, a mix design shall be submitted for each section of the site. The proposed plan area and depth of the different sections, covered by each mixture design, shall be approved by the Overseeing Organisation.

44 The mixture design for recycled cement bound material shall use the same method of mixture design as that used for plant mixed CBM specified in Clauses 1035 to 1039, except that the aggregate shall be crushed and processed in the laboratory, using a method approved by the Overseeing Organisation, to replicate as closely as possible the aggregate expected from pulverisation in the works. The permitted CBM alternatives and equivalent recycled mixture designs for each part of the Works shall be as described in Appendix 7/19.

45 The laboratory crushed and processed aggregate with a particle (or “lump”) sized distribution complying with sub-Clause 3 of this Clause shall be thoroughly mixed with measured proportions of the cement to produce trial mixtures with different cement contents. The type and grade of the cement used in the trial mixtures shall be the same as that used in the finished works.

46 If lime is required for stabilisation and/or modification of clay included from pulverisation of the upper subgrade layer, the same proportion of lime shall be added into the trial mixture.

47 The cement content of the recycled cement bound mixture shall be determined in the same manner as the cement content

for plant mixed CBM, to achieve the requirements in Table 10/9. The minimum cement content shall be 3% by weight.

48 The mixture design process shall be repeated until an acceptable mixture design is achieved. To achieve this the target composition of the mixture shall be systematically adjusted and the mixture design tests repeated.

49 In addition to the requirements of Table 10/9 the average compressive strength determined after 7 days immersion in water of five test specimens of the target composition mixture, prepared in accordance with sub-Clause 3 of this Clause, shall be not less than 80% of the average compressive strength of five control specimens when subjected to the test procedure described in BS 1924 : Part 2 : Clause 4.3. After 7 days immersion, the specimens shall not show any signs of cracking or swelling.

Induced Cracks

50 Recycled cement bound material shall have cracks induced during construction as described in Clause 1047 and in Appendix 7/20.

1047 Induced Cracking of Cement and Hydraulically Bound Material General

1 For those sections of the Works defined in Appendix 7/20, the material shall have transverse and longitudinal cracks induced using approved plant and equipment to comply with this Clause prior to laying the surfacing layers.

Scope

2 This Clause describes the methods for inducing cracks in new and recycled materials. Furthermore, this Clause deals with the induced cracking of cement bound material or hydraulically bound material.

Induced Cracking

3 Transverse cracks, at the pre-set spacing and tolerances described in Appendix 7/20, shall be induced by suitable plant and materials. Cracks may be induced either: in fresh material prior to compaction as described in sub-Clause 5 of this Clause; or, for cement bound materials, after 3 to 6 days using suitable plant as described in sub-Clause 6 of this Clause.

4 The spacing of the cracks shall be at the pre-set spacing and tolerances unless any underlying pavement construction comprises cracked cement bound material. In this event, the location of cracks in the existing pavement shall be recorded and the location of the induced cracks in the overlying material adjusted to ensure that these induced cracks align with cracks in the underlying construction.

Notches to achieve a regularity induced cracking are cut as follows for cement bound material:

- i) Transverse notches: at a distance of 5m except 2.5m if the total thickness of asphalt layers above is below 14cm.
- ii) Longitudinal notches: necessary if the laying width is above 8m. The depth of the transverse and longitudinal notches is at least 35% of the laying thickness of the CBM.

5 Where cracks are induced in fresh material, the transverse cracks shall be induced by grooving the fresh material to a

depth which leaves a vertical groove not more than 20 mm wide, between one half and two thirds the layer thickness after compaction, over the full width of the pavement. A crack inducing material shall be inserted into the groove prior to compaction, extending from the bottom of the groove to not less than half the height of the groove. During final compaction of the material, the groove shall be closed at the surface and the crack inducing material shall be fully encased and remain continuous within the closed groove.

6 For the cement bound material or hydraulically bound material, cracks shall be induced after 3 to 6 days. The cracks shall be induced by a cutting device or suitable plant capable of delivering variable preset impact loads to the material surface. In this case cracks shall be induced by one strike of the impacting head of such plant and without producing excess surface indentation or excess surface shatter. The plant and impact head shall be of sufficient mass and geared to prevent head bounce and any associated surface damage arising there from. The impact load shall be adjustable to achieve the cracking specified and the minimum load consistent with no surface shatter.

7 Where cracks cannot be induced over the full width of the pavement with one pass of the crack inducing plant, further parallel passes shall be made as necessary so that all subsequent cracks are aligned with those from the preceding pass.

8 The Contractor shall be responsible for varying the equipment and method of working so that crack inducement occurs and areas of material are rendered suitable for overlaying. The plant used to induce cracks in a fresh material shall be such as not to cause rutting of the provisionally

compacted layer that cannot be rectified by the subsequent compaction process. When cracking is to be induced after compaction of the roadbase, the plant shall be self-propelled with wheels having pneumatic tyres. Pneumatic tyres are also preferred for a cutting device.

Trial Length if necessary

9 The Contractor shall demonstrate that the plant, equipment and methods that are proposed for inducing cracks in the material are capable of producing the required type and pattern of cracks by first executing a trial over a minimum length of 100 m of new pavement. The location of the trial shall be agreed with the Overseeing Organisation. A trial length shall be carried out for each separate material design mix.

Assessment of Trial Length

10 Compliance with the crack inducing requirements when induced in accordance with sub-Clause 5 of this Clause shall be assessed as follows:

- (i) The correct depth of cracking shall be determined by either:
 - (a) Coring through the full depth of the layer positioned symmetrically about an induced crack. A set of 10 No 150 mm diameter cores shall be taken within the trial area at locations selected by the Overseeing Organisation. The trial area shall be deemed acceptable if 8 of the set of 10 cores exhibit crack inducing material that is continuously visible over the depth given in sub-Clause 5 of this Clause.

or

- (b) Removal of material to the full depth of the layer. Material shall be removed at 10 induced crack locations to allow visual inspection of the full depth of the layer and crack inducing material. The induced crack shall be inspected at least 300 mm from the edge of the pavement. The trial area shall be deemed acceptable if 8 of the set of 10 excavations exhibit crack inducing material that is continuously visible over the depth given in sub-Clause 5 of this Clause.

- (ii) Holes from which samples have been extracted shall be backfilled with fresh material compacted in layers not exceeding 50 mm.

11 Compliance with the crack inducing requirements when induced in accordance with sub-Clause 6 of this Clause shall be assessed as follows:

- (i) The amount of surface shatter shall be such that there is no requirement for surface sweeping.
- (ii) The maximum amount of surface indentation shall be half the maximum aggregate size if a suitable plant is used instead of a cutting device.
- (iii) Coring through the full depth of the layer positioned symmetrically about an induced crack. A set of 10 No 150 mm diameter cores shall be taken within the trial area at locations selected by the Overseeing Organisation. The trial area shall be deemed acceptable if all of the set of 10 cores exhibit no shattering at the base of the core and for the required cut depth is achieved.

- (iv) Holes from which samples have been extracted shall be backfilled with fresh material compacted in layers not exceeding 50 mm.

Approval to Proceed with Main Works

12 Approval of the cutting device or the plant, equipment and methods shall be given following a successful demonstration in the trial length that the induced cracking complies with the requirements of this Clause. The Contractor shall not proceed with the main works until the plant, equipment and methods used in the trial length have been approved by the Overseeing Organisation.

13 When approval has been given, the plant, equipment, methods and material shall not be changed, except for normal adjustment and maintenance of plant, without the prior approval of the Overseeing Organisation. Should it be necessary for the Contractor to change the plant, equipment, methods or the material the Overseeing Organisation may require the Contractor to carry out a further trial length.

Monitoring of Main Works

14 Monitoring of the induced cracking of the main works when induced in accordance with sub-Clause 5 of this Clause shall be as follows:

- (i) Monitoring of the induced cracking of the main works shall be carried out by the Contractor, by extracting 150 mm diameter full-depth cores at a rate of not less than one core for every 300 m² of material containing the crack inducing system. The core locations shall be selected by the Overseeing Organisation, with each core positioned symmetrically over the line

of the inserted crack inducing material. Not more than one core shall be extracted per transverse crack. The induced cracking system shall be deemed acceptable if at least four cores in any adjacent set of five cores reveal a crack inducing material extending to at least a quarter of the depth of the layer. The Contractor and Overseeing Organisation shall inspect the cores. The Overseeing Organisation shall determine the acceptability of each core in accordance with this sub-Clause.

- (ii) Holes from which samples have been extracted shall be backfilled with fresh material compacted in layers not exceeding 50 mm.

15 Monitoring of the induced cracking of the main works when induced in accordance with sub-Clause 6 of this Clause shall be as follows:

- (i) Monitoring of the induced cracking of the main works shall be carried out by the Contractor and shall be such that there is no requirement for surface sweeping.
- (ii) The maximum amount of surface indentation shall be checked to ensure that it is not greater than half the maximum aggregate size. If a cutting device is used the depth of the notches shall be determined.

1048 Use of Surfaces by Traffic and Construction Plant

1 Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so

that damage is not caused to the subgrade or the pavement courses already constructed. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

no vehicle shall run on cement bund material within 7 days of construction. This period shall be extended by one day for each night on which the temperature of the layer falls to 0°C or below.

2 Concrete slabs may be used by traffic when the characteristic compressive strength is assessed to have reached 25 N/mm² for pavement surface slabs, or 20 N/mm² for base courses with asphalt surfacing. The method of assessing the time when this strength is reached shall be as described in Clause 1004.

3 In the absence of test data establishing compliance with sub-Clause 2 of this Clause, no vehicle with an axle loading greater than 2 tonnes shall run on concrete slabs within a period of 14 days after placing the concrete. Vehicles with rubber tyres with an axle loading less than 2 tonnes, or wheels or tracks of concreting plant, shall not use any part of a newly constructed pavement within 7 days. The above periods before traffic may run on the pavement shall be increased if the 7-day cube strength is below that required in the Specification. These periods shall be extended by one day for each night on which the temperature of the layer falls to 0°C or below.

4 Cement Bound Material has to be kept moist for at least 3 days or to be protected against drying by other measures (Clause 1035, sub-clause 16). Further layers may be applied earlier if during layer no deformation of the sub-base arrive and if curing is not endangered by water-content reduction(e.g. application of tack coat before laying of an asphalt base course) Opening to traffic of the cement stabilization or the pavement including the cement stabilization or the pavement including the cement stabilization is only allowed if 70% of the compressive strength is achieved. Otherwise

Series 1100: Kerbs, Footways and Paved Areas

Kerbs, Channels, Edgings, Combined Drainage and Kerb Blocks and Linear Drainage Channel Systems

Units	1	The unit of measurement shall be:
	(i)	kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems linear metre.
Measurement	2	The measurement of kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall be the lengths required by the Contract. No deduction shall be made for gaps of 1 linear metre or less.
Itemisation	3	Separate items shall be provided for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I	1	Kerbs.
	2	Channels.
	3	Edgings.
	4	Combined drainage and kerb blocks.
	5	Linear drainage channel systems.
II	1	Permitted alternative materials and designs.
	2	Different materials and designs.
	3	Group reference.
III	1	Straight or curved exceeding 12 metres radius.
	2	Curved not exceeding 12 metres radius.

Kerbs, Channels, Edgings, Combined Drainage and Kerb Blocks and Linear Drainage Channel Systems

Item coverage	4	The items for kerbs, channels, edgings, and combined drainage and kerb blocks and linear drainage channel systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:
	(a)	trial mixes;
	(b)	making good after sampling and testing;
	(c)	excavation of acceptable material (as Series 600 paragraphs 17 and 18);
	(d)	excavation of unacceptable material (as Series 600 paragraph 19);
	(e)	excavation in Hard Material (as Series 600 paragraph 23);

- (f) disposal of material (as Series 600 paragraph 39);
- (g) concrete (as Series 1700 paragraphs 5 and 10);
- (h) formwork (as Series 1700 paragraph 15);
- (i) reinforcement (as Series 1700 paragraph 26);
- (j) mixing materials and extruding kerbs;
- (k) bedding, bonding, jointing, including movement joints, filling and sealing of joints;
- (l) keying of surfaces and tack coats;
- (m) surface finishing, curing and protecting;
- (n) gratings, frames, bedding and seatings;
- (o) tie bars;
- (p) drainage holes or pipes through concrete;
- (q) quadrants, dropper kerbs and other special kerb units;
- (r) edge support;
- (s) preservation of timber;
- (t) cutting;
- u) drainage layer;
- (v) additional pavement material below channels;
- (w) backfilling and compaction;
- (x) special units and fittings;
- (y) connections to chambers;
- (z) in the case of combined drainage and kerb blocks and linear drainage channel systems - design, certificates, provision of data and drawings, resubmissions, modifications and amendments to the Works.
- (aa) in the case of combined drainage and kerb blocks and linear drainage channel systems - internal checking and cleaning;
- (bb) reinstatement of surfaces.

Additional Concrete for Kerbs, Channels, Edgings, Combined Drainage and Kerb Blocks and Linear Drainage Channel Systems

Units

5 The unit of measurement shall be:

- (i) additional concrete for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems
..... cubic metre.

Measurement 6 The measurement of additional concrete for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall be the volume required by the Contract in excess of the standard requirements of the Contract for each type of kerb, channel, edging, combined drainage and kerb block or linear drainage channel system.

Itemisation 7 Separate items shall be provided for additional concrete for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Additional concrete of different mixes, classes or grades.
II	1 To kerbs. 2 To channels. 3 To edgings. 4 To combined drainage and kerb blocks. 5 To linear drainage channel systems.

**Additional Concrete for
Kerbs, Channels, Edgings,
Combined Drainage and Kerb
Channel Systems**

8 The items for additional concrete for kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- Item coverage
- (a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);
 - (b) excavation of unacceptable material (as Series 600 paragraph 19);
 - (c) excavation in Hard Material (as Series 600 paragraph 23);
 - (d) in situ concrete (as Series 1700 paragraph 5);
 - (e) formwork (as Series 1700 paragraph 15);
 - (f) reinforcement (as Series 1700 paragraph 26);
 - (g) forming, filling and sealing joints;
 - (h) surface finishing, curing and protecting;
 - (i) movement joints;
 - (j) drainage holes or pipes through concrete;
 - (k) disposal of material (as Series 600 paragraph 39).

**Remove from Store and Relay Kerbs, Channels, Edgings,
Combined Drainage and Kerb Blocks and Linear Drainage
Channel Systems**

Units	9	The unit of measurement shall be: (i) remove from store and relay kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems linear metre.
Measurement	10	The measurement for remove from store and relay kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall be the length required by the Contract. No deduction shall be made for gaps of 1 linear metre or less.
Itemisation	11	Separate items shall be provided for remove from store and relay kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems in accordance with Chapter II paragraphs 3 and 4 and the following:

Group	Feature
I	1 Remove from store and relay kerbs. 2 Remove from store and relay channels. 3 Remove from store and relay edgings. 4 Remove from store and relay combined drainage and kerb blocks. 5 Remove from store and relay linear drainage channel systems.
II	1 Different materials and designs.
III	1 Straight or curved exceeding 12 metres radius. 2 Curved not exceeding 12 metres radius.

Remove from Store and Relay Kerbs, Channels, Edgings, Combined Drainage Kerb Blocks and Linear Drainage Channel Systems	12	The items for remove from store and relay kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems shall in accordance with the Preambles to Bill of Quantities General Directions include for:
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Item coverage	(a) loading, transporting from store, unloading and positioning for relaying; (b) replacing items damaged during the foregoing operations; (c) modification and new materials; (d) kerbs, channels, edgings, combined drainage and kerb blocks and
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linear drainage channel systems (as this Series paragraph 4).

Footways and Paved Areas

Units	13	The units of measurement shall be: (i) footways and paved areas square metre. (ii) bituminous regulating course tonne. (iii) cement bound regulating course cubic metre.
Measurement	14	The measurement of footways and paved areas shall be calculated using the width of the top surface stated in the Contract.
	15	In the case of flexible construction where a Group reference is given for the whole construction, the total thickness of the combined sub-base, binder course, surface course and/or surface dressing shall be stated.
	16	In all other cases of flexible construction the thickness of each course shall be stated in the item description except that where a surface dressing is an integral part of any course then the combined thickness of the course and surface dressing shall be stated.
	17	In the cases of in situ and precast concrete, stone, slab and block paving the thickness of the sub-base, bedding and paving shall be separately stated in the item description.
	18	The measurement of bituminous regulating course shall be the tonnage certified by the Overseeing Organisation, being only that material included on delivery tickets which is incorporated in the Permanent Works in the locations and to the extent and thickness required by the Contract. The measurement of cement bound regulating course shall be the volume of material measured to the outlines stated in the Contract.
	19	No deduction shall be made for openings of 1 square metre or less.
Itemisation	20	Separate items shall be provided for footways and paved areas in accordance with Chapter II paragraphs 3 and 4 and the following:

Group Feature

I	1	Footways.
	2	Paved areas.
II	1	Different types of construction.
III	1	Different thicknesses.

