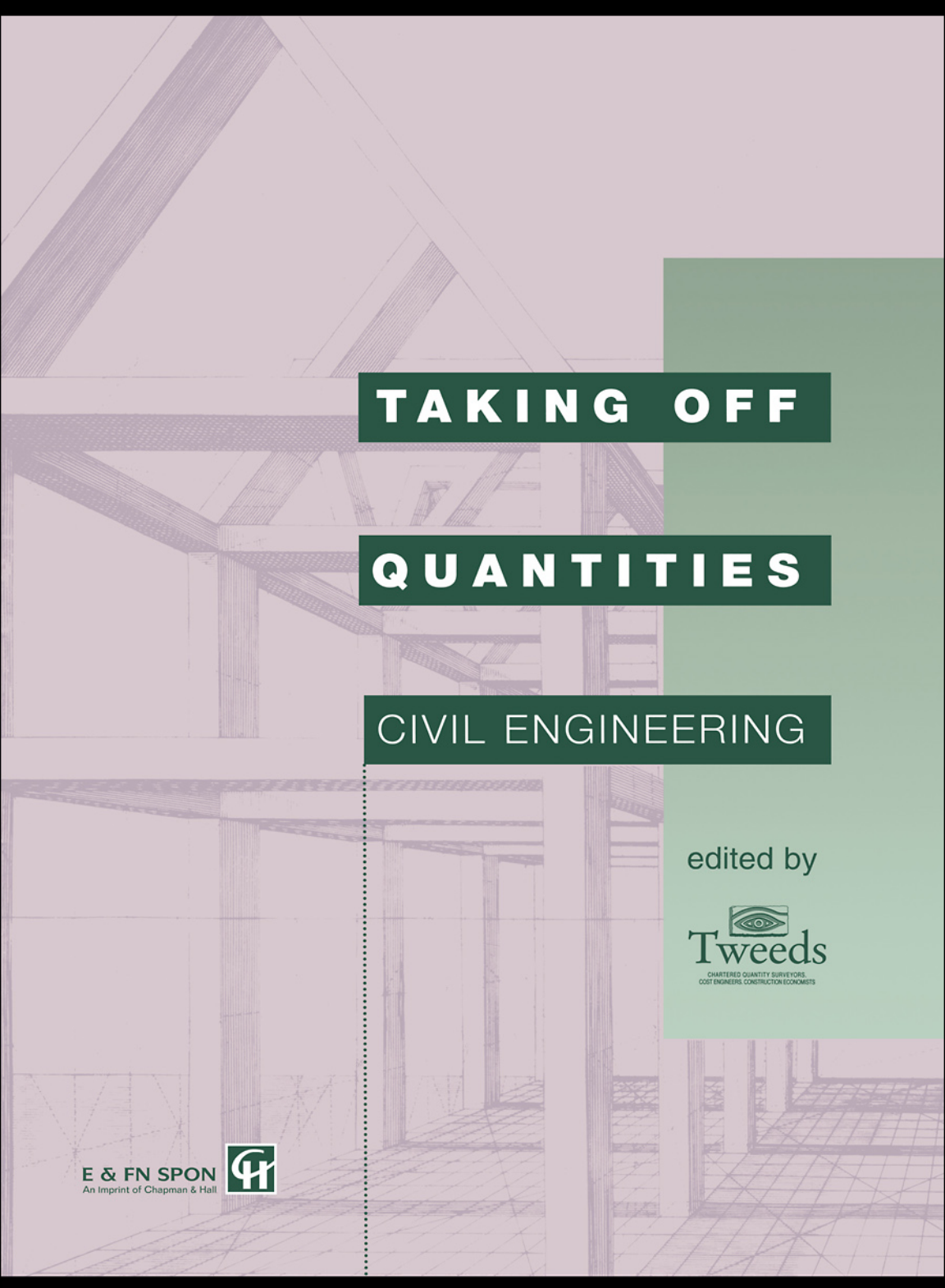

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Civil Engineering

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COST ENGINEERS, CONSTRUCTION
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PREFACE

The role of the quantity surveyor is changing rapidly and he is now expected to provide project and financial management services in addition to his traditional expertise. But whatever new skills are acquired, he must still possess a sound knowledge of building construction and the ability to take-off quantities from drawings.

CESMM 3 Explained was published in 1992 and was described as the definitive work on civil engineering measurement. Since publication, discussions have taken place with quantity surveyors, engineers, academics and students and it appeared that there was a need for a book containing examples of civil engineering taking-off only.

This book, *Taking-Off QuantitiesÐCivil Engineering,* re-presents the appendices from *CESMM 3 Explained* together with the first two chapters which deal with general principles of measurement and how CESMM 3 works. Although it is expected that civil engineering and quantity surveying students will form the major part of the readership, interest has already been expressed by practising engineers and surveyors on the need for a book providing examples of civil engineering taking-off accompanied by a commentary on the measurement techniques being used.

Despite the reduction in the number of disputes since Dr Martin Barnes produced CESMM 1 in 1976, disagreements over the definitive way to measure engineering work continue. It is hoped that this book can play a part in reducing this number even further and also save time and money in expensive litigation and arbitration proceedings.

I am indebted to Rona Harper, Neil Harper and Nikki Lark for their calligraphic skills, Paul Spain for presentation and Gil Nicholls who prepared the drawings. I am also grateful to Stephen Booth and the Institution of Civil Engineering Surveyors for permission to reproduce some of the information in Chapter 9. Finally, I would particularly like to thank Len Morley for the major role he played in the preparation of the taking-off examples.

I would welcome constructive criticism of the book together with suggestions for improving its scope and contents. Whilst every effort has been made to ensure the accuracy of the information given in this publication, neither the

author nor the publishers accept liability in any way or of any kind resulting from the use made by any person of such information.

There are now many women working in the construction industry; where the pronoun ‘he’ is used it applies to both men and women.

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TWEEDS
Chartered Quantity Surveyors
Cavern Walks
8 Matthew Street
Liverpool L2 6RE

Chapter 1
GENERAL PRINCIPLES OF MEASUREMENT

Until comparatively recently, the person preparing the Bill of Quantities—the 'taker-off'— had a limited choice of how to convert the information on the drawings into a Bill of Quantities.

Traditionally the systems followed a procedure of:

Taking off	-	measuring from the drawings and entering the dimensions on to specially ruled dimension paper
Squaring	-	calculating and totalling the lengths, areas and volumes of the dimensions
Abstracting	-	collecting the totals from the dimension paper on to an abstract to produce a final total for each individual description
Billing	-	reproducing the items from the abstract on to bill paper in draft form ready for typing.

It may be that some offices still adopt this system of taking off and working-up as they are commonly called but they cannot be in the majority. In any case there is less need for the preparation of the abstract in civil engineering work as in building. For example, in a school all the painting dimensions for every room are added together on the abstract and stated in the bill as the total for the whole project. In a sewage treatment works, however, the work will usually be presented as a series of locational sub-bills each containing similar items; e.g. the Inlet Works, Primary Treatment Tanks will each be billed separately and will contain similar items. The adoption of this system greatly increases the efficiency of the post-contract administration.

An experienced civil engineering taker-off can usually take off in bill order and if he adopts a system of allocating only one item to each dimension sheet it removes the need for abstracting.

Conversely, some practices have adopted a system of writing full descriptions on the abstract sheets in bill order (a skill possessed by an experienced worker-up) and typing the bill direct from the abstract.

In the last 30 years most quantity surveying practices have adopted the cut-and-shuffle method. This comprises the writing of item descriptions and

Figure 1

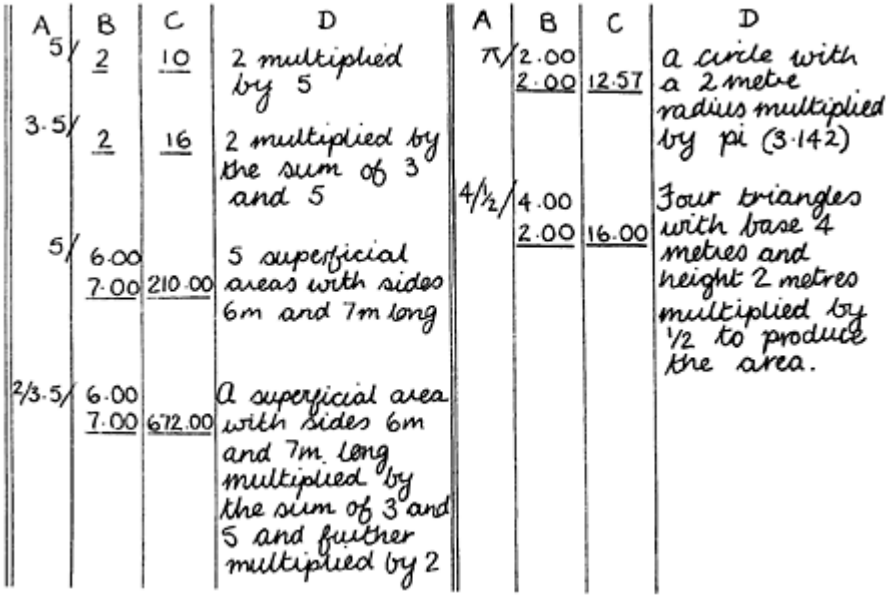


Figure 2

dimensions on to sensitised paper to produce two copies. When the taking off and squaring is complete the copies are split or 'cut' and one copy 'shuffled' into bill order with all sheets for the same item pinned together and their totals collected to produce a final quantity. More recently, other systems have come into use where the taker-off enters dimensions into a computer (sometimes by using a digitiser) which will then perform the squaring, abstracting, billing and printing functions.

Dimension paper

The ruling of dimension paper should conform to the requirements of BS3327—Stationery for Quantity Surveying, and the paper is vertically separated into two parts by a double line each with four columns (Figure 1).

Column A is the 'timesing' and 'dotting on' column where multiplication and addition of the dimensions can be recorded (Figure 2).

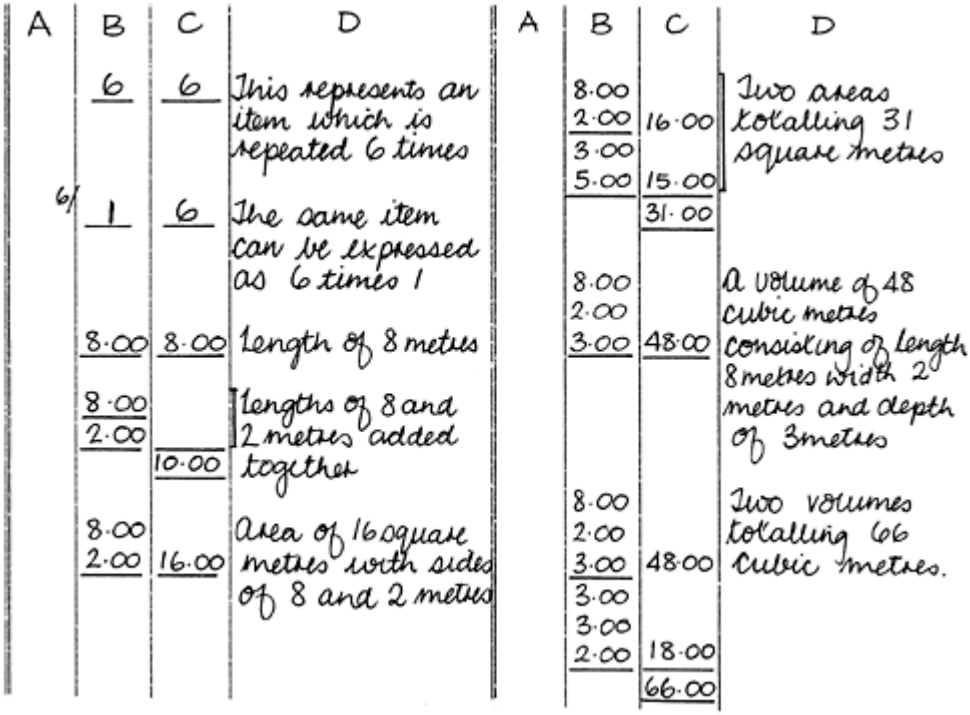


Figure 3

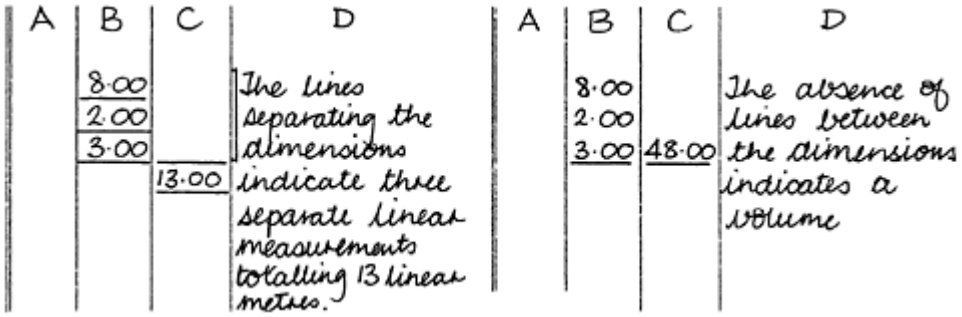


Figure 4

The practice of 'dotting-on' should be used only where absolutely necessary because of the dangers of mistaking the dot for a decimal point.

Column B is the dimension column and receives the measurements taken off from the drawings. The dimensions are normally expressed to two decimal points (Figure 3).

It is important to note that it is the insertion of the horizontal line which determines whether the dimension is intended as a linear, superficial or cubic measurement (Figure 4).

The dimensions should always be recorded in the order of length, width and height. Column C is the squaring column where the result of the addition, subtraction or multiplication of the entries in the dimension column is recorded. Figures which are to be added or subtracted are bracketed together in the manner shown.

Deductions are sometimes necessary where it is easier to take an overall measurement and deduct the parts not required (Figure 5).

Column D is the description column where the item being measured is described. This is done by using a form of standard abbreviations which have been listed separately. This column also contains annotations giving the location of the dimensions and waste calculations which show the build up of the figures entered in the dimension column. (Figure 6).

Quite often two item descriptions share the same measurement and this is indicated by linking the descriptions with an ampersand.

It may be considered desirable to insert the appropriate CESMM 3 code in the description column as shown in Figure 6, but the value of doing this will depend upon the subsequent method of processing the dimensions and descriptions that is adopted.

Figure 6 (continued)

Abstracting

The skill of preparing an abstract lies in the ability of the worker-up to arrange the items abstracted from the dimension sheets in bill order. This may not seem too difficult a task to anyone who has not tried it, but when tender documents are being prepared in a rush against a tight deadline (which must be 99% of the time!) the worker-up may be handed the dimension sheets in small lots but must lay out his abstract to accommodate items he has not yet seen.

A typical abstract is set out in Figure 7. The figures on the left-hand side are the column numbers of the dimension sheets and the first item has been stroked through to indicate that it has been transferred to the draft bill.

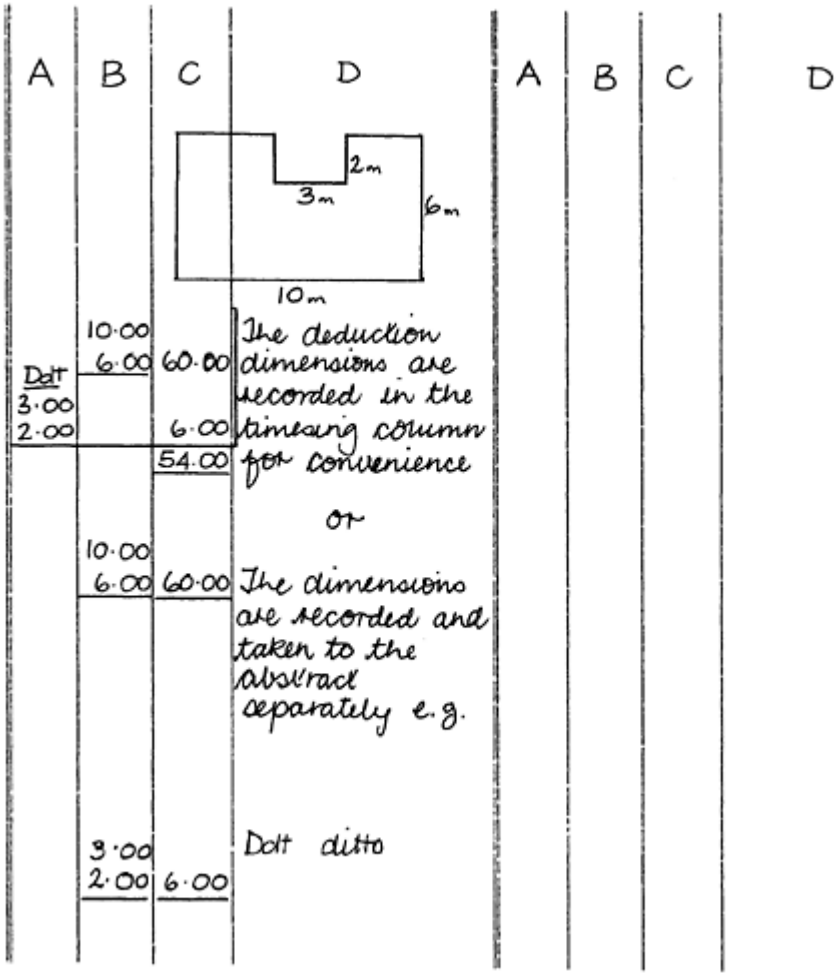

A
B
C
D
2m
3m
6m
10m
10·00
6·00
60·00
The deduction dimensions are recorded in the timesing column for convenience
Dolt
3·00
2·00
6·00
54.00
or
10·00
6·00
60·00
The dimensions are recorded and taken to the abstract separately e.g.
3·00
2·00
6·00
Dolt ditto

Figure 5

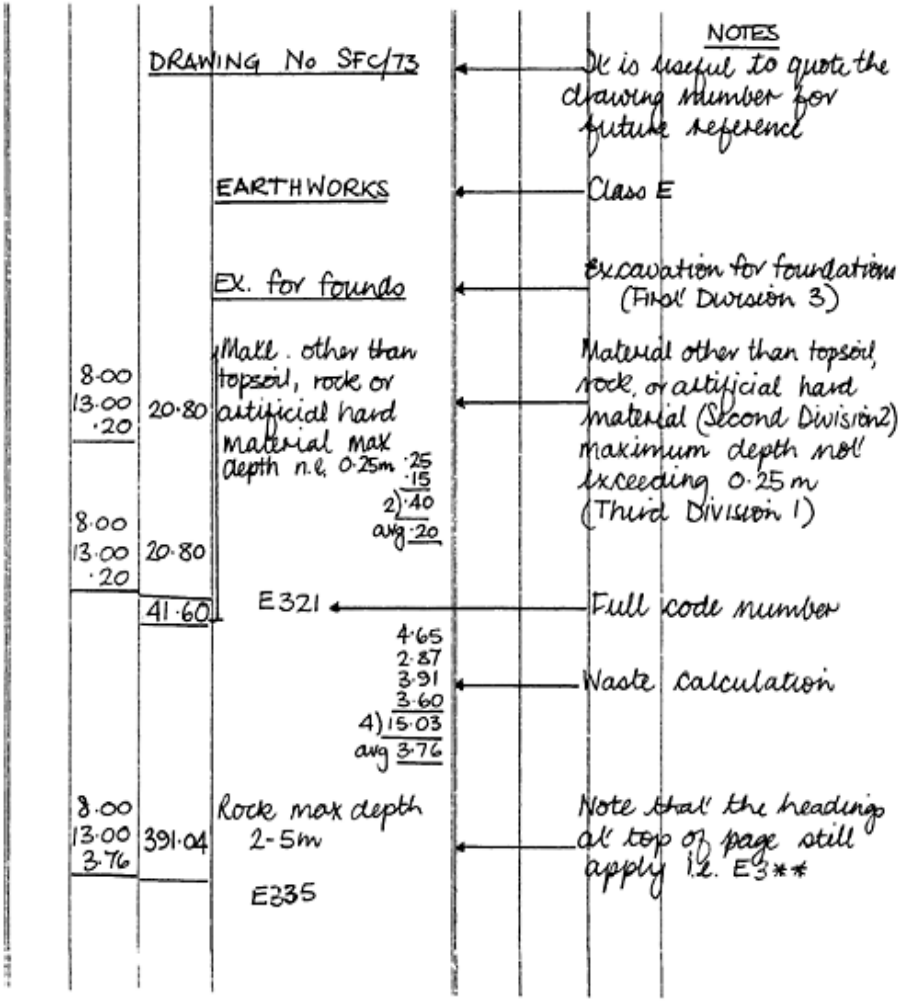
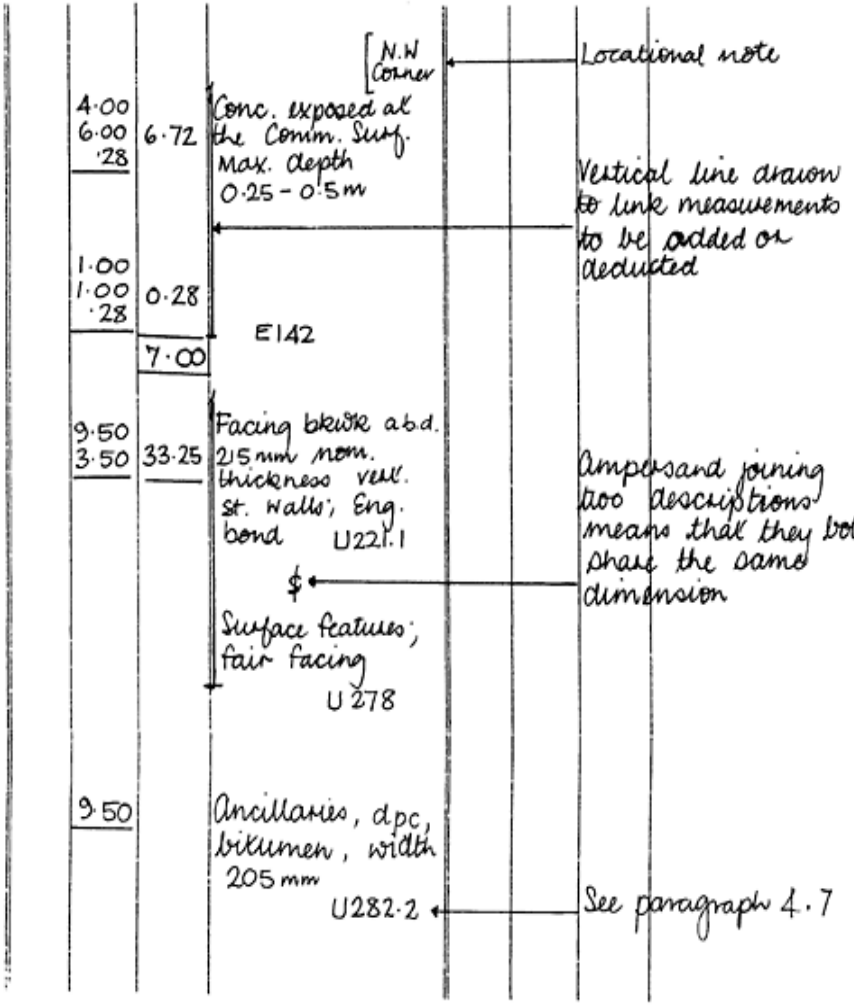

NOTES
DRAWING No SFC/73
It is useful to quote the drawing number for future reference
EARTHWORKS
Class E
Ex. for founds
Excavation for foundations (First Division 3)
Mass. other than topsoil, rock or artificial hard material max depth n.e. 0.25m
8.00
13.00
.20
20.80
.25
.15
2).40
avg .20
Material other than topsoil, rock, or artificial hard material (Second Division 2) maximum depth not exceeding 0.25 m (Third Division 1)
8.00
13.00
.20
20.80
41.60
E321
Full code number
4.65
2.87
3.91
3.60
4)15.03
avg 3.76
Waste calculation
8.00
13.00
3.76
391.04
Rock max depth 2-5m
E235
Note that the headings at top of page still apply i.e. E3**

Figure 6


N.W Corner
Locational note
4·00
6·00
·28
6·72
Conc. exposed at the Comm. Surf. Max. depth 0·25 – 0·5m
Vertical line drawn to link measurements to be added or deducted
1·00
1·00
·28
0·28
E142
7·00
9·50
3·50
33·25
Facing brickwork abd. 215mm nom. thickness vert. st. walls; Eng. bond U221.1
&
Ampersand joining two descriptions means that they both share the same dimension
Surface features; fair facing U278
9·50
Ancillaries, dpc, bitumen, width 205mm U282.2
See paragraph 4.7

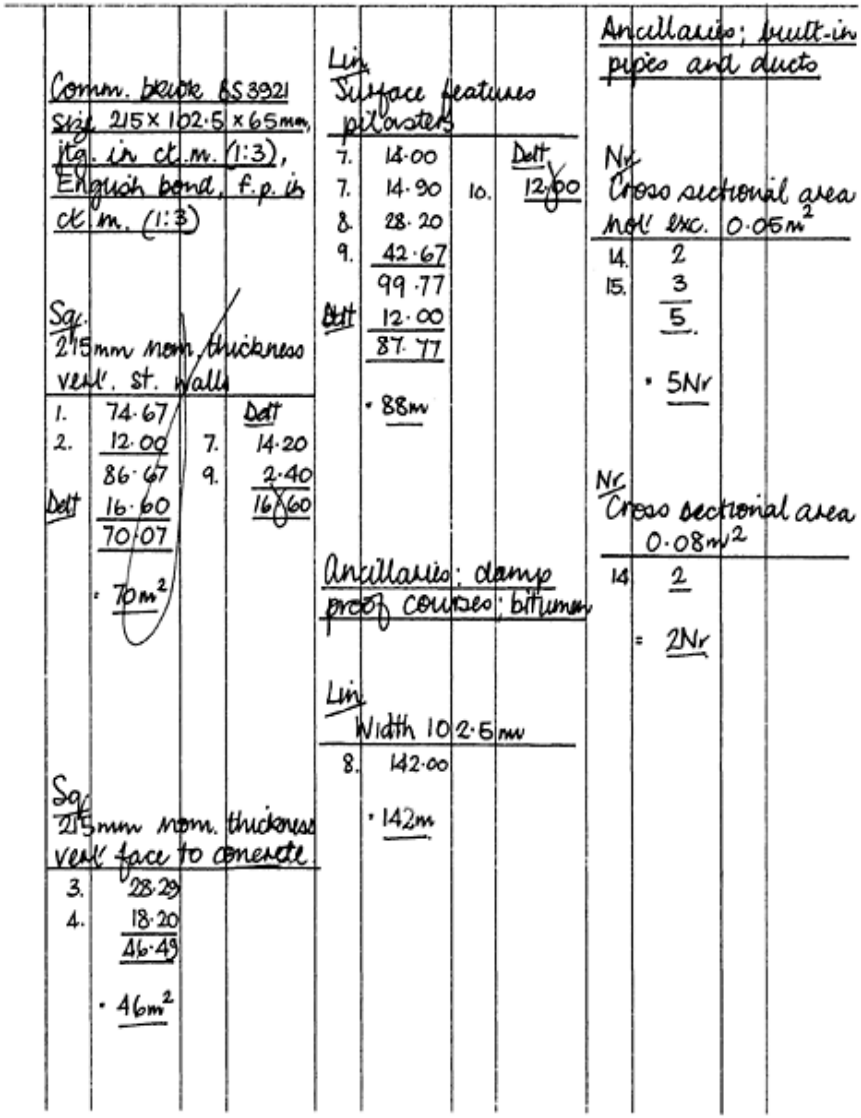

Comm. brick BS3921
size 215 x 102·5 x 65mm,
jtg. in ct. m. (1:3),
English bond, f.p. in
ct m. (1:3)
Sq.
215mm nom. thickness
vert. st. walls
1. 74·67
2. 12·00
86·67
Deft 16·60
70·07
• 70m²
Deft
7. 14·20
9. 2·40
16·60
Sq
215mm nom. thickness
vert face to concrete
3. 28·29
4. 18·20
46·49
• 46m²
Lin
Surface features
pilasters
7. 14·00
7. 14·90
8. 28·20
9. 42·67
99·77
Deft 12·00
87·77
• 88m
Deft
10. 12·00
Ancillaries; damp
proof courses; bitumen
Lin
Width 102·5mm
8. 142·00
• 142m
Ancillaries; built-in
pipes and ducts
Nr
Cross sectional area
not exc. 0·05m²
14. 2
15. 3
5
• 5Nr
Nr
Cross sectional area
0·08m²
14 2
= 2Nr

Figure 7

Chapter 2
CESMM3ÐHOW IT WORKS

SECTION 1:
DEFINITIONS

Reference should be made to the Method of Measurement when considering the following notes:

1.1 All the words and expressions used in the Method of Measurement and in the Bills of Quantities are deemed to have the meaning that this section assigns to them.

1.2 Where reference is made to the Conditions of Contract, it means the ICE (6th Edition) Conditions of Contract issued in January 1991.

1.3 Where words and expressions from the Conditions of Contract are used in CESMM 3 they shall have the same meaning as they have in the Contract.

1.4 Where the word 'clause' is used it is referring to a clause in the Conditions of Contract. The word 'Paragraph' refers to the numbered paragraphs in Sections 1 to 7 inclusive of CESMM 3.

1.5 The word 'work' is defined in a broader sense than that in common usage to include not only the work to be carried out but also the labour materials and services to achieve that objective and to cover the liabilities, obligations and risks that are the Contractor's contracted responsibility as defined in the Contract.

1.6 The term 'expressly required' refers to a specific stated need for a course of action to be followed. This would normally take the form of a note on the drawings, a statement in the specification or an order by the Engineer in accordance with the appropriate clause in the Conditions of Contract.