IV	1	Different sizes, groups or types.
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V	1	Surfaces sloping at 10o or less to the horizontal.
	2	Surfaces sloping at more than 10o to the horizontal.

VI	1	Regulating course of different groups or types.
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Footways and Paved Areas

Item coverage

21 The items for footways and paved areas shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- (a) sub-base (as Series 700 paragraph 5);
- (b) edge support;
- (c) concrete (as Series 1700 paragraphs 5 and 10);
- (d) formwork (as Series 1700 paragraph 15);
- (e) void formers (as Series 1700 paragraph 16);
- (f) reinforcement (as Series 1700 paragraph 26);
- (g) joint filler and sealant (as Series 2300 paragraphs 9 and 10);
- (h) trial mixes;
- (i) laying to levels and falls;
- (j) bedding, jointing and pointing;
- (k) straight, circular and radial cutting and fitting;
- (l) rough and fair cutting and fitting;
- (m) base, lower base, upper base, binder course, surface course and concrete slab (as Series 700 paragraph 9);
- (n) compacting;
- (o) membrane;
- (p) topsoiling (as Series 600 paragraph 80);
- (q) grass seeding (as Series 3000 paragraph 9).

Bituminous and Cement Bound Regulating Course

Item coverage

22 The items for bituminous and cement bound regulating course shall in accordance with the Preambles to Bill of Quantities General Directions include for:

- (a) bituminous and cement bound regulating course (as Series 700 paragraph 14).

Remove from Store and Relay Paving Flags, Slabs and Blocks

Units	23	The unit of measurement shall be:													
		(i) remove from store and relay paving flags, slabs and blocks square metre.													
Measurement	24	The measurement of remove from store and relay paving flags, slabs and blocks shall be the area of the top surface of the work stated in the Contract.													
		No deduction shall be made for openings of 1 square metre or less.													
Itemisation	25	Separate items shall be provided for remove from store and relay paving flags, slabs and blocks in accordance with Chapter II paragraphs 3 and 4 and the following:													
		<table><tr><th>Group</th><th>Feature</th></tr><tr><td>I</td><td>1 Remove from store and relay paving in footways. 2 Remove from store and relay paving in paved areas.</td></tr><tr><td>II</td><td>1 Different types of construction.</td></tr><tr><td>III</td><td>1 Different thicknesses.</td></tr><tr><td>IV</td><td>1 Different sizes groups or types.</td></tr><tr><td>V</td><td>1 Surfaces sloping at 10o or less to the horizontal. 2 Surfaces sloping at more than 10° to the horizontal.</td></tr></table>		Group	Feature	I	1 Remove from store and relay paving in footways. 2 Remove from store and relay paving in paved areas.	II	1 Different types of construction.	III	1 Different thicknesses.	IV	1 Different sizes groups or types.	V	1 Surfaces sloping at 10o or less to the horizontal. 2 Surfaces sloping at more than 10° to the horizontal.
Group	Feature														
I	1 Remove from store and relay paving in footways. 2 Remove from store and relay paving in paved areas.														
II	1 Different types of construction.														
III	1 Different thicknesses.														
IV	1 Different sizes groups or types.														
V	1 Surfaces sloping at 10o or less to the horizontal. 2 Surfaces sloping at more than 10° to the horizontal.														
Remove from Store and Relay Paving Flags, Slabs and Blocks	26	The items for remove from store and relay paving flags, slabs and blocks shall in accordance with the Preambles to Bill of Quantities General Directions include for:													
Item coverage		(a) loading, transporting from store unloading and positioning for relaying;													
		(b) replacing items damaged during the foregoing operations;													
		(c) modification and new materials;													
		(d) footways and paved areas (as this Series paragraph 21).													

Steps

	27	The unit of measurement shall be: (i) flights of steps number.
Measurement	28	The measurement of steps shall be the complete flight including landings.
Itemisation	29	Separate items shall be provided for steps in accordance with Chapter II paragraphs 3 and 4 and the following:
Group Feature		
	I	1 Flight of steps.
	II	1 Different locations.
Steps	30	The items for steps shall in accordance with the Preambles to Bill of Quantities General Directions include for:
Item coverage		<p>(a) excavation of acceptable material (as Series 600 paragraphs 17 and 18);</p> <p>(b) excavation of unacceptable material (as Series 600 paragraph 19);</p> <p>(c) excavation in Hard Material (as Series 600 paragraph 23);</p> <p>(d) backfilling, compaction and reinstatement;</p> <p>(e) disposal of material (as Series 600 paragraph 39);</p> <p>(f) completion of formation (as Series 600 paragraph 85)</p> <p>(g) brickwork, blockwork and stonework (as Series 2400 paragraphs 4 and 8);</p> <p>(h) kerbs, channels, edgings, combined drainage and kerb blocks and linear drainage channel systems (as this Series paragraph 4);</p> <p>(i) footways and paved areas (as this Series paragraph 21);</p> <p>(j) surface finishing and non-slip treatment;</p> <p>(k) tread nosings;</p> <p>(l) pedestrian guardrails and handrails (as Series 400 paragraph 46);</p> <p>(m) fencing (as Series 300 paragraph 4);</p> <p>(n) concrete foundation to timber posts (as Series 300 paragraph 5);</p> <p>(o) gates and stiles (as Series 300 paragraph 6);</p> <p>(p) reinstatement of surfaces.</p>

Series 1200

TRAFFIC SIGNS

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TRAFFIC SIGNS

1201 Regulations, Sign Classification and Standards Regulations

1 Subject to paragraphs 2 and 3 below, all traffic signs used (including retro-reflecting road studs and road markings), whether permanent or temporary, shall be of the size, shape, colour and type prescribed for that use in The Traffic Signs Regulations and General Directions 1994 (Statutory Instrument 1994 No. 1519), including Working Drawings for Traffic Sign Design and Manufacture (Volumes 1, 2 and 3), the Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997 (Statutory Instrument 1997 No. 2400) and subsequent amending Regulations. Other relevant requirements are contained in the above Regulations and General Directions.

2 Signs that are not prescribed in Regulations need to be specially authorised by the ADT. Where the Contractor proposes to use non-prescribed temporary traffic signs, he shall obtain the agreement of the Overseeing Organisation to their intended design and location. Where the Contractor proposes to use prescribed temporary traffic signs, he shall obtain the agreement of the police and the highway authority to their intended location. The Contractor shall obtain authorisation and approval from the Overseeing Organisation for the use of the signs at the specific locations proposed.

3 Signs that are changeable by means other than the purely mechanical require statutory type approval for their construction and operating mechanisms by the ADT. This requirement is in addition to the need for the design of the sign to be prescribed or

specially authorised. The Contractor's proposal for signs that require statutory type approval shall include the reference numbers of any approval already issued in respect of that equipment. The signs shall not be installed until appropriate approval or confirmation of existing approval, by the Overseeing Organisation has been obtained.

Sign Classification

4 For the purposes of the Contract the following classifications apply:

- (i) permanent traffic signs. Any of the traffic signs prescribed in the Regulations, or specially authorised by the ADT, or any part thereof, designed to remain in position at the completion of the Permanent Works or a traffic cone, cylinder or other traffic delineator to be retained by the Employer;
- (ii) prescribed temporary traffic signs. Any of the traffic signs defined in the Regulations, or specially authorised by the ADT, or any part thereof, described in Appendix 12/1 which, unless otherwise described in Appendix 12/1, comply with the requirements of a permanent traffic sign but which will not remain in position at the completion of the Permanent Works;
- (iii) temporary traffic signs. Any of the traffic signs defined in the Regulations, or specially authorised by the ADT, or any part thereof, designed by the Contractor, in compliance with Clause 1216 which will not remain in position at the completion of the Permanent Works.

1202 General Requirements for Permanent Traffic Signs

1 Materials for permanent traffic signs and their construction, assembly, location and erection shall comply with this Series, Series 1400 and the requirements described in Appendix 12/1. The manufacture and installation of traffic signs shall be in accordance with the quality management scheme described in Appendix A.

2 Each complete traffic sign or part thereof shall be capable of passing the tests in BS 873 : Part 1.

3 Sign panels of internally illuminated signs and luminaire face panels shall, unless otherwise described in Appendix 12/1, comply with impact Category 1 of BS 873 : Part 5.

4 All lit traffic signs shall comply with Category 1 luminance of BS 873 : Part 5 unless otherwise described in Appendix 12/1.

5 Before the commencement of fabrication of any traffic sign, unless otherwise stated in Appendix 12/1, the Contractor shall submit for the Overseeing

Organisation's approval:

- (i) fabrication drawings for 'directional' and 'informatory' signs as required in Appendix 1/4;
- (ii) the information about 'warning', 'regulatory' and other traffic signs required in Appendix 12/1.

6 All traffic sign housings shall be provided with vandal and weather resistant locks. Keys, in the quantities stated in Appendix 12/1, shall be provided to the Overseeing Organisation. Types of lock shall be kept to a minimum.

7 The backs of traffic signs shall have a location identifying mark as described in Appendix 12/1.

8 Traffic signs shall be carefully handled to prevent damage, transported and stored in accordance with the sign face manufacturer's instructions.

1203 Foundations for Permanent Traffic Signs and Signals

1 The type and size of foundations for permanent traffic signs and signals shall be as described in, and unless otherwise stated therein shall comply with, this Clause.

2 All excavations for foundations shall be carried out in compliance with Clause 604 and shall be cleared of all loose material before placing of concrete and backfilling.

3 Unless otherwise described in Appendix 12/1 traffic signs and signals supported by a single post placed in the ground shall have the post installed centrally in 300 mm diameter or square holes filled in compliance with Clause 2602 with mix ST2 concrete to within 150 mm of the ground surface.

4 Unless otherwise described in Appendix 12/1, posts shall be supported for a minimum of 3 days after placing the concrete and backfilling shall not take place until at least 48 hours after placing.

5 For traffic signals and illuminated signs provision shall be made for cable entry through the foundation by means of ducting as described in Appendix 12/1.

6 Where pockets are formed in concrete foundations their plan dimensions shall be sufficiently larger than those of the post to

allow for positioning and bedding of the post and backfilling of the pocket.

7 All backfilling of foundations shall comply with Clause 611 except that where pipes or buried cables are installed it shall comply with Clauses 505 and 1421 respectively.

8 Reinstatement of existing surfaces above foundations shall comply with Clause 706.

1204 Posts for Permanent Traffic Signs

1 Posts for permanent traffic signs shall be as described in Appendix 12/1 and shall comply with BS 873 : Part 7, the surface protection requirements of BS 873 : Part 6 and with the following:

- (i) steel posts shall be tubular or rectangular hollow section complying with BS EN 10 210, joists, universal beams or columns complying with BS 4, and shall be manufactured from steel complying with grade S275 JO or S275 J2;
- (ii) aluminium posts shall be of tubular or rectangular hollow section;
- (iii) concrete for reinforced or prestressed concrete posts shall comply with Series 1700 and Appendix 12/1.

2 Posts shall not protrude above the top of the sign unless supporting an external luminaire, in which case the protrusion shall be kept to a minimum.

3 Internally illuminated posts for pedestrian crossing beacons shall comply with this Clause and where appropriate with BS 873 : Part 7.

4 Signs erected on a single post shall be positioned so that the post is in the centre of the

sign, unless otherwise described in Appendix 12/1.

5 Compartments for electrical equipment shall be as described in Appendix 12/1 and, wherever practicable, access doors shall be on the side of the compartment furthest from approaching traffic. In the case of signs supported by more than one post, such compartment shall be on the post furthest from the carriageway unless otherwise described in Appendix 12/1.

6 Flange plates shall have holes or slots as described in Appendix 12/1 to accommodate the attachment system.

1205 Sign Plates for Permanent Traffic Signs

1 All permanent sign plates shall comply with BS 873 : Part 6, and with this Clause.

2 Plate signs not exceeding 1.2 m in height and 2.4 m width shall be made of a single sheet. Where more than one sheet is used to make up a sign, the number of sheets shall be kept to a reasonable minimum and the separate sheets shall be rectangular and of comparable size and shape.

3 Extruded plank signs up to 4.8 m wide shall have no vertical joints. Above this size, joints in extruded planks should preferably be positioned at a vertical support; if not, then the vertical joints in adjacent planks should not be less than 1.0 m apart and only one joint per extruded plank is permitted.

4 Fabricated plank signs up to 4.8 m wide shall have no vertical joints, but each plank may be constructed from a maximum of two pieces of sub-strate material, producing one split line. Split lines should be lined up vertically or horizontally. Above 4.8 m wide, joints in the stiffening extrusions of adjacent planks should preferably be positioned at a vertical support; if not, then the vertical joints in the stiffening

extrusions of adjacent planks should not be less than 1.0 m apart and only one such joint per fabricated plank shall then be permitted.

5 Where top and bottom light spill screens are required in Appendix 12/1, these shall extend for the whole width of the sign and be fabricated out of the same material as the sign plate.

6 Top and bottom light spill screens shall be considered as part of the sign plate and any stiffeners and mounting fittings shall be designed to accommodate the combined size.

1206 Faces for Permanent Traffic Signs

1 Faces for permanent traffic signs shall be as described in Appendix 12/1. They shall comply with BS 873 : Part 6 and with this Clause.

2 All plastics sheeting shall be fixed in accordance with the sheeting manufacturer's instructions.

3 Only vertical and horizontal joints shall be permitted and all joints in plastics sheeting shall be overlapped by not less than 6 mm. The overlap in the horizontal joints shall be from the top. Butt joints in plastics sheeting shall not be used, except between individual planks or in electro cutable overlay film, or as recommended by the sheeting manufacturer.

4 All materials comprising the sign face, including the background, border and legends shall be carefully matched for colour at the time of sign fabrication to provide uniform appearance both by day and night. The sheeting manufacturer's recommendations on colour matching methods shall be observed.

5 Letters, numerals, symbols and borders shall be clear cut, sharp edged and without cracks.

6 Any cut-out letters, numerals, symbols and borders shall be of material compatible with the

sheeting to which they are applied. They shall be applied in accordance with the sheeting manufacturer's instructions.

7 Screen processed letters, numerals, symbols and borders shall be screen printed with materials in accordance with the sheeting manufacturer's instructions. Any inks, pastes and finishing coats used shall be compatible with the sheeting material or the face panel of internally illuminated signs.

8 Sheeting materials including letters, numerals, symbols and borders shall be fully adhered and there shall be no air bubbles, creases, cracks or other blemishes. Where the sheeting manufacturer requires the assembled materials to be provided with a coat of clear lacquer, it shall be uniform and continuous. All lacquer shall be applied at the time of fabrication of the sign face and shall be of a type specified or supplied by the sheeting manufacturer.

1207 Construction and Assembly of Permanent Traffic Signs

General

1 Construction and assembly of traffic signs shall comply with BS 873 : Part 6 and with this Clause.

2 All sign plates and planks, frames, purlins, posts and other components shall be de-burred prior to assembly.

3 Where framing and stiffening are not an integral part of the sign plate their joints shall be welded or joined with suitable brackets utilising nuts, bolts and washers.

4 Where purlins are adopted they shall be attached to each vertical member of the sign frame and the sign stiffening and framing shall

be continuous in the vertical direction. Purlins shall be spaced equally apart. Connections shall be made at every point where a purlin crosses a post.

5 Where purlins are not adopted the sign stiffening and framing shall be continuous in the horizontal direction.

6 Rivets and other devices used for fixing sheet sign plates to their stiffeners or framework, or in the construction of housings, shall be of a material compatible with the materials being joined. Spacing of rivets or other fixing devices shall be uniform and shall not exceed 150 mm around the outside edge of any sheet or section of sheet, and shall not exceed 300 mm on cross braces. Hollow rivets shall not be used. Where sign plates need to be stiffened this shall be achieved in a manner such that the sign face material is not punctured or otherwise damaged to accommodate the stiffening.

7 An additional washer of neoprene, nylon or other suitable material shall be used between the sign face and any metal nuts, bolts, washers and screws to protect it from corrosive or other damaging effects.

8 Where supports to traffic signs, including external lighting luminaires, are required to have flange plates these shall be secured by anchorages and attachment systems complying with Series 1300. The bolts shall be lightly greased before final installation and they and their anchorages shall be installed so as to achieve the loadings, torque settings and other requirements described in Appendix 12/1.

9 Sheet and plank signs shall be connected to posts by an appropriate method. Banding systems shall be of stainless steel complying with AISI Grade 201.