1.7 The 'Bill of Quantities' is defined as a list of brief descriptions and estimated quantities. The quantities are defined as estimated because they are subject to admeasurement and are not expected to be totally accurate due to the unknown factors which occur in civil engineering work.

1.8 'Daywork' refers to the practice of carrying out and paying for work which it is difficult to measure and value by normal measurement conventions.

1.9 'Work Classification' is the list of the classes of work under which the work is to be measured in Section 8, e.g. Class E Earthworks.

1.10 'Original Surface' is defined as the ground before any work has been carried out. It should be stressed that this definition refers not to virgin untouched ground but ground on which no work has been carried out on the contract being measured.

1.11 'Final Surface' is the level as defined on the drawings where the excavation is completed. Pier or stanchion bases, soft spots or any other excavation below this level would be described as 'below the Final Surface'.

1.12 The definitions of 'Commencing Surface' and 'Excavated Surface' in CESMM 1 were amended significantly in CESMM 2.

and

1.13 These amendments were made because of the confusion surrounding their definitions. It is important when considering these changes that Rules M5, D4 and A4 of Class E are also considered.

Where only one type of material is encountered in an excavation the Commencing Surface is always the top surface prior to excavation and the Excavated Surface is always the bottom surface after excavation unless separate stages of excavation are expressly required. Complications arise, however, when the excavation penetrates through more than one type of material.

Previously, many takers-off were incorrectly stating the maximum depth of each *layer* of material instead of the maximum depth of the excavation itself.

The additional sentences added to Paragraphs 1.12 and 1.13 clarified what was always intended, i.e. that the top of the excavation is the Commencing Surface and the bottom is the Excavated Surface no matter how many layers of different materials lie between the two.

The maximum depth of the excavation of an individual layer of material in accordance with Paragraph 5.21 is the maximum depth of the excavation even though the depth of the layer is significantly less. This rule is acceptable when the excavation is a regular shaped hole in the ground but problems arise when it is applied to a large area of land-forming or reduced level excavation.

Figure 8 illustrates a sloping site which is being cut and filled to produce a level surface with the topsoil removed separately. The first operation to remove the topsoil is where the anomaly occurs. The information which is of most interest to the estimator is the depth of the topsoil itself. Over the filled area the Commencing Surface and the Excavated Surface is the top and bottom of the topsoil layer and the

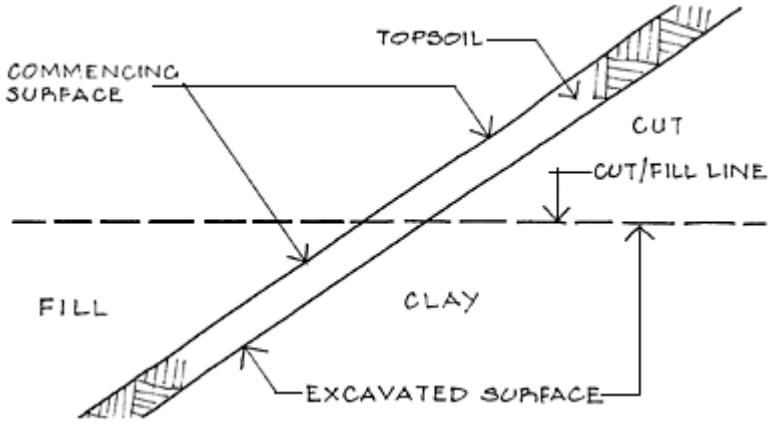


Figure 8

maximum depth in accordance with Paragraph 5.21 is the difference between the two.

Unfortunately this is not the case over the cut area. The Excavated Surface is the cut-and-fill line so the maximum depth is far greater in this area than over the filled section. This creates two separate items for identical work. This is obviously undesirable because the estimator requires only one item to cover all the work to be carried out under the scope of the description. Careful thought should be given to including either an additional preamble or enlarging the description to cover this set of circumstances.

1.14 A 'hyphen between two dimensions' means the range of dimensions between the figures quoted in excess of the first number but including the second, e.g. '150–300mm' means 151 to 300mm inclusive.

Other words commonly used in CESMM 3 are defined as follows:

'shall'	-	mandatory
'should'	-	optional
'may'	-	optional
'given'	-	stated in the Tender Documents
'inserted'	-	included by the Contractor

1.15 Problems arose in the last few years over the reference to BS numbers where the documents were intended for use in countries belonging the European Community, particularly Ireland. This has been overcome by the widening of the clauses' meaning to include equivalent standards of other countries.

SECTION 2:
GENERAL PRINCIPLES

2.1 The formal title of the document is 'Civil Engineering Standard Method of Measurement' which can be referred to in an abbreviated form as CESMM. Although not mentioned it is inevitable that the revised edition will be called CESMM 3 and the previous versions CESMM 1 and 2.

2.2 Building (with the exception of work covered by Class Z), mechanical, electrical or any other work which is not civil engineering, but which is part of a civil contract should be measured in accordance with the appropriate method of measurement for the particular work involved. An item should be included in the Preamble to the Bill of Quantities stating which work is affected and how it has been measured.

2.3 Although this paragraph states that the defined procedures of the CESMM 3 shall be observed in the preparation and pricing of the Bill of Quantities and the description and measurement of the quantities and items of work, it is possible to depart from the rules where thought appropriate. The authority for the departure lies in Paragraphs 5.4 and 5.10.

2.4 The object of preparing the Bill of Quantities is stated as twofold. First, to assist estimators to produce an accurate tender efficiently. It should be borne in mind, however, that the quality of the drawings plays a major part in achieving this aim by enabling the taker-off to produce an accurate bill and also by allowing the estimator to make sound engineering judgements on methods of working. Second, the Bill of Quantites should be prepared in such a style (within the framework of the CESMM 3) to assist the post-contract administration to be carried out in an efficient and cost-effective manner.

2.5 This paragraph defines the need to present the measured items in the Bill of Quantities in sufficient detail so that items covering separate classes of work can be easily distinguished. It also requires that work of the same nature carried out in different locations is kept separate. This is a direct result of complying with the requirements of the preceding Paragraph 2.4 and is intended to assist the site surveyor or measurement engineer in the admeasurement and valuing of the work.

For example if the Bill of Quantities is being prepared for a water treatment works, it is desirable that separate parts are given for, say, the raw water storage reservoir, the slow sand filters and pump houses. The alternative of adding together similar items from each structure would produce a Bill of Quantities which would have limited post-contract value.

2.6 This paragraph states that all work (as defined in Paragraph 1.5) that is expressly required (as defined in Paragraph 1.6) should be covered in the Bill of Quantities. This paragraph is intended to remove any doubt about the status of formwork or any other temporary works which are required

but are not left on site on completion to become the property of the Employer.

2.7 It is the proper application of the Work Classification tables that enables the aims of Paragraphs 2.4, 2.5 and 2.6 to be achieved. The tables and rules state how the work is to be divided, the scope of the item descriptions, the measurement unit for each individual item and the method (with a small 'm') to be adopted to produce the quantities.

SECTION 3: APPLICATION OF THE WORK CLASSIFICATION

This section deals with the details of how to use the Work Classification and the Rules. There are 26 classes in the Work Classification and each class comprises:

(a) up to three divisions each containing up to a maximum of eight descriptive features of the work
(b) units of measurement
(c) Measurement Rules
(d) Definition Rules
(e) Coverage Rules
(f) Additional Description Rules.

3.1 The Work Classification is prefaced by an 'Includes' and 'Excludes' section which defines in general terms the nature and scope of the work contained in each individual class This is particularly useful where there would appear to be a choice of which class to use. For example, in Class R (Roads and Pavings) it clearly states that associated Earthworks and Drainage are to be measured separately in Class E and Classes I, J, K and L respectively.

There are three divisions or levels of description and up to eight part descriptions or descriptive features in each division. These descriptive features are intended to cover the broad range of activities in civil engineering but they are not exhaustive. At its simplest, it should be possible to take a descriptive feature from each division and produce an item description, e.g. in Class C—Concrete Ancillaries the following item description could be assembled:

First Division	2	Formwork: fair finish
Second Division	3	Plane battered
Third Division	1	Width: not exceeding 0.1m.

This item would then appear in the bill as 'Formwork fair finish, plane battered, width not exceeding 0.1m' with a coding of C. 2 3 1.

This example is straightforward and it is not typical of the compilation of most item descriptions. It is essential that the rules are carefully studied before attempting to build up a description in case there is a restriction which would not be apparent by merely assembling descriptive features from the divisions. The use of the exact form of wording in the divisions is not mandatory but it would be unwise to depart from the printed descriptive features without a sound reason.

It is not essential that the punctuation is adhered to rigidly. The Work Classification is intended as a foundation upon which the 'taker-off' can base the needs of the individual project he is working on.

In the selection process from the three divisions it is important to note the need to observe the function of the horizontal lines. The selection must be made horizontally and be contained within the lines joining adjacent divisions. It would not be possible, for example, to select features in Class G to produce an item coded G. 1 1 8 because of the line preventing the Second Division Code 1 being linked with any of the void depth descriptive features.

3.2 This paragraph states that there is a basic assumption built into the descriptive features which removes the need for a comprehensive list of activities which the Contractor must perform in order to achieve the fixing of the material described. For example:

> Item U. 1 2 1 does not require a preface stating that the rate set against the item must include for unloading the bricks, transporting them to a suitable place, carrying
>
> them to the Bricklayers' side, lifting them by the Bricklayers' hand and laying to the correct line and level. That is all assumed in the item 'Common brickwork, thickness 230mm, vertical straight wall'.

3.3 If the scope of the work to be carried out is less than that normally covered by item descriptions in similar circumstances then that limitation must be clearly defined. For example, it is not uncommon for the Employer to purchase special pipes or fittings in advance of the main civil contract where there is a long delay between order and delivery.

These materials would be handed to the Contractor on a 'free issue' basis and the item description would be headed 'Fix only'.

The scope of the term 'Fix only' should be clearly defined in the Preamble and could include such activities as taking charge of, handling, storing, transporting, multiple handling, laying and jointing including all necessary cutting.

The item or items involved must be unequivocally stated to avoid any ambiguities and if a number of items are covered by the limitation it would be prudent to insert 'End of fix only' after the last item.

3.4 The taker-off must not take more than one descriptive feature from any one division when compiling an item description.

3.5 The units of measurement are stated within the Work Classification and apply to all the items to which the descriptive features relate.

3.6 The Measurement Rules are defined as the circumstances existing for the implementation of the rules listed under M1 *et seq.* Reference must be made to Paragraph 5.18 for general additional information on measurement conventions.

3.7 Definition Rules lay down the parameters of the class of work covered by words or phrases in the Work Classification or the Bill of Quantities.

3.8 Coverage Rules describe the scope of work that is included in an item description although part of the required action may not be specifically mentioned. The rule will not necessarily cover all the work required and does not cover any work included under the Method Related Charges section.

3.9 The Additional Description Rules are included to provide a facility for the inclusion of extra descriptive features where those listed in the Work Classification are not considered comprehensive enough. The authority for this comes from Paragraph 3.1.

3.10 This note clears any confusion between the Work Classification and the Additional Description Rules. The example quoted refers to Class I. If item I. 5 2 3 was assembled by reprinting the descriptive features, the items would read:

‘Clay pipes, nominal bore 200–300mm, in trenches depth 1.5–2m.’

Rule A2 requires, among other things, that the nominal bore is stated. Paragraph 3.10 states that where these circumstances occur the provision of the note should override that of the descriptive feature so this item would read:

‘Clay pipes, nominal bore 250mm, in trenches depth 1.5–2m.’

N.B. The other requirements of A2 would probably be included in a heading or in an enlargement of the First Division entry ‘Clay pipes’.

3.11 It should be noted that on the rules side of the page in many classes there is a horizontal double line near the top of the page. All the rules above this line refer to all the work in the class. Rules below the double line refer only to the work contained within the same horizontal ruling.

SECTION 4:
CODING AND NUMBERING OF ITEMS

This section deals with coding of items and it is important to remember that the provisions of the section are not mandatory. The value of applying the CESMM system of coding must be judged by the engineer or surveyor preparing the Bill of Quantities. If by following the recommendations of this section a series of unwieldy codings is produced it may be better not to apply them.

The aim of the coding is to produce a uniformity of presentation to assist the needs of the estimator and the post-contract administration.

4.1 The structure of the coding system is simple and easy to apply. Each item is allocated four basic symbols to produce a four-unit code. The class is represented by the class letter (e.g. G—Concrete Ancillaries) followed by the numbers taken from the First, Second and Third Division, respectively.

Item G.1 2 3 therefore refers to an item description of 'Formwork, rough finish plane sloping, width 0.2–0.4m'.

4.2 Where the symbol * appears it denotes all the numbers in the appropriate division. For example item G. 1 * 3 refers to items G. 1 1 3, G. 1 2 3, G. 1 3 3, G. 1 4 3 and G. 1 5 3. This symbol would never appear in the coding of an item description in a Bill of Quantities because by definition it refers to more than one item. Its main use is to assist, in an abbreviated form, in the application of the rules (e.g. see Rule M2 in Class P).

4.3 The option is given whether to apply the provisions of this section in the Bill of Quantities or not. The authors' reservations stated at the beginning of this section about the use of the codes apply only to their appearance in the Bill of Quantities. It is desirable that they are used in the taking off and working-up stages as an aid to the presentation of the items in a regular and uniform bill order.

4.4 This paragraph states that if the code numbers are to appear in the Bill of Quantities they must be placed in the item number column and not become part of the item description. The code numbers have no contractual significance.

4.5 The highest number listed in the Work Classification is 8 and if a completely new descriptive feature is to be added it should be given the digit 9 in the appropriate division.

4.6 Conversely, the digit 0 should be used if no descriptive feature in the Work Classification applies or if there are no entries in the division itself.

4.7 The code numbers refer only to the descriptive features in the three divisions. If additional descriptive features are required (see Paragraph 3. 9) by the implementation of the Additional Description Rules they shall be identified by the addition of a further digit at the end of the code number. The example quoted in Paragraph 4.7 quotes item H. 1 3 6, but when Rule A1 is applied the additional information generates a code number of H. 1 3

6.1. If there was a need for more than one item they would appear as H. 1 3 6.2, H. 1 3 6.3, H. 1 3 6.4, etc.

What is not explained is the technique for dealing with this situation when the number of items containing additional descriptive features exceeds 9. The choice lies between H. 1 3 6.10, H. 1 3 6.9.1 or H. 01 03 06.01, but the authors feel that the latter nomenclature is probably the most suitable.

SECTION 5: PREPARATION OF THE BILL OF QUANTITIES

It should be noted that the term used in this section heading, i.e. 'Bill of Quantities', is correct. The phrase 'Bills of Quantities' is more appropriate to a building contract where the General Summary contains a list of individual Bills. In civil engineering documents the equivalent Bills are called Parts (Paragraph 5. 23) so the overall document is a Bill of Quantities.

5.1 This paragraph states that the rules and provisions used in the pre-contract exercise of measuring the work also apply to the post-contract task of measurement. The correct term for this task is re-measurement where the work is physically measured on site or admeasurement where the actual quantities are calculated from records.

5.2 There are five sections in the Bill of Quantities:

A	List of Principal Quantities
B	Preamble
C	Daywork Schedule
D	Work Items (divided into parts)
E	Grand Summary

The Daywork Schedule can be omitted from the Bill of Quantities if required. The above sections should be allocated the letters A to E and the parts of the Bill contained within Section D are enumerated, e.g.

Section A	List of Principal Quantities	
B	Preamble	
C	Daywork Schedule	
D	Work Items	
	Part 1	General Items
	Part 2	Boldon Sewers
	Part 3	Cleadon Sewers

	Part 4	Rising Mains
	Part 5	Shackleton Pumping Station
	Part 6	Roker Pumping Station
E	Grand Summary	

5.3 It should be noted that the list of principal quantities is prepared by the taker-off or the person assembling the Bill of Quantities and should satisfy two requirements. First, to give the estimator an early feel for the scope of the work before he commences pricing and, second, to assist the participants at the Contractor's pretender meeting with regard to the type and size of the contract when considering the application of the adjustment item (Paragraph 5.26). The list has no contractual significance. A notional list of principal quantities for the job mentioned in Paragraph 5.2 could be as follows:

Part 1 General Items	
Provisional Sum	75,000
Prime Cost Sums	100,000
Part 2 Boldon Sewers	
Pipelines	1200m
Manholes	22nr
Part 3 Cleadon Sewers	
Pipelines	1500m
Manholes	28nr
Part 4 Rising Mains	
Pipelines	2000m
Valve Chambers	12nr
Part 5 Shackleton Pumping Station	
Excavation	600m3
Concrete	50m3
Brickwork	200m2
Part 6 Roker Pumping Station	
Excavation	650m3
Concrete	80m3
Brickwork	240m3

5.4 The Preamble is an extremely important section of the Bill of Quantities and is the potentially vital source of information to the estimator. If any other Methods of Measurement have been used in the preparation of the Bill of Quantities, the fact should be recorded here. This is not uncommon where, say, the Administration Building of a Sewage Treatment Works or even the superstructure of a large pumping station has been measured in

accordance with the current Method of Measurement for Building Works, although the inclusion of Class Z should reduce the need for this.

The Preamble should also contain information on work to be designed by the Contractor or where the Contractor is involved in alternative forms of construction. The style of measurement to deal with these events will involve a departure from the rules laid down so warranting an insertion in the Preamble.

The Preamble will also contain a list of departures from the rules and conventions of CESMM 3 if the taker-off considers it desirable. Because the preamble note will usually commence 'Notwithstanding the provisions of…' these notes have become known as 'notwithstanding' clauses. A common example affects Paragraph 5.9. Many surveyors and engineers do not wish to adopt the lining-out system as set out in this paragraph and would insert the following clause in the Preamble:

> 'Notwithstanding the provisions of Paragraph 5.9, lines have not been drawn across each bill page to separate headings and sub-headings.'

It should be noted that the Preamble can also be used as a vehicle to extend the Rules. The Item Coverage Rules are the most likely to be enlarged and the taker-off should not hesitate to use this facility in order to improve the quality of the information provided to the estimator.

Where the word 'Preamble' is used in this book it refers to the section of the Bill of Quantities as defined in this paragraph. The term 'preamble' (with a small p) has been used to mean a clause or note.

5.5 It is also necessary to include in the Preamble a definition of rock. On first consideration it may seem odd that what is primarily an engineering matter should find its place in the Preamble of the Bill of Quantities. The reason of course is that it is the definition of what rock is, that will determine to what extent it is measured. It is the measurement of rock which is the main consideration in the Preamble and the definition should clearly state in geological terms what materials will be defined and paid for as rock. If any borehole information is available it would be useful to make reference to the logs and use the same terms wherever possible.

The practice of defining rock as 'material which in the opinion of the Engineer can only be removed by blasting, pneumatic tools, or wedges' is not recommended because it creates doubt in the minds of the taker-off, the estimator and, most importantly, of the people engaged the post-contract work.

5.6 It is not mandatory that a Daywork Schedule is included in the Bill of Quantities. If it was omitted, either by design or error, any daywork that occurred would be measured in accordance with Clause 52(3) of the

Conditions of Contract and valued at the rates applicable to the FCEC schedules without any increase or decrease to the current percentages.

The other two methods of including dayworks in the Bill of Quantities are fully described in Chapter 3—General Items.

5.7 Where the method set out in Paragraph 5.6(6) is adopted for dayworks it is usual to include separate provisional sums for the Labour, Materials, Plant and Supplementary Charges. The Contractor would be given the opportunity to insert his adjustment percentages after each item. (Chapter 4—General Items).

5.8 It is important that careful thought is given to layout of the Bill of Quantities. Almost the first task of the taker-off should be to consult the Engineer and draw up the Grand Summary to identify the various parts. In the example given in Paragraph 5.2 the various parts are easily identified. The work in Part 2 headed Boldon Sewers should be presented in a style which locates the work in more detail, e.g. Manhole 1 to Manhole 2, etc.

In sewage disposal works and water treatment works it is usually quite straightforward to prepare a list of parts based on individual structures in the same order in which they are involved in the treatment process. It is more difficult in major bridge contracts and it is usual for the parts to be related more to CESMM 3 work classes than the locations of the work.

Whatever decisions are taken regarding the arrangements of the parts, the order of billing within each part should conform to the order of classes and items created by the Classifications within each class.

5.9 This paragraph provides for the placing of headings and sub-headings above item descriptions to prevent the repetition of material common to each item. These headings and sub-headings should be repeated at the top of each new page (perhaps in an abbreviated form) to assist the estimator in appreciating the full content of the item he is pricing.

A more controversial part of this paragraph deals with the procedure of what has come to be known as ‘lining out’. This is the arrangement by which lines are drawn across the Item Description column of the bill page to end the influence of a previous heading or sub-heading.

Figure 9 shows how the lining out is done.

5.10 This paragraph gives the authority to the taker-off to add additional descriptive material to a description constructed from the three divisions if the work being measured has special characteristics which ‘give rise to special methods of construction or consideration of cost’.

The implications of this paragraph are far reaching for the taker-off. He can impose his own judgement on the measurement of any item and depart from the format provided he believes it is a special case. It would be unwise, however, for the taker-off to abuse the power entrusted to him by this paragraph. The larger the number of items in the Bill of Quantities that conform to the preferred style of the CESMM 3 the more uniformity will be achieved which will benefit all parties. The taker-off should use the

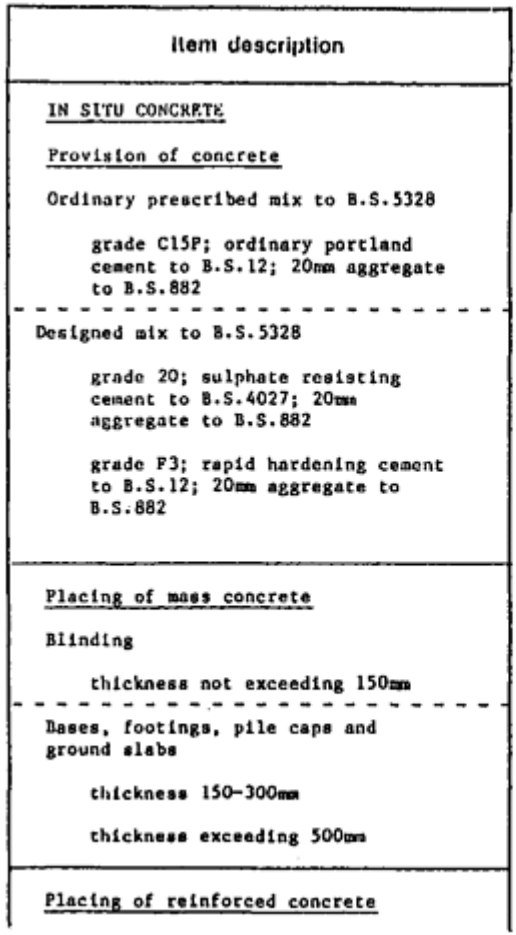


Figure 9

powers of this paragraph sparingly but on the occasions where it is felt that a new form of item description or additional descriptive material is necessary, the opportunity should be taken with the needs of the estimator and post-contract administration overriding those of the generalities of CESMM 3.

If the new form of item description conflicts with the rules of the method, a 'notwithstanding' clause should be raised in the Preamble (Paragraph 5.4).

5.11 This paragraph reinforces the secondary role of the Bill of Quantities. The estimator is actively discouraged from relying on the item descriptions as a sole source for the information he requires to build up his rates. The 'exact

nature and extent of the work' (or as near as it is possible to define it) must be determined from the Drawings, the Specification and the Contract. The item descriptions should not be held to be comprehensive but used to 'identify' the work being measured. This downgrading of the descriptions does not in any way relieve the taker-off from his responsibility of producing the most lucid descriptions he can within the framework of the method of measurement.

5.12 Where an unusual feature occurs in the work it is sometimes easier and more accurate to direct the estimator to a clause in the Specification or a detail of a drawing rather than produce a clumsy description which does not fully cover the work to be measured. Although this paragraph gives the authority for this form of referencing, it also contains an important proviso that the reference must be precise. A general reference to a drawing containing standard details would be unacceptable unless it identified the exact detail in the drawing being referred to.

5.13 In civil engineering contracts the work is subject to admeasurement. The quantities that are measured in the contract document are approximate because of the uncertainties inherent in civil engineering. The method of measurement has by necessity great flexibility and affords the taker-off opportunities to use his professional skill and judgement denied to his opposite number in the building side of the industry. This paragraph demonstrates this freedom. There are many situations where the choice of the style of measurement and placing of the items in the bill is entirely at the discretion of the taker-off. One example of this concerns thrust blocks in Class L. Where a block is large, say 10m3, the taker-off may feel it more helpful to measure it in detail using Classes E, F and G rather than item L. 7 8 0. A major consideration in this decision would be the knowledge that if the item was enumerated and the drawing reference given (as Paragraph 5.12) each tendering estimator would need to measure the excavation, concrete and formwork so it is less wasteful if the taker-off prepares these. Whatever decision the taker-off makes in these matters it should be clear and unequivocal so that the estimators are not confronted by ambiguities and uncertainties.

The comments made earlier about the quantities being approximate should not give the impression that anything less than the highest professional standards should be employed in the preparation of the tender documents. The quantities are described as approximate because in many cases the scope of the work is not known but the measurements should be as accurate as possible even in the knowledge that they will be taken again on completion of the works.

5.14 Where a range of dimensions is given in the Work Classification tables but the measured items have an identical thickness it is permissible to state the thickness instead of the range. For example, item K. 1 1 3 describes brick manholes in a depth range of 2 to 2.5m. If there were three manholes all 2.

2m deep the item description should read ‘Manholes, brick, depth 2.2m’ and would carry the same code number K. 1 1 3.

5.15 Where work is to be carried out by a Nominated Sub-Contractor the estimated cost of the work should be given as a Prime Cost Item. Items to cover what used to be called general and special attendances follow this sum and are dealt with in Chapter 3 General Items.

The scope of the facilities to be available to the Nominated Sub-Contractor include for temporary roads, hoists and disposing of rubbish.

5.16 Any goods, materials or services supplied by a Nominated Sub-Contractor which are to be used by the Contractor must be referenced to the Prime Cost Item involved by a heading or mention made in the item itself.

5.17 The use of provisional quantities is discouraged by CESMM. Prior to 1976, items frequently appeared in Bills of Quantities under a heading of Provisional. This procedure was usually adopted because the Design Engineer either did not know the scope of the work or did not have enough time to design it. The assumption that the Contractor had better knowledge at tender stage than the Engineer, and was able to price the work, was completely unacceptable. On occasions, if the provisional quantities included were small, the Contractor would insert high rates which would hardly affect his tender total but could lead to a windfall if the quantities increased on admeasurement.

This paragraph states how the cost of uncertainties in design should be treated. If there are specific areas of work where the design has not advanced far enough to allow accurate quantities to be prepared, the work should be placed in the General Itemsagainst a Provisional Sum. It is also usual to include a Provisional Sum in the Grand Summary for general contingencies.

Recently, however, some Employers are resisting the inclusion of this general contingency allowance in the spurious belief that the Contractor will somehow regard that sum as ‘spendable’ and attempt to recover it through claims. This notion shows little confidence in the skills of post-contract management team acting on the Employer’s behalf.

5.18 This paragraph confirms the long-standing convention that measurements are taken net—unless there is a specific requirement to the contrary. Ideally, the quantities are computed from dimensions on the drawings. Common sense must be applied in the matter of rounding-off quantities. The total quantity and the effect on it of rounding off must be considered.

5.19 The units of measurement are set out in this paragraph and the abbreviations must be used in the Bill of Quantities. Care should be taken when using the abbreviation for Number because the handwritten ‘nr’ is very similar to ‘m’ and mistakes can be made when documents are produced at speed by confusing the two abbreviations.

5.20 It is a requirement that where a body of open water is either on the site or bounds the site, it shall be identified in the Preamble to the Bill of

Quantities stating its boundaries and levels or fluctuating levels. This requirement should not be taken too literally. If a power station was to be constructed on the west Cornish coast it would be sufficient to state in the Preamble that the Atlantic Ocean was adjacent to the site together with tidal information. It would be unnecessary and foolish to attempt to define the bounds of the Atlantic!

It is interesting to note that Rule A2 in Class E provides a further requirement for the body of water to be identified in the item description for work which is below the feature; this requirement is not thought necessary in other Classes such as F, I or P where similar situations could occur.

5.21 This paragraph deals with the definition of the terms Commencing Surface and Excavated Surface. This matter has been dealt with under paragraphs 1.12 and 1.13. See also Class E.

5.22 A sample of the ruling and headings of bill paper is shown in Figure 10.

Number	Item description	Unit	Quantity	Rate	Amount	

Figure 10

5.23 The summary of each Part would be printed on standard bill paper but the Part total would be styled 'Carried to Grand Summary' (see Figure 11).

5.24 The Grand Summary collects the totals from the parts of the Bill of Quantities and is usually printed on plain paper (Figure 12).

5.25 The General Contingency Allowance is discussed in Paragraph 5.17.

5.26 The Adjustment Item is to be placed at the end of the Grand Summary and its significance and purpose are discussed in Paragraph 6.3, 6.4 and 6.5.