10 Plank signs shall be assembled in accordance with the manufacturer's instructions.

11 Where ferrous components are permitted any drilling of them shall be completed before the application of any finish.

12 Any hole drilled in plates with plastics sheeting to accommodate a rivet or bolt shall immediately prior to the insertion of the rivet or bolt have a clear lacquer, recommended by the plastics sheeting manufacturer, applied to its edge to prevent the ingress of moisture. The surfaces of rivets or bolts exposed on the sign face shall be covered by a suitable material of a colour to match that part of the face.

13 Prior to fitting any sign to any lighting column, the Contractor shall ensure that the sign is included in the technical approval of the lighting column in accordance with the Technical Approval Scheme adopted by the Overseeing Organisation and with Standard BD 26. No holes shall be drilled in the lighting column except those whose location and size are included in the technical approval.

14 Traffic signs to be erected on road lighting columns shall have fixings compatible with the column cross-section and finish. Wiring shall be contained in external conduit complying with BS 4568. Conduits shall be affixed to concrete lighting columns with stainless steel banding systems complying with AISI Grade 201. Conduits shall be affixed to other lighting columns with stainless steel clamps, which shall be screwed with stainless steel screws into tapped holes in the lighting column. Alternatively permanent cabling shall be placed on the inside of the lighting column and shall exit via a bushed drilled hole.

Variable Message Traffic Signs

15 Variable message traffic signs shall comply with this Clause.

1208 Location and Erection of Permanent

Traffic Signs

1 The approximate location of each traffic sign is described in Appendix 12/1. All traffic signs shall have their exact location determined and recorded in compliance with Clause 1403.

2 All posts shall be erected plumb and where two or more posts are provided for any one sign, the faces of the posts shall be lined up.

3 Signs erected on two posts shall have each post positioned so that the distance from the centre of the post to the edge of the sign plate is 300 mm unless otherwise described in Appendix 12/1.

4 Any pockets formed in concrete foundations to receive the posts shall be cleaned out immediately prior to erection. The posts shall be placed centrally in the pockets and be bedded on mortar designation

(i) complying with Clause 2404 and, unless otherwise described in Appendix 12/1, the pockets shall be filled up to finished foundation level with mix ST5 concrete.

5 Traffic signs mounted on posts, except those on gantries, shall be erected to have their face plumb and be orientated in relation to the carriageway in accordance with Chapter 1 of the Traffic Signs Manual.

6 Traffic signs mounted on gantries shall be erected as described in Appendix 12/6 and all other traffic signs shall be erected as described in Appendix 12/1.

7 The site records required by Clause 1402, shall include daily records for non-lit traffic signs.

8 No traffic sign shall be dismantled, re-sited or removed without the prior approval of the Overseeing Organisation.

1209 Covering of Permanent Traffic Signs

1 Where it is required in Appendix 12/1 that permanent traffic signs be blanked-out or have an alternative message, the method to be adopted shall comply with the following, unless otherwise described in Appendix 12/1:

(i) for plate signs: A cover plate compatible with the plate sign's material, or a covering of a suitable, opaque, non damaging material, or, for covering periods of up to one year, a self adhesive plastic film to support the temporary sign face sheeting;

(ii) for other traffic signs: A covering of a suitable, opaque, non damaging material.

2 Cover plates shall be suitably fixed to give a 10 mm minimum air gap between the sign face and cover plate. The fixing method shall not cause damage or staining to the sign face. Any holes remaining in the finished sign face after removal of the plate shall be filled with a suitable material, of a colour to match that part of the face.

3 Where self-adhesive plastic film is used it shall be compatible with the sign face materials and be applied and removed in compliance with the manufacturer's instructions.

4 Any loose covering used must be sufficiently opaque to prevent reflection from and legibility of the covered sign and be securely fastened to the back of the sign. Under no circumstances shall tape or other adhesive material be applied to the face of the sign. Sufficient space shall be left between the covering and the face to permit air flow over the sign.

5 Traffic signs which are to be covered shall not be erected on trafficked highways without the covering in place.

6 Removal of any covering shall be carried out with the minimum disturbance to traffic.

7 Irrespective of any requirement in Appendix 12/1 to cover signs, any traffic sign erected at such a time that its legend does not relate either wholly or in part to the traffic movement and route in operation, shall have its sign face securely covered with one of the materials in sub-Clause 1 of this Clause until such time as its legend is applicable.

1210 Permanent Bollards

1 Permanent bollards shall be as described in Appendix 12/1 and shall comply with appropriate Clauses of this Series.

2 Internally illuminated bollards and, unless otherwise described in Appendix 12/1 reflective-only bollards, shall be secured by stainless steel holding down bolts, nuts and washers. Holding down bolts and anchorages cast into the foundation shall be capable of complying with the performance requirements of BS 873 : Part 3 when tested as described therein.

3 All bolts shall be lightly greased before final installation and tightening to the bollard manufacturer's torque setting.

1211 Permanent Marker Posts

General

1 Permanent marker posts shall be constructed to the dimensions and be installed in the locations and by methods described in Appendix 12/2 and shall comply with this Series and sub-Clauses 2 and 3 of this Clause.

Distance Marker Posts

2 Distance marker posts shall be made from plastics, timber, or other materials described in Appendix 12/2.

Hazard Marker Posts

3 Hazard marker posts shall comply with BS 873 : Part 2. Post construction and colour and type of reflective marker shall be as described in Appendix 12/2.

1212 Road Markings

General

1 Road markings shall be white or yellow (Classes Y1 and Y2) complying with BS EN 1436 Table 6, as appropriate except where an alternative shade has been specified in Appendix 12/3. The markings shall consist of continuous or intermittent lines, letters, figures, arrows or symbols and comply with sub-Clauses 2 to 12 of this Clause. Statutory requirements controlling road markings are contained in The Traffic Signs Regulations and General Directions 1994 (Statutory Instrument 1994 No. 1519) and subsequent amending Regulations.

Permanent Road Markings

2 Permanent road markings shall be one of the following materials and comply with the colour, location and material type requirements described in Appendix 12/3:

- (i) thermoplastic road marking material or paint in accordance with BS EN 1871;
- (ii) permanent preformed road markings in accordance with BS EN 1790;
- (iii) other materials as described in Appendix 12/3 to BS EN 1871.

They shall be also tested in road trials to the Roll-over class P5 in accordance with the procedure stated in BS EN 1824 to demonstrate compliance with the performance requirements as stated in sub-Clauses 3 to 6. The test report shall give particulars of the quality and quantity of the material, including drop on glass beads laid at the test site for future reference and comparison purposes should such a need arise.

3 Road markings shall have the following road performance as defined in BS EN 1436 for the period of the functional life starting from the date of application or when the road is trafficked, whichever is later. The materials to be used shall be to the same mix, material quality, quantity and rate of application as used on the test site.

Property	BS EN 1436 Reference	Requirement*	Value
Colour	Table 6	1. White 2. Yellow Class Y1, Y2	X,y co-ordinates given x,y, co-ordinates given
Luminance Factor	Table 5	1. Class B2 2. Class B1	0.3 0.2
Skid Resistance	Table 7	1. Class S1 2. Class S1	45 45
Retroreflectivity	Table 2 Class of R, For dr markings	1. Class R2 2. Class R1	100 80

* Note: 1 = White, 2 = Yellow

4 The width tolerances and thickness for screed, spray, preformed and extruded white or yellow lines shall be in accordance with The Traffic Signs Regulations and General Direction 1994. With the exception of the road markings listed in Article 29 (2) of The Traffic Signs Regulations and General Directions, in no case shall any materials be laid more than 5 mm thick. Unless specified, all white markings shall be reflectorised with glass beads in accordance with BS EN 1423 and BS EN 1424 by incorporation (apart from preformed markings) into the road marking mixture and to the wet surface of the marking.

Property	BS EN 1436 Reference	Requirements	Value
Retroreflectivity	Table 3	Class RW3	50

5 Where there is requirement for improved visibility in wet conditions at night, products showing the following performance in addition to that stated in sub- Clause 3 shall be used.

6 Where there is a requirement for improved skid resistance as referred to in Appendix 12/3 products showing the following performance in addition to that stated in sub-Clause 3 shall be used.

Property	BS EN 1436 Reference	Requirements	Value
Skid Resistance	Table 7	Class S3	55

7 The pavement shall be prepared in accordance with the following:

- (i) Where the marking is to be applied on concrete carriageways, the transverse texturing shall be freed from all traces of curing compound by wire brushing or other approved means. Prior to the application of the thermoplastic material a tack coat compatible with the road surface and the marking material shall be applied in accordance with the manufacturer's instructions.
- (ii) On surface dressed carriageways, all loose chippings where the marking is to be applied shall be removed prior to application.

8 The application of permanent road markings shall be in accordance with the Sector Scheme described in Appendix A. Road marking materials shall only be applied to surfaces, which are clean and dry. Markings shall be free from raggedness at their edges and shall be uniform and free from streaks. Longitudinal road markings shall be laid to a regular alignment.

Raised Rib Road Markings

9 Raised Rib Road Markings shall only be used on motorways with full width hardshoulders or all-purpose roads (both single and dual carriageway) with at least 1 metre wide hardstrips. They shall comply with sub-Clauses 1, 2(i), 3, 5, 6, 7 and 8 of this Clause.

10 Raised Rib Road Markings shall be white lines, which are continuous over the sections where they are specified in Appendix 12/3. Where specified in Appendix 12/3 gaps shall be provided for drainage purposes.

11 Raised Rib Road Markings shall be in accordance with The Traffic Signs Regulations and General Directions 1994 (Statutory Instrument 1994 No. 1519), Diagrams 1012.2 and 1012.3, as appropriate. Spacing of the transverse raised ribs shall be 500 mm or 250 mm as specified in Appendix 12/3.

12 Raised Rib Road Markings shall not be used adjacent to hatched areas or central reserve crossings except as prescribed for use with diagrams 1040.3, 1040.5 and 1042.

Temporary Road Markings

13 Temporary road markings shall only be adopted with the prior approval of the Overseeing Organisation. They shall comply with sub-Clauses 1 to 8 of this Clause or if required to be removable, be constructed only from a proprietary preformed road marking material complying with BS EN 1790.

14 When temporary road markings are used on surfaces that will continue to be used by public traffic after their removal, any shadow trace remaining after their removal shall be permanently obliterated. Preformed materials shall not be used for this obliteration.

15 Temporary road markings constructed from a proprietary preformed road marking material shall only be adopted in locations and on types of road surface as described in Appendix 12/3 and shall comply with any other requirement therein. The marking material shall be new and together with any primer shall be stored and installed in accordance with the manufacturer's instructions and within the recommended shelf life.

16 Temporary preformed road markings shall only be applied to surfaces that are clean and dry. Upon removal they shall be disposed of off Site and if any making good is necessary to the road surface it shall be satisfactorily carried out before the road is opened to traffic.

Road Markings on Porous Asphalt Surfacing

17 Spray paint, thermoplastic applied by machine screed, spray or extrusion or preformed road markings shall be used for carriageway markings on porous asphalt surfacing. Manual screeding shall not be permitted except for directional arrows and similar markings.

Removal of Road Markings

18 The removal of road markings on surfaces that will continue to be used by traffic shall be undertaken in a manner that will avoid damage to the surface. The removal of temporary road markings shall comply with sub-Clauses 14 and 15 of this Clause.

The removal of permanent road markings shall be by mechanical means only. The Contractor shall submit details of the system he proposes to use to the Overseeing Organisation for approval.

Masking of Road Markings

19 When black masking materials are required to cover existing permanent road markings, they shall either comply with BS 7962 or have received written type approval from the Overseeing Organisation and if required to be removable, be constructed from a proprietary preformed removable black masking material.

1213 Road Studs

Retro-reflecting Road Studs

1 Statutory requirements controlling retro-reflecting road studs are contained in The Traffic Signs Regulations and General Directions 1994 (Statutory Instrument 1994 No. 1519) Regulations 28, 29 and Direction 50 and subsequent amending Regulations.

2 All retro-reflecting road studs shall comply with BS EN 1463-1 and 1463-2, and shall be installed in accordance with the manufacturer's instructions and the Sector Scheme described in Appendix A.

3 Retro-reflecting road studs and components which do not fall into a category of BS EN 1463, but which have statutory type approval by the ADT for the Overseeing Organisation can be incorporated into the Works. They shall be installed in accordance with the manufacturer's instructions.

4 The Contractor shall submit details of the retro-reflecting road studs he proposes to use in the Works to the Overseeing Organisation for approval.

Retro-reflecting Road Studs

5 Permanent retro-reflecting road studs shall be installed in the locations and to any other requirements as described in Appendix 12/3.

Temporary Retro-reflecting Road Studs

6 Temporary retro-reflecting road studs shall be of the fluorescent green-yellow type to BS EN 1463-1 and shall be appropriate for the situation concerned. They shall not be used for a second application. Adhesive used for the temporary retro-reflecting road studs shall be removed from the carriageway on completion of the Works.

Non retro-reflecting Road Studs

7 All non retro-reflecting road studs shall be installed in accordance with the manufacturer's instructions in locations, and complying with any other requirements, described in Appendix 12/3.

Retro-reflecting Road Studs on Porous Asphalt Surfacing

8 The edges of recesses for inset retro-reflecting road studs in porous asphalt surfacing shall be milled when the material has cooled to ambient temperature. Care shall be exercised when removing porous asphalt to form the recess to prevent damage occurring to the cut edges and to prevent detritus clogging the porous asphalt surfacing. Surface applied road studs should not be applied if there is evidence of moisture present on the surface of porous asphalt, nor should inset road studs be installed if moisture is present in the recess after milling of the asphalt.

1214 Traffic Cones, Traffic Cylinders, Flat Traffic Delineators and Other Traffic Delineators

General

1 Traffic cones and traffic cylinders, hereinafter termed cones and cylinders, shall comply with

Designation 1 or Designation 2 of BS 873 : Part 8. Cones shall be to Category A.

2 Flat Traffic Delineators, hereinafter termed FTDs, shall comply with sub-Clauses 3 to 17 of this Clause.

3 An FTD shall comprise a flat blade fixed to a base. The flat blade may incorporate stiffeners provided that they do not encroach into the white retro-reflective area.

4 FTDs shall be constructed of rubber or plastic materials. It shall be possible to insert and remove blades without requiring a special tool. The height of the FTD shall be 750 mm or 1000 mm as stated in Appendix 12/4. The width of the top of the blade shall be 45 ± 10 mm. Other dimensions shall be in accordance with Diagram 7102 of TSRGD 1994.

5 FTD bases shall be so designed that they will stack without binding and without causing damage to the retro-reflective surfaces. Additionally the blades and their attachment to the base or fixing shall be so designed that the blade's face presents throughout its design life a plane to the approaching traffic no more than 12.5° from the vertical.

6 FTD bases may be coloured red, black, grey or brown. They may have a 100 mm wide white reflective line placed on one edge of the base provided:

- (i) the edge of the base where the white line is to be attached comprises a sloping surface which is at an angle to the road surface of no more than 60° and is of such dimensions either to fully accommodate the 100 mm wide white line or, where the angle between the road surface and the sloping surface exceeds 30° , to accommodate at least 80 mm of the width of the white line, the excess

(maximum 20 mm) being returned onto the top surface of the base;

- (ii) the material from which the base is manufactured allows proper adhesion or attachment of the white reflective line to prevent it becoming detached during normal use;
- (iii) the coverage of white reflective material is maintained at more than 70% of the area treated.

7 The white reflective strip material shall comply with BS EN 1436 and BS EN 1871 or BS EN 1790 as appropriate. Additionally when tested using a portable retro-reflectometer the white line shall have a coefficient of retro-reflectance of Class R2 or better to Table 2 of BS EN 1436.

8 FTD blades shall be coloured red and white as indicated in Diagram 7102 of TSRGD 1994.

9 The white portions of the FTD blades shall comply with the chromaticity co-ordinates and luminance factor given in BS 873 : Part 6.

10 The red portions of the FTD shall comply with the chromaticity co-ordinates and luminance factor for traffic cones given in BS 873 : Part 8 when measured in accordance with BS 873 : Part 1.

11 That part of the blade coloured white shall comprise retro-reflective material, complying with the requirements for Class 1 or Class 2 as specified in BS 873 : Part 6, which shall be securely applied or attached to the blade to prevent it becoming detached during normal use.

12 The red portions may also be retro-reflective.

13 The minimum mass of the FTD including any ballast recommended by the manufacturer

shall comply with the mass of a traffic cone as defined in BS 873 : Part 8.

14 FTDs shall be clearly and durably marked with the following information in the following order:

- (a) the name, trade mark or other means of identification of the manufacturer or vendor;
- (b) the title and date of this document, e. Specification for Road Works, with appropriate date.