PART 4 - RISING MAINS

Number	Item description	Unit	Quantity	Rate	Amount	
	COLLECTION					
	Page 6/1					
	Page 6/2					
	Page 6/3					
	Page 6/4					
	Page 6/5					
	Page 6/6					
	Total Carried to Grand Summary £					

GRAND SUMMARY

	£	p
PART 1 GENERAL ITEMS		
PART 2 BOLDON SEWERS		
PART 3 CLEADON SEWERS		
PART 4 RISING MAINS		
PART 5 SHACKLETON PUMPING STATION		
PART 6 ROKER PUMPING STATION		
	£	
GENERAL CONTINGENCY ALLOWANCE		50,000 00
ADJUSTMENT ITEM ADD/DEDUCT*		
TENDER TOTAL	£	

* Delete as required.

Figure 12

5.27 The Grand Summary must contain a provision for the addition of the individual bill parts, the General Contingency Allowance and the addition or subtraction of the Adjustment Item. This total is often called the Tender Total but it should not strictly receive that title until the acceptance of the Contractor's Tender for the Works in accordance with Clause 1(i)(h).

SECTION 6:
COMPLETION, PRICING AND USE OF THE BILL OF QUANTITIES

6.1 The rates to be inserted in the rates column shall be expressed in pounds sterling with the pence given as a decimal fraction. Thus 6.47 denotes 6 pounds 47 pence. It is important that the amount is written clearly with the decimal point well defined to avoid subsequent misunderstandings and disputes. If 647 was entered in the rate column and it was intended to be 647 pounds it should be expressed as 647.00. Careful inspection of the presentation of the rates together with their values should be part of the tender appraisal process. Where rates are not inserted the other priced items are deemed to carry the price of the unpriced items.

6.2 This paragraph confirms the requirement made in Paragraph 5.22 that each part must be totalled and then carried to the Grand Summary.

6.3 The introduction of the Adjustment Item was warmly welcomed by the industry in 1976 when CESMM 1 was published and its use is now well established.

and

6.4 Most Contractors contend that they are rarely allowed sufficient time to prepare their tenders. Each job needs careful scrutiny and the application of sound engineering judgements to determine how the construction work should be tackled. Enquiries for material prices and sub-contractors' quotations' must be sent out and it frequently happens that they do not arrive until quite late in the tender period. If, for example, a quote for ready-mixed concrete was obtained on the day before a tender was due to be submitted which was substantially below other quotations the Contractor would be keen to include the effect of the offer in his tender.

Pre-1976 he would have probably deducted the difference from a convenient sum in the General Items and thus created an imbalance in the pricing structure. By using the Adjustment Item the Contractor can now increase or decrease his Tender Total at a stroke yet still present a well-balanced bid.

Another reason for using the device could arise from the Contractor winning or losing other contracts during the tender period which would lessen or increase his determination to put in a keen bid. This decision would normally be taken at a tender appraisal meeting before the signing of the offer.

The sum inserted should be regarded as a lump sum and will be paid or deducted in instalments in the same proportion that the amount being certified bears to the Tender Total before the application of the Adjustment Item in the Grand Summary.

It is a requirement of CESMM that this should be stated in the Preamble to the Bill of Quantities.

The amount involved shall be calculated before the deduction of retentions and the aggregate total must not exceed the amount inserted in the Grand Summary. When the Certificate of Substantial Completion (Clause 48) is issued the difference (if any) between the aggregate total and the amount in the Grand Summary should be paid or deducted in the next certificate to be issued.

6.5 This new paragraph clears up any misunderstandings over the position of applying the Adjustment Item when the Contract is subject to a Contracts Price Fluctuation (CPF) clause. When the Effective Value is calculated it should take into account the effect of deducting or adding the Adjustment Item as appropriate in assessing the amount due to the Contractor under Clause 60.

SECTION 7: METHOD-RELATED CHARGES

Method-Related Charges were first introduced in CESMM 1 in 1976. It was felt that a different approach was required in the valuation of items where quantities were increased or decreased from those in the tender document. Research had shown that modern construction techniques had substantially increased the proportion of the non-quantity related part of a Contractor's costs to a level where it was becoming inequitable both to the Employer and the Contractor that changes in the quantities should be valued merely by multiplying the admeasured quantity by the bill rate.

The unit rates are made up of quantity-related costs—the labour, material and that part of the plant and overheads directly related to the item of work being constructed, and the non-quantity related items such as the transporting to site, erection, maintenance, dismantling of plant, cabins and other consumables which may have no direct link with the quantity of the permanent works being constructed.

It is sensible therefore to give the Contractor the opportunity to declare the cost of those items which he does not wish to be subject to the admeasurement process so that his real costs are recovered without being affected by changes in quantity.

7.1 A Method-Related Charge is the sum inserted in a Bill of Quantities in the space provided (Class A) and is either a Time-Related Charge or a Fixed Charge.

A Time-Related Charge is a sum which is directly proportional to the time taken to carry out the work which is described.

A Fixed Charge is a sum which is neither quantity-related nor time-related but is a set cost regardless of changes in the admeasured work or

the time taken to execute it, e.g. the cost of bringing a batching plant on to site.

7.2 The Contractor has the opportunity to insert the cost of Time-Related and Fixed Charges in the Bill of Quantities (see General Items Class A).

7.3 The Contractor should enter the item description for his Method-Related Charges in the same order as the order of classification in Class A. He must also list the Time-Related Charges separately from the Fixed Charges and insert a sum against each item. He has the freedom, of course, to enter other items which are not listed or do not have a direct counterpart in Class A.

7.4 The Contractor should unambiguously describe the scope of the work that is covered by each sum. He should also list the labour, plant and materials involved and, where applicable, state the parts of the Permanent or Temporary Works that are linked to the sum inserted.

7.5 The Contractor is not obliged to follow the method he has set out in the tender document when he carries out the work on site.

7.6 This paragraph states that the Method-Related Charges are not to be admeasured. The wording was expanded in CESMM 2 to include the words '…but shall be deemed to be prices for the purposes of Clauses 52(1), 52 (2) and 56(2)'.

The addition of these words confirms what was always inferred in CESMM 1. It is sometimes difficult for students to understand the true meaning of what this paragraph covers. An unequivocal statement that Method-Related Charges are not to be admeasured seems to sit uneasily beside the assertion that they are subject to the provisions of Clause 56(2).

If the items for Time-Related Charges and Fixed Charges have been set out by the Contractor in a sensible fashion it should be a straightforward task of apportionment each month to arrive at the amount due. One complication may arise if the time being expended on a Time-Related Charge looks like increasing or decreasing from that shown in the Bill of Quantities. If, for example, an operation was scheduled to occupy 6 months, after 1 month the Contractor would rightly ask for 1/6 of the sum. If his progress increased dramatically and the work looked like being completed in only 4 months, he would be fully entitled to ask for 1/2 of the sum at the end of the second month. It can be seen, therefore, that the numerator in the fraction will increase each month by 1 but the denominator could vary as the Contractor and the Engineer determine the likely length of time the event will last.

It should be noted that a statement must be included in the Preamble to the Bill of Quantities confirming that payment must be made in accordance with Clauses 60(1)(d) and 60(2)(a). This apparent confliction is explained if one remembers that the charges will be paid in full whether they were incurred tenfold or not at all, providing the risk that the Contractor undertook and priced did not vary.

If there was a significant change in quantity or in the time an item of plant was required which was substantially different from that envisaged when the Contractor prepared his tender, then an adjustment to the Method-Related Charges would be in order and the provisions of Clauses 52(1), 52(2) and 56(2) would be implemented.

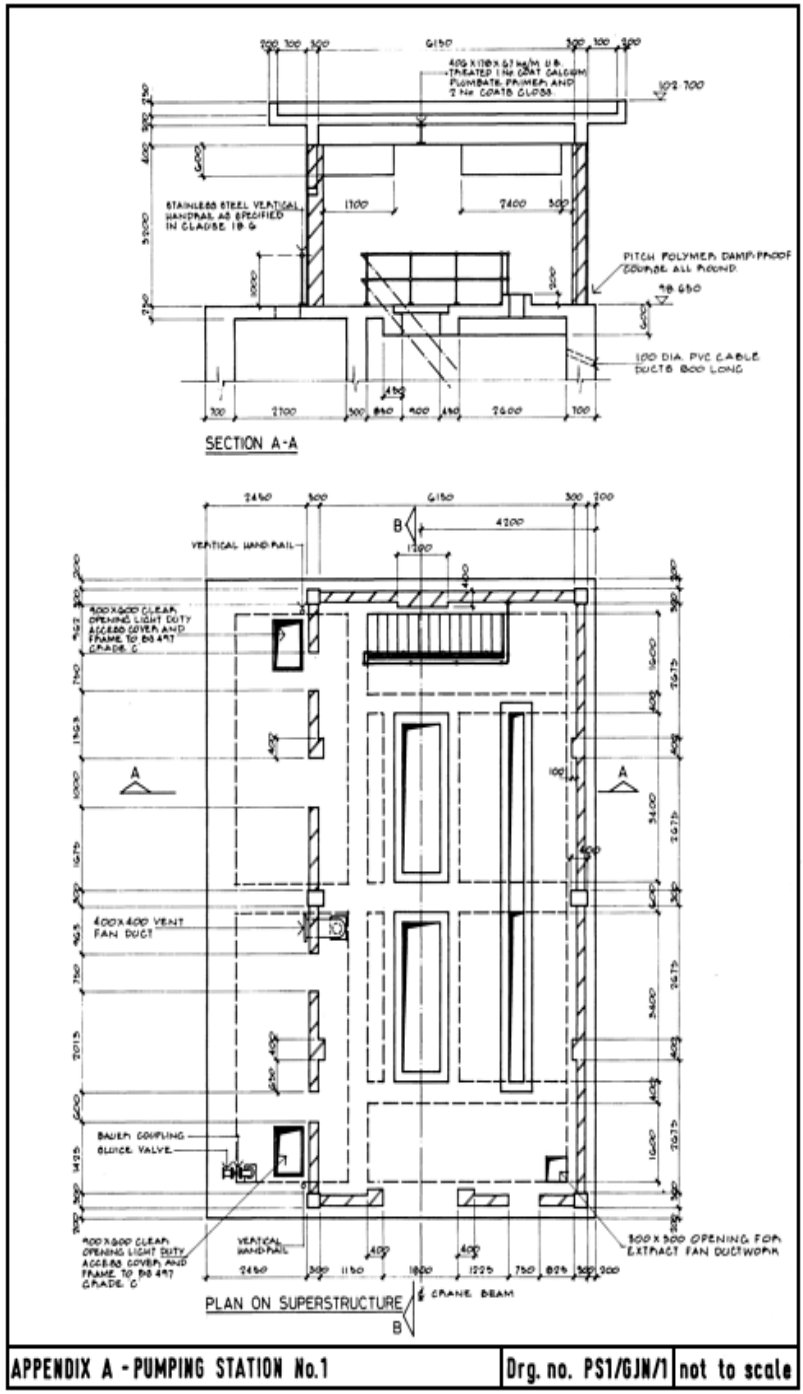
7.7 Method-Related Charges are to be certified and paid for in exactly the same manner as other parts of the work and this should be stated in the Preamble.

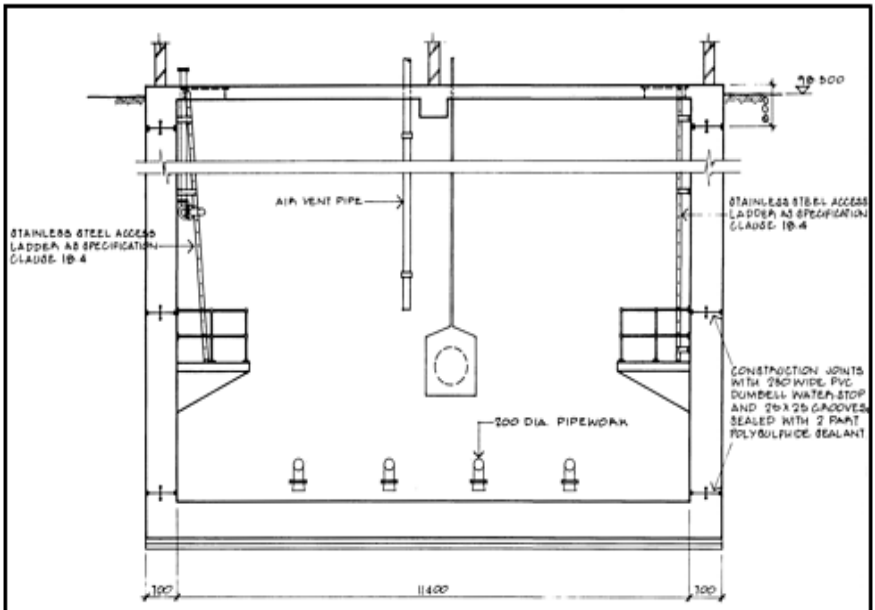
7.8 It may be that the method of working stated by the Contractor is not adopted (Paragraph 7.5) but in the absence of a variation (see Paragraph 7. 6) the sum inserted must be paid in full. It is obviously desirable that the Contractor and the Engineer agree a method of apportioning the sum each month for payment by linking it to progress of a relevant part of the works or indeed the whole works. If agreement cannot be reached the sum would then be added to the Adjustment Item (which would increase a positive Adjustment Item and decrease a negative one) and would be treated as described in Paragraph 6.4.

SECTION 8:
WORK CLASSIFICATION

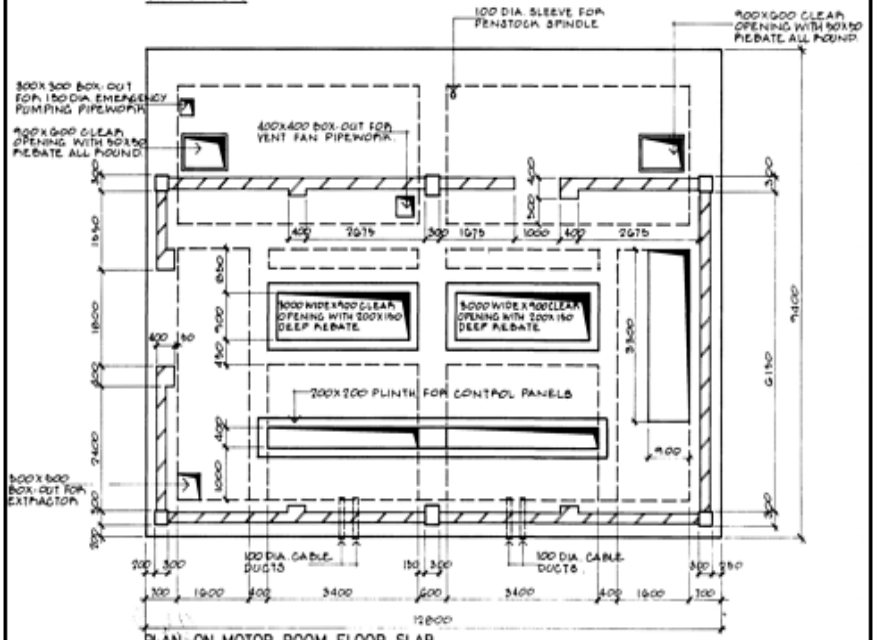
This section lists the 26 classes in CESMM 3. Each class consists of the Classification Tables containing three divisions of descriptive features and four types of rules. See Section 3 for details on the application of the tables and rules.

Chapter 3
PUMPING STATION NO. 1


SECTION A-A
PLAN ON SUPERSTRUCTURE
APPENDIX A - PUMPING STATION No.1
Drg. no. PS1/GJN/1
not to scale



SECTION C-C

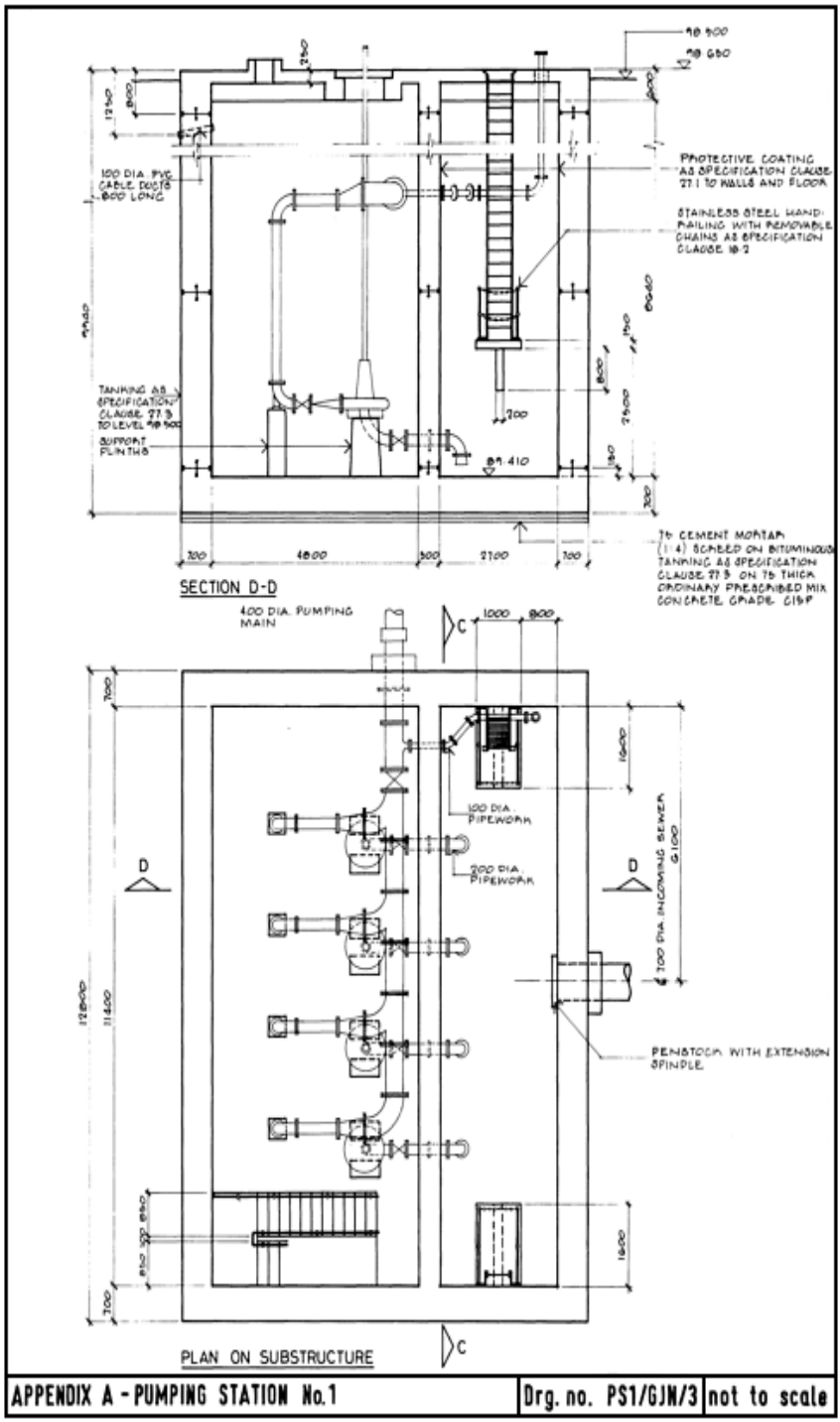


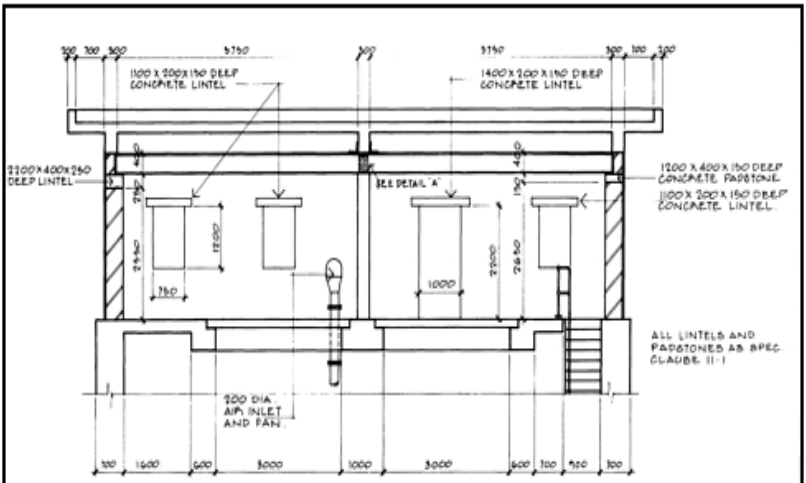
PLAN ON MOTOR ROOM FLOOR SLAB

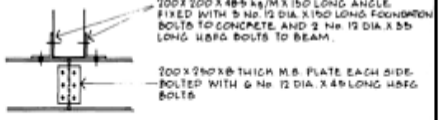
NOTES

1. ALL LEVELS IN METRES ABOVE DATUM.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING Nos. PS1/GJN/1, 3, 4 AND 5.
3. ALL CEMENT BELOW GROUND TO BE SULPHATE RESISTING TO BS4027. ALL OTHER CEMENT TO BE ORDINARY PORTLAND TO BS146.
4. ALL CONCRETE TO BE DESIGNED MIX GRADE C20 UNLESS OTHERWISE STATED.
5. ALL EXPOSED CONCRETE TO HAVE FAIR FACED FINISH EXCEPT ALL TOP SURFACES OF CONCRETE WHICH ARE TO HAVE A WOOD FLOAT FINISH.

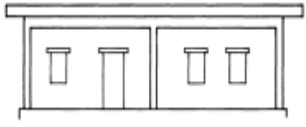
APPENDIX A - PUMPING STATION No.1	Drg. no. PS1/GJN/2	not to scale


PROTECTIVE COATING AS SPECIFICATION CLAUSE 27.1 TO WALLS AND FLOOR
STAINLESS STEEL HAND RAILING WITH REMOVABLE CHAINS AS SPECIFICATION CLAUSE 10.2
100 DIA. PVC CABLE DUCTS 600 LONG
TANKING AS SPECIFICATION CLAUSE 27.3 TO LEVEL
SUPPORT PLINTHS
7b CEMENT MORTAR (1:4) SCREED ON BITUMINOUS TANKING AS SPECIFICATION CLAUSE 27.3 ON 7b THICK ORDINARY PRESCRIBED MIX CONCRETE GRADE C19P
SECTION D-D
400 DIA. PUMPING MAIN
100 DIA. PIPEWORK
200 DIA. PIPEWORK
300 DIA. INCOMING SEWER G100
PENSTOCK WITH EXTENSION SPINDLE
PLAN ON SUBSTRUCTURE
APPENDIX A - PUMPING STATION No.1
Drg. no. PS1/GJN/3
not to scale

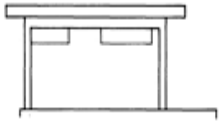




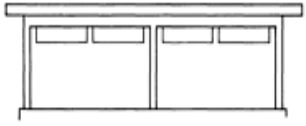
DETAIL 'A'



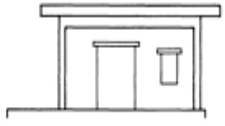
SOUTH-EAST ELEVATION



SOUTH-WEST ELEVATION



NORTH-WEST ELEVATION

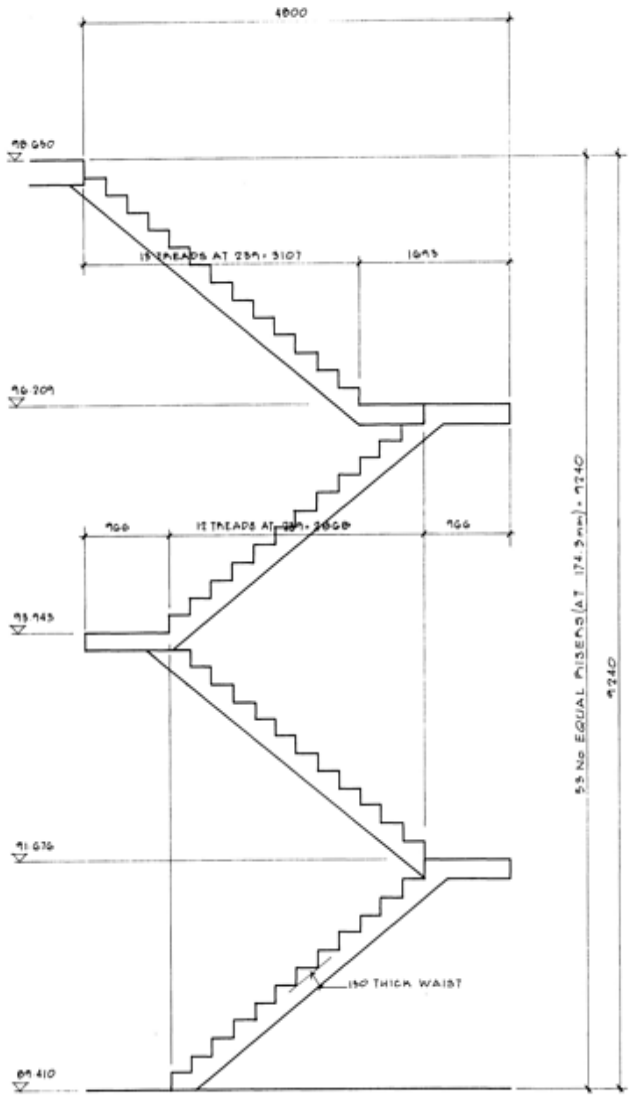


NORTH-EAST ELEVATION

NOTES

1. ALL LEVELS IN METRES ABOVE DATUM
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH DRAWING Nos. PS1/GJN/1, 2, 3 AND 5
3. ALL CEMENT BELOW GROUND TO BE SULPHATE RESISTING TO BS 4027. ALL OTHER CEMENT TO BE ORDINARY PORTLAND TO BS 146
4. ALL CONCRETE TO BE DESIGNED MIX GRADE C20 UNLESS OTHERWISE STATED.
5. BUTTERFLY WALL TIES TO BE USED BETWEEN BLOCK-WORK AND REINFORCED CONCRETE COLUMNS AT 500 CRS.
6. BLOCKS TO BE 200mm THICK 3.5 N/mm² SOLID TYPE TO BS 6073 WITH FAIR FACE.
7. ALL EXPOSED CONCRETE TO HAVE FAIR FACED FINISH EXCEPT FOR ALL TOP SURFACES WHICH ARE TO HAVE A WOOD FLOAT FINISH

APPENDIX A - PUMPING STATION No.1	Drg. no. PS1/GJN/4	not to scale



STAIRCASE DETAILS

APPENDIX A - PUMPING STATION No. 1	Drg. no. PS1/GJN/5	not to scale

Pumping Station 1

Explanatory Notes

Drawing Numbers PS1/GJN/1
PS1/GJN/2
PS1/GJN/3
PS1/GJN/4
PS1/GJN/5

The following example shows a typical reinforced concrete pumping station with a concrete and blockwork superstructure.

It is assumed that the existing site is level with 200 mm of topsoil, with a rockhead at level 94.600. The surrounding finished ground level is also taken as being the existing level.

This example demonstrates measurement in accordance with Classes E, F, G, H, N, U, V and W only. The pipework has not been measured, nor has the reinforcement to concrete. A separate example of reinforcement measurement is given elsewhere.

The structure has been measured in two elements, substructure and superstructure.

Pumping Station 1

				SUBSTRUCTURE			Explanatory Notes
				ETHWKS			This is the depth classification for all the materials in the excavation. This is because there is no express requirement to excavate the void in stages (M5), and the commencing and excavated surface for all materials would be the same i.e. the top and bottom of the void.
				(depth for classifctn)			
						98500	
					89410		
			Slab	700			
			Screed	75			
			blindg	75	850	88560	
						9940	
				Excavn for foundns Pumping Station 1			Although drawing PS1/GJN/2 shows the overall dimensions, the prudent taker off would check these by adding the individual dimensions. The volume of topsoil is based on the net plan area, as is all excavation. It is not necessary to state the commencing surface as it is also the Original Surface. The Excavated Surface is not stated because it is also the Final Surface (Paragraphs 1.12 and 1.13 and Rule A4)
9·40				Topsoil; max depth 5-10m (E 316)			
12·80							
0·20							
		24·06					
				$			
				Disposal (E 531)			None of the excavated material is required for re-use and there are no particular requirements for its disposal. It is therefore deemed to be taken off site (D4).

Pumping Station 1

		Excaon for foundns (cont)	Explanatory Notes
		Dep. 98500 topsoil 200 98300 rock level 94600 3700	
9.40 12.80 3.70		Mkll other than topsoil, rock or artfl hard matl, max depth 5-10m. (E326) $	The depth of material is calculated by deducting the rock head level from the ground level after topsoil has been stripped.
	445.18	Disposal (E532)	
		Dep rock level 94600 89410 base 700 blinding 75 screed 75 850 88560 6040	
9.40 12.80 6.04		Rock; max depth 5-10m (E336) $	The depth of rock is calculated from the top of the rock head to the underside of the blinding.
	726.73	Disposal (E533)	

Pumping Station 1

			Excavn. Anc.	Explanatory Notes
	9.40 12.80		Prepn of excavated surfs; rock (E523)	Preparation of surfaces is measured only to the underside of the blinding as this is the only surface to receive Permanent Works. The sides of the excavation will have formwork measured and no preparation is measured (M11). As no angle of inclination is stated, it is assumed that the preparation is less than 10° to the horizontal (A7)
		120.32		
			IN-SITU CONCRETE	
			Provn. of conc.	
	9.63		Standard mix ST3; sulphate resistg; cement to BS. 4027; 20 agg. to B.S. 882 (F137)	The quantities for provision of concrete are calculated last, and are abstracted from the squared dimensions for the placing of concrete items.
		9.63 m³	(blinding)	Because of the rounding up and down of dimensions, it is possible to have provision of concrete items which are slightly different to the total billed quantities for the placing items.
	84.22		Designed mix grade C20; sulphate resistg cement to BS. 4027; 20 agg. to B.S.882 (F247)	
	0.74			
Deft 3.62	26.69			
	52.67			
Deft 0.27	263.89			
	0.65			
	1.91			
	1.86			
		428.73 m³	(structure)	

Pumping Station 1

			Placg of mass conc.	Explanatory Notes
			Blinding; thness n.e. 150mm (F511)	It is not necessary to state that blinding is placed against the excavated surface (A2). The top surface of the blinding would have a general levelling and no further items would be measured under G81*
	9.40			
	12.80			
	0.08			
		9.63		
			Placg of r/f'd conc	
			Bases, footgs, pile caps and grnd slabs; thness ex. 500mm (F624)	Note that up to this point the annotation or 'signposting' of dimensions has been minimal. This is because it has been quite obvious where they apply i.e there is only one blinding layer and only one base.
	9.40			
	12.80			
	0.70			
		84.22		
			Susp. slabs; thness n.e. 150mm (F631)	The supporting concrete to the platform is an integral part of the slab and therefore classed and measured as part of it.
2/	1.00			
	1.60			
	0.15	0.48		
2/½	1.60		(platform at bottom of ladders)	
	0.20			
	0.80	0.26		
		0.74		

Pumping Station 1

			Placg of Mf'd conc (cont)	Explanatory Notes
			Susp. slabs; thness 150-300mm (F632)	The suspended slabs are measured from the inside face of the walls. The classification of the thickness ignores the presence of the attached beams and upstands (D7)
	4·80		(pump chamber) (roof	
	11·40			
	0·25	13·68		
	2·70			
	11·40	7·70	(penstock chamber)	
	0·25			
	2·70		(beams	Beams integral with suspended slabs are classed as suspended slabs (M4). In this case the upstand to the control panels is measured separately. Beams are measured to the inside face of the walls from which they span.
	0·60	0·57	(penstock chamber)	
	0·35			
2/	4·80			
	0·40	1·34		
	0·35		(pump chamber across width)	
	4·80			
	0·60	1·01		
	0·35			
2/2/	0·90			
	0·20	0·25		
	0·35			
2/2/	3·40		(pump chamber spanning between previous)	
	0·45	2·14		
	0·35			
		26·69		

Pumping Station 1

Placg of r/f'd conc (cont'd)

Explanatory Notes

Add

Susp. slabs; thkness 150-300mm and (F632)

2/0.90		
3.00		
0.10	0.54	(rebated openings)
2/1.30		
3.40	1.33	
0.15		
0.40		
7.40	0.74	(control panel opening)
0.25		
0.90		
3.30	0.74	(staircase opening)
0.25		
2/0.90		
0.60	0.27	(access covers above penstock chamber)
0.25		
	3.62	

dep
600
150
350 500
100

These openings must be deducted from the concrete volume as their area exceeds 0.5 m². All other openings in the slab are measured as voids and are therefore not deducted (see D3 of Class G)

height
98650
89410
9240

Add

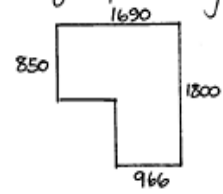
Walls; thkness 300 - 500mm (F643

11.40		
0.50		(ext' wall)
9.24		
	52.67	

The walls are measured from the top of the base slab to the top of the suspended slab. No deductions are made for joint components or cast in components unless they exceed 0.1m³ (M1).

2/9.00		Walls; thkness ex 500mm (F644)
0.70		
9.24	116.42	
2/11.40		(exte walls)
0.70		
9.24	147.47	
	263.89	

Pumping Station 1

			Placg. of r/f'd conc (cont'd)	Explanatory Notes
			Deft	The incoming sewer is the only cast in component large enough to warrant a deduction from the volume
			Walls; thkness Ex. 500mm abd (F644)	
T1	0.35			
	0.35			
	0.70			
		0.27		
			Add Upstands; size 200 x 200mm (F680)	Although these have been classified under other concrete forms, they could have been measured under the classification for walls.
2	7.40			
	0.20	0.59	(control panel)	
	0.20			
2	0.80			
	0.20			
	0.20	0.06		
		0.65		
			Stairs and landings (F680.1)	Plan of top landing
	1.69			
	0.85	0.26		
	0.18		(top landing)	
	0.97			
	0.96	0.17		
	0.18			
2	0.97		(intermediate landings)	
	1.80	0.63		
	0.18			
3	12 1/3		(bottom flights steps)	The top step and associated waist of the lower three flights will have been measured with the landings. This is acceptable because both items are combined under the same description. (See next item for calculation of step and waist volumes).
	0.85			
	0.24	0.62		
	0.17			
13	1/3		(top flight steps)	
	0.85			
	0.24	0.23		
	0.17			
		1.91		

Pumping Station 1

Placg +/f'd conc (cont)

Stairs & landings (cont)

Len

$x^2 = 239^2 + 174.34^2$

$x = 295.83$

295.83 × 13 = 3846

295.83 × 12 = 3550

(waists)

3·85		
0·85		
0·15	0·49	(top flight)
3/ 3·55		
0·85	1·36	(bottom flights)
0·15		
	1·85	

CONCRETE ANCILLARIES

Fmwk. Rough Fin

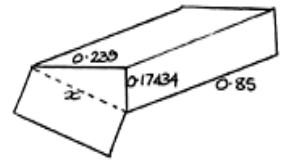
	dep.	
Top joint	93650	
	800	
	97850	
bottom joint	89410	
	150	
	89560	
	8290	

Plane vert. ex. 1·22m (G145)

2/ 9·40		
8·29	155·86	(extl wall outside face)
2/ 12·80		
8·29	212·22	
	368·07	

Explanatory Notes

The calculation of the length of the waist is done by calculating the length for each individual step and multiplying it by the number of steps in the flight. The calculation of the volume of the steps is done by calculating the cross-sectional area of the step and multiplying by its length.



Formwork to the top and bottom of the wall is classed as width 0·4–1·22 because of the the position of the joints and is therefore excluded from this measurement.

Pumping Station 1

Fmwk. Rough Fin (cont')

			dep
		top joint' fair face	800 150
			650
		Plane vert' 0.4-1.22m (G144)	
2/ 9.40 0.65	12.22	(top joint)	(extl wall outside face)
2/ 12.80 0.65	16.64		
2/ 9.40 0.85	15.98	(bottom joint)	
2/ 12.80 0.85	21.76		
	66.60		

The formwork to the areas above and below the top and bottom joints are classed as 0.4-1.22m. The upper 150mm of the top joint' formwork is exposed to view and must be fair faced. It is deducted from the total area and measured separately, classed as 0.1-0.2m wide.

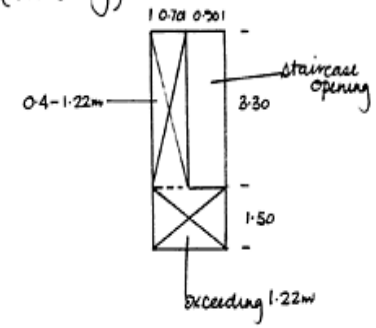
Fmwk. Fair Fin

		Plane vert'. 0.1-0.2m (G242)
2/ 9.40	18.80	(top 150mm of outside face of extl wall)
2/ 12.80	25.60	
2/ 4.80	9.60	(internally at kicker lvl' to all walls)
2/ 2.70	5.40	
2/2/ 11.40	45.60	
	105.00	
		Plane vert' ex. 1.22m (G245)
2/ 4.80 8.29	79.58	(internally between bottom and top joint' to all walls)
2/ 2.70 8.29	44.77	
2/2/ 11.40 8.29	378.02	
	502.37	

The formwork to the inside face of the walls is classed as 0.1-0.2m at the base because of the presence of the kicker joint.

Pumping Station 1

			Fmwk. Fair Fin (cont'd)	Explanatory Notes
			dep 800 256 550	
			Plane vert. 0.4-1.22m (G 214)	It is recommended that no deduction is made from the area of formwork between the top joint and the underside of the slab for intersections with beams because their cross-sectional area does not exceed $0.5m^2$
2/	4.80			
	0.55	5.28		
2/	2.70		(internally between top joint and U/S of slab)	
	0.55	2.97		
2/2/	11.40			
	0.55	25.08		
		33.33		
			Len 1600 400 3400 5400	
			Plane horiz. Ex 1.22m (G 215)	Narrow width formwork caused by openings is only classed as such where formwork to the openings is measured under the general formwork classification and not as voids as defined in D.3. The only areas to the soffit of the pump chamber roof which are not below 1.22m wide are the area at the opposite end of the stairs and the area between the staircase opening and the long external wall (see diag)
	2.70			
	5.40	29.16	(penstock chamber roof)	
Det				
2/	0.30			
	0.60	1.08	(for access covers)	
	1.60			
	4.80	7.68	(pump chamber roof)	
	1.60			
	1.50	2.40		
		38.16		



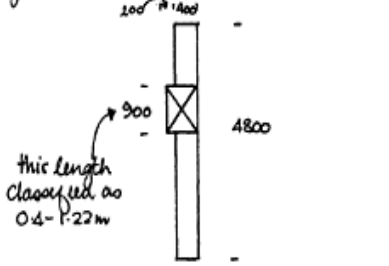
Pumping Station 1

			Fmwk. Fair. Fin (cont')
			Deff
			Plane horiz. 0·4 - 1·22m
	0·70	2·31	(next stairs) (G214)
	3·30		(soffit of pump chamber
2/	3·40	6·80	(either side of plinth
	1·00		panel opening)
2/	3·40	8·16	
	1·20		
2/	3·40	3·06	(between int. wall & rebated
	0·45		opening)
		20.33	
			Add
			Plane. horiz. 0·4 - 1·22m
	4·80	2·88	(central (G214)
	0·60		beam across (beam soffits
2/	0·90	0·36	width of pump
	0·20		chamber)
2/	0·90	1·08	(outside beams
	0·60		across width of
			pump chamber)
2/	3·40	3·06	(long beams to
	0·45		rebated opening)
		7·38	
			Plane horiz. 0·2 - 0·4m
2/	4·80	3·84	(G213)
	0·40		(outside beams
			across width of
			pump chamber)
Deff			
2/	0·90	0·72	
	0·40		
		3·12	

Explanatory Notes

Because of the smaller nature of the work, formwork to beams is measured in accordance with G1-4 1-4* and not G1-4 8*

The beams which span the width of the pump chamber (orden out) where they cross the rebated beams. In the case of the central beam this simply means an additional area of formwork in the 0·4-1·22 classification. The outside beams however are classified as 0·2-0·4m and this bordering means that the beam is classified as 0·4-1·22m for the length of the additional width



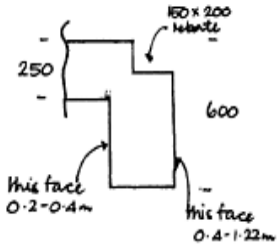
Pumping Station 1

Formwk. Fair Fin (cont'd)

			Plane vert. 0.2-0.4m (G243)
2/2·70			(penstock chamber) (beam sides
0·35	1·89		
2/4·80			(outside beams across width of pump chamber)
0·35	3·36		
2/2·60			
0·35	1·82		
2/0·40			
0·35	0·28		
2/2/3·40			(long beams to isolated opening - outside face only)
0·35	4·76		
	12·11		
			Plane vert. 0.4-1.22m (G244)
2/2/3·00			(openings in roof slab
0·45	5·40		(isolated openings)
2/0·90			
0·45	0·81		
2/7·40			(control panel openings - long sides)
0·45	6·66		
	12·87		
			Plane. vert. 0.2-0.4m (G243)
2/0·40			(control panel openg - short sides) (openings in roof slab
0·45	0·36		
2/2/0·90			
0·25	0·90		(access covers in penstock chamber)
2/2/0·60			
0·25	0·60		
3·30			
0·25	0·83		(staircase)
0·90			
0·26	0·23		
	2·92		

Explanatory Notes

The sides of the long beams on either side of the isolated openings are in two different width classifications



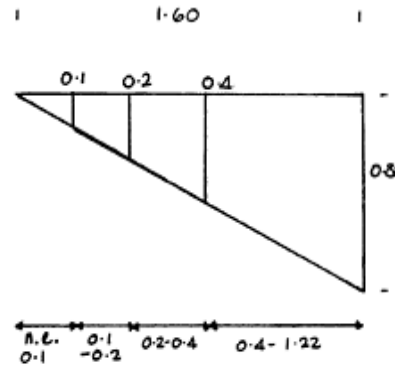
These holes are above the minimum size to enable measurement under the voids classification and have to be measured under the general formwork classification. Their area must therefore be deducted

Pumping Station 1

Fwwk. Fair Fin (cont)

		Plane vert. 0.1-0.2m (G242)
2/2/ 3.40	13.60	(rebate to rebated opng) (opngs in roof slab
2/2/ 1.30	5.20	
2/ 8.00	16.00	(control panel opng- side of plinth)
2/ 0.80	1.60	
	36.40	
		Plane horiz; 0.2-0.4m (G213)
2/2/ 0.40		(landings to ladders)
1.60		
	2.56	
		Plane vert. 0.1-0.2m (G242)
2/2/ 1.60	6.40	(landings
2/ 1.00	2.00	to ladders)
	8.40	
		Plane vert; average width 0.4m (G246)
2/2/½/ 0.80		(landings to ladders)
1.60		
	2.56	
		Plane slopg; 0.1-0.2m (G222)
		$x^2 = 1.6^2 + 0.8^2$
2/ 1.78		$x = 1.78$
	3.56	(landings to ladders.

Explanatory Notes

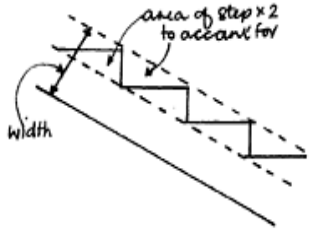


Strictly speaking the formwork to the sides of the support to the landing should be classified as above. With such small quantities this would be unhelpful and therefore an additional description in accordance with Paragraph 5.10 is incorporated into the description and the average width is stated.

Pumping Station 1

Fmwk. Fair Fin (cont)

			Plane vert. 0.1-0.2m (G 242)	Because of the 100mm gap between the stairs, the top riser in the bottom three flights will effectively be 100mm longer
14/	0.85	11.90	(risers - top flight) (Stairs	
3/	0.95	2.85	(risers - bottom flight)	
3/12/	0.86	30.60		Len 1693 966 727
	0.73	1.69	(top landing)	
	0.96			
2/	0.96	1.92	(intermediate landing)	
		48.96		
			Plane vert. 0.2-0.4m (G 243)	The classification for the width of formwork to the waist is taken as the maximum width and the area is taken as the gross area. The top flight and flight second from bottom have formwork measured to one side only as the other side is cast against the external wall. The calculation of the area is done by adding the area of the waist to twice the area of the side of the step.
	3.85			
	0.15	0.58	(top flight) (sides of stairs	
13/½/	0.24			
	0.17	0.27		
2/½/	3.55			
	0.15	2.13		
2/12/½/	0.24			
	0.17	0.49	(bottom flight)	
	3.55			
	0.15	0.53		
12/½/	0.24			
	0.17	0.24		
		4.24		
			Plane. slopg 0.4 - 1.22m (G 224)	
	3.85			
	0.85	3.27	(soffits) (Stairs	
3/	3.56			
	0.85	9.05		
		12.32		



Pumping Station 1

			Fmwk. Rough Fin.	Explanatory Notes
			For voids	It is assumed that the formwork to the sides of the voids will have a rough finish because they will be eventually filled in around the insert.
	1		small void depth n.e. 0·5 (G171) (emergency pumping pipework) (in roof	
		1		
	1		large void depth n.e. 0·5 (vent fan) (G175)	
	1		(extractor) (in roof.	
		2		
			Joints	
			Open surf plain 0·5 - 1m (G612)	The average width of the joint is measured from outside face to outside face with no deduction for the width occupied by the rebate (M11) There is no surface treatment to the joints so they are classed as plain.
2/3	9.00 0·70	37·80	(jnts at all three levels extl walls)	
2/3	11·40 0·70	47·88		
		85·68		
			Open surf plain n.e. 0·5m (G611)	
3	11·40 0·50		(int wall)	
		17·10		

Pumping Station 1

			Joints (cont)	Explanatory Notes
			PVC waterstop, dumbell type, 230 wide (G653)	As the width of the waterstop is stated it is not necessary to also state the width in the ranges given in the Third Division. Note that there is no separate measurement for angles as these are deemed to be included (C4)
3/	36.00	108.00	(Exth walls)	
3/	12.10	36.30	(Int walls)	
		144.30		
			Exth 4/2/4/700	11400 8000 19400 x2 38800 2800 36000
			Int 2/4/700	11.400 .700 12.100
			Sealed rebate or groove; 25×25 mm with two part polysulphide sealant (G670)	Although not specifically mentioned, the measurement of the groove is taken at its exposed face. No formwork is measurable to any work classed as joints (C3)
2/3/	36.00	216.00	(exst walls)	
2/3/ Deff	0.70	4.20		
2/3/	11.40	68.40	(int walls)	
		280.20		
			Conc. Accessories	
			Fin top surfs; wood float	No deduction is made for the areas of the support plinths as they do not exceed $0.5m^2$ (M14)
	11.40 2.70	30.78	(penstock chamber floor) (G811)	
	11.40 4.80	54.72	(pump chamber floor)	
2/	1.00 1.60	3.20	(ladder landings)	
		88.70		

Pumping Station 1

			Conc. Accessories (Cont'd)	Explanatory Notes
			Fin top surfs; wood float (G811)	
13/	0·24			
	0·85	2·65	(treads) (stairs	
3/12/	0·24			
	0·85	7·34		
	1·69			
	0·85	1·44	(top landing)	
	0·97			
	0·95	0·92		
2/	0·97			
	1·80	3·49	(intermediate landings)	
		15·84		
			Fin. top surfs; wood float (G811)	
	12·80		(roof slab	
	9·40			
		120·32		
			Ditt	
			Fin. top surfs; wood float (G811)	Although not clear from CESMM no deduction is made from the area for that which is subsequently covered by the brick walls. No deduction is made for openings less than $0.5m^2$ (M14)
	0·90			
	3·30	2·97	(stairs opng)	
2/	3·00			
	0·90	5·40	(elevated opngs)	
	7·40			
	0·40	2·96	(control panel opng)	
2/	0·90			
	0·60	1·08	(access covers)	
		12·41		

Pumping Station

		Inserts	Explanatory Notes
4/ 1	4	100mm dia. PVC cable ducts, 800 long; proj. two sides (pump chamber ext. wall at high level) (G832)	This item would also include for the supply of the duct as it has not been otherwise stated (CT)
1	1	700 mm dia. pipe proj. one side (supply incl. elsewhere) (sewer thro ext. wall) (G832.1)	This is classified as projecting from one surface because the end of the pipe is flush with the internal face of the wall.
1	1	400mm dia. pipe proj. two sides (supply incl. elsewhere) (pump main thro ext. wall) (G832.2)	
4/ 1	4	200 mm dia. pipe proj. two sides (supply incl. elsewhere (pump main thro int. wall) (G832.3)	
2/ 1	2	100mm dia. pipe proj. two sides (supply incl. elsewhere) (G832.4) (emergency pump pipe thro int. wall) (sleeve for penstock spindle)	

Pumping Station 1

			Inserts (cont'd)	Explanatory Notes
			150mm dia pipe in 300 x 300 x 250mm deep preformed box out proj. two sides as Spec Clause 12.1 (G 832-5)	Inserts grouted into preformed openings must be described. The work in grouting into preformed openings can be quite involved so reference is made to the schedule Specification Clause rather than give a detailed description
1			(emergency pump pipe thro roof)	
	1			
			200 mm dia pipe in 400 x 400 x 250mm deep preformed box out proj. two sides as Spec Clause 12.1 (G832-6)	
1			(air inlet thro roof)	
	1			
			300 x 300mm duct in 500 x 500 x 250mm deep preformed box-out proj two sides as Spec Clause 12.1 (G832-7)	
1			(Extractor fan thro roof)	
	1			

Pumping Station 1

Miscellaneous Metalwork

Ladders, stainless steel as Spec. Clause 18.4 and drwg no. PS1/GJN/12; incl. all fixing to conc.

(N130)

2/6.59

Len

98660
83410
9240

13.18

2500
150 2650

6690

Handrails; level; stainless steel as Spec. Clause 18.2; incl. all fixing

(N140)

2/2/1.60 6.40 (ladder landings)

8.53 8.53 (stair landings)

Len

1200

14.93

top of stair 3300
200
727

1st inter down 200
966

2 & 3rd inters 966
966

8525

Ditto sloping

(N140.1)

3.95

$x^2 = 3.16^2 + 2.45^2$

2/2/3.66

$x = 3.95$

3.66

$x^2 = 2.87^2 + 2.25^2$

$x = 3.66$

22.25

Explanatory Notes

Alternatively the ladders could have been enumerated stating the length. The item includes for all fixing to concrete (C1). Alternatively the pockets and bolts could have been measured in Class G.

Although not a specific requirement, level handrails and raking handrails are kept separate because it is considered that they have different cost considerations. Alternate flights will have a handrail either one or both sides depending on whether it is next to the external wall or not.

x is the length of the sloping handrail which is the hypotenuse of a right angled triangle (Pythagoras' theorem)

Pumping Station 1

			Miscellaneous Metalwork (cont)	Explanatory Notes
			Handrail; level; stainless steel as Spec. Clause 18.6, incl. all fixing (extl) (N140.2)	Although this handrail and part of the handrail before is strictly speaking a superstructure item, they have been included here in order to keep all similar items of work together.
	11.40			
		11.40		
			Access covers & fr. 900 x 600 mm light duty to B.S. 497 grade C (N190.1)	There is no separate classification for access covers so this is a rogue item.
2	1		(penstock chamber roof)	
		2		
			Safety chains 900 mm long; stainless steel as Spec. Clause 18.2 incl. all fixing. (N190)	There is no separate classification for safety chains so this is a rogue item.
2	1			
		2		

Pumping Station 1

			Waterproofing	Explanatory Notes
			Bituminous Tanking as Spec Clause 27.3	Because the description contains reference to the relevant specification clause, it is not necessary to go into detail about the number of coats and thickness of material.
			Upper surfs. n.l. 30° to Horiz (W241)	
	12·80		(U/S of structure)	
	9·40			
		120·32		
			Surfs. ex. 60° (W243)	
2/	12·80			
	9·87	252·67	(outside of Extl. walls)	
2/	9·40			
	9·87	185·56		
				ht
				98500
				89410
				9090
			base	700
			Screed	75
				9865
		438·23		
			Damp proofing	
			Protective coating as Spec. Clause 27.1 n.l 30° to Horiz (W141)	
	2·70		(floor penstock chamber)	
	11·40			
		30·78		

Pumping Station 1

		Damp proofing (cont'd)	Explanatory Notes
		Protective coating as Spec. Clause 27.1 ex. 60° to horiz.	No deduction is made where the beams meet the walls or the sewer as the cross-sectional area does not exceed $0.5m^2$
2/2·70		(W 143) (penstock chamber	
8·99	48·55		
2/11·40			
8·99	204·97		
	253·52		
		Protective Layers	
		Sand and cement (1:4) screed 75mm thick in one coat n.e. 30° to horiz. (W 441)	
12·80			
9·40		(U/S of structure)	
	120·32		

Pumping Station 1

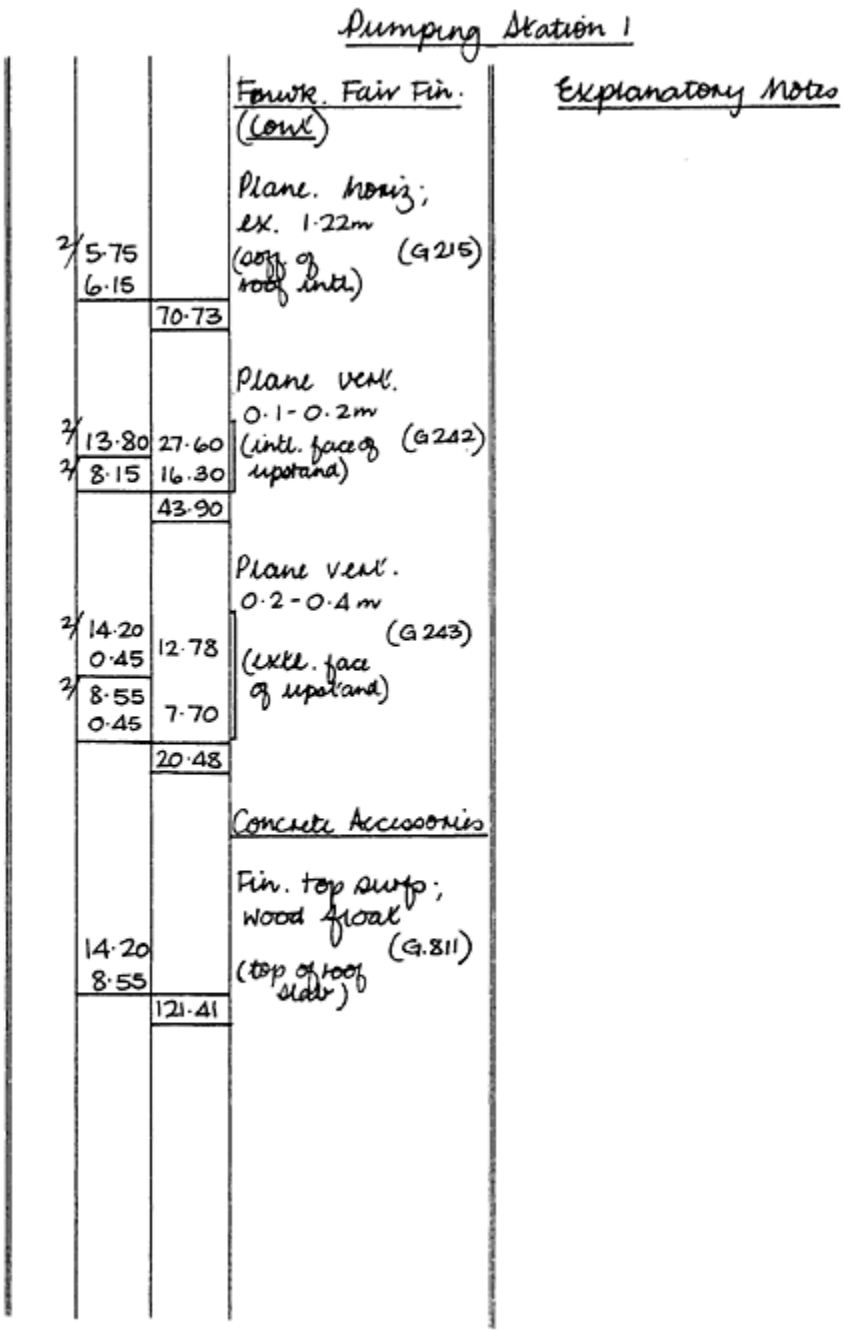
			SUPERSTRUCTURE	Explanatory Notes
			Provn. of conc.	
			Designed mix grade C20; OPC to BS. 146; 20mm agg to BS. 882 (F243)	
	1·30			
	0·86			
	4·24			
	24·28			
	2·24			
		32·92m³	Placg of r/f'd conc.	
			Columns and piers; X-sect. area 0·03 – 1m² (FC52)	The columns are measured from the top surface of the pumphouse floor to the underside of the roof slab. The beams are then measured between the columns.
4/	0·30			
	0·30		3200	
	3·60		400	
			3600	
		1·30		
			Ditto 0·1 – 0·25m² (F653)	
2/	0·30			
	0·40			
	3·60			
		0·86		Again note that there is no annotation or 'signposting' of the dimensions as it is quite apparent on the drawing where the descriptions are derived from
			Beams; X-sect area 0·1 – 0·25m² (F663)	
2/	6·15			
	0·30	1·48		
	0·40			
2/2/	5·75			
	0·30			
	0·40	2·76		
		4·24		

Pumping Station 1

			Explanatory Notes
		Placg. of r/f'd cond. (cont'd)	
		Len 2/200 400 2/700 1400 2/300 600 2/5750 11500 300 14200	
		Wid 2/200 400 2/700 1400 2/300 600 6150 8550	
		Susp. slabs thress 150-300mm (F632)	The suspended slab is measured over the beams and under the perimeter kerb
14.20 8.55 0.20		(roof)	
	24.28		
		Upstands; sizg 200x250mm (F680) girth	Again the perimeter kerb to the roof has been classified as an upstand rather than a wall as it is felt that this more accurately reflects the work involved.
44.70 0.20 0.25		(roof) 4200 8550 22750 x2 45500	
	2.24	4/2/½/200 800 44700	

Pumping Station I

			CONCRETE ANCILLARIES	Explanatory Notes
			Fmwk. Fair Fin.	
4/	3.60		To components of constant x-sect; Columns size 300 x 300 mm; extl walls of superst. (G282)	The measurement of the columns and beams to the superstructure is done as components of constant cross-section in order to demonstrate the classification. In practice on a contract of this size it is not of much benefit to the contractor in that the number of uses of the formwork will be very small.
		14.40		
			Ditto 300 x 400 mm (G282.1)	
2/	3.60			
		7.20		
			To components of constant x sect; Beams size 300 x 400 mm; roof slab (G281)	To be strictly correct, the area of the columns in contact with the brickwork should be deducted from the area of the fair finish and added back as rough because it is not exposed to view. However, it is felt that this is totally impracticable and the fair finish is carried through.
2/	6.15	12.30		
2/2	5.75	23.00		
		35.30		
			Plane horiz; 0.4 - 1.22 m² (G214)	
2/	14.20			
	0.90	25.56	(perimeter of hang of roof)	
2/	6.75			
	0.90	12.15		
		37.71		