The marking shall be in characters legible at a normal reading distance such that the total area of the marking does not exceed 30 cm². Additionally the legend 'DUAL CARRIAGEWAY AND MOTORWAY USE ONLY' shall be applied to the lowermost red portion of the blade, using block capitals of minimum height 15 mm, in such a location that it can be clearly seen when the FTD is in position.

15 All markings shall be sufficiently durable to last the expected life of the FTD to which they are applied and in no case less than 5 years.

16 When checked by inspection and by rubbing lightly, first for 15 seconds with a piece of cloth soaked in water and then for 15 seconds with a piece of cloth soaked in petroleum spirit, followed by 15 seconds with a piece of cloth soaked in diesel oil, the marking shall still be legible.

17 FTDs shall be supplied with the following information:

- (a) instructions for ballasting (if required);
- (b) instructions for fixing blades to bases.

18 Other traffic delineators hereinafter termed delineators shall be as described in Appendix 12/4.

19 The Contractor shall submit to the Overseeing Organisation a copy of a test certificate confirming that samples of the identical type of cone, cylinder, FTD or delineator as those to be used in the Works and supplied as permanent cones, cylinders, FTDs or delineators under the Contract, have been tested and found to comply with sub-Clauses 1 to 18 of this Clause.

Permanent Cones, Cylinders, FTDs and Other Delineators

20 Where required in Appendix 1/5 the Contractor shall arrange for the tests described in sub- Clauses 22 to 56 of this Clause, for cones, cylinders, FTDs and other delineators, to be carried out at a UKAS approved testing laboratory. The numbers to be tested, as given in Appendix 1/5, are to be selected at random from the batch to be supplied under the Contract. Failure of any test will result in rejection of the batch.

Temporary Cones, Cylinders, FTDs and Other Delineators

21 The Contractor shall submit to the Overseeing Organisation certification substantiating that at least 1 in every 500 of any batch of cones, cylinders, FTDs and delineators to be used in the Temporary Works have passed the tests described in sub-Clauses 22 to 56 of this Clause as appropriate.

Testing

22 Cones and cylinders shall be tested in compliance with BS 873 : Part 8.

23 FTDs shall be tested in compliance with sub- Clauses 24 to 55 of this Clause.

24 Test procedures shall be carried out on each size of FTD and each method of attachment between blade and base.

25 When tested in accordance with sub-Clauses 31 to 38 of this Clause with the exception of the white retro-reflective material, no part of the FTD shall crack, split or deform.

26 When samples with retro-reflective portions attached are tested in accordance with sub-Clauses 31 to 38 of this Clause the coefficient of luminous intensity, R (as defined in Publication CIE No 54; Retro-reflection, definition and measurement), after testing shall be not less than 80% of the value previous to the test.

27 When tested in accordance with sub-Clauses 39 to 43 of this Clause, no part of the FTD with the exception of white retro-reflective material, shall crack, fracture or split and any ballast or ballast container shall not have become displaced within the base or separated from it. Any ballast container as either an integral part of the base or enclosed within it shall not have been damaged to the extent that ballast is discharged. Caps or bungs to ballast containers shall not have been forced from their sockets or other fixings.

28 When tested in accordance with sub-Clauses 44 to 49 of this Clause, no part of the FTD with the exception of white retro-reflective material shall crack, fracture or split. Bases shall remain in contact with the reference surface.

29 When tested in accordance with sub-Clauses 50 to 55 of this Clause, no part of the FTD with the exception of the white retro-reflective material shall crack, fracture or split. Bases shall remain in contact with the reference surface.

30 Throughout the tests in sub-Clauses 31 to 38, 44 to 49, and 50 to 55 of this Clause, the blade shall remain fixed in position. On completion of the testing in accordance with sub-Clauses 44 to 49 and 50 to 55 of this Clause the residual deflection of the top of the blade in any horizontal direction, measured 30 seconds to 60 seconds after completion of the tests, shall be not more than 12.5% of the height of the FTD. The height of the FTD, H , is as measured from the reference surface.

Low Temperature Impact Test

31 The test shall be conducted using a steel ball swung on a pendulum. The apparatus shall be as shown in RCD Drawing Number K3. The steel ball shall have a mass of 0.9 ± 0.045 kg and be suspended by one or two steel pendulum wires of not more than 1 mm diameter so that the pendulum radius is 1750 ± 10 mm. The point of impact shall be vertically beneath the centre of radius of the pendulum and at a height on the specimen of $H/2 \pm 10$ mm where H is the height of a FTD above the reference surface.

32 FTDs shall be fixed to the reference surface using the base.

33 The test shall be carried out on specimens with and without retro-reflective portions attached.

34 For samples with retro-reflective portions attached, the coefficient of luminous intensity, R , of every such face at an observation angle of 20° and at an entrance angle normal to the face of the blade prior to the conditioning shall be determined; the definitions of observation angle and entrance angle being those given in BS 873 : Part 1.

35 All test samples shall be conditioned for a period of not less than 2 hours at a temperature of $-16 \pm 2^\circ\text{C}$. Impact testing shall be carried out within 60 seconds after conditioning.

36 Impact shall be made in ambient conditions of not greater than 20°C.

37 Within 1 hour of impacting, samples shall be immersed with retro-reflective portions attached, in water at $20 \pm 5^\circ\text{C}$ for 10 minutes. After draining for 10 minutes the coefficient of luminous intensity, R, shall be measured in accordance with sub-Clause 34 of this Clause.

38 The sample shall be examined and any damage, percentage change in the coefficient of luminous intensity, or any detachment of a blade from its base shall be reported.

Drop Test

39 FTDs requiring the addition of ballast shall be ballasted as instructed by the manufacturer.

40 The FTD shall be conditioned for a period of not less than 2 hours at a temperature of $32 \pm 2^\circ\text{C}$.

41 Within 1 minute after conditioning the FTD shall be suspended with its normal vertical axis horizontal (any cap or bung to a ballast container forming an integral part of the FTD shall be positioned uppermost) and with its lowest part 1500 ± 5 mm above a solid horizontal surface and dropped once vertically from rest onto the solid surface.

42 The test detailed in sub-Clause 41 shall be repeated after conditioning at a temperature of $-16 \pm 2^\circ\text{C}$.

43 Any damage observed shall be reported.

Bending Test

44 The test shall be carried out on specimens with and without retro-reflective portions attached.

45 The blade shall be fixed to the base in accordance with the manufacturer's instructions. The blade and its base shall be conditioned for a period of not less than 2 hours at a temperature of $-16 \pm 2^\circ\text{C}$. Within 1 minute after conditioning, the blade shall be bent over about its base line by applying a force to the face of the blade at a point on its vertical centre line $H/2 \pm 10$ mm from the top, so that the top edge touches the reference surface or a surface coplanar with it as indicated in the RCD Drawing Number K3. H is the height of the FTD. When the top edge of the blade touches the reference surface the bending force shall be removed immediately.

46 From 30 seconds to 60 seconds after completion the maximum residual horizontal deflection of the top of the blade shall be measured from the vertical axis passing through the centre of the base of the blade and perpendicular to the reference surface.

47 The test shall be repeated in the opposite direction.

48 The procedure in sub-Clauses 45 to 47 of this Clause shall be repeated at a temperature of $32 \pm 2^\circ\text{C}$.

49 The deflections, any damage observed, any detachment of the blade from its base, and any movement of the base shall be reported.

Fatigue Test

50 The test shall be carried out on specimens with and without retro-reflective portions attached. This test is to be carried out on a different specimen to that or those tested in sub-Clauses 31 to 38 and 44 to 49 of this Clause.

51 The blade shall be fixed to the base in accordance with the manufacturer's instructions. The test shall be carried out after conditioning the blade and its base for a period

of not less than 2 hours at a temperature of $-16 \pm 2^{\circ}\text{C}$.

52 By applying a force to the face of blade at a point on its vertical centre line $H/2 \pm 10$ mm from the top, the top of the blade shall be oscillated as indicated in the RCD Drawing Number K3 at a frequency of 60 oscillations per minute to 90 oscillations per minute at an amplitude of $H/4$ for 10 minutes with the reference surface held in a horizontal position. H is the height of the FTD. One oscillation is the movement from the upright position to the maximum amplitude in one direction, then to the maximum amplitude in the opposite direction and then the return to the upright position.

53 From 30 seconds to 60 seconds after completion the maximum residual horizontal deflection of the top of the blade shall be measured from the vertical axis passing through the centre of the base of the blade and perpendicular to the reference surface.

54 The procedure in sub-Clauses 51 to 53 of this Clause shall be repeated at a temperature of $32 \pm 2^{\circ}\text{C}$.

55 The deflection, any damage observed and any detachment of the blade from its base shall be reported.

56 Other traffic delineators shall be tested in compliance with Appendix 12/4.

1215 Road Danger Lamps and High Intensity Flashing Beacons

1 Road danger lamps and high intensity flashing beacons shall be used in accordance with Regulations 43 and 42 respectively of TSRGD 1994, or Regulations 44 and 43 and shall comply with BS 3143.

1216 Temporary Traffic Signs

1 Temporary traffic signs shall be designed by the Contractor, comply with Clause 1201, satisfy Clause 117, have the consent of the Overseeing Organisation prior to installation, and comply with sub- Clauses 2 to 6 of this Clause.

Temporary traffic signs shall comply with The Traffic Signs Regulations and General Directions 1994, or The Traffic Sign (Welsh and English Language Provisions) Regulations and General Directions 1985, and be designed in accordance with Working Drawings for Traffic Sign Design and Manufacture (Volumes 1, 2 and 3) and where appropriate Local Transport Notes.

2 Temporary traffic signs shall be constructed as follows:

- (i) plate signs and internally illuminated signs:
 - (a) the coefficient of retro-reflection of the material for the faces of signs used for Type A or Type B works, as defined in Chapter 8 of the Traffic Signs Manual, and any amendment thereto including the amendments specified in sub-Clause 117.8, shall be as given in BS 873 : Part 6 for Class 1 material;
 - (b) where the sign is to be erected for less than 6 months, it shall, unless Appendix 12/1 requires it to be constructed to a similar standard as a permanent sign, be either portable sign complying with BS 873: Part 2 or a fixed short life sign complying with sub-Clause 3 of this Clause;
 - (c) where the sign is to be erected for periods of 6 months or more, or

where Appendix 12/1 requires it to be constructed to the standard for a permanent sign, it shall comply with the requirements for permanent traffic signs;

- (d) in addition to either (b) or (c) above, electrical work related to temporary traffic signs shall comply with the Series 1400 except Clauses 1402, 1410 and 1425;
- (ii) bollards and marker posts shall comply with Clauses 1210 and 1211;
- (iii) road studs:
 - (a) temporary retro-reflecting road studs shall comply with Clause 1213 and only be installed for periods of up to 3 months and thereupon be replaced;
 - (b) if permanent retro-reflecting road studs are used for temporary purposes they shall comply with Clause 1213 and have the prior approval of the Overseeing Organisation;
- (iv) road markings, cones, cylinders and delineators, road danger lamps and high intensity flashing beacons shall comply with Clauses 1212, 1214 and 1215 as appropriate;
- (v) portable traffic signals and haul route crossing signals shall, where relevant, comply with Clause 1217;
- (vi) any other signal, lamp, barrier or device shall be suitable for its intended purpose and where relevant shall comply with appropriate British Standards.

3 Fixed short life signs shall be constructed as follows:

- (i) materials:
 - (a) sign plates may be constructed of materials to the standard for a permanent sign, or alternatively shall be constructed of timber, hardboard, plywood or chipboard;
 - (b) stiffening frames for sign plates constructed of timber, hardboard, plywood or chipboard, shall be constructed of timber, mild steel or aluminium sections;
 - (c) mounting posts shall be constructed of steel, cast iron, aluminium alloy, reinforced or prestressed concrete or timber;
 - (d) fittings for signs made of materials to the standard for a permanent sign shall be similar to those used for permanent signs. For signs made of timber, hardboard, plywood or chipboard, fittings shall be of steel, stainless steel, or brass wood screws, or wire nails. Adhesives may be used for fixing provided they are weatherproof and are not affected by variations in temperature;
 - (e) sign plates constructed of timber, hardboard, plywood or chipboard shall be sealed or otherwise treated to ensure that the final finish will provide a satisfactory appearance and will not deteriorate during the period the sign is expected to be in use;
- (ii) construction:

- (a) sign plates shall be constructed on similar principles to those required for permanent signs, although stiffening may be omitted provided the sign plate passes the bending test given in BS 873 : Part 1;
- (b) stiffening frames constructed of timber members shall be jointed so that they withstand adverse weather conditions;
- (c) mounting posts constructed of timber shall have dimensions that are sufficient to withstand the estimated loading on the sign;
- (d) fixing of signs to the stiffening frame where required, and to the mounting posts shall be by screwing, nailing or gluing;
- (e) timber sign plates, stiffening frames and mounting posts shall be preserved with copper/ chrome/ arsenic (CCA) complying with BS 4072. The sign plate face shall be finished to comply with BS 873 : Part 6.

4 Erection of temporary traffic signs mounted on posts shall comply with Clause 1208.

5 Any temporary covering of temporary traffic signs shall comply with Clause 1209. Any temporary covering of road studs and road markings shall comply with any requirements described in Appendix 12/3.

6 Removal of temporary traffic signs shall be carried out as soon as they become superfluous or a hazard to traffic. Methods of removal shall ensure the minimum disturbance to traffic consistent with safety. Making good shall be carried out immediately after removal of the traffic sign.

7 Posts shall not protrude above the top of the sign unless supporting an external luminaire, in which case the protrusion shall be kept to a minimum.

1217 Traffic Signals

General

1 Traffic signals shall comprise road junction signals, pelican and puffin pedestrian crossing signals, haul route signals and wig-wag signals and shall be of the type described in Appendix 12/5.

2 Traffic signals shall comply with sub-Clauses 3 to 15 of this Clause and the requirements described in Appendix 12/5. The installation and maintenance of traffic signals shall be in accordance with the quality management scheme described in Appendix A.

3 Traffic signal equipment shall comply with BS 505 : 1971 (AMD 1990, 1976) as amended by Specification TR 0102. It shall consist of control equipment including detector loops of a type which has received statutory type approval by the ADT in accordance with the procedure described in Specification TRG 0500. They shall be maintained and serviced as described in Appendix 12/5.

4 All traffic safety and management measures associated with work on traffic signals shall comply with Clause 117, and any work entailing the switching off of existing signals shall not be carried out until the highway authority has been informed and until agreed alternative traffic management measures are in operation to safeguard and control vehicles using the highway.

Controllers

5 Controllers shall be provided and installed as described in Appendix 12/5. The cabinet shall be mounted on a foundation, with or without an adjacent inspection chamber as described in Appendix 12/5. The foundation shall make provision for the entry of the appropriate number of cable ducts.

6 Traffic signal controllers shall, in addition to any testing carried out in compliance with Clause 1424 be tested before delivery to Site and again after installation but before commissioning, to ensure they comply with the specification in Appendix 12/5.

Cabling and Electrical Requirements

7 Traffic signal equipment on each post shall be connected to the controller in accordance with the requirements described in Appendix 12/5.

8 The installation shall comply with BS 7671 Regulations for Electrical Installations (IEE Wiring Regulations) and the rules and regulations of the electricity supplier which provides the supply.

9 Cables shall be PVC insulated and sheathed 600/1000 V grade with steel wire armouring to BS 6346 and shall be installed in ducts in compliance with Clause 1421 and terminated in compliance with Clause 1423. Reinstatement shall be in compliance with Clause # 706.

10 Earthing of all posts, pushbutton boxes and the controller cabinet shall comply with Clause 1420. One conductor in each cable between a post and the equipment cabinet shall be a protective conductor and shall bond the earth terminal at the post to the main earth terminal.

11 Cable testing shall be in accordance with Clause 1424. Tests (a), (b), (c), (e), (f), (g), (h)

and (j) as defined in sub-Clause 1424.2 shall be conducted and all measurements recorded.

Telecommunications Carrier Interface

12 Where a connection interface to the plant of a telecommunications carrier is specified in Appendix 12/5 the installation shall comply with the rules and regulations of that carrier.

Posts

13 Posts for traffic signals shall be installed in compliance with Clause 1203 and in the locations specified in Appendix 12/5.

Signal Heads

14 All backing boards shall have a border of Class 1 retro-reflective material (white). Pressure sensitive material shall normally be supplied but vacuum applied material may be used in accordance with the manufacturer's process. Application of pressure sensitive material shall take place only on dry surfaces. An ambient temperature of 15°C minimum is recommended for satisfactory adhesion. The material shall have a 50 mm width throughout. Where the continuous border bridges each backing board/signal head a distinct cut edge shall be made to avoid any subsequent stretching/ shrinkage of dissimilar surfaces. The finished border shall be of a neat appearance and not made up of short lengths of cuttings.