Pumping Station 1
Explanatory Notes
Fawk. Fair Fin.
(cont)
Plane. Horiz;
ex. 1·22m
(G215)
(cop of roof intl.)
2/ 5·75
6·15
70·73
Plane vert.
0·1 - 0·2m
(intl. face of upstand)
(G242)
2/ 13·80
2/ 8·15
27·60
16·30
43·90
Plane vert.
0·2 - 0·4m
(G243)
(extl. face of upstand)
2/ 14·20
0·45
2/ 8·55
0·45
12·78
7·70
20·48
Concrete Accessories
Fin. top surfs;
wood float
(G.811)
(top of roof slab)
14·20
8·55
121·41

Pumping Station 1

		Concrete Accessories (cont)	Explanatory Notes
2/6/ 3·20	38·40	Butterfly wall ties; 300mm centres; proj from one surf (G831) (both. column & block wall)	Alternatively the measurement of the wall ties could have been included in Class U, but it would still have been necessary to measure an item in Class G for the building in. Although the ties have been measured under the linear inserts classification stating the spacing, they could have been enumerated.
2/3/ 1	6	Fndn. bolts 12 dia x 150mm long; proj from one surf (G832) (fixing crane rail to central conc. beam)	
		PRECAST CONCRETE	
		Lintels	There is no separate classification for lintels in Class C and this is therefore a rogue item. Because the actual size is stated it is considered that it is not necessary to also state the weight. The specification clause would contain details of reinforcement etc., or alternatively this may be contained on a drawing
3/ 1	3	1100 x 200 x 150mm deep as Spec. Clause 11.1 (window) (H900)	
1	1	1400 x 200 x 150mm deep as Spec. Clause 11.1 (personnel door) (H900·1)	

Pumping Station 1

			Lintels (cont'd)	**Explanatory Notes**
			2200 × 400 × 150 mm deep as Spec. Clause 11.1	
1			(door under crane beam) (H900.2)	
	1			
			Padstones	
			1200 × 400 × 150 mm deep as Spec. Clause 11.1 (H900.3)	
1				
	1			
			STRUCTURAL METALWORK	
			Fabrication of crane beams; straight on plan, 406 × 178 × 67 kg/m U.B. (M421)	The weight of the plate and angle must also be included in the mass of steel measured, but not the bolts (M3). The section size and weight is also given to assist the contractor although this is not strictly necessary.
11.80	0.79	(UB)		
0.067				
2/ 0.15	0.02	(angles)		
0.049				
3/ 0.25				
0.25	0.01	(plate)		
0.06				
	0.82 kg			
	÷ 1000			
	0.01 t		Permanent Erection (M720)	

Len
5750
300
5750
11800

Pumping Station 1

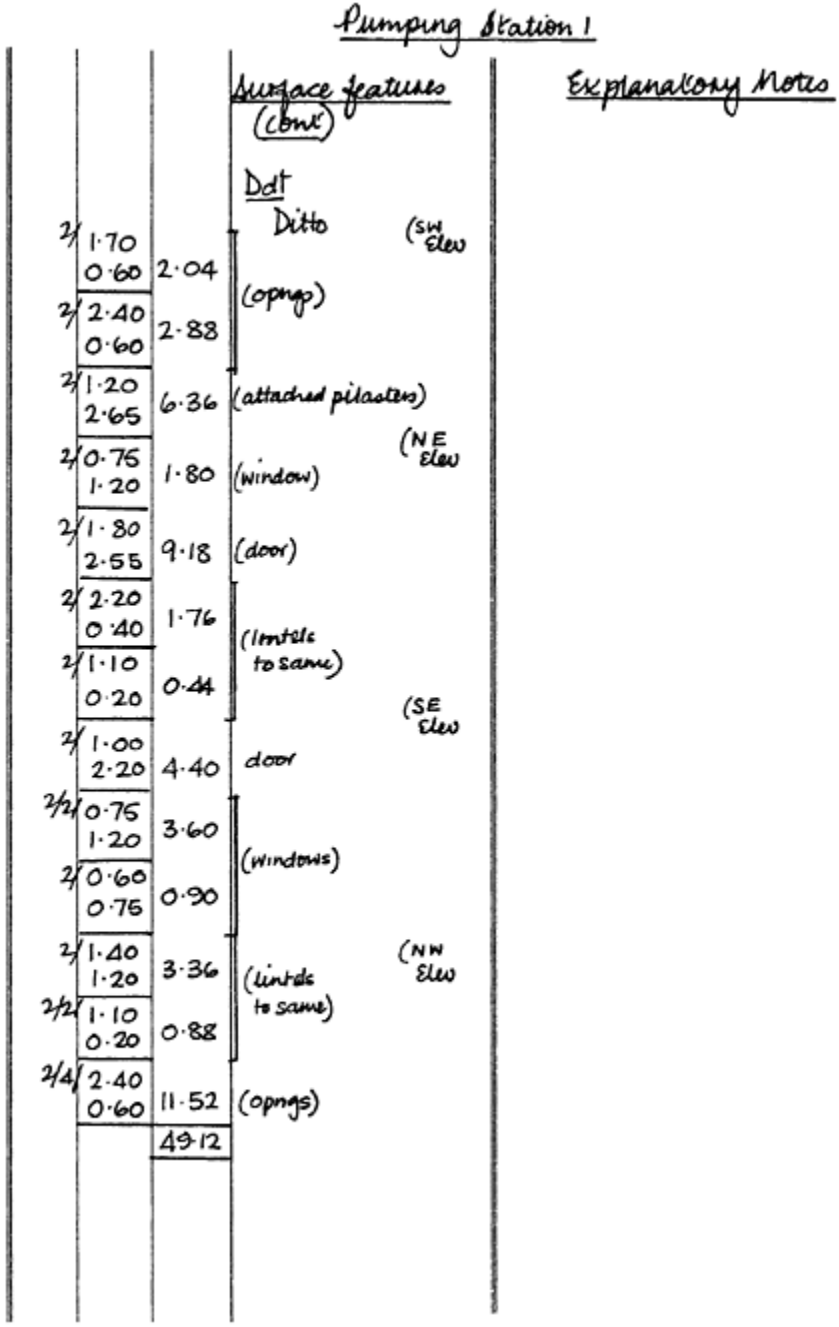
		Site bolts	Explanatory Notes
		HSFG general grade	Although not a specific requirement the actual diameter and length of bolts is also stated. The bolts which fix the angles to the concrete are measured in Class G.
6/ 1		12 dia x 45mm long (plate) (M741)	
	6		
		12 dia x 35mm long (flange/angle) (M741·1)	
2/2/ 1			
	4		
		BRICKWORK AND BLOCKWORK	
		Dense concrete blocks to BS 6073 part 1 3·5N/mm² solid; 450 x 225 x 200mm; jointing in cement mortar (1:3); Stretcher bond.	
		Vert, straight walls; 200mm th. (U521)	The measurement of the external walls is taken over all openings and holes for which the deductions are made separately.
2/2/ 5·75			
3·20	73·60	(extl. walls)	
2/ 6·15			
3·20	39·36		
	112·96		
		Vert. straight walls; 400mm th. (U531)	
1·20			
2·65		(pilaster to S.W. wall.)	
	3·18		

Pumping Station I

			Dense conc. blocks (cont'd)	Explanatory Notes
			Ddt	
			Wall, straight walls 200mm th.	The length of the attached pilaster to the N.W wall exceeds 4 times its projecting width so that the area of wall is measured separately as 300 thick. The area of the padstone is less than $0.25\,m^2$ in area and is not deducted (M_2)
	1·70			
	0·60	1·02	(US2) (SW elev. (for openg)	
	2·40			
	0·60	1·44		
	1·20		(for attached	
	2·65	3·18	pilaster)	
	0·75		(NE elev.	
	1·20	0·90	(Window)	
	1·80			
	2·55	4·59	(door)	
	2·20			Although the smaller lintels are less than $0.25\,m^2$ they are deducted from the overall area because they form part of the window openings and their combined area exceeds the minimum.
	0·40	0·88	(lintels to same	
	1·10			
	0·20	0·22		
	1·00		(SE elev	
	2·20	2·20	(door)	
2/	0·75			
	1·20	1·80	(Windows)	
	0·60			
	0·75	0·45		
	1·40			
	0·20	0·28	(lintels to same)	
2/	1·10			
	0·20	0·44		
			(NW elev.	
4/	2·40			
	0·60	5·76	(opgs)	
		23·16		

Pumping Station 1

			Surface features	Explanatory Notes
			Add Pilasters size 400 × 100 mm	Although the cross-sectional area of the pilasters is less than that specified in A7, the size is still stated because it is considered that this gives the Contractor the information necessary to identify any cutting or special bricks in accordance with A.6.
2/2/	3·20	12·80	(to N.W. & S.W walls) (U576)	
2/	2·55	5·10	(either side of main door)	
		17·90		
			Fair facing; flush pointing as work proceeds (U 578)	Fair facing is measured separately to all items of brickwork and blockwork. In this case it is measured by doubling the area of the wall, deducting the openings and adding the area of reveals etc.
2/2/2/	5·75			
	3·20	147·20	(both sides of gross buildable measurement)	
2/2/	6·15			
	3·20	78·72		
2/	0·20			
	2·20	0·88	(personnel door) (reveals	
2/	0·20			
	2·55	1·02	(main door)	
2/3/	0·20			
	1·20	1·44	(windows)	
2/	0·20			
	0·75	0·30		
2/5/	0·20			
	0·60	1·20	(openings)	
	0·20			
	0·60	0·12		
2/2/2/	0·10			
	3·20	2·56	(pilasters)	
2/2/	0·10			
	2·55	1·02		
2/	0·20			
	2·65	1·06	(sides of wall thickening under padstone)	
		235·52		


Pumping Station 1
Surface features (cont'd)
Explanatory Notes
Ddt
Ditto (SW Elev
2/ 1·70 0·60 2·04
2/ 2·40 0·60 2·88
(opngs)
2/ 1·20 2·65 6·36
(attached pilasters)
(NE Elev
2/ 0·75 1·20 1·80
(window)
2/ 1·80 2·55 9·18
(door)
2/ 2·20 0·40 1·76
2/ 1·10 0·20 0·44
(lintels to same)
(SE Elev
2/ 1·00 2·20 4·40
door
2/2/ 0·75 1·20 3·60
2/ 0·60 0·75 0·90
(windows)
2/ 1·40 1·20 3·36
2/2/ 1·10 0·20 0·88
(lintels to same)
(NW Elev
2/4/ 2·40 0·60 11·52
(opngs)
49·12

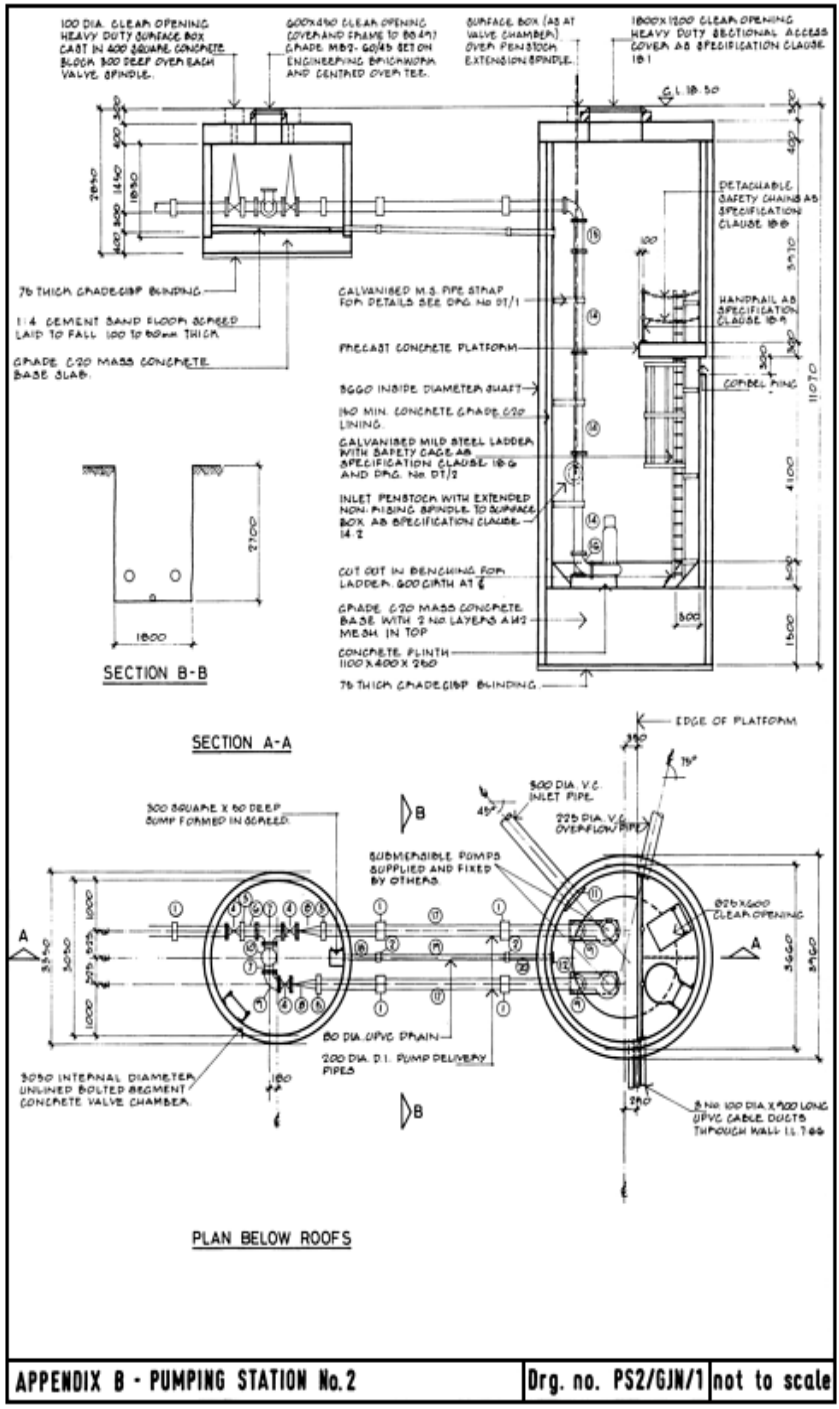
Pumping Station 1

			Ancillaries	Explanatory Notes
			Add	
			Damp proof course; pitch polymer; 200 wide (U582)	It is necessary to state the nature and width of damp proof courses (A8). Consequently the length of damp proof course over the wall thickening and pilaster has to be classified separately. The damp proof course does not carry through the door openings and is deducted.
2/2	5·75	23·00		
2	6·15	12·30		
		35·30		
Ddt				
1·20	1·20		(for door spngs)	
1·80	1·80			
4 0·40	2·40		(for pilasters)	
1·20	1·20	6·60	(for wall thickening to SW elevation)	
		28·70		
			Ditto 300 wide	
4	0·40		(pilasters) (U582·1)	
		2·40		
			Ditto 400 wide (U582·2)	
	1·20		(wall thickening to SW elevation)	
		1·20		

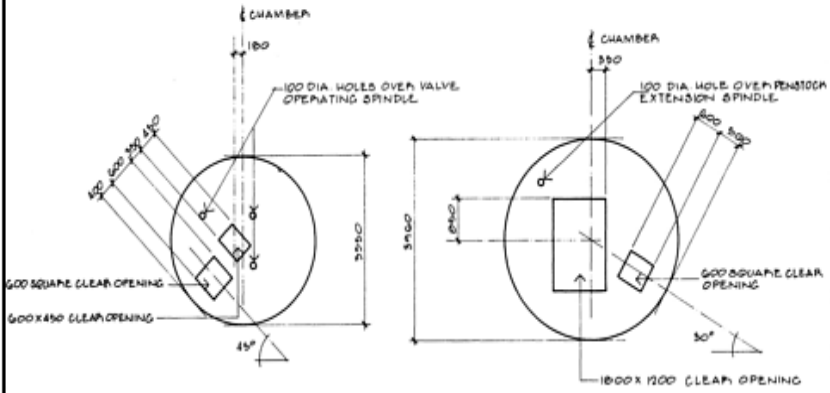
Pumping Station 1

		Ancillaries (cont)	Explanatory Notes
		Building in pipes and ducts X-sect area 0·16m² (U588)	
1		(vent fan duct.	
	1		
		Painting	
		1 coat calcium plumbate primer (2 to gross paint to metal sections (V1 & 470)	The girth calculated for the crane rail will be slightly overmeasured as it does not deduct the area where the web meets the flange or allow for the curves etc. However, it is considered to be sufficiently accurate for measurement purposes
11·80		(crane rail) girth	
1·52		4/178 712	
	17·94	2/406 812	
		1524	

Chapter 4
PUMPING STATION NO. 2



APPENDIX B - PUMPING STATION No. 2	Drg. no. PS2/GJN/1	not to scale



PLAN ON ROOF SLABS

ITEM No	No OFF	NOM. DIA.	DESCRIPTION
1	5	200	DETACHABLE FLEXIBLE COUPLING
2	2	80	DETACHABLE FLEXIBLE COUPLING
3	1	200	FLANGE SPIGOT 1200 LONG
4	3	200	DOUBLE FLANGE RISING SPINDLE SLUICE VALVE WITH GEARBOX AND EXTENSION SPINDLE TO GIVE NON-RISING VALVE OPERATING CAP APPROX. 100 BELOW SOFFIT OF ROOF SLAB.
5	3	200	FLANGE ADAPTOR
6	1	200	FLANGE SPIGOT 250 LONG
7	2	200	ALL FLANGE EQUAL TEE
8	2	200	DOUBLE FLANGE CHECK VALVE
9	3	200	DOUBLE FLANGE 90° BEND
10	1	200	BLANK FLANGE
11	1	300	PENSTOCK AND EXTENSION SPINDLE SUITABLE FOR AN OFF SEATING PRESSURE OF 8.5M OF WATER FOR BOLTING TO THE STRUCTURE
12	1	80	FLAP VALVE FOR BOLTING TO THE STRUCTURE
13	2	200	FLANGE SPIGOT 1500 LONG
14	6	200	DOUBLE FLANGE STRAIGHT 2000 LONG
15	7	200	DOUBLE FLANGE STRAIGHT 605 LONG
16	2	200	DOUBLE FLANGE DUCKFOOT BEND
17	2	200	DOUBLE SPIGOT STRAIGHT 2900 LONG
18	1	80	DOUBLE SPIGOT UPVC STRAIGHT 760 LONG
19	1	80	DOUBLE SPIGOT UPVC STRAIGHT 3000 LONG
20	1	80	DOUBLE SPIGOT UPVC STRAIGHT 1000 LONG

FITTINGS SCHEDULE

No. OFF	CLEAR OPENING	DESCRIPTION
1	1800 X 1200	HEAVY DUTY ACCESS COVER
2	600 X 600	HEAVY DUTY HINGED LIFT OUT ACCESS COVER
1	600 X 450	HEAVY DUTY COVER
4	100 DIA.	HEAVY DUTY SURFACE BOX.

COVERS SCHEDULE

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS IN METRES
2. ROCK HEAD LEVEL AT APPROXIMATELY 10.35 M
3. SHAFT TO BE PRECAST CONCRETE BOLTED SEGMENTAL LININGS
4. ALL EXPOSED CONCRETE TO HAVE A TYPE 'B' FINISH
   ALL UNEXPOSED CONCRETE TO HAVE A TYPE 'A' FINISH

APPENDIX B - PUMPING STATION No. 2	Drg. no. PS2/GJN/2	not to scale

Pumping Station 2

Drawing Numbers PS2/GJN/1
PS2/GJN/2

Explanatory Notes

The following worked example shows a second type of pumping station constructed from bolted precast concrete shaft rings.

It is assumed that the existing site is level with no topsoil. Rockhead is at level 10·350 and the existing site levels are to be maintained.

This example demonstrates measurement in accordance with Classes E, F, G, H, J, N and T. As all the structure is below ground it is not necessary to divide it into substructure and superstructure. The work measured includes only for pipework inside rings between and in the shafts. Inlet and overflow pipework are not included.

Pumping Station 2

			TUNNELS	Explanatory Notes
			Exc. straight shaft in mat. other than topsoil, rock or artificial hard mat.; dia 3·96m (T143)	As there are no payment lines shown on the drawings the excavation is measured to the net dimensions of the volumes to be excavated (M2). Due to the small size of the work, it is considered that the classification for 'other stated material' should be kept as simple as possible and the description of the material is taken from Class E. Detailed annotation of the dimensions is not necessary as it is quite apparent from the drawings where they apply.
			dep	
			gl. 18500	
π/1·98			rock head 10350	
1·98			8150	
8·15				
		100·39		
			Exc. straight shaft in rock; dia. 3·96m (T133)	
			dep	
			total dep 11070	
			blinding 75	
π/1·98			11145	
1·98			Less rock 8150	
3·00			2995	
		36·95		
			Exc. straight shafts in mat. other than topsoil, rock or artificial hard mat.; dia. 3·35m (T143·1)	Although the smaller of the two shafts falls in the same Third division classification as the larger shaft, it is necessary to keep it separate because the actual external diameter must be stated.
			dep	
π/1·68			2850	
1·68			blinding 76	
2·93			2926	
		25·98		

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			Exc. straight shaft in mat other than topsoil, rock or artifical hard mat.) dia. 3·96m used as filling above cover slab. (T143.2)	Explanatory Notes This is the approximate volume of material required for filling above the shaft cover slabs. AA requires item descriptions for excavated material used as filling to be so stated and consiquently it has to be measured separately.
π/	1·98			
	1·98			
	0·30	3·70		
Dedt				
1·80				
1·80				
0·30	0·97			
0·60			(dedts for openings)	
0·60				
0·30	0·11			
π/ 0·05				
0·05				
0·30	0·01	1·09		
		2·61	Dedt	
			Exc. straight shaft in mat. other than topsoil, rock or artificial hard mat.; dia 3·96m a.b.d (T143)	The volume measured for filling has to be dedicted from the overall volume for excavation. The balance of material is decmed to be disposed of off site. (C1)

Pumping Station 2

Explanatory Notes

			Add Exc. straight shaft in mat. other than topsoil, rock or artificial hard mat.; dia. 3.35m used as filling above cover slab. (T143.3)
π	1.68		
	1.68	2.66	
Delt	0.30		
0.60			
0.60			
0.30	0.11		(datts for opngs)
0.60			
0.45			
0.30	0.08		
3/π 0.05			℄
0.05			
0.30	0.01	0.20	
		2.46	
			Delt Exc. straight shaft in mat. other than topsoil, rock or artificial hard mat.; dia 3.35m a.b.d. (T143.1)

Pumping Station 2

			Exc. surfs. in mat. other than topsoil, rock or artificial hard mat.; filling voids both grout. C.S. Spec. Clause 24.10
π/	3.96		
	8.15	101.40	(large shaft sides) (T180)
π/	3.35		
	2.93	30.84	(small shaft sides)
		132.24	
			Exc. surfs. in rock; filling voids with grout. C.S. Spec. Clause 24.10
π/	3.96		
	3.00		(large shaft sides) (T170)
		37.33	
			Exc. surfs. in mat. other than topsoil, rock or artificial hardmat. to receive blinding conc.
π/	1.68		
	1.68		(T180.1)
		8.87	
			Exc. surfs in rock to receive blinding conc.
π/	1.96		
	1.96		(T170.1)
		12.07	

Explanatory Notes

It is not necessary to classify the measurement of excavated surfaces according to the external diameter and therefore the quantities for both shafts can be combined. It is necessary to state the nature of the material to be used as filling for voids (A5) and this is best done by reference to the relevant specification clause.

It is important that the base of the shaft is not forgotten, but as this will not be treated in the same way as the sides, then it must be measured separately.

Pumping Station 2

Preformed segmental linings to shafts

Precast conc. bolted rings; flanged; nom. ring width 610mm max. piece weight 0.27t.; 4No. O segments, 2No. T segments, 1No key segment; 34No. 7" x 7/8" circle and cross bolts; 2No 10½" x 7/8" key bolts; 3mm bituminous packing to longitudinal joints; int. dia. 3·00m

(T613)

			No
16/	1		1500
		16	500
			4100
			300
			3970
			610) 10370
			17No
			conv. ring 1No
			16No.

Ditto but with conv. ring for half the dia.

1	
	1

Explanatory Notes

All the details of the constituent components of the shaft rings would be contained in the relevant manufacturers catalogue or in the specification. The number of rings is calculated by dividing the total shaft depth by the nominal ring width. One of the rings has a corbel and this is measured separately. The diameter given is the internal diameter.

Pumping Station 2

Explanatory Notes

Preformed segmental lining (cont)

Precast conc. bolted rings; flanged; nom. ring width 610mm; max. piece weight 0·25t; 4 No O segments, 2 No T segments, 1 No key segment; 28 No 6½" x ¾" circle and cross bolts; 2 No 10½" x ¾" Key bolts; 3mm bituminous packing to longitudinal joints; intl. dia. 3.05m

(T613.1)

			No
3/1		610) 1830	
	3		3No

Pumping Station 2

				Explanatory Notes
			Lining ancillaries	
			Caulking with mat. do Spec. Clause 24.8 (T674)	There is no requirement to distinguish between longitudinal and circumferential caulking and they are therefore measured together providing the materials are the same, and they are the same size. It is not a requirement to state the size, but this should not be automatically discounted, particularly if there are various sized caulking grooves.
4/	10·37	62·22	(longitudinal caulking)	
6/	1·83	10·98		
11/16/	3·66	184·00	circumferential caulking)	
11/2/	3·05	19·17		
		276·37		
			Support and stabilization	
			Pressure grouting	No permanent support is required. It is considered unassessable to measure temporary support and M8 would have to be suitably amended in the Preamble. It is further considered that the number of sets of drilling and grouting plant should be left up to the Contractor's discretion and therefore item T831 would have to be taken out. The specification requires the grouting to be done in two stages. The first stage is to drill to a depth of 4m and then grout. The second stage is to drill a further 2m and grout.

Pumping Station 2

				Explanatory Notes
			Support and stabilization (cont)	
			Pressure grouting (cont)	
			face packers (T832)	The specification calls for 3 injection points per ring. As each injection point is injected twice, the number of face packers measured is double the number of injection points (M10)
2/17/3/	1	102	(large shaft)	
2/3/3/	1	18	(small shaft)	
		120		
			Drilling and flushing 100mm dia. in holes of dep. n.e. 5m (T834)	The length of the holes has to be stated in stages of 5m (A17). As the initial stage of drilling is 4m this is classified as not exceeding 5m.
17/3/	4·00	204·00	(large shaft)	
3/3/	4·00	36·00	(small shaft)	
		240·00		
			Re-drilling and flushing 100mm dia. in holes of dep. 5-10m (T835)	For the second stage of grouting, the total hole depth is 6m, i.e. stage 5-10m, and this is used for the classification of the re-drilling item, even though the re-drilling depth is only 4m. The depth of the re-drilling is the same as the initial drilling, with the second 2m stage being classed as 'initial' drilling in depth of hole 5-10m
17/3/	4·00	204·00	(large shaft)	
3/3/	4·00	36·00	(small shaft)	
		240·00		

Pumping Station 2

				Explanatory Notes
			Support and stabilization (cont'd)	
			Pressure grouting (cont'd)	
			Drilling and flushing 100mm dia. in holes of depth 5-10m (T834.1)	
17/3	2.00	102.00	(large shaft)	
3/3	2.00	18.00	(small shaft)	
		120.00		
			Injection of grout to Spec. Clause 24.9	The total tonnage of grout measured will be an estimate of the likely quantity based on the Engineer's knowledge of the prevailing ground conditions. The quantity inserted here is based on 1 tonne of dry material per ring.
			No of rings large shaft 17 small shaft 3 20 x 10 t/ring 200	
200				
	200			

Pumping Station 2

			Explanatory Notes
			ALL THE FOLLOWING WORK IN SHAFTS
		IN-SITU CONCRETE	Due to the fact that there are several different classifications of concrete involved, it is considered that it is more appropriate to measure the in-situ concrete and ancillaries in accordance with Classes F and G.
		Roun of conc.	
		Standard mix, ST3, OPC to B.S. 146; 20agg. to B.S. 882	Because the concrete is measured in Class F instead of Class T it would be prudent to state in a general heading that all the work is in shafts
		(F133)	
	1·70		
		1·70m³ (blinding)	
		Designed mix grade C20; OPC to B.S.146; 20agg to B.S. 882.	
	18·48		
	3·43	(F243)	
	30·60	(structure)	
Det			
10·77			
	1·04		
		42·78m³	

Pumping Station 2

Explanatory Notes

IN-SITU CONCRETE (CONT)

Placg. of mass conc.

Blinding; thness n.e. 150mm (F611)

π/	1·98		
	1·98		
	0·08	0·99	(large shaft)
π/	1·68		
	1·68		(small shaft)
	0·08	0·71	
		1·70	

Bases, footgs, pile caps & ground slabs thness ex. 500mm (F524)

π/	1·98		
	1·98		
	1·50		(bottom of large shaft)
		18·48	

Although the base to the large shaft has two layers of mesh in the top it is not considered 'reinforced' for the purposes of the concrete classification.