Road Markings

15 Road markings associated with traffic signals shall comply with Clause 1212.

1218 Detector Loops

1 The installation and testing of detector loops shall be in accordance with Specification MCH 1540.

1219 Controlled and Un-controlled Crossings

1 The location of controlled and un-controlled crossings shall be as described in Appendix 12/5. Details shall be as described in Appendix 12/5.

2 Surfacing of Zebra crossing areas shall be laid with materials and to methods specified in Appendix 12/5. The finished surfacing shall have a minimum skid resistance Class of S3 when tested in compliance with BS EN 1436.

3 Non retro-reflecting road studs shall comply with Clause 1213.

4 Road markings shall be white and comply with Clause 1212 for permanent markings and be of the material described in Appendix 12/5.

5 Traffic signals, related control and other equipment where incorporated in controlled crossings together with installation and reinstatement shall comply with Clause 1217 for permanent traffic signals.

1220 Traffic Signs on Gantries

1 Where traffic signs (including signals) are erected on gantries the signs shall comply with the requirements of the relevant Clauses of this Series.

2 Fabricated steel gantries shall be constructed to the requirements described in Appendix 12/6, and to comply with Series 1800. Reinforced or prestressed concrete gantries shall be as described in Appendix 12/6 and shall comply with Series 1700.

1221 Preparation and Finish of Metal and Other Surfaces

General

1 Permanent traffic signs and, where specified in Appendix 12/1 prescribed temporary traffic signs shall be prepared, protected against corrosion and finished in compliance with BS 873 : Part 6 and with sub-Clauses 2 to 9 of this Clause.

Faces

2 Faces of sign plates shall be prepared to receive sign face materials in compliance with BS 873 : Part 6 and to the recommendations of the sign face material manufacturer following completion of any preparation and finish in sub-Clauses 3 and 6 of this Clause.

Steel Sign Plates, Purlins, Frames and Fittings

3 Steel sign plates, frames and fittings and purlins shall be prepared and protected in compliance with BS 873 : Part 6 and be as described in Appendix 12/1. Preparation to clean steel 2nd Quality and painting of surfaces shall comply with Series 1900.

Steel Posts and Post Housings

4 Steel posts and post housings shall be prepared and protected in compliance with BS 873 : Part 7. Painting shall comply with Series 1900 and be as described in Appendix 19/2.

Aluminium or Aluminium Alloy Posts and Post Housings

5 Aluminium or aluminium alloy posts and post housings shall, unless otherwise required in Appendix 19/2, be left unpainted, except for the bituminous coating required by BS 873 : Part 7 below ground level. A matt appearance shall be achieved in accordance with sub-Clause 6(ii) of this Clause.

Aluminium or Aluminium Alloy Sign Plates, Framework and Stiffening and Luminaire Housings

6 Backs of aluminium or aluminium alloy sheet and planks forming plate signs and external parts of luminaire housings and other permanently exposed components shall, to prevent specular reflection, be dulled using a method to be agreed by the Overseeing Organisation or be coated with either paint or plastics as follows:

- (i) plastics coating, and pre-treatment before its application, shall be in compliance with BS 873 : Part 6;
- (ii) surfaces to be painted shall be lightly abraded in accordance with sub-Clauses 1903.5 and 1903.6 or degreased and etch primed with primer detailed in Standard BD35, Item No. 14. Except for etch primed surfaces, all surfaces shall be immediately cleaned in accordance with sub-Clause 1903.9. All surfaces, including etch primed surfaces, shall be applied with one coat of matt polyurethane paint to Standard BD35, Item No. 168, and colour as described in Appendix 19/2. The paint application shall comply with the appropriate recoat time (over etch primer) as detailed in the paint manufacturer's data sheet and Clauses in Series 1900.

Internally Housed Electrical Components and Ancillary Equipment

7 Ferrous steel shall be finished inside and out by galvanizing, electro-plating or zinc or aluminium spray all in accordance with Series 1900, or other equivalent preparation and finish. Aluminium and other metals shall unless otherwise required in Appendix 14/4 be left untreated.

Stainless Steel Components

8 Unless otherwise required in Appendix 19/2 stainless steel shall be left untreated except where the component is visible against the sign face when it shall be covered by a suitable material, of a colour to match that part of the face.

Cast Iron and Cast Steel Components

9 External surfaces shall be prepared and protected as described in Appendix 19/2. Cabinets and feeder pillars shall have final coats of paint applied on Site after final installation including the fitting of any internal apparatus required as part of the Permanent Works. Internal surfaces shall unless otherwise specified in Appendix 19/2 receive the same treatment as for external surfaces except that final paint coats shall be applied before internal components are installed.

Road Markings

Permanent Road markings

1 Road marking shall have the following road performance as defined in BS EN 1436 for the period of the functional life starting from the date of application or when the road is trafficked, whichever is later. The materials to be used shall be to the same mix, material

quality, quantity and rate of application as used on the test site.

Property	BS EN 1436 Reference	Requirement*	Value
Colour	Table 6	1. White 2. Yellow Class Y1, Y2	X,y co-ordinates given x,y co-ordinates given
Luminance Factor	Table 5	1. Class B2 2. Class B1	0.3 0.2
Skid Resistance	Table 7	1. Class S1 2. Class S1	45 45
Retroreflectivity	Table 2 Class of R, For dr markings	1. Class R2 2. Class R1	100 80

* Note: 1 = White, 2 = Yellow

2 The width tolerances and thickness for screed, spray, preformed and extrusion white or yellow lines shall be in accordance with the Traffic Signs Regulations (Northern Ireland) 1997. With the exception of the road markings listed in Article 29 (2) of The Traffic Signs Regulations (Northern Ireland), in no case shall any materials be laid more than 5 mm thick. Unless otherwise specified, all white markings shall be reflectorised with glass beads in accordance with BS EN 1423 and 1424 by incorporation (apart from preformed markings) into the road marking mixture and to the wet surface of the marking.

3 Where there is requirement for improved visibility in wet conditions at night, products showing the following performance in addition to that stated in sub- Clause 3 shall be used.

Property	BS EN 1436 Reference	Requirements	Value
Retroreflectivity	Table 3	Class RW3	50

4 Where there is a requirement for improved skid resistance as referred to in Appendix 12/3, products showing the following performance in addition to that stated in sub clause 3 shall be used.

Property	BS EN 1436 Reference	Requirements	Value
Skid Resistance	Table 7	Class S3	55

5 The pavement shall be prepared in accordance with the following:

- (i) where the marking is to be applied on concrete carriageways, the transverse texturing shall be freed from all traces of curing compound by wire brushing or other approved means. Prior to the application of the thermoplastic material a tack coat compatible with the road surface and the marking material shall be applied in accordance with the manufacturer's instructions;
- (ii) on surface dressed carriageways, all loose chippings where the marking is to be applied shall be removed prior to application.

6 The application of permanent road markings shall be in accordance with the Sector Scheme described in Appendix A. Road marking materials shall only be applied to surfaces which are clean and dry. Markings shall be free from raggedness at their edges and shall be uniform and free from streaks. Longitudinal road markings shall be laid to a regular alignment.

Raised Rib Road Markings

7 Raised Rib Road Markings shall only be used on motorways with full width hard shoulders or all-purpose roads (both single and dual carriageway) with at least 1 metre wide hard strips. They shall comply with sub- Clauses 1, 2(i), 3, 5, 6, 7 and 8 of this Clause.

8 Raised Rib Road Markings shall be white lines which are continuous over the sections where they are specified in Appendix 12/3. Where specified in Appendix 12/3 gaps shall be provided for drainage purposes.

9 Raised Rib Road Markings shall be in accordance with The Traffic Signs Regulations (Northern Ireland) 1997, Diagrams 1012.2 and 1012.3, as appropriate. Spacing of the transverse raised ribs shall be 500 mm or 250 mm as specified in Appendix 12/3.

10 Raised Rib Road Markings shall not be used adjacent to hatched areas or central reserve crossings except as prescribed for use with diagrams 1040.3, 1040.5 and 1042.

Temporary Road Markings

11 Temporary road markings shall only be adopted with the prior approval of the Overseeing Organisation. They shall comply with sub-Clauses 1 to 8 of this Clause or if required to be removable, be constructed only from a proprietary preformed road marking material complying with BS EN 1790.

12 When temporary road markings are used on surfaces that will continue to be used by public traffic after their removal, any shadow trace remaining after their removal shall be permanently obliterated. Preformed materials shall not be used for this obliteration.

13 Temporary road markings constructed from a proprietary preformed road marking material shall only be adopted in locations and on types of road surface as described in Appendix 12/3 and shall comply with any other requirement therein. The marking material shall be new and together with any primer shall be stored and installed in accordance with the manufacturer's instructions and within the recommended shelf life.

14 Temporary preformed road markings shall only be applied to surfaces that are clean and dry. Upon removal they shall be disposed of off Site and if any making good is necessary to the

road surface it shall be satisfactorily carried out before the road is opened to traffic.

Road Markings on Porous Asphalt Surfacing

15 Spray paint, thermoplastic applied by machine screed, spray or extrusion, or preformed road markings shall be used for carriageway markings on porous asphalt surfacing. Manual screeding shall not be permitted except for directional arrows and similar markings.

Removal of Road Markings

16 The removal of road markings on surfaces that will continue to be used by traffic shall be undertaken in a manner that will avoid damage to the surface. The removal of temporary road markings shall comply with sub-Clauses 14 and 15 of this Clause.

The removal of permanent road markings shall be by mechanical means only. The Contractor shall submit details of the system he proposes to use to the Overseeing Organisation for approval.

Masking of Road Markings

17 When black masking materials are required to cover existing permanent road markings, they shall either comply with BS 7962 or have received written type approval from the Overseeing Organisation and if required to be removable, be constructed from a proprietary preformed removable black masking material.

1213 Road Studs

Retro reflecting Road Studs

1 Statutory requirements controlling retro-reflecting road studs are contained in The Traffic Signs Regulations (Northern Ireland) 1997 and subsequent amending Regulations.

2 All retro reflecting road studs shall comply with BS EN 1463-1 and 1463-2, and shall be installed in accordance with the manufacturer's instructions and the Sector Scheme described in Appendix A.

3 Retro reflecting road studs and components which do not fall into a category of BS EN 1463, but which have type approval of the Overseeing Organisation can be incorporated into the Works. They shall be installed in accordance with the manufacturer's instructions.

4 The Contractor shall submit details of the retro reflecting road studs he proposes to use in the Works to the Overseeing Organisation for approval.

Permanent Retro-reflecting Road Studs

5 Permanent retro reflecting road studs shall be installed in the locations and to any other requirements as described in Appendix 12/3.

Temporary Retro-reflecting Road Studs

6 Temporary retro reflecting road studs shall be of the fluorescent green-yellow type to BS EN 1463-1 and shall be appropriate for the situation concerned. They shall not be used for a second application. Adhesive used for the temporary retro reflecting road studs shall be removed from the carriageway on completion of the Works.

Non retro-reflecting Road Studs

7 All non-retro reflecting road studs shall be installed in accordance with the manufacturer's

instructions in locations, and complying with any other requirements, described in Appendix 12/3.

Retro-reflecting Road Studs on Porous Asphalt Surfacing

8 The edges of recesses for inset retro reflecting road studs in porous asphalt surfacing shall be milled when the material has cooled to ambient temperature. Care shall be exercised when removing porous asphalt to form the recess to prevent damage occurring to the cut edges and to prevent detritus clogging the porous asphalt surfacing. Surface applied road studs should not be applied if there is evidence of moisture present on the surface of porous asphalt, nor should inset road studs be installed if moisture is present in the recess after milling of the asphalt.

SERIES 1300

**ROAD LIGHTING COLUMNS AND
BRACKETS AND CCTV MASTS**

Contents

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ROAD LIGHTING COLUMNS AND BRACKETS AND CCTV MASTS

1301 General

1 This Series shall apply to the design, supply and installation of lighting columns and brackets and CCTV masts within the following dimensional limitations:

- (i) For steel, aluminium and concrete lighting columns:
 - (a) post top columns not exceeding 20 m nominal height;
 - (b) columns with brackets not exceeding 18 m nominal height;
 - (c) bracket projections not exceeding 0.25 x nominal height or 3 m whichever is the lesser.
- (ii) For glass fibre reinforced plastic lighting columns:
 - (a) columns not exceeding 10 m nominal height;
 - (b) bracket projections not exceeding 1.5 m.
- (iii) For steel CCTV masts:
 - (a) post top masts not exceeding 25 m nominal height.

2 The Contractor shall propose lighting columns and brackets and CCTV masts, which have been designed by the manufacturer. The manufacture, supply and verification of lighting columns and bracket arms shall comply with the quality management scheme described

in Appendix A. The Contractor shall design foundations for planted lighting columns as described in Appendix 13/1.

The Contractor shall where required design:

- (i) anchorages and attachment systems for columns and masts with flange plates to foundation or bridge deck;
- (ii) foundations for columns and masts with flange plates; as described in Appendix 13/1 and Appendix 13/4.

3 Lighting columns and brackets and CCTV masts shall be supplied and installed in compliance with BS EN 40 : Part 1 and BS 5649 : Parts 2, 3, 5, 6, 7, 8 and 9 together with the amendments and additions stated in Clauses 1309, 1310 and 1311 and all the other requirements of this Series.

4 Brackets for lighting columns shall include wall mounted brackets and fixtures.

5 Temporary lighting on temporary diversions for traffic, and crossovers, shall comply with this Series.

6 Where lighting columns and CCTV masts are to be in the vicinity of overhead power lines the Contractor shall ensure that the appropriate Electricity Authorities are notified and give written agreement to the specific clearances to be provided and that warning notices as described in Appendix 13/1 and Appendix 13/4 are permanently fixed to the columns affected prior to erection.

1302 Design of Lighting Columns, Brackets, CCTV Masts, Foundations, Anchorages and Attachment Systems

1 Lighting columns, brackets, CCTV masts, the foundations of both planted columns and columns and masts with flange plates, and the anchorages and attachment systems for columns and masts with flange plates shall be designed to comply with the requirements of Standards BD 26, BD 83 and the technical approval scheme adopted by the Overseeing Organisation.

The Contractor shall submit to the Overseeing Organisation a copy of the design and check certificates for lighting columns, brackets, CCTV masts and foundations.

Aesthetic Requirements

2 The aesthetic design of lighting columns, luminaires including those with bracket arms and CCTV masts shall be submitted by the Contractor to the Overseeing Organisation. The design of lighting columns and luminaires including those with bracket arms shall comply with the general advice given in BS 5489 for the appearance of lighting installations by day and by night both from the viewpoint of the road and from the surrounding neighbourhood.

Foundations for Planted Lighting Columns

3 The Contractor shall submit designs appropriate to the soil types encountered on Site, as identified in Appendix 13/1, to the Overseeing Organisation for its acceptance.

1303 Data Sheets

1 The Contractor shall complete the details in Appendix 13/2 Sheet 1 and Sheet 2, and Appendix 13/5 in accordance with the instructions given in Appendices 13/3 and 13/6. He shall provide the Overseeing Organisation with triplicate copies of the completed Data Sheets for each type of column and bracket and CCTV mast not later than the date stated in Appendices 13/1 and 13/4.

2 The columns and brackets and CCTV masts shall not be ordered or erected until the Overseeing Organisation has notified its acceptance of the completed Data Sheet in writing to the Contractor.

1304 Identification and Location Markings

1 All lighting columns and brackets and CCTV masts shall carry unique identification marks which indicate the name of the manufacturer, year of production, and other information, to enable details of the lighting column and bracket, and CCTV masts to be determined by reference to the appropriate Lighting Column and Bracket and CCTV Mast Data Sheets.

2 The column and mast identification marks shall be permanent, legible and clearly visible and be:

- (i) on a permanent fixed label; or
- (ii) hard stamped; or
- (iii) formed in the material of the column/mast on an external face only.

It shall be located either within the base compartment or, except in the case of hard stamping, immediately above or below the door. It shall not be located on the door. All hard stamping shall be made only in a secondary member of the column/mast and shall be done in a manner, which will not induce any stresses in the material of the main member of the column/mast.

3 The bracket identification mark shall be permanent and legible and be:

- (i) hard stamped; or
- (ii) formed in the material of the bracket on an external face only. The mark

shall be located either on the luminaire spigot or on the underside of the bracket adjacent to the column shaft or wall or pole mounting plate.

4 Alternatively the bracket identification mark shall be hard stamped or formed in a detachable label supplied fixed to the bracket. This label shall be moved from its temporary position and fixed on erection to a suitably provided hole next to the label on the column.