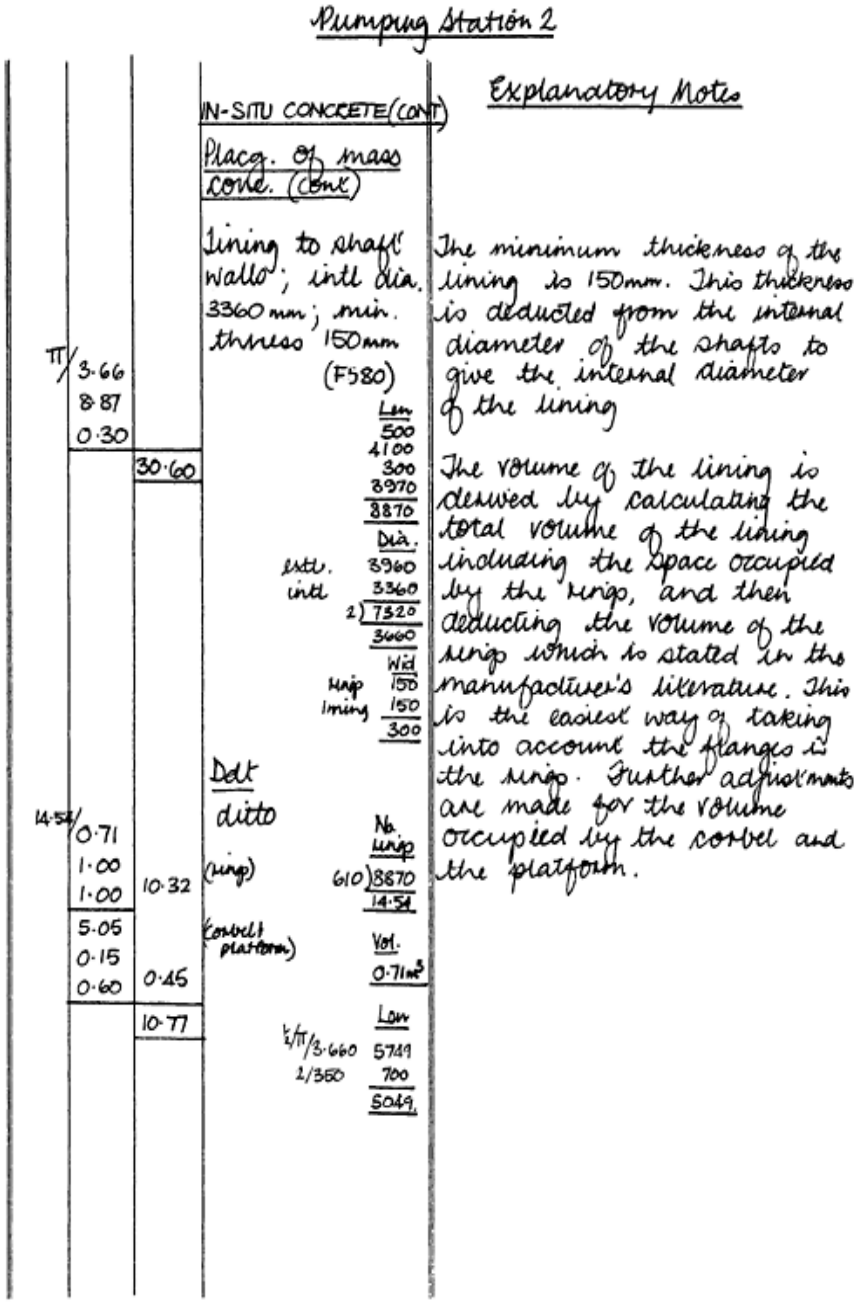
ditto 300-500mm (F523)

π/	1·68		
	1·68		(bottom of small shaft)
	0·40	3·55	
Delt			
π/	3·20		
	0·15		
	0·08	0·12	
		3·43	

A deduction is made from the volume where the bottom ring 'sits' in the top of the base because the cross sectional area exceeds $0.01 m^2$ (M1(d))

	dia
300	2850
400	700
	2150
	1830
	320
	400
	320
	80

dia
3350
3050
2)6400
3200



Pumping Station 2

IN-SITU CONCRETE (CONT)

Placg. of mass conc. (cont)

Lining to shaft walls; intl dia. 3360 mm; min. thkness 150mm (F580)

π/ 3.66
8.87
0.30
30.60

Len
500
4100
300
3970
3870

Dia.
extl. 3960
intl 3360
2) 7320
3660

Wid
Rnfp 150
lining 150
300

Dedt
ditto
(ring)

14.54/ 0.71
1.00
1.00
10.32

No.
rings
610) 3870
14.54

(corbel/platform)

5.05
0.15
0.60
0.45
10.77

Vol.
0.71m³

Len
π/3.660 5749
2/350 700
5049

Explanatory Notes

The minimum thickness of the lining is 150mm. This thickness is deducted from the internal diameter of the shafts to give the internal diameter of the lining

The volume of the lining is derived by calculating the total volume of the lining including the space occupied by the rings, and then deducting the volume of the rings which is stated in the manufacturer's literature. This is the easiest way of taking into account the flanges in the rings. Further adjustments are made for the volume occupied by the corbel and the platform.

Pumping Station 2

IN-SITU CONCRETE (CONT)

Placg. of mass conc. (cont'd)

Benching; 500 x 500 o/all; bott. of shaft (P580.1)

1/2/11	2.86			
	0.50			
	0.50	1.12		
Deft			dia	
1/2	0.60		3360	
	0.50		2/1/2/500 500	
	0.50	0.08	2860	(for cut out for ladder)
		1.04		

Explanatory Notes

The volume of the benching is calculated by multiplying its cross-sectional area by the mean diameter. The volume of the cut out for the ladder is deducted, but the overlap with the concrete plinths is not.

Pumping Station 2

			CONCRETE ANCILLARIES	Explanatory Notes
			Fmwk. type A fin.	
			Plane curved to 3.35m rad. in one plane 0.2-0.4m (G153)	The radius of the curved formwork must be stated in item descriptions (A4). As the formwork to the outside face of the base to the small shaft is exposed, it has a type A finish.
π/	3.35		(ext. face of base to small shaft)	
	0.32	3.37		
			Fmwk. type B fin.	
			Plane curved to 3.36m rad. in one plane ex 1.22m (G255)	Note that the measurements of the lining formwork does not include the area behind the benching, but does include for the area to the ladder cut out.
π/	3.36		(lining to large shaft) Lan 8870	
	8.37	88.36		
	0.60		(ladder bending cut out) 500	
	0.50	0.30	8370	
Ddt			(for corbel platform) ½π/3360 Lan 5278	
4.58			2/350 700	
0.60	2.76		4578	
		85.91		
			Plane curved to varying radii; min 2360; max 3360 (G260)	It is not clear whether curved formwork which is also the upper surfaces of concrete should be so described. It is considered that it is not necessary in this particular case, although it should be made clear in the Preamble.
π/	2.86		(benching) Hid	
	0.71	6.38		
Ddt			(for ladder cut out) $x^2 = 500^2 + 500^2$	
0.60			$x = 707$	
0.70	0.42			
		5.96		

Pumping Station 2

			Explanatory Notes
		CONCRETE ANCILLARIES (CONT)	
		Fwwk. type B fin (cont)	
2/ 1/ 0.50		Plane. vert. average width 0.25m (G243)	This is not strictly the correct method of measuring this item, but the quantity is so small that it is considered to be more applicable than dividing the item into the various width classifications which could give inordinately high quantities.
0.50		(sides of cut out to benching)	
	0.25		
		Reinforcement	
		Fabric to B.S. 4483 ref. A142. (G562)	The area of fabric is the net area with no allowance for fabric in laps (M9).
2/π/ 1.98		(base to large shaft)	
1.98			
	24.64		

Pumping Station 2

CONCRETE ANCILLARIES (CONT)

Concrete Accessories

Fin. of top surfs; steel trowel fin.

π/ 1·18			(G812)
1·18	4·37	(base to large shaft)	radius
0·60		(ladder cut out)	2)2360
0·50	0·30		1180
	4·67		

C. & S. (1:4) screed; av. 75mm th. with steel trowel fin. (G815)

π/ 1·53		radius
1·53		2)3050
	7·36	1525

Inserts

80mm dia. pipe through precast conc. shaft linings; proj. both sides (supply incl. elsewhere) (G832)

1		(drain i small shaft)
	1	

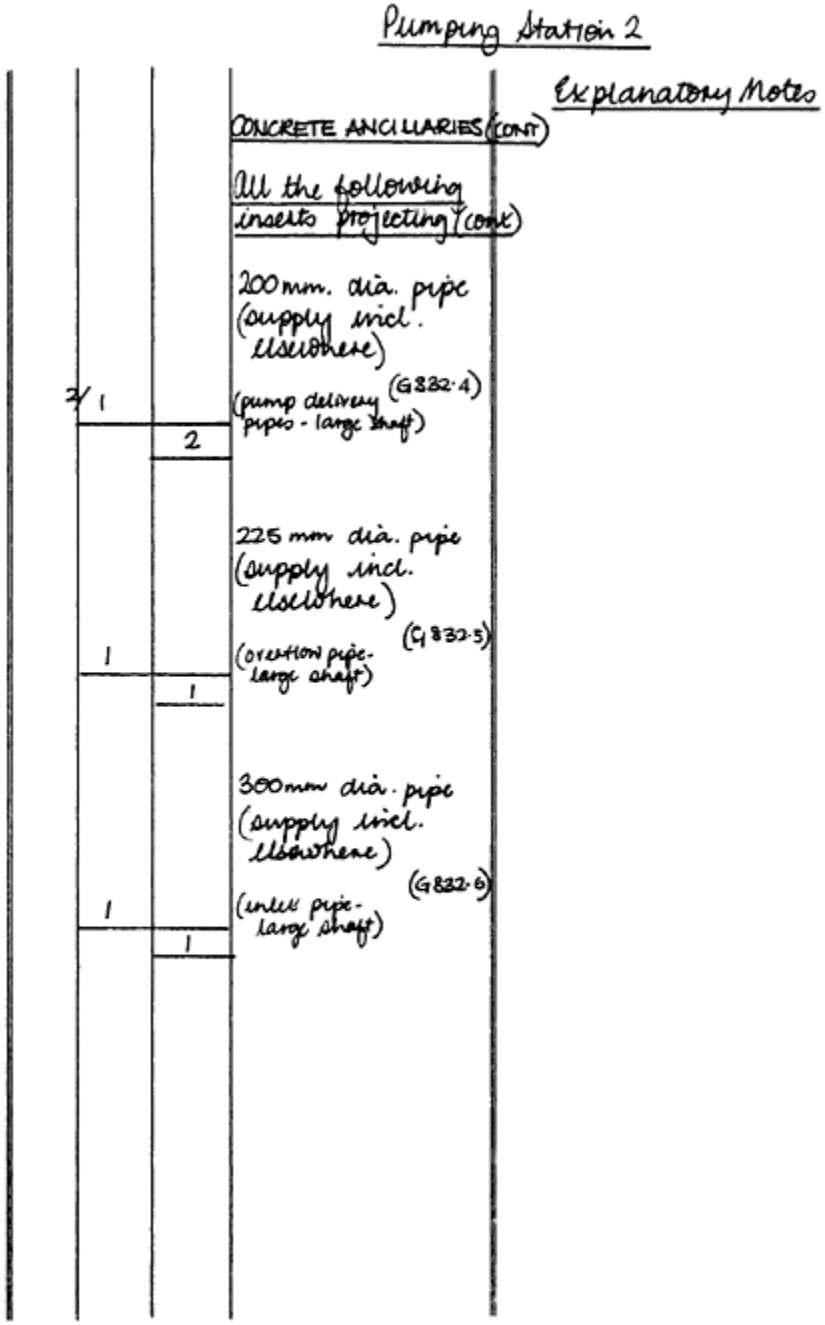
Explanatory Notes

The specification calls for a steel trowel finish to the base of the large shaft. No deduction is made for the support plinths as their plan area does not exceed 0·5 m² (M14)

AIB requires the materials, thickness and surface finish of applied finishes to be stated. No deduction is made for the sump as this is less than 0·5m². The forming of the sump could be measured separately or as in this case Coverage Rule C6 could be extended to include it.

Pumping Station 2

			Explanatory Notes
		CONCRETE ANCILLARIES (CONT)	
		Inserts (cont)	
		200mm dia. pipe through precast conc. shaft lining; proj. both sides (supply incl. elsewhere) (G832.1)	One area not covered by Class T is the work involved in breaking through linings for incoming pipes and similar inserts. It is therefore necessary to create new items which inform the Contractor of the work involved.
3/1	3	(pump pipes - small shaft)	
		All the following inserts projecting both sides of precast conc. shaft segments with in-situ conc. lining	
		100mm dia x 900mm long U.P.V.C cable ducts (G832.2)	The supply and fixing of the ducts is included in this item (C7)
3/1	3	(large shaft)	
		80mm dia. pipe; (supply included elsewhere) (G832.3)	
1	1	(drain - large shaft)	


Pumping Station 2
Explanatory Notes
CONCRETE ANCILLARIES (CONT)
All the following inserts projecting (cont)
200mm. dia. pipe (supply incl. elsewhere)
2/1
(pump delivery pipes - large shaft) (G832·4)
2
225 mm dia. pipe (supply incl. elsewhere)
(G832·5)
1
(overflow pipe - large shaft)
1
300mm dia. pipe (supply incl. elsewhere)
(G832·6)
1
(inlet pipe - large shaft)
1

Pumping Station 2

PRECAST CONCRETE

Slabs; cone. designed mix grade C30, OPC to B.S. 146; 10 agg to BS. 882.

Areas

Large cover slab

T/ 1·98
1·98
12·31 m²

Small cover slab

T/ 1·68
1·68
8·86 m²

platform

½/T/ 1·83
1·83 5·24

less
0·35
1·83 0·64
4·62 m²

Weights

12·31
0·40
2·40 t/m²
11·82 t

8·86
0·40
2·40 t/m²
8·51 t

4·62
0·30
2·40 t/m²
3·33 t.

Explanatory Notes

At requisite the specification of concrete to be stated in items for precast concrete. The second and third divisions of the slab's classification require the area and weight of the slabs to be stated in bands as classified. These only have to be approximate, as the Contractor will ascertain from the drawings the exact nature of the work involved.

Pumping Station 2

			Explanatory Notes
		PRECAST CONCRETE (CONT)	
		Slabs (cont)	
1	1	Roof slab to large shaft; area 4-15 m²; weight 10-20 t; thkness 400 mm (H537)	A1 requires the position in the works of each unit to be stated. The units do not have mark or type numbers and these cannot be stated in accordance with A2.
1	1	Roof slab to small shaft; area 4-15 m²; weight 5-10 t; thkness 400 mm (H536)	
1	1	Intermediate platform to large shaft; area 4-15 m²; weight 2-5 t; thkness 300 mm (H535)	

Pumping Station 2

Explanatory Notes

It was recommended in the text that the measurement of pipelines is considered on an individual basis for each contract. The majority of the pipes and fittings in this example are in the shafts but there are the lengths between the shafts to take into account. To try and measure these pipes as 'in trenches' would cause undue complication because the fittings into the chamber would be then paid 'extra over' the pipe in the trench and paid 'full value' for the length in the chamber. In this instance the recommended procedure is to measure the excavation for all three pipes separately and to enumerate all the pipes and fittings regardless of length as 'not' in trenches. It would be necessary to state the measurement philosophy adopted in the Preamble.

Pumping Station 2

		EARTHWORKS TO PIPEWORK	**Explanatory Notes**
		Pipe tr. exc. ac dwg PS2/GSN/1 mat. other than topsoil, rock or artificial hard mat.; max dep. 2-5m (E425)	There is no classification for pipe trench excavation and backfilling so these are rogue items. This is a slight overmeasurement as the length is taken as the length of the UPVC drain which lies between the inside faces of the chamber.
4·75		750	
1·80		3000	
2·70		1000	
	23·09	4750	
		↓	
		Disposal; backfilling around pipes (E532)	

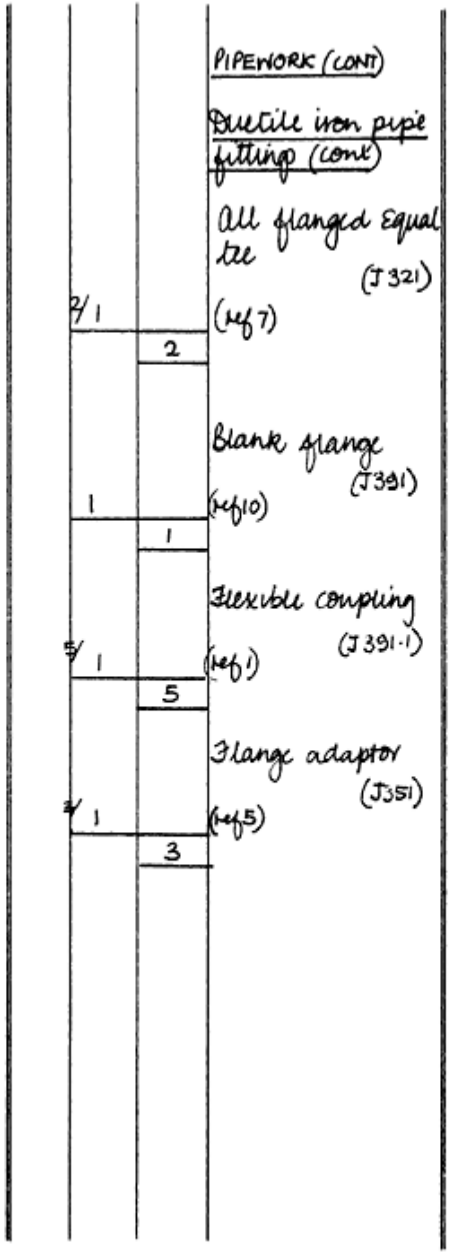
Pumping Station 2

		PIPEWORK - FITTINGS AND VALVES; NOT IN TRENCHES	Explanatory Notes
		Ductile iron pipe fittings; B.S. 4772; flanged joints; nom. bore 200mm; as Spec. Clause 13.1	Whilst all the fittings are scheduled, the prudent taker off would still check the fittings off the drawing as they were measured.
1		Flanged spigot pipe 1200mm long (J381) (ref 3)	Although the fittings are described as having flanged joints, the first fitting has a spigot one end and this tells the estimator that this end does not have a flanged joint. This end has a flexible coupling which is measured separately and the cost of the joint to the spigot end is therefore included elsewhere.
	1		
		Flanged spigot pipe 250mm long (J381.1)	
1		(ref 6)	
	1		
		Flanged spigot pipe 1300mm long (J381.2)	
3/ 1		(ref 13)	
	2		
		Double flanged pipe 2000mm long. (J381.3)	
6/ 1		(ref 14)	
	6		

Pumping Station 2

		PIPEWORK (CONT)	Explanatory Notes
		Ductile iron pipe fittings (cont)	
2/ 1		Double flanged pipe 605mm long (J381.4) (ref 15)	
	2		
2/ 1		Double spigot pipe 2900mm long (J381.5) (ref 17)	Although this fitting does not have flanged joints at either end it is still classed as such for convenience. The estimator will know that the flexible couplings are measured separately and that he does not have to allow for joints for this fitting.
	2		
3/ 1		Double flanged 90° bend (J311) (ref 9)	
	3		As both these bends are less than 300mm it is not necessary to describe them as vertical.
2/ 1		Double flanged 90° duckfoot bend (J311.1) (ref 16)	
	2		

Pumping Station 2

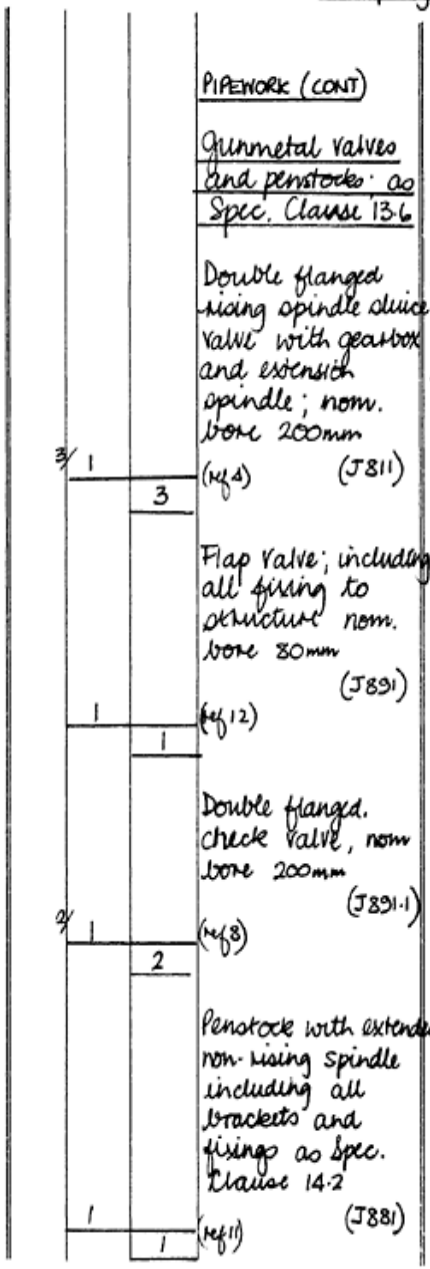


Explanatory Notes

Pumping Station 2

		PIPEWORK (CONT)	Explanatory Notes
		U.P.V.C pipe fittings; B.S. 4660; nom. bore 80mm	As the flexible couplings are measured separately it is not necessary to state the nature of the joints in the item descriptions
1		double spigot pipe 750mm long. (J481) (ref 18)	
	1		
1		double spigot pipe 3000mm long (J481.1) (ref 19)	
	1		
1		double spigot pipe 1000mm long (J481.2) (ref 20)	
	1		
2/ 1		Flexible coupling (J491.2) (ref 2)	
	2		

Pumping Station 2.



PIPEWORK (CONT)

Gunmetal valves and penstocks: as Spec. Clause 13.6

Explanatory Notes

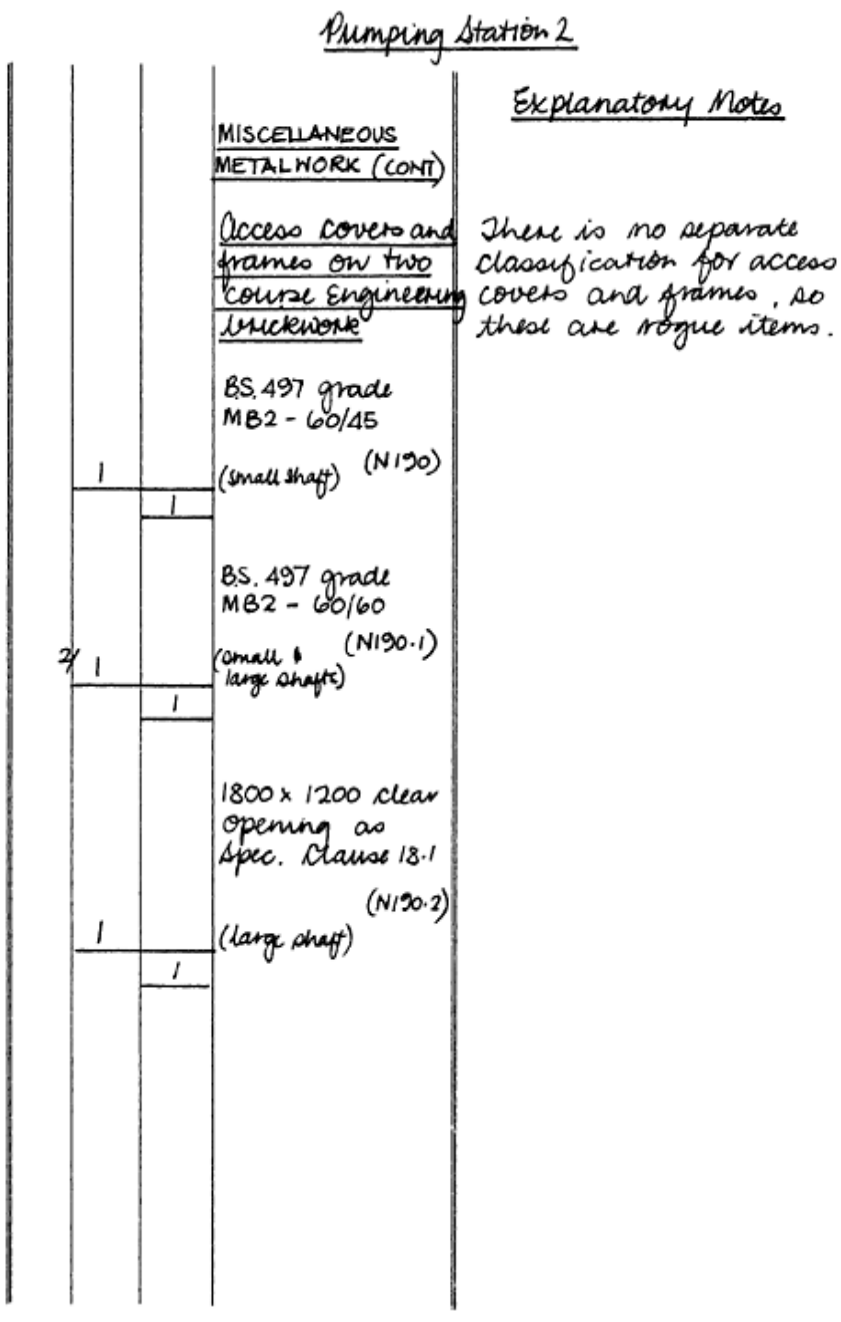
3/ 1	3	Double flanged rising spindle sluice valve with gearbox and extension spindle; nom. bore 200mm (ref 4) (J811)	The specification would have complete details of the valves and penstocks, and reference is made to the relevant clause: no attempt is made to describe them fully in the description.
1	1	Flap valve; including all fixing to structure nom. bore 80mm (J891) (ref 12)	
2/ 1	2	Double flanged. check valve, nom bore 200mm (J891.1) (ref 8)	
1	1	Penstock with extended non-rising spindle including all brackets and fixings as Spec. Clause 14.2 (J881) (ref 11)	

Pumping Station 2.