5 In addition, location marks for inspection and maintenance purposes shall be applied to each column as described in Appendix 13/1 and Appendix 13/4.

1305 Installation of Foundations, Anchorages and Attachment Systems

Planted Lighting Columns

1 A layer of concrete mix ST4, 75 mm thick, complying with Clause 2602 shall be placed and compacted in the bottom of the excavation up to the base of the column.

2 The cable entry slot shall be temporarily plugged as necessary in order to prevent any ingress of concrete or filling material during the concreting and backfilling operations.

3 The hole into which the column is placed shall be backfilled as follows:

- (i) in the case of metal and glass fibre reinforced plastic columns with concrete or other material described in Appendix 13/1;
- (ii) in the case of concrete columns with concrete or earth fill complying with sub-Clause 5 of this Clause or other material described in Appendix 13/1.

4 Concrete backfill shall be mix ST5 complying with Clause 2602, well compacted by vibration over the full planting depth of the column. A duct equal in size to the width of the cable entry hole, shall be formed through the concrete filling using a suitable preformed lining tube capable of retaining its cross-sectional shape during compaction. The concrete shall be placed 10 mm above ground level adjacent to the column and taper to ground level 100 mm from the column face.

5 Earth backfill shall be Class 8 material complying with Clause 601, Table 6/1 unless otherwise described in Appendix 13/1. The material shall be placed in 150 mm thick layers and shall be well rammed and compacted in order to provide full lateral support to the planting depth of the column. If the backfilling is disturbed for any reason it shall be reinstated in compliance with this Clause. A duct equal in size to the width of the cable entry hole, shall be made through the backfill material using a suitable preformed lining tube capable of retaining its cross-sectional shape during compaction.

Columns and Masts with Flange Plates

6 Concrete in the foundations shall comply with Series 1700.

7 The bedding mortar between the underside of the column/mast flange plate and the top of the concrete base shall comply with Clause 2601.

8 A cable duct, 75 mm diameter, shall be provided through the foundation or bridge component as described in Appendix 13/1 and Appendix 13/4.

9 Steel anchorages and attachment systems shall be used and the anchorage shall include an internally threaded component to receive the attachment system, i.e. holding down bolt or stud.

10 Where anchorages in drilled holes are to be used, the Contractor shall, unless otherwise described in Appendices 13/1 or 13/4, submit to the Overseeing Organisation at least 4 weeks before installation well attested and documented evidence that the proposed anchorage is:

- (i) capable of complying with the test requirements specified in Clause 1306; and
- (ii) capable of resisting pulsating loading. Anchorages in drilled holes of an expanding type shall not be used.

11 For anchorages in drilled holes the hole location shall be checked to ensure that the hole will be clear of reinforcement before drilling is carried out.

12 Before installation of anchorages in drilled holes, the hole shall be sound, clean and dry and the tolerance of the hole shall be within the values given by the anchorage manufacturer.

13 The threads of steel anchorages shall be lined with grease having a high resistance to creep and being suitable for hot or cold smearing. The grease shall provide protection to the threads for a minimum of either 18 months under cover or 6 months exposed on Site.

14 Attachment systems shall be tightened to the appropriate torque and have the minimum thread engagement calculated in accordance with the requirements of BS 6779 : Part 1 : 1992 : sub-Clause 12.4.1

15 All voids in anchorages, attachment systems and flange plates shall be filled with a non-setting passive filler to prevent the collection of water.

1306 Site Tests on Anchorages in Drilled Holes

1 The Contractor shall carry out site tests on anchorages in drilled holes. For the purpose of this sub-Clause the types of fixing referred to in Clause 1 of BS 5080: Part 1:1993 shall include “anchorages”. Where anchorages are tested they shall be loaded incrementally in tension in accordance with BS 5080: Part 1: 1993 except that they shall be capable of resisting a test load equal to 10 per cent above the nominal tensile load to be resisted by the anchorage in lieu of testing to failure. The tensile load shall be determined in accordance with the criteria given in sub-Clauses 8.15 to 8.18 of Standard BD 26 and Section 7 of Standard BD 83. Incremental loads shall be held for not less than half a minute and the test load for not less than five minutes. Readings shall be taken immediately after applying load and at the end of the time intervals stated above.

2 The total movement of the anchorage shall not exceed 1.0 mm during the test. Any evidence of slip during loading up to the test load, as demonstrated by a significant change in the slope of the load/extension curve, shall constitute failure. A test rig deemed to be equivalent to that shown in Figure 3 of BS 5080 : Part 1 : 1993 is contained in the RCD : Section 2.

3 The Contractor shall test anchorages selected on behalf of the Overseeing Organisation at the testing frequency in accordance with Appendix 1/5.

1307 Materials and Surface Finishes

1 All steel fixings including doors, door hinges, chains and locks shall be stainless steel to BS EN 10029, BS 970:Part 1 or BS EN ISO 3506 Parts 1 and 2 as appropriate or steel to BS EN 10 025, or BS 5649:Part 3: 1982 galvanized in compliance with Series 1900.

2 Where different metals are in contact, consideration shall be given to the necessary measures to avoid galvanic corrosion.

3 The surface preparation and protection of steel lighting columns, brackets and wall mountings and CCTV masts, mountings and housings shall comply with Appendix 19/1 and the relevant Clauses in Series 1900.

4 The exterior and interior surfaces of the intended planted depth of an aluminium alloy column shaft and a length of 250 mm above the ground level shall be coated with a non-porous electrically insulating bitumen with a minimum layer thickness of 250 microns. The coating shall only be applied after degreasing and after an approved preliminary treatment in order to ensure adhesion.

5 The underside of an aluminium alloy flange plate shall be treated before erection with bituminous paint complying with BS 3416 or BS 6949.

6 The finish to concrete lighting columns and brackets shall be Class F3 in compliance with Clause 1708.

1308 Handling, Transport and Erection

1 Lighting columns and brackets and CCTV masts shall be handled, transported and stored in such a way as to avoid any structural damage or damage to the surface protection system. Any damage incurred shall be made good in such a way that the structural performance and durability of the item shall be in no way reduced.

2 Lighting columns and brackets and CCTV masts shall be stored clear of the ground in such a way that contact with cement, groundwater, soil or ash or other deleterious material is prevented and that water does not accumulate on any surfaces or inside sections. Suitable

packings shall be placed between the columns to allow a free passage of air and dispersion of water.

3 All rivets, bolts, nuts, washers, screws, small plates and small articles generally shall be suitably packed and identified. All such items shall be stored under cover.

4 Columns and masts shall be installed in accordance with the manufacturer's recommendations. The door shall face the direction described in Appendices 13/1 and 13/4.

5 Wall mounted lighting brackets and fixtures shall be fixed as described in Appendix 13/1.

1309 Amendments and Additions to BS 5649 : Part 2 : 1978 (AMD 3136, 1979) for Lighting Columns

Page 4 - Clause 3

Delete Note "Lantern fixing angle 5° or 15°" and

Insert Note "Lantern fixing angle 3°, 5° or 15°".

In the Table insert additional bracket projections w of "0.5 m, 1.0 m, 1.5 m and 2.5 m".

Page 5 - Clause 4

Delete cable entry slot width dimension "50 mm" and

Insert cable entry slot width dimension "X".

Insert additional note as follows:

"5) Cable entry slot width dimension "X" shall be either 75 mm or 50 mm as described in Appendix 13/1."

Page 7 - Clause 6

Delete existing Tables and replace by the following:

h m	s min	a	d ₁ min	d ₂ min
≤5	8	200	M12	13
≤12	10	300	M16	17
≤20	15	300 400	M24	26

Delete '1' from Figure 7 and 'c' from Figure 8.

Insert additional notes as follows:

"2 Unless otherwise described in Appendix 13/1 circumferential slotted holes shall be used instead of round holes in the flange plates in order to allow $\pm 5^\circ$ of rotational adjustment.

3 Where slotted holes are required in the flange plate to allow for rotational adjustment of the column then the flange plate sizes shall be increased to give a suitable edge distance.

4 The distance from the edge of the hole or slot to the edge of the plate shall be not less than d_2 .

5 Washers complying with BS 4320 shall be used between the holding down fastener and the flange plate."

Page 8 - Clause 7

Delete existing Table for post top lanterns and replace by the following:

Delete existing Table for side entry lanterns and replace by the following:

Page 9 - Clause 8

8.7 Column cross-section

Insert additional sub-Clause as follows:

"8.7.1.3 Material thickness tolerance

(+ unspecified, - 5%)".

8.7.2.2 Deviation in shape

Delete content of entire sub-Clause and insert the following:

"Cross-section dimensional tolerances $\pm 5\%$ with a maximum of ± 10 mm."

1310 Amendments and Additions to BS 5649 : Part 3 : 1982 for Lighting Columns and Brackets and CCTV Masts

1310.1 For Lighting Columns and Brackets:

Page 2 - Clause 7

Delete sub-Clause 7.1 and insert the following:

"7.1. Steel and Aluminium Lighting Columns

7.1.1 General. Arc welding of carbon manganese steels shall comply with BS 5135. Arc welding of stainless steels shall comply with BS 4677. Arc welding of aluminium alloys shall comply with BS 3019 or BS 3571 as appropriate.

7.1.2 Procedures. Written welding procedures shall be used with testing to BS EN 288 Parts 1, 2 and 3 for steel and BS EN 288 Parts 1, 2 and 4 for aluminium alloys and shall apply to all production and repair procedures. These shall be subject to reapproval after a period of seven years. When applying BS EN 288 Parts 1, 2 and 3 the welding consumables and procedures used for steel shall be such that the mechanical properties of deposited weld metal will not be less than the respective minimum specified values of the parent metal being welded. Testing shall be by a laboratory appropriately accredited for weld testing. Approval shall be by an Independent Inspecting Authority using Registered Welding Engineers, Registered Welding Quality Engineers or equivalent.

7.1.3 Welder Qualification. All welders shall be approved to BS EN 287 Part 1 for steel and BS EN 287 Part 2 for aluminium alloys. The tests shall include in addition an application test representative of the ‘main structural’ joints on which the welder is to be approved to work. The main structural joints shall include, where relevant, the flange plate joint, the base compartment to shaft joint, the door reinforcement, any intermediate column joint, the column to bracket joint and the column seam weld. Welders shall be subject to reapproval in accordance with BS EN 287. Testing shall be by a laboratory appropriately accredited for weld testing. Approval shall be by an Independent Inspecting Authority using Registered Welding Engineers, Registered Welding Quality Engineers

7.1.4 Inspection and Non-Destructive Testing

7.1.4.1 Inspection Personnel. The manufacturer shall provide suitable personnel to carry out inspection of production welds as required in 7.1.4.2 to 7.1.4.4. Personnel conducting visual inspection shall have a nationally recognised certificate of competence appropriate to the type of welding being inspected. Personnel conducting non-destructive testing (NDT) shall be certified according to a nationally recognized certification scheme appropriate to the equipment used and the weld groups inspected. Evidence of training and qualification shall be retained and made available for examination when required. The results of all weld inspections shall be recorded.

7.1.4.2 Visual Inspection. All welds shall be subject to visual inspection in accordance with BS EN 970 : 1997 prior to any NDT and galvanizing. Weld surfaces shall be free of slag residues and sharp edges. All surfaces shall be free of traces of weld spatter, arc strikes and contaminants. The apparent throat dimensions of butt welds and the apparent leg length and apparent throat dimensions of fillet welds, as measured by a welding gauge and taking into account any known lack of fit, shall not be less than those specified, except that local shortfalls up to 0.5 mm may be accepted provided the average over any 50 mm length is not less than the specified dimension. The toe angle shall not be less than 110°. The surface of all welds shall be free from cracks, lack of fusion including overlap, and slag. Isolated discontinuous porosity may be accepted provided it is not detrimental to the galvanizing process. Undercut shall not result in a section loss of more than 5% over any 50 mm length of joint, nor shall its depth exceed 0.5 mm or 10% of the thickness, whichever is the less.

7.1.4.3 Magnetic Particle Inspection (MPI) and Liquid Penetrant Inspection. MPI shall be applied in accordance with BS 6072 to joints in steel lighting columns selected in accordance

with 7.1.4.5, where any of the material thickness exceeds 20 mm. Liquid penetrant inspection in accordance with BS EN 571-1 shall be applied to transverse welds in aluminium columns selected in accordance with 7.1.4.5. Notwithstanding the requirements of 7.1.4.5, one of the

above methods shall be applied as appropriate where on visual inspection the presence of cracking or lack of fusion may be suspected. To aid inspection the profile of the weld may be dressed by burr grinding provided that the specified throat size and leg length is still maintained. The surface of the weld shall be free of cracks, lack of fusion and slag.

7.1.4.4 Ultrasonic Testing. All butt joints selected in accordance with 7.1.4.5 shall be ultrasonically tested in accordance with BS EN 1714 where the column shaft is 8 mm thick or greater. For aluminium the principles in BS 3923 shall be applied. The weld shall be free of cracks. The height of buried slag, lack of fusion or lack of penetration shall not exceed 3 mm. Within 6 mm of the outer surface, their individual length shall not exceed 5 mm. The resulting net throat area loss over any 50 mm length of weld shall not exceed 5%.

7.1.4.5 Frequency of Testing. Joints for MPI, liquid penetrant inspection or ultrasonic testing shall be selected as follows:

10% of lighting columns of each type shall be inspected. The sample shall include all variations in joint geometry, material thickness and weld size covered by the basic type, that are within the scope of 7.1.4.3 and 7.1.4.4. If non-conformances are found the scope of MPI, liquid penetrant inspection and ultrasonic testing shall be doubled. If further non-conformances are found, the whole batch shall be tested.

7.1.4.6 Reporting. Inspection records for production welds shall be retained by the manufacturer for seven years and those covering the production periods relating to the lighting columns supplied shall be made available for examination.

7.1.5 Destructive Testing. Copies of certified reports of destructive tests on lighting columns supplied under earlier contracts with the Overseeing Organisation shall be made available for examination.

The Contractor shall supply sample joints cut from complete lighting columns for destructive testing as selected on behalf of the Overseeing Organisation. The sample joints shall be cut from the column, extension piece, bracket and welded anchorage where relevant. The basis of selection shall be as follows:

- a) For orders of 1 to 10 lighting columns – one complete lighting column for each type, unless destructive testing has been carried out within the last year on a lighting column of that type. The manufacture, supply and verification of lighting columns and bracket arms shall comply with the quality management scheme described in Appendix A.
- b) For orders of 11 to 300 lighting columns - one complete lighting column for each type unless destructive testing has been carried out within the last month on a lighting column of that type where the lighting column to be tested was also selected on behalf of the Overseeing Organisation.
- c) For orders exceeding 300 lighting columns - two complete lighting columns for each type.

Acceptance criteria shall be as specified in 7.1.4, except that in 7.1.4.2 the throat and leg

dimension shall apply to the true rather than the apparent dimension.

In the event that there is a non-conformance arising from a serious deviation in materials, preparation, assembly, or welding procedure, the batch concerned shall be rejected and further production of the columns affected stopped until such time as the fault has been corrected. A minor non-conformance shall only be accepted on the basis that further sampling and testing shows that fault is not repetitive and in the view of the Overseeing Organisation will not in that instance impair structural integrity.

If the problem can be traced to a particular manufacturing period, operator, piece of equipment or batch of materials and if proper trace ability to individual batches of components can be assured, only those batches affected may be subject to rejection.

The destructive test reports shall be retained by the manufacturer and recorded in a register for a period of two years. The destructive test specimens shall be retained for a period of 12 months. These shall be made available for examination on future contracts with the Overseeing Organisation.

7.1.6 Remedial Work. Welds which do not comply with the Specification may be repaired to an approved procedure, as described in 7.1.2.”

Page 2 - Clause 7

Delete sub-Clause 7.2 in its entirety.

1310.2 For CCTV Masts:

BS 5649 : Part 3 : 1982: Clause 2, Clause 6, sub-clause 7.1 and sub-clauses A1 and A3 shall apply, subject to the following amendments:

Page 2 - Clause 2

Delete the last sentence and replace with: “The steel shall be equivalent to or better than BS EN 10025, Grade S275 JR”.

Page 2 - Clause 6

Delete and replace with: “The steel used for foundation bolts shall be equivalent to or better than BS EN 10025, Grade 275 JR”.

Page 2 - Clause 7

Delete sub-Clause 7.1 and insert the following:

“7.1. Steel CCTV masts

7.1.1 General. Arc welding of carbon manganese steels shall comply with BS 5135. Arc welding of stainless steels shall comply with BS 4677.