			PIPEWORK - SUPPORTS AND PROTECTION	Explanatory Notes
			Concrete stools and thrust blocks; concrete grade C20, OPC to B.S. 146, 20agg to BS 882; unreinforced Vol. 1·1 0·4 0·25 0·11 m³	A5 requires the specification of concrete to be stated and whether it is reinforced. If there were several reinforced stools within the same volume classification, it would be necessary to itemise them individually if their reinforcement requirements were different.
			Vol. 0·1 - 0·2 m³. nom bore 200mm	
2	1		(large shaft) (L721)	
		2		
			Other isolated pipe supports; as dwg DT/1	Although A6 states that the principal dimensions and materials should be stated in item descriptions, the reference to the drawing would in effect be giving the same information
			height n.e. 1m. nom. bore 200mm	
2/3	1		(large shaft) (L811)	
		6		

Pumping Station 2

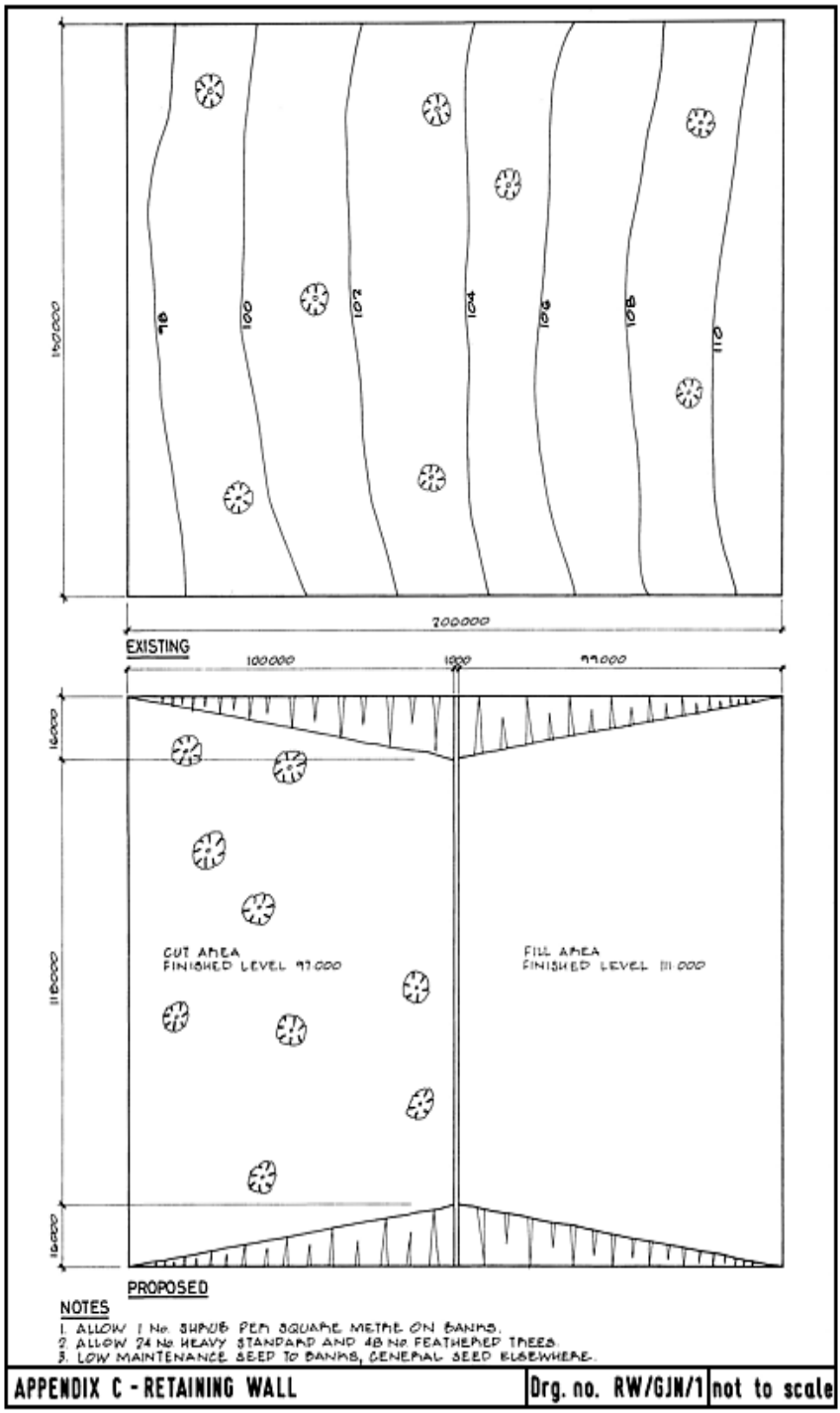
		MISCELLANEOUS METALWORK	**Explanatory Notes**
1		Ladders; galvanised mild steel as Spec. Clause 18.6 & drwg DT/2 with safety cage; ladder 5700m long incl. all fixing. (N130)	The unit of measurement for ladders in Class N is linear metres, but this ladder has a safety cage for part of its length which would mean measuring it as two items, one with and one without the cage. It is considered that enumerating the ladder stating the length is a fairer method of measurement.
	1		
3.20		Handrail as Spec. Clause 18.9 incl. all fixings (N140)	
	3.20		
2/ 1		Safety chain as Spec. Clause 18.8; net. length 1300mm including all fixings (N190)	There is no separate classification for safety chains and this is a rogue item. They could have been measured in linear metres as an alternative to enumeration.
	2		

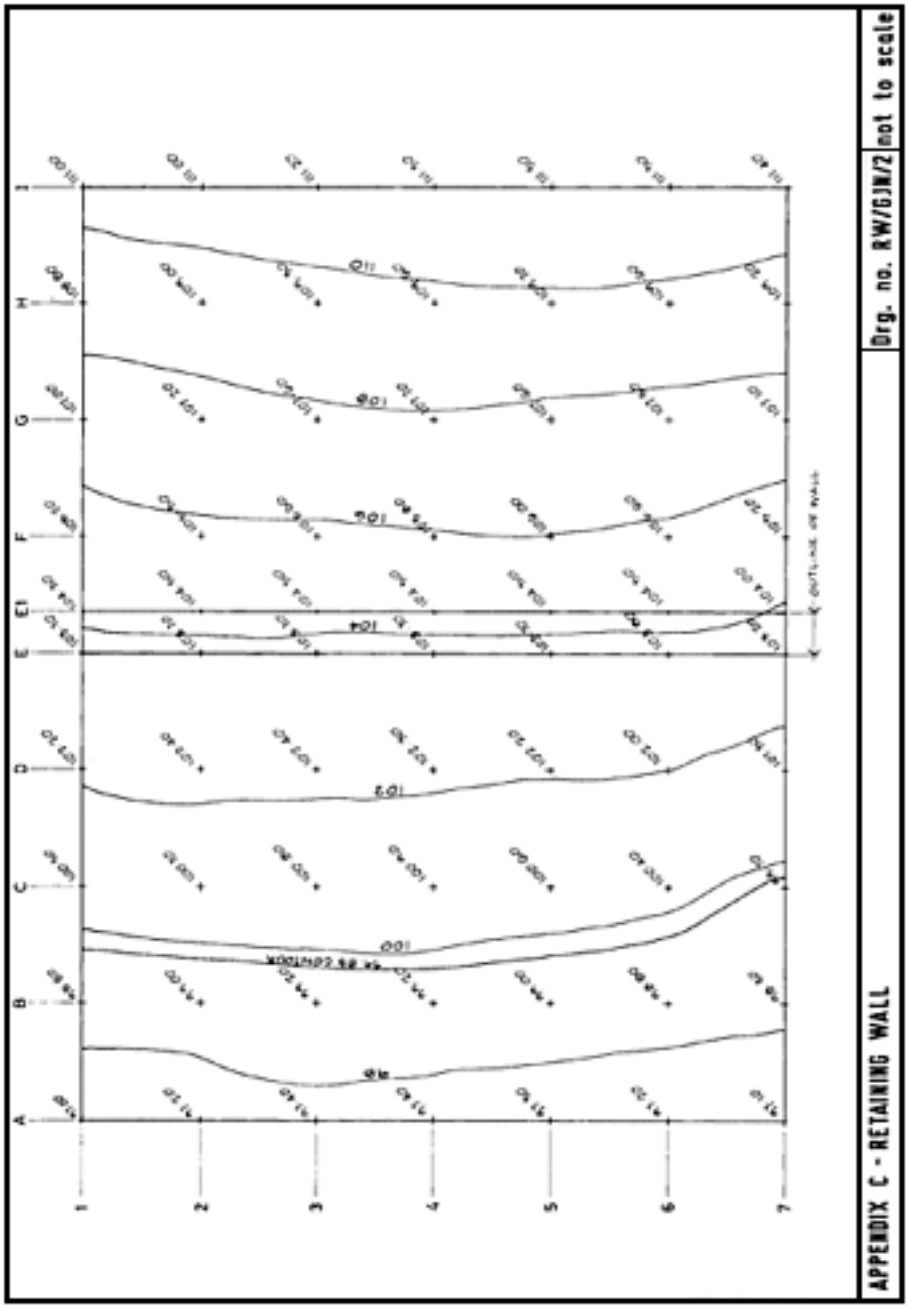

Pumping Station 2
Explanatory Notes
MISCELLANEOUS METALWORK (CONT)
Access covers and frames on two course Engineering brickwork
There is no separate classification for access covers and frames, so these are rogue items.
BS. 497 grade MB2 - 60/45
(small shaft) (N190)
1
1
BS. 497 grade MB2 - 60/60
(small & large shafts) (N190.1)
2/ 1
1
1800 x 1200 clear opening as Spec. Clause 18.1
(N190.2)
(large shaft)
1
1

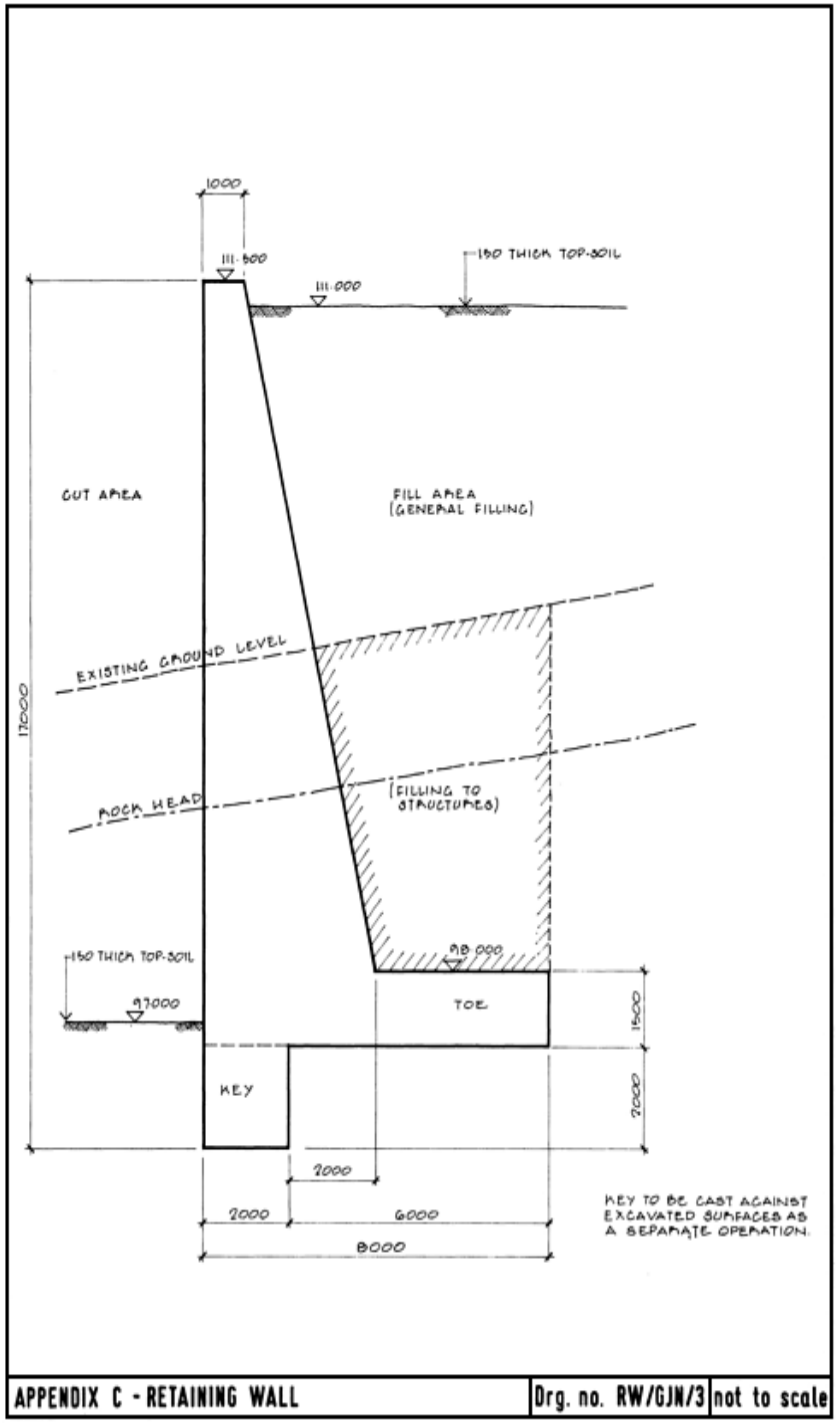
Pumping Station 2

			MISCELLANEOUS METALWORK (CONT)	Explanatory Notes
			Heavy duty surf. box incl casting in 400 x 400 x 300mm deep concrete	The concrete surround is given in the item description, which is considered more appropriate than measuring it in detail in accordance with Classes F & G.
			100mm dia. clear opng. (for valve spindle) (J190.3)	
3	1	3		
	1	1		
		4		

Chapter 5
RETAINING WALL


96
100
102
104
106
108
110
150000
200000
EXISTING
100000
1000
99000
16000
118000
16000
CUT AREA
FINISHED LEVEL 97.000
FILL AREA
FINISHED LEVEL 111.000
PROPOSED
NOTES
1. ALLOW 1 No. SHRUB PER SQUARE METRE ON BANKS.
2. ALLOW 24 No HEAVY STANDARD AND 48 No FEATHERED TREES.
3. LOW MAINTENANCE SEED TO BANKS, GENERAL SEED ELSEWHERE.
APPENDIX C - RETAINING WALL
Drg. no. RW/GJN/1
not to scale


APPENDIX C - RETAINING WALL
Drg. no. RW/GJK/2
not to scale



APPENDIX C - RETAINING WALL	Drg. no. RW/GJN/3	not to scale

Retaining Wall

Explanatory Notes

Drawing Numbers RW/GJN/1
RW/GJN/2
RW/GJN/3

The following example shows a rectangular virgin field with a reasonably steep gradient. The example involves the construction of a major concrete retaining wall across the middle of the site to enable one half of the area to be filled to a constant level whilst lowering the other half.

It is assumed that the site will have a constant 100mm of good quality topsoil together with various old trees which will have to be removed. Rock level is 3m below original ground level. This example deals only with Class E: Earthworks, the removal of the trees and the retaining wall itself would be measured under classes D, F and G.

The measurement of Earthworks invariably produces large amounts of waste calculations. If these are particular to any one item or group of items it is recommended that they are done adjacent to the item of work to which they apply as in this particular example.

Retaining Wall

Explanatory Notes

Alternatively, large amounts of general calculations may be done at the beginning of the take off with relevant annotation as to how and to which sections it applies.

For the purposes of measurement the site is divided into the following

1. Topsoil strip.
2. Excavation for the retaining wall.
3. Excavation over cut area.
4. Excavation ancillaries.
5. Filled area.
6. Topsoil and Landscaping.

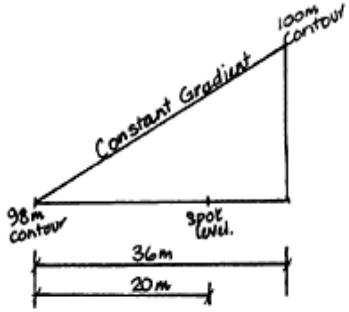
Retaining Wall

			Explanatory Notes
		1. TOPSOIL STRIP	
		gen. exc; topsoil max. dep. n.e 0·25m; exc. surf U/S topsoil (E411)	It is not necessary to state the commencing surface as it is also the original surface. The excavated surface and hence the maximum depth is different depending upon whether the topsoil is in the cut or filled area. However due to the nature of the work it is felt that it would be more helpful to state the excavated surface as underside of topsoil and therefore give the maximum depth as the depth of the topsoil in accordance with paragraph 5.21.
200·00			
150·00			
0·10			
	3000·00		
			The original site survey drawing RW/GJN/1 had level information by way of contours. This has been processed into a 25 metre grid of levels by interpolation as follows:-

Retaining Wall

Explanatory Notes

1. TOPSOIL STRIP (CONT)



The height of the spot level is derived by calculating the vertical rise per metre of horizontal distance between the contours and multiplying it by the distance of the spot height from the lower contour. Add this value to the value of the lower contour to give the spot height e.g.

$$\text{spot height} = \left(\frac{2}{36} \times 20\right) + 98$$

$$= \underline{99.111}$$

Retaining Wall

Explanatory Notes

2. RETAINING WALL
EXCAVATION

			Avge G.L.	
Level				
E1	1/103700		103700	It is an express requirement
E2	2/103700		207400	of the Specification to
E3	2/103700		207400	carry out the bottom 'key'
E4	2/103700		207400	excavation as a separate
E5	2/103700		207400	operation and concrete
E6	2/103800		207600	immediately against the
E7	1/103200		103200	excavated surface and
E11	1/104300		104300	this is deemed to be a
E12	2/104500		209000	separate stage for
E13	2/104500		209000	excavation under M5. The
E14	2/104500		209000	first part of the excavation
E15	2/104500		209000	is from the stripped level
E16	2/104500		209000	to the underside of the
E17	1/104000		104000	toe.
		24)	2497400	
			104058	This is the calculation of
Less	topsoil		100	the average ground level
Average level after topsoil strip			103958	after topsoil strip over
				the retaining wall area.
				Drawing RW/GJN/2 has
				the outermost outline of
			Formation	the foundations shown
top of toe			98000	together with the
toe thness			1500	interpolated levels, (see the
			96500	calculation of the average
				ground level for the
				lower side of the site
				for an explanation of
				the weighting of the levels)

Retaining Wall

Explanatory Notes

2 RETAINING WALL

EXCAVATION (CONT)

Max dep of excavtn

highest spot lw. 104600
topsoil 100
104400
formn lw. 96500
7900
ie. 5-10m

The maximum depth of the excavation must be stated and is calculated in accordance with paragraph 5.21

Overall av. dep of excav

av. lw after topsoil strip 103968
formn lw. 96500
7458

This is the calculation of the average overall depth of the excavation and will include excavation of natural material and rock. It is necessary to calculate the average depth of both in order to measure both separately.

Av. dep of natural materia

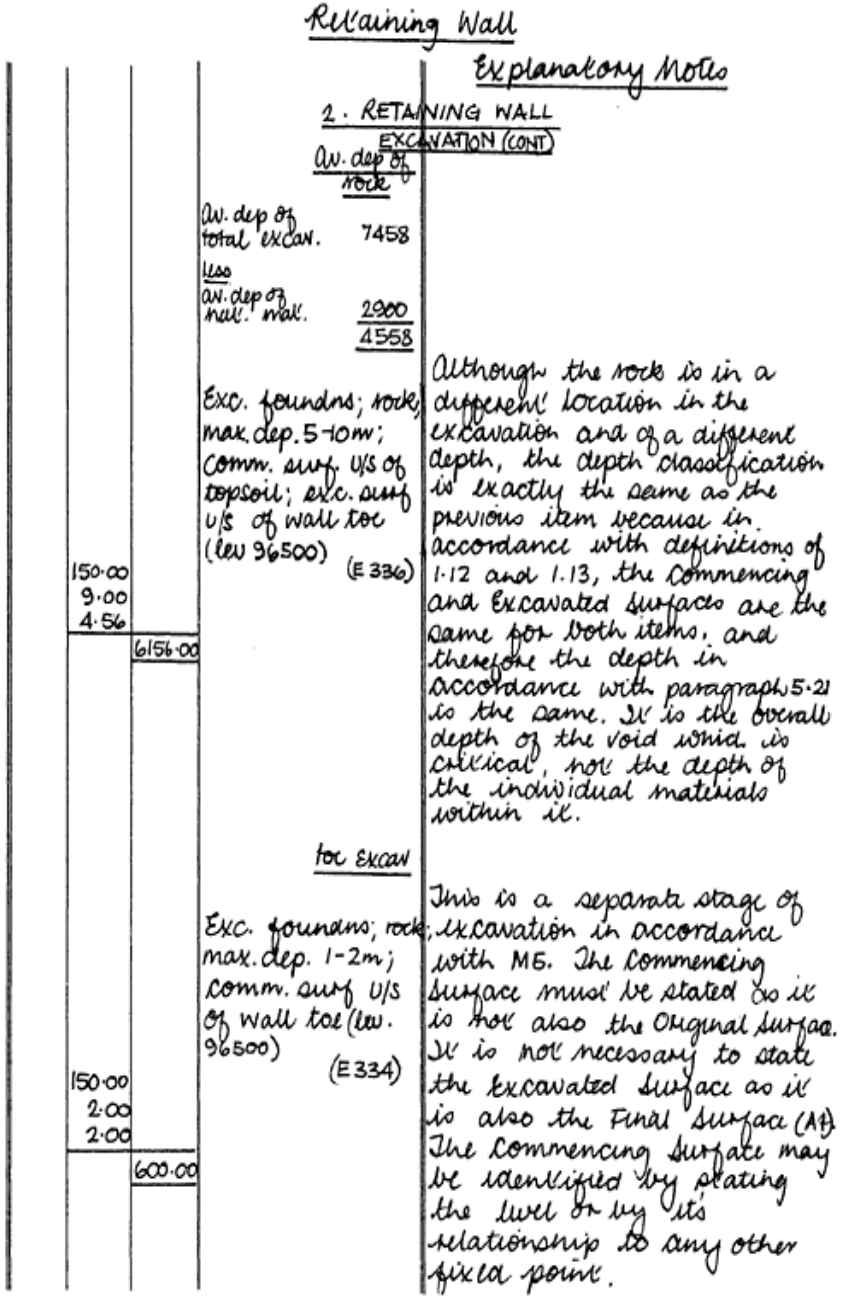
overall av. dep. g.l to top of rock 3000
Less topsoil 100
2900

The commencing surface in this case is the underside of the topsoil which is not also the Original surface and therefore must be stated. The Excavated surface is bottom of the first stage of excavation ie. underside of the toe. As this is not also the Final surface it also must be stated (A4). It is not necessary to state the type of material as it is deemed to be natural material other than topsoil, rock or artificial hard material (D1).

Exc. foundns; max dep 5-10m; comm. surf. u/s of topsoil; exc surf u/s of wall toe (lw 96500)

(E 326)

150.00	
9.00	
2.90	
	3915.00



Retaining Wall

Explanatory Notes

2. RETAINING WALL

EXCAVATION (CONT)

Av. dep of rock

Av. dep of total excav. 7458

Less

Av. dep of nail. max. 2900

4558

Exc. foundns; rock; max. dep. 5-10m; comm. surf. U/S of topsoil; exc. surf U/S of wall toe (lev 96500) (E336)

150.00
9.00
4.56

6156.00

Although the rock is in a different location in the excavation and of a different depth, the depth classification is exactly the same as the previous item because in accordance with definitions of 1.12 and 1.13, the commencing and excavated surfaces are the same for both items, and therefore the depth in accordance with paragraph 5.2) is the same. It is the overall depth of the void which is critical, not the depth of the individual materials within it.

toe excav

Exc. foundns; rock; max. dep. 1-2m; comm. surf U/S of wall toe (lev. 96500) (E334)

150.00
2.00
2.00

600.00

This is a separate stage of excavation in accordance with M5. The commencing surface must be stated so it is not also the original surface. It is not necessary to state the excavated surface as it is also the Final Surface (AF). The commencing surface may be identified by stating the level or by its relationship to any other fixed point.

Retaining Wall

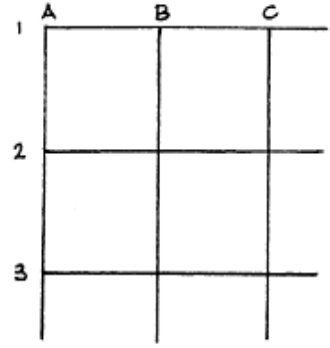
Explanatory Notes

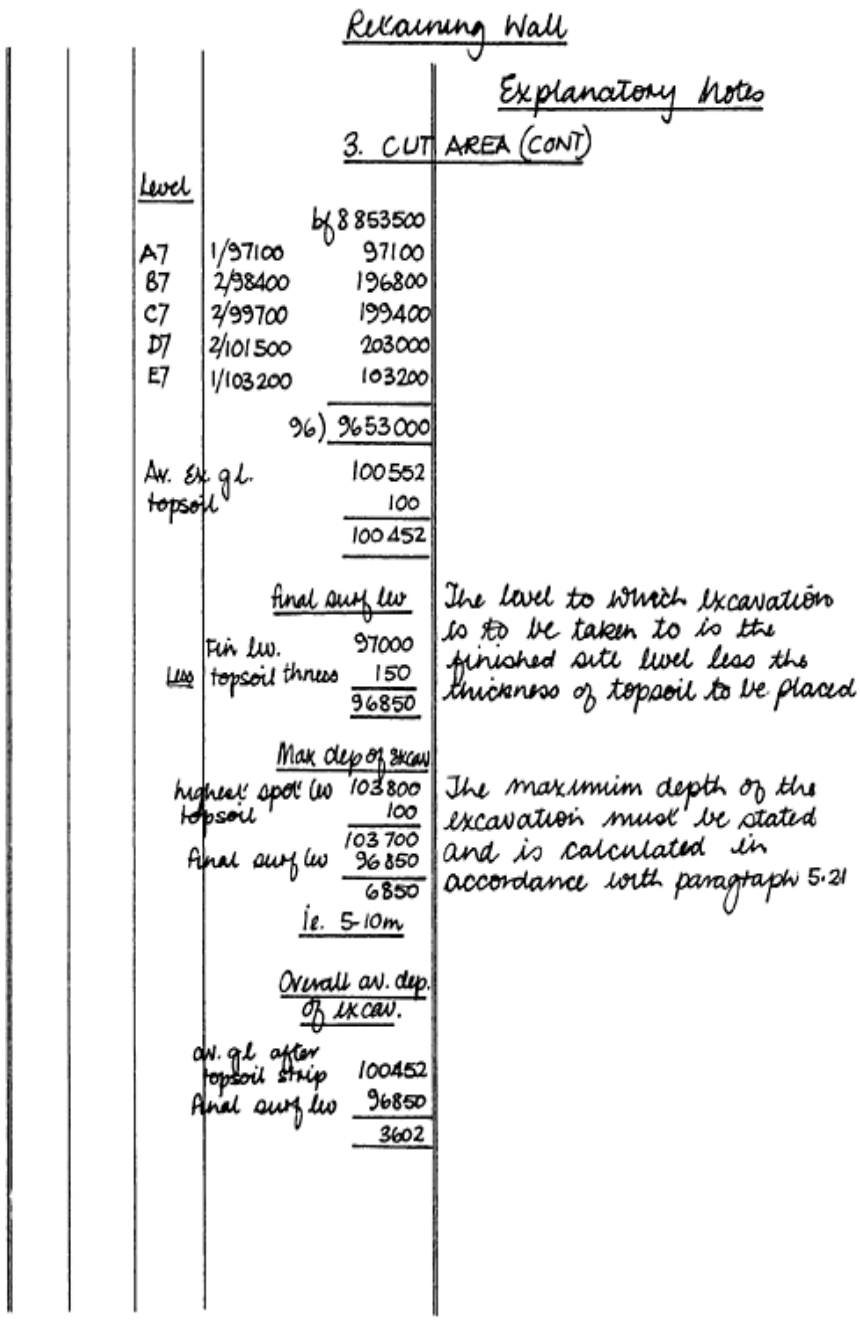
3 CUT AREA

Level		Av. gl after topsoil strip
A1	1/97000	97000
B1	2/98800	197600
C1	2/100500	201000
D1	2/102200	204400
E1	1/103700	103700
A2	2/ 97200	194400
B2	4/ 99000	396000
C2	4/100700	402800
D2	4/102400	409600
E2	2/103700	207400
A3	2/ 97400	194800
B3	4/ 99200	396800
C3	4/100800	403200
D3	4/102400	409600
E3	2/103700	207400
A4	2/ 97400	194800
B4	4/ 99200	396800
C4	4/100900	403600
D4	4/102300	409200
E4	2/103700	207400
A5	2/ 97300	194600
B5	4/ 99000	396000
C5	4/100600	402400
D5	4/102200	408800
E5	2/103700	207400
A6	2/ 97200	194400
B6	4/ 98800	395200
C6	4/100400	401600
D6	4/102000	408000
E6	2/103800	207600
		Σ 8853500

This is the calculation of the average ground level of the lower side of the site after topsoil strip.

The grid of levels extends from A-E / 1-7. The corner levels (A1) only have on sphere or 'square' of influence and are used only once. The side levels (B1, C1) have two spheres or 'squares' of influence and are used twice and the internal levels have four spheres or 'squares' of influence and are used four times. The total is then divided by the total number of spheres or 'squares' of influence to give the average level.





Retaining Wall

Explanatory Notes

3. CUT AREA (CONT)

Level		
		bf 8 853500
A7	1/97100	97100
B7	2/98400	196800
C7	2/99700	199400
D7	2/101500	203000
E7	1/103200	103200
		96) 9653000
Av. Ex. gl.		100552
topsoil		100
		100452

final surf lev

Fin lev. 97000
Less topsoil thness 150
96850

The level to which excavation is to be taken to is the finished site level less the thickness of topsoil to be placed

Max dep of excav

highest spot lev 103800
topsoil 100
103700
final surf lev 96850
6850

ie. 5·10m

The maximum depth of the excavation must be stated and is calculated in accordance with paragraph 5.21

Overall av. dep. of excav.

av. gl after topsoil strip 100452
final surf lev 96850
3602

Retaining Wall

Explanatory Notes

3. CUT AREA (CONT)

Gen. exc.; max dep. 5-10m; comm surf U/S of topsoil (E426)

100·00
150·00
3·60
54000·00

It is not necessary to state the Excavated Surface as this is also the Final Surface. The Commencing Surface must be stated as it is not also the Original Surface (A4)

This quantity is overmeasured as it also contains the rock excavation which has to be measured separately and because it also assumes that the sides of the excavation are vertical when in fact they are sloping. Unlike the excavation for the foundations to the wall itself where the natural material and rock were measured separately, here it is easier if the total excavation is measured as if it were all natural material and the rock then measured and deducted from the gross quantity of natural material.

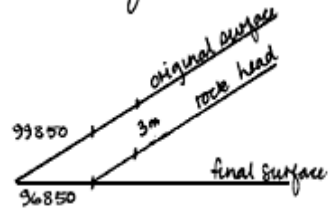
Retaining Wall

Explanatory Notes

3. CUT AREA (CONT)

Level		Av. rockhead lev.
C1	1½/100500	150750
C2	3/100700	302100
C3	3/100800	302400
C4	3/100900	302700
C5	3/100600	301800
C6	2½/100400	251000
C7	1/99700	99700
D1	2/102200	204400
D2	4/102400	409600
D3	4/102400	409600
D4	4/102300	409200
D5	4/102200	408800
D6	4/102000	408000
D7	2/101500	203000
E1	1/103700	103700
E2	2/103700	207400
E3	2/103700	207400
E4	2/103700	207400
E5	2/103700	207400
E6	2/103800	207600
E7	1/103200	103200
	53)	5407150
		102022
Less dep to rock head		3000
		99022

As stated, the previous excavation item will include rock excavation for which adjustment will have to be made and it is therefore necessary to determine the area and depth over which the rock excavation will occur. In our example the rock head is 3 metres below original ground level. If we take a section through this area we



need to determine the line at which the final surface level intersects the rock head. This is most easily done by adding 3m onto the final surface level (96850) and plotting this contour on the original ground levels plan by interpolation (See RN/GSN/2). The area bounded by the 99850 contour and the retaining wall is the plan area of rock.