7.1.2 Procedures. Written welding procedures shall be used with testing to BS EN 288 Parts 1, 2 and 3 for steel and shall apply to all production and repair procedures. These shall be subject to reapproval after a period of seven years. When applying BS EN 288 Parts 1, 2 and 3 the welding consumables and procedures used for steel shall be such that the mechanical properties of deposited weld metal will not be less than the respective minimum specified values of the parent metal being welded. Testing shall be by a laboratory appropriately accredited for weld testing. Approval shall be by an Independent Inspecting Authority using Registered Welding Engineers, Registered Welding Quality Engineers or equivalent.

7.1.3 Welder Qualification. The tests shall include in addition an application test representative of the ‘main structural’ joints on which the welder is to be approved to work. The main structural joints shall include, where relevant, the flange plate joint, the base compartment to shaft joint, the door reinforcement, any intermediate mast joint, the mast to bracket joint and the mast seam weld. Welders shall be subject to reapproval in

accordance with BS EN 287. Testing shall be by a laboratory appropriately accredited for weld testing. Approval shall be by an Independent Inspecting Authority using Registered Welding Engineers, Registered Welding Quality Engineers or Welding Inspectors or equivalent.

7.1.4 Inspection and Non-Destructive Testing

7.1.4.1 Inspection Personnel. The manufacturer shall provide suitable personnel to carry out inspection of production welds as required in 7.1.4.2 to 7.1.4.4. Personnel conducting visual inspection shall have a nationally recognized certificate of competence appropriate to the type of welding being inspected. Personnel conducting non-destructive testing (NDT) shall be certified according to a nationally recognized certification scheme appropriate to the equipment used and the weld groups inspected. Evidence of training and qualification shall be retained and made available for examination when required. The results of all weld inspections shall be recorded.

7.1.4.2 Visual Inspection. All welds shall be subject to visual inspection in accordance with BS EN 970 : 1997 prior to any NDT and galvanizing. Weld surfaces shall be free of slag residues and sharp edges. All surfaces shall be free of traces of weld spatter, arc strikes and contaminants. The apparent throat dimensions of butt welds and the apparent leg length and apparent throat dimensions of fillet welds, as measured by a welding gauge and taking into account any known lack of fit, shall not be less than those specified, except that local shortfalls up to 0.5 mm may be accepted provided the average over any 50 mm length is not less than the specified dimension. The toe angle shall not be less than 110°. The surface of all welds shall be free from cracks, lack of fusion including overlap, and slag. Isolated discontinuous porosity may be accepted provided it is not detrimental to the galvanizing process. Undercut shall not result in a section loss of

more than 5% over any 50 mm length of joint, nor shall its depth exceed 0.5 mm or 10% of the thickness, whichever is the less.

7.1.4.3 Magnetic Particle Inspection (MPI). MPI shall be applied in accordance with BS 6072 to joints in steel CCTV masts selected in accordance with 7.1.4.5, where any of the material thickness exceeds 20 mm. Notwithstanding the requirements of 7.1.4.5, one of the above methods shall be applied as appropriate where on visual inspection the presence of cracking or lack of fusion may be suspected. To aid inspection the profile of the weld may be dressed by burr grinding provided that the specified throat size and leg length is still maintained. The surface of the weld shall be free of cracks, lack of fusion and slag.

7.1.4.4 Ultrasonic Testing. All butt joints selected in accordance with 7.1.4.5 shall be ultrasonically tested in accordance with BS EN 1714 where the mast shaft is 8 mm thick or greater. The weld shall be free of cracks. The height of buried slag, lack of fusion or lack of penetration shall not exceed 3 mm. Within 6 mm of the outer surface, their individual length shall not exceed 5 mm. The resulting net throat area loss over any 50 mm length of weld shall not exceed 5%.

7.1.4.5 Frequency of Testing. Joints for MPI or ultrasonic testing shall be selected as follows:

10% of CCTV masts of each type shall be inspected. The sample shall include all variations in joint geometry, material thickness and weld size covered by the basic type, that are within the scope of 7.1.4.3 and 7.1.4.4. If non-conformances are found the scope of MPI and ultrasonic testing shall be doubled. If further non-conformances are found, the whole batch shall be tested.

7.1.4.6 Reporting. Inspection records for production welds shall be retained by the manufacturer for seven years and those covering the production periods relating to the CCTV masts supplied shall be made available for examination.

7.1.5 Destructive Testing. Copies of certified reports of destructive tests on CCTV masts supplied under earlier contracts with the Overseeing Organisation shall be made available for examination.

The Contractor shall supply sample joints cut from complete CCTV masts for destructive testing as selected on behalf of the Overseeing Organisation. The sample joints shall be cut from the mast, extension piece, bracket and welded anchorage where relevant. The basis of selection shall be as follows:

- a) For orders of 1 to 10 CCTV masts – one complete CCTV mast for each type, unless destructive testing has been carried out within the last year on a CCTV mast of that type.
- b) For orders of 11 to 300 CCTV masts – one complete CCTV mast for each type unless destructive testing has been carried out within the last month on a CCTV mast of that type where the CCTV mast to be tested was also selected on behalf of the Overseeing Organisation.
- c) For orders exceeding 300 CCTV masts – two complete CCTV masts for each type.

Acceptance criteria shall be as specified in 7.1.4, except that in 7.1.4.2 the throat and leg dimension shall apply to the true rather than the apparent dimension.

In the event that there is a non-conformance arising from a serious deviation in materials,

preparation, assembly, or welding procedure, the batch concerned shall be rejected and further production of the columns affected stopped until such time as the fault has been corrected. A minor non-conformance shall only be accepted on the basis that further sampling and testing shows that fault is not repetitive and in the view of the Overseeing Organisation will not in that instance impair structural integrity.

If the problem can be traced to a particular manufacturing period, operator, piece of equipment or batch of materials and if proper traceability to individual batches of components can be assured, only those batches affected may be subject to rejection.

The destructive test reports shall be retained by the manufacturer and recorded in a register for a period of two years. The destructive test specimens shall be retained for a period of 12 months. These shall be made available for examination on future contracts with the Overseeing Organisation.

7.1.6 Remedial Work. Welds which do not comply with the Specification may be repaired to an approved procedure, as described in 7.1.2.”

Page 2 - Clause 7

Delete sub-Clause 7.2 in its entirety.

Page 3, Appendix A1

Delete and replace with: “The following grades of steel are considered to comply with Clause 2 of this standard.

BS EN 10025 : Grades S275 JR, S275 JO, S275 J2G3, S275 J2G4, S355 JR, S355 JO, S355 J2G3, S355 J2G4

BS EN 10210 : Grades S275 JOH, S275 J2H, S355 JOH, S355 J2H”.

Page 3 - Appendix A3

Delete and replace with: “The following grades of steel are considered to comply with Clause 6 of this standard Foundation bolts: BS 4190 Grades 4.6 and 4.8 BS 3692 Grade 8.8”.

**1311 Amendments and Additions to BS 5649
: Part 5 : 1982 for Lighting Columns
and CCTV Masts**

**1311.1 For Lighting Columns and CCTV
Masts:**

Page 3

3.2, after paragraph 2

Insert additional paragraphs as follows:

“The door arrangement shall be such that it can be opened by releasing a single threaded locking fastener. The fastener shall be of stainless steel to BS 6105 or BS 970 : Part 1 with the dimensions given in RCD Drawing Number K1.

When the door is secured the fastener head shall be completely recessed into the door in a circular recess as indicated in RCD Drawing Number K1.

Six door keys as shown on RCD drawing No. K1, or for alternative vandal resistant locks approved by the Overseeing Organisation shall be supplied to the Overseeing Organisation. The locking fastener shall be suitable for opening with the standard key detailed in RCD Drawing Number K1.”

1311.2 For Lighting Columns:

Page 3

3.4, after paragraph 2

Insert additional paragraph as follows:

“Where a cable entry slot width of 75 mm is provided, the minimum size of cableway from the cable entry slot to the base compartment shall be 75 mm”

After Page 3

Insert “RCD Drawing Number K1.”

**1312 Attachments to Lighting Columns and
CCTV Masts**

1 Attachments to lighting columns and CCTV masts shall be by means of circumferential clamps of stainless steel complying with AISI Grade 201 or other suitable material which shall not damage the column or its protective coating.

**1313 Laminated Glass Fibre Reinforced
Plastic (GFRP) Lighting Columns**

Manufacture of GFRP Laminates

1 The columns shall be produced either by hand layup for mechanical moulding technique. The mechanical manufacture shall be carried out either by filament winding, centrifugal casting, compression moulding, resin injection or any other appropriate method accepted by the Overseeing Organisation.

2 An exterior resin rich layer of at least 0.25 mm thickness shall be provided to ensure adequate protection of the reinforcing fibres against adverse effects of the weather and possible chemical attack.

3 Columns containing bubbles, cracks, holes, pits or other voids each greater than 7 mm² in area shall be rejected.

4 The dimension and tolerances shall be those given in BS 5649 : Part 2: 1978 for seamless metal columns. The outer surface shall have a smooth uniform taper along its total length.

Materials for GFRP Laminates

5 The fibre reinforced plastic shall be in the form of laminate made of thermosetting resin, fibre reinforcement (mainly glass fibre), catalyst system and filler.

6 The resins used shall conform to the appropriate British Standards. Polyester resins shall be based on isophthalic acid and conform to BS 3532, Type B.

7 Any fillers and pigments incorporated in the resin shall form part of the total resin system and shall be subject to acceptance of the Overseeing Organisation.

8 Fibre reinforcement shall conform to the appropriate British Standards. Where glass fibre is used as the base for mat or chopped fibre it shall conform to BS 3691 and shall be treated with an appropriate finish compatible with the resin system used.

9 All accelerators, catalysts and hardeners shall be used in accordance with the resin manufacturer's instructions.

Testing of GFRP Laminates

10 The properties of the laminates shall be verified by testing as described in sub-Clauses 13 to 18 of this Clause. Any material failing any of the tests listed shall be rejected. Such tests shall, unless otherwise described in Appendix 13/1, be carried out on samples representing the batch of columns to be supplied under the Contract.

11 Two types of samples shall be provided for the tests:

- (i) Samples from a specially prepared flat laminate for type tests or where changes in raw materials or manufacturing techniques are proposed. These shall comprise tests for colour fastness, electric strength, water absorption and impact strength.
- (ii) Samples cut from complete columns to be used for quality control purposes, to be carried out at a frequency of one in each two hundred-production columns.

Each column for tests will be selected on a random basis and will be examined by visual inspection and for loss on ignition.

12 A flat laminate sample 300 mm \pm 10 mm square by 3 mm + 0.5 mm/-0.0 mm thick shall be prepared by hand lay-up method using the same curing conditions resin and reinforcement systems as used for production columns. The total glass fibre content shall not exceed 40% by weight.

13 The colour fastness test shall be conducted in accordance with BS 2782 : Part 5 : Method 550A and the results assessed by Method 552A. Material with a colour change assessed greater than moderate will not be accepted.

14 The electric strength test shall be carried out in accordance with BS 2782 : Part 2 : Method 221. The electric strength shall be not less than 10 kV/mm.

15 The water absorption test shall be carried out in accordance with BS 2782 : Part 4 : Method 430A. The absorption of water shall be not greater than 50 milligrammes.

16 The impact strength test shall be carried out in accordance with BS 2782 : Part 3 : Method 359. The impact resistance shall be at least 30 kJ/m².

17 The loss on ignition tests shall be carried out in accordance with BS 2782 : Part 10 : Method 1002. The loss on ignition on samples taken at random throughout the length of a column shall not exceed 60% after subtracting the amount allowed for non-combustible fillers. The percentage of glass fibre remaining following ignition shall be at least 40% by weight.

18 Samples cut randomly throughout the length of a column shall be visually inspected to confirm that there are no delaminations or voids greater than specified in sub-Clause 3 of this

Clause and that the laminate is fully densified and includes the required number of laminations.

1314 Brackets for Laminated GFRP Lighting Columns

General

1 Brackets shall consist of a galvanized steel tube assembly with an external self-skinning rigid polyurethane foam moulding.

Materials

2 The steel tube assembly shall comply with BS EN 40 : Part 1 and BS 5649 and the requirements of this Series.

3 The rigid polyurethane foam shall be moulded in accordance with the manufacturer's instructions to give a bulk density within the range of $500 \pm 50 \text{ kg/m}^3$, when in the form of a test sheet in accordance with sub-Clause 5 of this Clause. The surface shall be free from obvious defects such as voiding, pitting or cracking. It shall have a surface hardness of at least D/30/1 when measured in accordance with BS 2782 : Part 3 : Method 365B.

4 The polyurethane moulding shall be primed with a two part polyurethane primer and finished with a two part polyurethane top coating all in accordance with the manufacturer's instructions.

Testing of Polyurethane Foam

5 Properties of foam shall be verified by testing using specimens cut from moulded test sheets of 10 mm nominal thickness using the same material as in the manufacture of the bracket arms.

6 The apparent bulk density of a specimen shall be determined and be within the range of $500 \pm 50 \text{ kg/m}^3$. The method of testing shall be in accordance with the polyurethane foam manufacturer's instructions.

7 The impact strength of a specimen shall be determined in accordance with BS 2782 : Part 3 : Method 359 and shall be at least 6.0 kJ/m^2 .

8 The flexural stress at a deflection of 10 mm carried out on a specimen shall be in the range of 24 to 30 MPa. The method of testing shall be in accordance with the polyurethane foam manufacturer's instructions.

9 The tests specified in sub-Clauses 6, 7 and 8 of this Clause shall each be carried out on two specimens and, unless otherwise stated in Appendix 13/1, the results shall be representative of the batch of columns to be supplied.

10 Evidence of quality control including results of tests similar to those required in sub-Clauses 6, 7 and 8 of this Clause shall be made available when required by the Overseeing Organisation.

11 Tests specified in sub-Clauses 6, 7 and 8 of this Clause shall be carried out when changes in raw materials or manufacturing techniques are proposed. For quality control purposes testing shall be carried out in accordance with sub-Clause 3 of this Clause on each production batch of brackets, which are to be fitted to columns.

STRUCTURAL CONCRETE

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SERIES 2000

WATERPROOFING FOR CONCRETE STRUCTURES

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WATERPROOFING FOR CONCRETE STRUCTURES

2001 General

1 Immediately before the application of the primer or laying of the waterproofing system or protective layer, the concrete surface or primed surface shall be clean, dry and free from laitance, loose aggregate dust and where the adhesion to the concrete would be impaired, free form curing liquids, compound and membranes.

2 The waterproofing membrane, primer and bonding agents including tack coat, shall be compatible with each other.

3 The use of ventilation layers, partial bonding or bond breakers with the waterproofing system is not permitted.

4 The surface finish for new bridge decks between parapet up stands and to top of buried structures to be waterproofed shall be Class U4 finish in accordance with sub-Clause 1708.4.

5 Existing waterproofing systems to bridge decks between parapet up stands are to be repaired or replaced in accordance with Clause 2008.

6 An additional protective layer shall be applied immediately above bridge deck waterproofing only to those areas shown on the Drawings and shall comply with this Series

2002 Protection of Bridge Deck Waterproofing During Construction

1 On any structure, providing no damage results, plant and equipment all fitted only with rubber tyres may stand or travel on waterproofing systems solely for the purposes of laying an additional protective layer or surfacing course on that structure.

Rollers shall not be permitted to stand or travel directly on the waterproofing system.

Where it is necessary for plant, equipment or traffic to stand or travel on a bridge deck that has been waterproofed (mastic asphalt waterproofing or proprietary waterproofing systems) with a permitted system before the laying of an additional protective layer, suitable temporary protection shall be provided. All such plant and equipment shall have its tyre treads regularly inspected and any embedded hard objects removed.

2 Temporary protection shall be provided where damage to the waterproofing, protective layer or additional protective layer could result from particular site traffic.

3 The protective layer of a two layer waterproofing system, or any protective layer additional to that included as part of a waterproofing system, shall be laid immediately after the waterproofing layer's bonding agent has set or cured. Where a waterproofing membrane also serves as an adhesive for the protective layer, any additional protective layer shall not be laid until the liquid

waterproofing membrane/adhesive has set or cured.

2003 Materials for Waterproofing Concrete Bridge Decks

Primer for Mastic Asphalt

1 Primer for sealing concrete surfaces prior to waterproofing shall be spirit based and compatible with mastic asphalt. The viscosity of the primer shall be such that it penetrates the concrete without forming a skin.

Mastic Asphalt

2 Unless otherwise described in Appendix 20/2, mastic asphalt for waterproofing complying with NBS 6925, type R988. Where mastic asphalt for waterproofing complying with BS 6925, type T1097 is required, the hardness number at the time of laying shall not exceed 90 at 25 °C.

Proprietary Waterproofing Systems

3 Proprietary Waterproofing systems incorporated in the Permanent Works shall have a current International Agreement Board Roads and Bridges Certificate. Each System shall also have a current PWS (Proprietary Waterproofing System) Data sheet cleared through IAB in their certification procedure.

The contractor shall furnish the Engineer with 3 copies of the PWS Data Sheet and Annex 'A' a blank copy of which is shown in Appendix 20/1. The system shall not be adopted for the works until the Engineer has provided his written acceptance of the complete system, its

component materials, their characteristic properties and the preparation and installation instructions all as stated on the PWS Data Sheet and its Annex 'A'. When furnishing the Engineer with the PWS Data sheet the contractor shall include for acceptance any additional information or limitation necessary to cater for the conditions at site including climatic and environmental limitations, compatibility of materials and details at the interface of the waterproofing with the bridge deck movement joints. No departures from the specified constituent materials as stated on the International Agreement Board Roads and Bridges Certificate and the PWS Data Sheet shall be permitted.

Additional Bituminous Protection

4 Bituminous protection where shown on the drawings as an additional protective layer, shall comply with BS 594 : Part 1 recipe Type F wearing course mixture Designation 0/3 except that 5% \pm 0.5% of the total mix shall be inorganic red oxide and regarded as part of the filler content, where the additional protective layer is required to be tinted.

2004 Materials for Waterproofing Below Ground Concrete Surfaces

Primer for Tar and Bitumen

1 Primer for sealing concrete surfaces prior to waterproofing shall be compatible with the selected tar or bitumen waterproofing material. The viscosity of the primer shall be such that it penetrates the concrete without forming a skin.

Tar

2 Tar shall comply with BS 76 of viscosity grade within the range 30-38°C equi-viscous temperature.

Cut Back Bitumen

3 Cut back bitumen shall comply with BS 3690 : Part 1 of viscosity grade 50 seconds.

Proprietary Materials

4 Subject to any restrictions specified in Appendix 20/2, proprietary materials may be used.

2005 Workmanship for Waterproofing Concrete Bridge Decks

Mastic Asphalt

1 Unless otherwise agreed by the Engineer, the concrete surface shall be thoroughly sealed with evenly applied primer. The primer shall be well brushed in to avoid ponding in any depression in the deck.

2 Mastic asphalt shall be laid directly onto the primer surface:

- (i) on horizontal surface and sloping surfaces up to 30 °C to the horizontal in two coats or equal thickness to a total thickness of not less than 20 mm;
- (ii) on vertical surface and sloping surfaces of over 30 °C to the horizontal in two or three coats of equal thickness to a total thickness of not less than 20 mm.

3 The method of laying and workmanship shall comply with the recommendations of British Standard Code of Practice CP 144: Part 4: 1970, Section 4 except that:

- (i) in addition to sub-clause 4.6.1., visible blow holes and other defects shall be made good before laying a subsequent coat.
- (ii) Sub-Clause 4.6.2. and 3 and 4.7.1, 2, 8 and 9 shall not apply; and
- (iii) details described in the contract shall prevail over any conflicting requirements in the Code of Practice.

4 Joints shall be staggered a distance of at least 150mm between courses and their position and the sequence of working shall be agreed by the Engineer before commencement of the work. The mating edges of all the joints shall be intimately bonded. The surfaces of gullies or other metal features with which the waterproofing will be in contact shall be clean, dry and painted with at least 2 coats of cut back bitumen.

5 Proprietary waterproofing systems shall be only installed by applicators approved by the manufacturers and in accordance with the PWS Data Sheet and its Annex 'A'. The formation of defects affecting the integrity of the membrane including pin/blow holes (continuous or non-continuous) and blisters in the waterproofing shall:

- (i) be made good by repair in accordance with the International Roads and Bridges Agreement

Certificate before any subsequent layers are applied; or

- (ii) require the system to be replaced where directed by the Engineer.

For sheet membranes bonded with oxidized bitumen the heating and temperature of the bitumen shall comply with the manufacturer's requirements within the limits stated in BS 8000 : Part 4.

A means of checking the bitumen temperature shall be provided.

Sheet membranes shall wherever possible be laid in the direction that the additional protective layer or surfacing will be laid and compacted by roller.

6 Unless otherwise specified in the International Roads and Bridges Agrément Certificate, joints between sheets shall be lapped with end laps of at least 150 mm and side laps of at least 100 mm. The joints shall be arranged so that:

- (i) at no point are there more than three thicknesses of sheeting and,
- (ii) water will drain away from the exposed edge.

7 Proprietary waterproofing systems shall be laid to follow the contours of the concrete surface. Laps, ridges and ripples in waterproofing sheeting, and peaks and steps at butt joints in waterproofing boards, shall not be greater than 10 mm in height.

Additional Bituminous Protection

8 Bituminous protection complying with sub-Clause 2003.4 shall be laid on the clean and dry substrate, and compacted in accordance with Clause 901 to the areas and thickness shown on the Drawings.

Bond Between Additional Protective Layer or Surfacing and the Waterproofing System

9 The additional protective layer or surfacing laid on the waterproofing system shall be firmly bonded to the system for the life of the system. Where a tack coat for the additional protective layer or surfacing is not provided as part of the waterproofing system, a satisfactory bond to the membrane shall be obtained from

- (i) a separate compatible tack coat or
- (ii) the binder within the directly applied additional protective layer or surfacing.

Where the tack coat is of the type activated by the heat of the succeeding bituminous layer the rolling temperature of this layer shall be sufficient to ensure adhesion.

2006 Workmanship for Waterproofing Below Ground Concrete Surfaces

Priming for Tar and Bitumen

1 Unless otherwise described in Appendix 20/2 and prior to the application of the selected tar or bitumen waterproofing, concrete surfaces shall be

thoroughly sealed with an evenly applied primer. The primer shall be well brushed in and not allowed to pond in any depressions.

Tar

2 For tar waterproofing, two coats of tar shall be hot applied at a rate of spread per coat of 1 litre/m². The first coat shall be allowed to dry before the second coat is applied.

Cut Back Bitumen

3 For bitumen waterproofing two coats of cut back bitumen shall be hot applied at a rate of spread per coat of 0.6 litre/m². The first coat shall be allowed to dry before the second coat is applied.

Proprietary Materials

4 For proprietary materials the method of application, rate of spread, number of coats and other requirements for each system shall be as described in the manufacturer's method statement and application requirements and shall satisfy the requirements of Appendix 20/2.

2007 Integrity Testing of Concrete Bridge Deck Waterproofing

1 Waterproofing systems to concrete bridge decks shall be tested where required in Appendix 20/2 in accordance with the requirements therein to verify the integrity of the waterproofing.

2008 Repair and Replacement of Bridge Deck Waterproofing

1 The repair and replacement of existing bridge deck waterproofing systems shall comply with the requirements of Clauses 2002, 2003, 2005 and 2007 and any additional requirements described in Appendix 20/1.

SERIES 2400

BRICKWORK, BLOCKWORK AND STONework

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BRICKWORK, BLOCKWORK AND STONWORK

2401 Cement

1 Cement shall be one of the following:

- (i) Portland cement CEMI complying with MSA EN 197-1;
- (ii) Masonry cement complying with BS 5224;
- (iii) Sulfate-resisting Portland cement complying with MSA EN 197-1 where described in Appendix 24/1.

2402 Aggregates

1 Sand shall comply with BS 1199 and 1200.

2403 Water

1 If water for the Works is not available from a water company's supply, the Contractor shall ensure that the water complies with the guidance given in BS 3148. Water from the sea or tidal rivers shall not be used.

2404 Mortar

1 Cement mortar for brickwork, blockwork and stonework shall be mixed in the proportions given in Table 24/1 according to the mortar designation described in Appendix 24/1.

2 The chloride ion content of the mortar determined in accordance with BS 812 : Part 117 shall not exceed 0.3% of the mass of cement for mortar made with Portland cement and 0.2% for mortar made with sulfate-resisting Portland

cement. Calcium chloride or admixtures containing calcium chloride shall not be used.

3 For work in which cement mortars of designation (ii) or (iii) as defined in BS 5628 : Part 3 are required, the Contractor shall select the appropriate mortar from one of the mixes for the designation given in Table 24/1. Admixtures shall comply with either BS 4887 or BS 5075 and shall not contain calcium chloride.

TABLE 24/1: Mortar Proportions by Volume

Mortar designation	Cement Lime: sand	Masonry Cement: sand	Cement Sand with plasticiser
(i)	1:0 to 1 / 4: 3	-	-
(ii)	1: ½ 4 to 4 ½	1:2 ½ to 3 ½	1:3 to 4
(iii)	1:1:5 to 6	1: 4 ½	1:5 to 6

4 The inclusion of lime in mortar designation (i) is optional. The proportions of lime given in Table 24/1 are for lime putty complying with BS 890. If the lime is measured as the dry hydrate, the amount may be increased up to 1.5 volumes for each volume of lime putty. Where a range of sand contents is given in the Table, the higher shall be used for sand that is well graded and the lower for coarse or uniformly fine sand.

5 Mortar shall be mixed thoroughly either by hand or mechanically until its colour and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of sand. Mortar shall be made in small quantities only as and when required. Mortar which has begun to set or which has been mixed for a period of more than one hour in the case of a mortar designation (i) or more than two hours in the case of other designations shall be discarded.

2405 Lime Mortar

1 Lime mortar shall consist of one part by volume of hydrated lime complying with BS 890 to 2.5 parts by volume of sand.

2406 Bricks

1 Clay bricks shall comply with the particular requirements of BS 3921 as described in Appendix 24/1.

2 Calcium silicate bricks (sand lime and flint lime) shall comply with BS 187.

3 Concrete bricks shall comply with BS 6073 : Part 1.

4 Bricks beneath frames for chambers and gullies, and for the construction of brick chambers, shall, unless otherwise described in Appendix 24/1, be Class B clay engineering bricks complying with BS 3921; or concrete bricks complying with BS 6073 : Part 1 having a crushing strength not less than 20 N/mm² when used for surface water drainage, or special purpose concrete bricks having a minimum cement content of 350 kg/m³ when used for foul drainage and for situations where improved durability is required

2407 Blocks

1 Concrete blocks shall comply with the particular requirements of BS 6073 : Part 1 as described in Appendix 24/1.

2408 Reconstructed Stone

1 Reconstructed stone shall be used only in blockwork and shall comply with BS 6457 and any particular requirements described in Appendix 24/1.

2409 Natural Stone

1 Building stone shall be of the type and quality described in Appendix 24/1.

2410 Reinforcement

1 Wire or fabric, laid between brickwork or blockwork shall be austenitic stainless steel to BS 970 : Part 1 Type 304 S 15, 316 S 31 or 316 S 33, softened condition, excluding free machining specifications.

2 Steel bars laid between brickwork or blockwork shall be austenitic stainless steel to BS 6744 Grade 250 or 460, Type 304 S 31 or 316 S 33, softened condition, excluding free machining specifications.

2411 Anchorages, Dowels, Fixings and Ties

1 Anchorages, dowels, fixings and ties shall be austenitic stainless steel Type 304 S 15, 316 S 31 or 316 S 33, softened condition, excluding free machining specifications, complying with the requirements given in the British Standards listed in Table 24/2.

TABLE 24/2: Austenitic Stainless Steel

Form	Standard to be complied with
Strip	BS 1449 : Part 2
Rod	BS 970 : Part 1
Bar	BS 6744
Tube	BS 6323 : Part 8
Wire	BS 1554

2412 Brickwork and Blockwork

1 Brickwork and blockwork shall be laid on a full bed of mortar and bonded as described in Appendix 24/1. Single frogged bricks shall be laid with the frog uppermost. Perpend between bricks and blocks shall be filled with mortar before the next mortar bed is laid. Whole bricks and blocks shall be used except where it is necessary to cut closers or where otherwise agreed by the Engineer.

2 Brickwork and blockwork shall be built uniformly. Corners and other advanced work shall be stepped back and not raised above the general level more than 900 mm. Courses shall be kept horizontal and matching perpend shall be in vertical alignment.

3 Unless stated in Appendix 24/1, overhand work shall not be permitted.

4 Bed-joint reinforcement may have a 15 mm minimum of mortar cover to each masonry face. It shall not be laid dry on a bed face, but shall be completely embedded within the mortar bed thickness.

5 Where pointing is required in Appendix 24/1 the joint shall be raked out to a depth of 12 mm and after the completion of the entire facework, pointed in mortar as described in Appendix 24/1.

6 Where jointing is required in Appendix 24/1 it shall be done as the work proceeds to the finish described in Appendix 24/1.

2413 Stonework

General

1 Except where otherwise described in Appendix 24/1, the length of any stone shall not exceed three times its height. The breadth on the bed shall be not less than 150 mm, nor greater than three-quarters of the thickness of the wall.

2 All stratified stone possessing bedding planes shall be laid with its natural bed as nearly as possible at right angles to the direction of load. In the case of arch rings, the natural bed shall be radial.

3 Facework quoins shall be built to a height not exceeding 900 mm in advance of the main body of the work and adjacent walling stepped down on either side.

4 Stone facework between the quoins shall then be built to a height not exceeding 450 mm above the backing which shall then be brought up level with the completed facework. At no time shall the backing be built up higher than the facework.

5 Except for dry rubble walling, all joints shall be sufficiently thick to prevent stone-to-stone contact and shall be completely filled with mortar.

Ashlar

6 All stones shall be dressed to accurate planes on the beds and joints, and they shall be fair and neatly or fine tooled on the face as described in Appendix 24/1.

Block-in-course

7 Beds and joints shall be squared and dressed for a distance of at least 225 mm from the exposed face. Bond stones shall

form not less than one sixth of the area of the exposed face and shall extend at least 900 mm into the wall or for the full thickness of the wall if the latter is less than 900 mm. Unless described in Appendix 24/1 as tooled or worked, the exposed face of all stone shall be blocked and left rough. Arrises shall be dressed square at all beds and joints.

Squared Random Rubble Coursed and Uncoursed

8 All stones shall be truly squared and dressed on the beds and joints for a distance of at least 125 mm from the exposed face. Bond stones shall be provided at the rate of not less than one to every square metre of exposed face, and shall measure not less than 150 mm x 150 mm on the face, and not less than 450 mm or the full thickness of the wall if the latter is less than 450 mm. Sneck stones shall be not less than 75 mm in any dimension. Vertical joints shall not include more than three consecutive stones, and the horizontal lapping of the stones shall be not less than 100 mm.

Random Rubble Coursed and Uncoursed

9 All stones shall be carefully set with a bond stone provided at the rate of not less than one to every square metre of exposed face. Bond stones shall measure not less than 150 mm x 150 mm on the exposed face, and not less than 450 mm in length or the full thickness of the wall if the latter is less than 450 mm unless otherwise described in Appendix 24/1. For coursed work the joints shall be levelled as described in Appendix 24/1 and the backing flushed up in mortar.

Dry Rubble

10 Dry rubble stonework shall be constructed generally to the requirements of uncoursed random rubble stonework, as specified in sub-Clause 9 of this Clause but without mortar. All stones shall be carefully shaped to obtain a close fit at all beds and joints, any interstices between the stones being filled with selected stone chippings or spalls. The exposed tops or copings of dry rubble walls shall be formed as shown on the Drawings.

Special Stonework Including Quoins, Copings, Plinths, Voussoirs etc

11 Special stonework shall consist of selected stones dressed to the shapes and dimensions, and where required their faces worked, all as shown on the Drawings.

2414 Cold Weather Working

1 No bricks, blocks or stones shall be laid when the air temperature in the shade is below 3°C unless precautions are taken in accordance with BS 5628: Part 3.

2415 Protection of New Work

1 Immediately after laying and for 3 days thereafter, brickwork, blockwork and stonework shall be protected against the harmful effects of weather. The upper surface of newly laid brickwork, blockwork and stonework shall be protected against rain as the work proceeds until such time as the work is completed and the upper damp-course, coping or other finishing feature is laid.

2 All visible brickwork, blockwork and stonework and any surface below such work which is visible at the completion of the Works shall be clean and free from damage

and spillage. All purpose-made open joints shall be free from debris of any description.

2416 Brick, Block and Stone Facework Fixed to Concrete

1 Any loose material shall be removed from the concrete, and its surface washed with clean water before any bricks, blocks or masonry is laid.

2 The portion of the stainless steel fixing projecting from the concrete shall be completely embedded in the mortar of the facework and shall be kept back a minimum of 30 mm from the face of the brickwork and blockwork or 40 mm from the face of the masonry.

3 The cavity between brick and block facework and the concrete shall be completely filled as the work proceeds with mortar of the same mix as that specified for the facework.

4 The variation in depth, front to back of stones for natural stone facework shall not exceed that described in Appendix 24/1 and the space between the facework and the backing shall be completely filled as the work proceeds with concrete Class 15/10 complying with the 1700 Series.

Series 2600 is not taken up

Series 2700 is not taken up