Retaining Wall

Explanatory Notes

3 CUT AREA (CONT)

		Av. dep of rock	The average rock depth is calculated by deducting the final surface from the average rock level as shown opposite.
		Av. rock lev	99022
		Fin. surf	96850
			2172
		Gen exc; rock; max. dep. 5-10m; comm. surf u/s of topsoil (E436)	The easiest method of calculating the rock area is to divide it up into equal 25m strips as on the grid and measure the area of each.
63·00			
25·00			
2·17	3417·75		
		$	
65·00			
25·00			
2·17	3526·25	Dat	
		Gen exc; max. dep 5-10 m; comm surf u/s of topsoil a.b.d. (E426)	This is the deduction of the rock volume from the total quantity of the general excavation in natural materials a.b.d. stands for 'as before described' and shows that the item has already been measured.
67·00			
25·00			
2·17	3634·75		
66·00			
25·00			
2·17	3580·50		
62·00			
25·00			
2·17	3363·50		
55·00			
25·00			
2·17	2983·75		
	20506·50		

Retaining Wall

Total vol of both pyramids

$2 \times \frac{1}{3} \times \frac{1}{2} \times 16 \times 6.50 \times 100$

$= 3467 m^3$

Total vol. of rock within both pyramids

$2 \times \frac{1}{2} \times (8.90 \times 3.50 \times 54.00) +$
$2 \times \frac{1}{3} \times (0.5 \times 7.1 \times 3.50 \times 54.00)$

$= 2130 m^3$

∴ Vol. of mat. max.
3467.00
2130.00
1337.00 m^3

Det
Gen exc; max. dep 5-10m; comm. surf U/S topsoil a.b.d.
(E426)

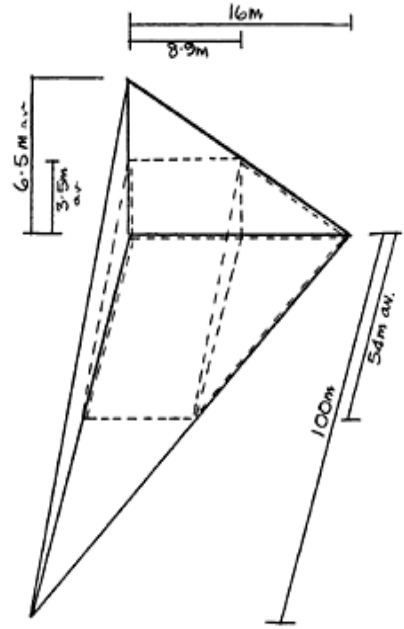
1337.00
1.00
1.00
1337.00

Det
Gen. exc; rock; max dep. 5-10m; comm surf. U/S topsoil a.b.d.
(E436)

2130.00
1.00
1.00
2130.00

Explanatory Notes

Adjustment must also be made to the general excavation in natural material quantities for the two sloping banks on either side which are not excavated. These are in the rough shape of a triangle based pyramid as follows:-



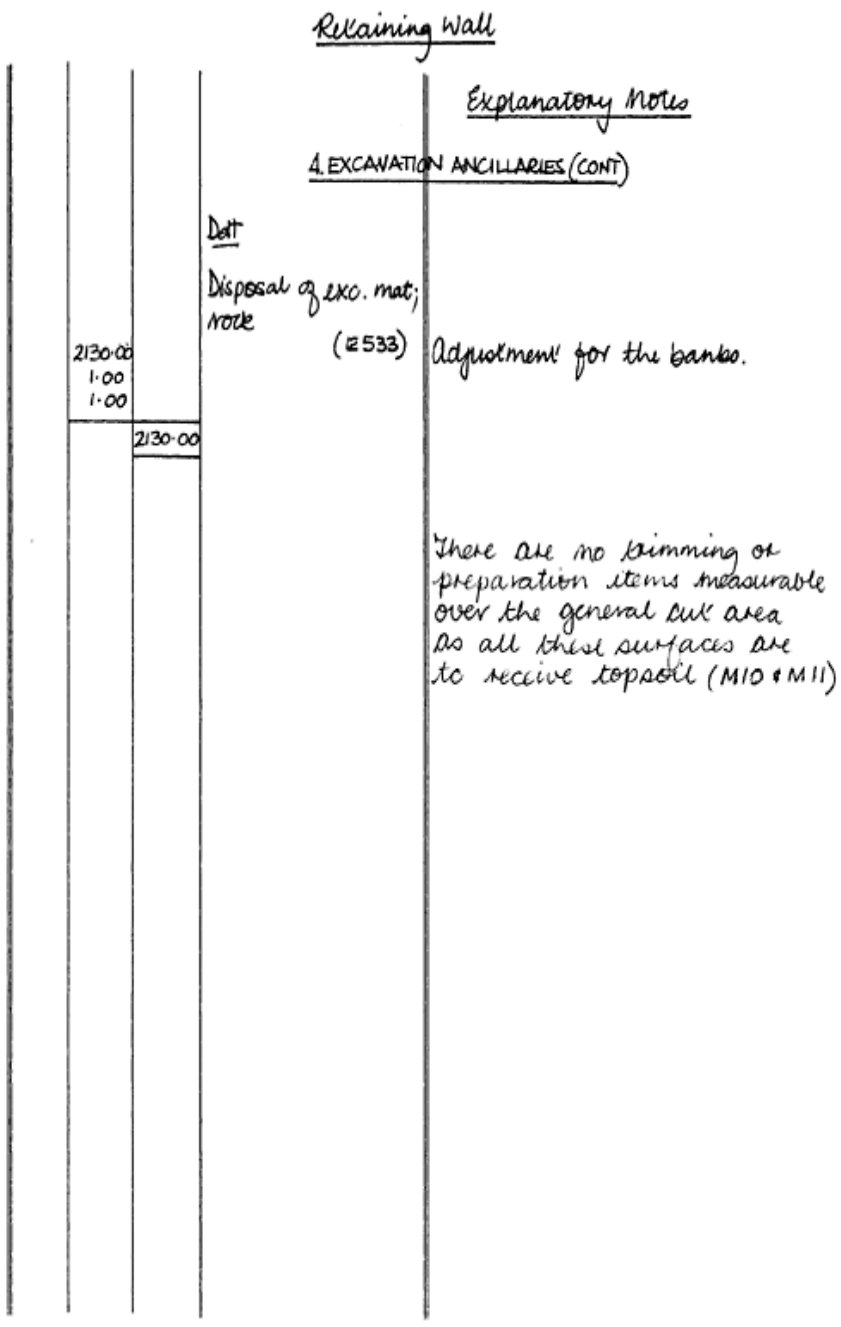
With the volume of rock being enclosed by the dotted lines.

Retaining Wall

Explanatory Notes

4. EXCAVATION ANCILLARIES

		Add	Bottom of retaining wall excavation. No preparation is measurable over the general cut area as it is to receive topsoil (M11)
		Prep. of surfs; rock (E 523)	
150.00 9.00			
	1350.00		
		Prep. of surfs; rock; vert. (E 523.1)	Either side of key where the concrete is cast against excavated surfaces.
2/150.00 2.00			
2/9.00 2.00		(ends)	
	636.00		
		Disposal of exc. mat; rock (E 533)	In our example, the rock material is deemed not to be suitable for the general filling behind the retaining wall and therefore removed from site
150.00 9.00 4.56	6156.00	(wall findns)	
150.00 2.00 2.00	600.00		
63.00 25.00 2.17	3417.75		
65.00 25.00 2.17	3526.25		
67.00 25.00 2.17	3634.75	(gen exc.)	
66.00 25.00 2.17	3580.50		
62.00 25.00 2.17	3363.50		
55.00 25.00 2.17	2983.75		
	27262.50		


Retaining Wall
Explanatory Notes
4. EXCAVATION ANCILLARIES (CONT)
Dett
Disposal of exc. mat; rock
(E533)
Adjustment for the banks.
2130·00
1·00
1·00
2130·00
There are no trimming or preparation items measurable over the general cut area as all these surfaces are to receive topsoil (M10 & M11)

Retaining Wall

Explanatory Notes

5. FILLED AREA

Mat. available	
dett	Add
	3515·00
	54000·00
20506·50	
1337·00	
21843·50	57915·00
	21843·50
	36071·50

There are two types of filling involved. The first is backfilling to the structure above the toc level to bring the levels up to the stripped level, and then general filling to the required finished levels. The first calculation should be to compute the amount of excavated materials available for filling.

Fdl. to structure	
	dep.
av. lev. after topsoil strip	103958
top of toc	98000
	5958

	wid
	5000
6483 / 13500 x 3000	1441
	6441

Fill to structure; non-selected exc. material (E 613)

Backfilling above toc of retaining wall to stripped level.

150·00	
6·44	
5·96	
	5757·36

Retaining Wall

Explanatory Notes

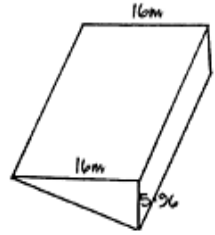
5. FILLED AREA (CONT)

Ddt

Fill to structures; non-selected exc. material a.b.d. (E613)

2/½/ 5.96
16.00
6.44
614.11

Adjustment on last item for either end of the filling to the wall which has a sloping bank and is therefore not filled



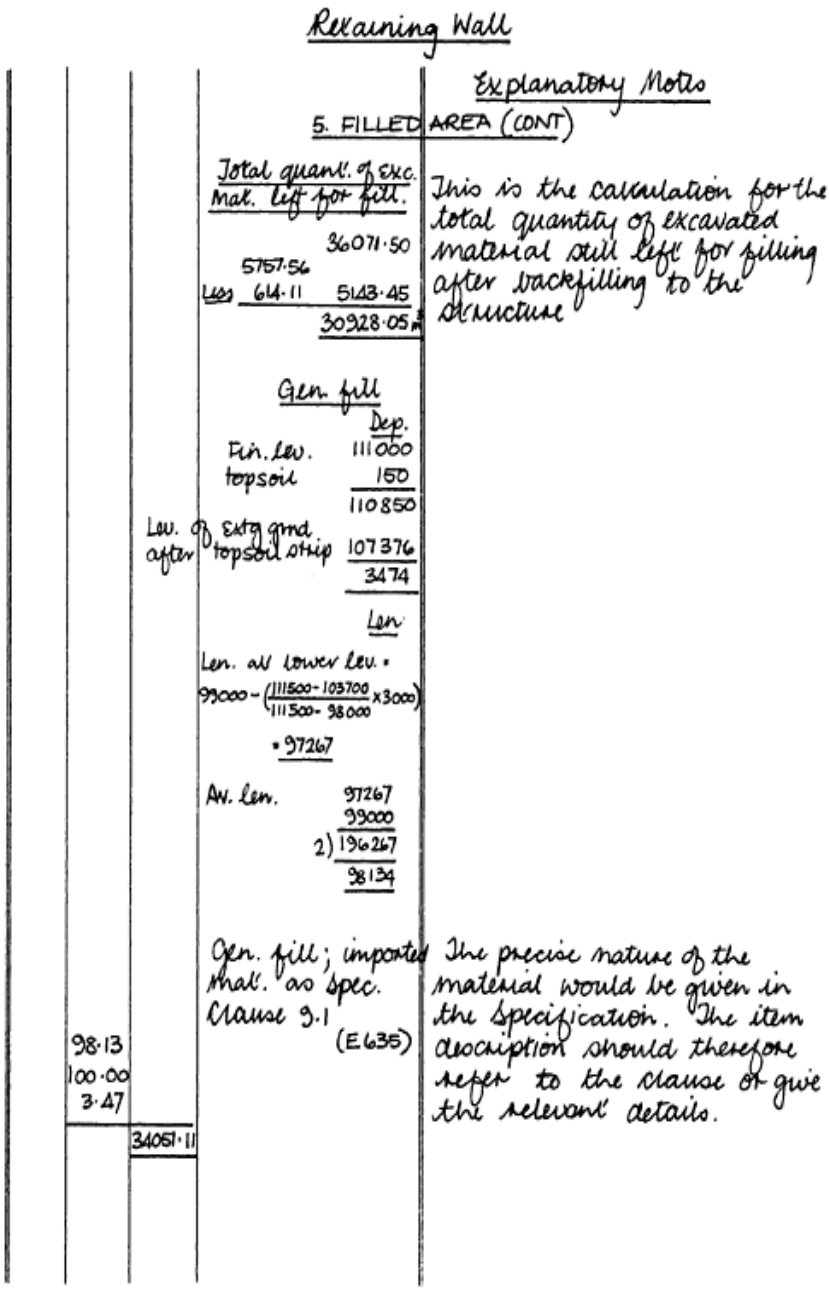
N.B. in actual fact this is very slightly over size but the calculation to compute the actual size would be so complicated that it would never be done in practice.

Retaining Wall

Explanatory Notes

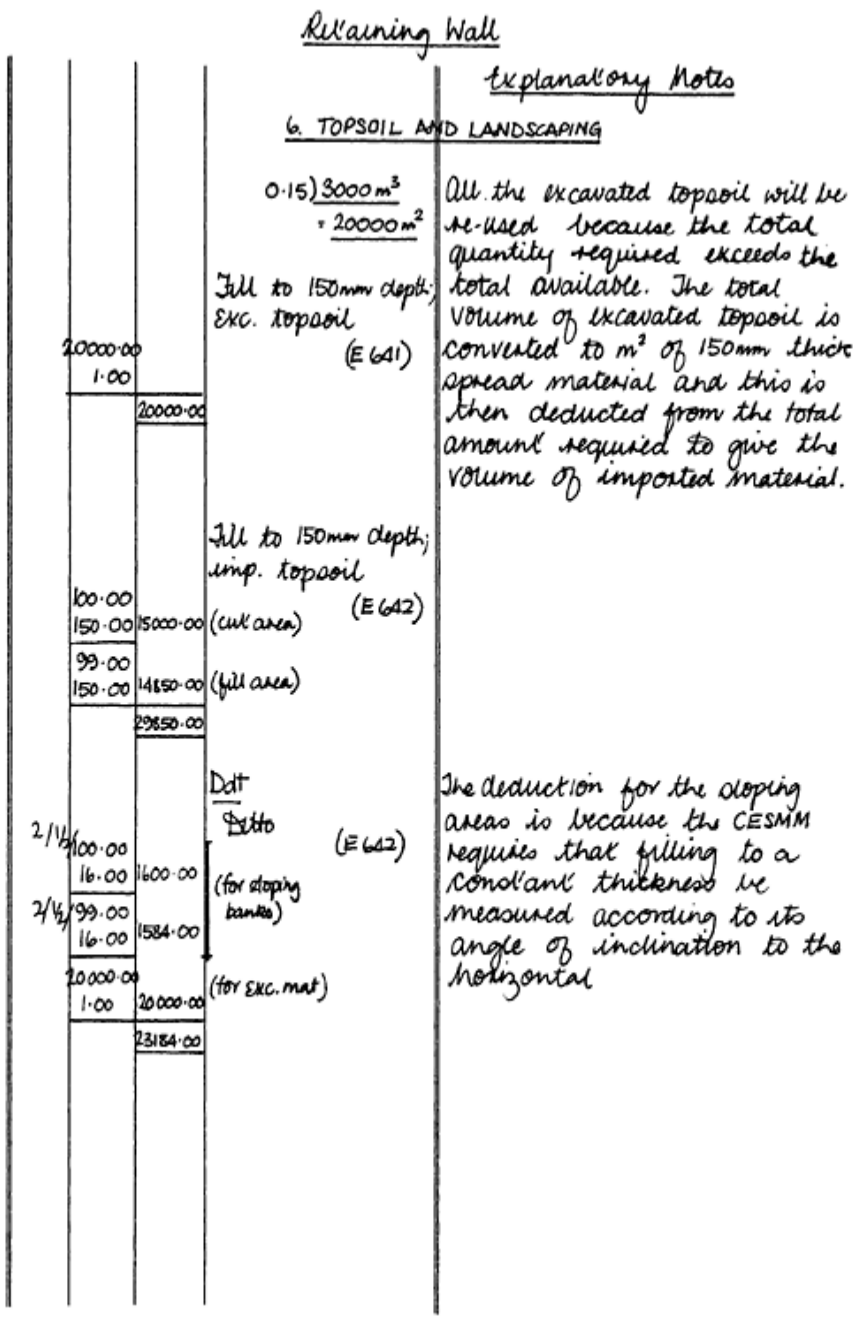
5. FILLED AREA (CONT)

Level		Av. g.l after topsoil strip
E1	1/103700	103700
E2	2/103700	207400
E3	2/103700	207400
E4	2/103700	207400
E5	2/103700	207400
E6	2/103800	207600
E7	1/103200	103200
F1	2/105200	210400
F2	4/105600	422000
F3	4/105600	422400
F4	4/105800	423200
F5	4/106000	424000
F6	4/105600	422400
F7	2/105200	210400
G1	2/107000	214000
G2	4/107200	428800
G3	4/107600	430400
G4	4/107700	430800
G5	4/107600	430400
G6	4/107500	430000
G7	2/107100	214200
H1	2/108800	217600
H2	4/109000	436000
H3	4/109300	437200
H4	4/109600	438400
H5	4/109700	438800
H6	4/109600	438400
H7	2/109200	218400
I1	1/111000	111000
I2	2/111000	222000
I3	2/111200	222400
I4	2/111300	222600
I5	2/111500	223000
I6	2/111500	223000
I7	1/111400	111400
		96)10317700
		107476
Less	topsoil	100
		107376


Retaining Wall
Explanatory Notes
5. FILLED AREA (CONT)
Total quant. of exc. mat. left for fill.
This is the calculation for the total quantity of excavated material still left for filling after backfilling to the structure
36071·50
5757·56
Less 614·11 5143·45
30928·05 m³
Gen. fill
Dep.
Fin. Lev. 111000
topsoil 150
110850
Lev. of extg grnd after topsoil strip 107376
3474
Len
Len. at lower lev. =
99000 − (111500 − 103700 / 111500 − 98000 × 3000)
= 97267
Av. len. 97267
99000
2) 196267
98134
Gen. fill; imported mat. as spec. Clause 9.1 (E635)
The precise nature of the material would be given in the Specification. The item description should therefore refer to the clause or give the relevant details.
98·13
100·00
3·47
34051·11

Retaining Wall

				Explanatory Notes
			5. FILLED AREA (CONT)	
			Deit Gen fill; imported mat'. Spec. Clause 9.1 abd. (E635)	Adjustment on previous item for the banks which are now filled.
2/1/3/1/3/	116.00 3.47 98.13	1816.06		For filling with the excavated material still surplus which reduces the amount of import. (See next item)
	30328.05 1.00 1.00	30328.05		
		32744.11		
			Add Gen. fill; non-selected exc. mat. other than topsoil or rock (E633)	This is the total quantity of excavated material left for general filling.
	30328.05 1.00 1.00			There are no filling or preparation items to be measured as all the filled surfaces are to receive topsoil (M22 and 23)
		30328.05		



Rl'aining Wall

Explanatory Notes

6. TOPSOIL AND LANDSCAPING

0.15) 3000 m³
= 20000 m²

All the excavated topsoil will be re-used because the total quantity required exceeds the total available. The total volume of excavated topsoil is converted to m² of 150mm thick spread material and this is then deducted from the total amount required to give the volume of imported material.

Fill to 150mm depth; Exc. topsoil (E 641)

20000·00
1·00
20000·00

Fill to 150mm depth; imp. topsoil (E 642)

100·00
150·00 15000·00 (cut area)

99·00
150·00 14850·00 (fill area)

29850·00

Deduct
Ditto (E 642)

2/1½ 100·00
16·00 1600·00 (for doping banks)

2/½ 99·00
16·00 1584·00

20000·00
1·00 20000·00 (for Exc. mat)

23184·00

The deduction for the doping areas is because the CESMM requires that filling to a consistent thickness be measured according to its angle of inclination to the horizontal

Retaining Wall

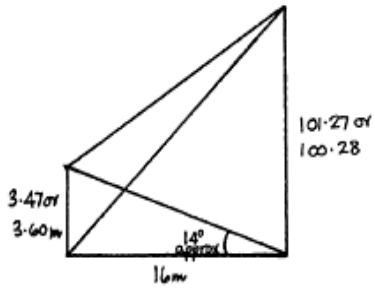
Explanatory Notes

6. TOPSOIL AND LANDSCAPING (CONT)

cut side base length:
$\sqrt{3.60^2 + 16.00^2}$
= 16.40

fill side base length:
$\sqrt{3.47^2 + 16.00^2}$
= 16.37

The angle of inclination is most easily calculated either by the use of logarithms or by scaling as shown.



Add

Fill ; 150mm dep; imp. topsoil ; 10-45° to the horiz. (E 642·1)

2/½/ 101·27		
16·40	1660·83	
2/½/ 100·28		
16·40	1644·59	
	3305·42	

Seeding with low maintenance grass seed as Spec. Clause 2·13; over 10° to horiz. (E 830)

The sloping areas can be treated as triangles for the purposes of measurement. The area is slightly underassessed, but is considered sufficiently accurate for this purpose

Seeding as Spec. Clause 2·12; n.e 10° to the horiz. (E 830·1)

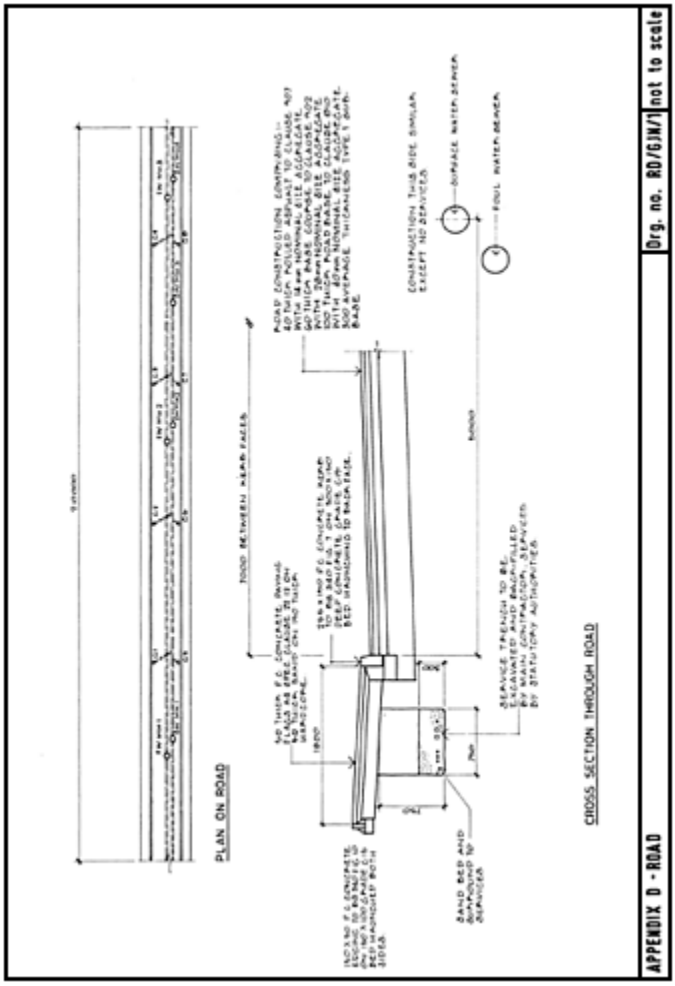
100·00	
150·00	15000·00
99·00	
150·00	14850·00
	29850·00

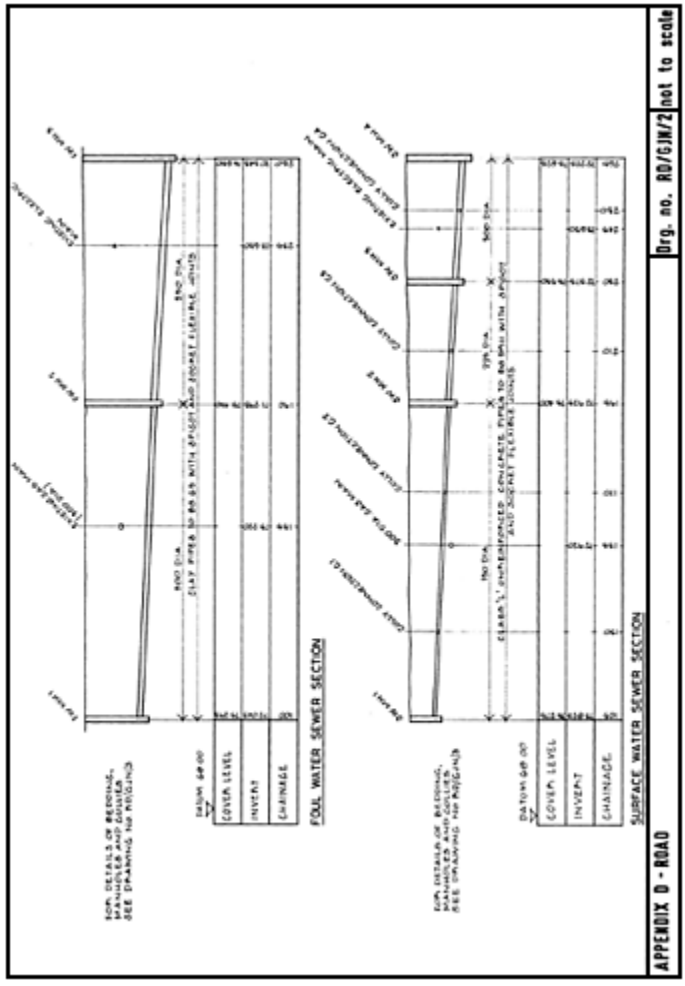
The precise method, types, and laying rates would be contained in the specification to which reference should be made; item coverage should define exactly what treatments are to be included in the rates

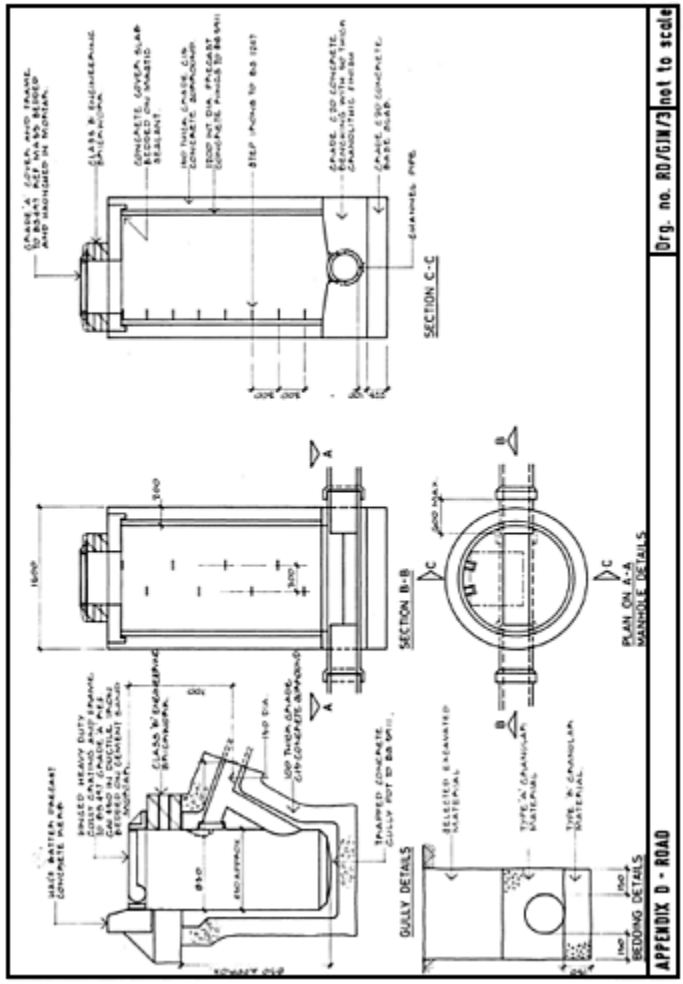
Retaining Wall

				Explanatory Notes
			6. TOPSOIL AND LANDSCAPING (CONT)	
			Dett Seeding as Spec. Clause 2.12; n.e. 10° to the horiz. a.b.d. (E 830.1)	
2/1/2	100.00			
	16.00	1600.00	(for sloping banks measured elsewhere)	
2/1/2	99.00			
	16.00	1584.00		
		3184.00		
	3305		Plant shrubs; Acer griseum 45-60 cms high (to sloping banks (E 850) 1/m²)	Stating that trees are bare root is not a CESMM requirement but is an additional description under 5.10.
		3305		
	24		Plant trees; Acer campestre; heavy standard; bare root (E 860)	The specification will normally detail the planting, treatment and techniques required, and it may be necessary to refer to these in the item description; item coverage rules should be extended or included to state exactly what is to be allowed for in the rates.
		24		
	48		Plant trees; Acer platanoides; feathered; bare root (E 860.1)	
		48		

Chapter 6
ROAD


PLAN ON ROAD
CROSS SECTION THROUGH ROAD
APPENDIX D - ROAD
Drg. no. RD/GJW/1
not to scale


FOUL WATER SEWER SECTION
SURFACE WATER SEWER SECTION
COVER LEVEL
INVERT
CHAINAGE
DATUM AT 0.00
APPENDIX D - ROAD
Drg. no. RD/GJK/2
not to scale


SECTION C-C
SECTION B-B
PLAN ON A-A
MANHOLE DETAILS
GULLY DETAILS
BEDDING DETAILS
APPENDIX D - ROAD
Drg. no. RD/GIN/3
not to scale

Road

Drawing Numbers RD/GJN/1
RD/GJN/2
RD/GJN/3

Explanatory Notes

The following example shows a length of road and footpath with associated drainage and services.

The example demonstrates measurement in accordance with classes I, J, K, L and R only. Rock head is at level 71750.

The foulwater pipework is measured between manholes FWMH1 and FWMH3 and the surface water pipework between SWMH1 and SWMH4. In practice the pipework would be scheduled in order to simplify the taking off process and this is shown in the example, demonstrating how each length of pipework is calculated within each of the depth classifications.

FOUL WATER PIPEWORK				DEPTH CLASSIFICATION			
RUN	TYPE	DIA	2·5-3	3-3·5	3·5-4	4-4·5	4·5-5
FWMH1-MH2	CLAY	300	24·48	48·95	15·37		

CALCS

1st dep. 75293 − 72043 = 3250; Less road 500 = 2750

2ND dep. 75450 − 71293 = 4157; Less road 500 = 3657

total dep. of fall 3657 − 2750 = 907

Length: $\frac{3-2.75}{0.907} \times 22.80 = 24.48$

Length: $\frac{3.5-3}{0.907} \times 22.80 = 48.95$

Length: $\frac{3.657-3.5}{0.907} \times 22.80 = 15.37$

The calculation of the pipe length within each depth classification is done by interpolation. The total pipe length is measured from the inside faces of manholes (MS)

Total pipe length 190 000 − 100 000 = 90 000

MH 2/3/1400 1600 = 88 400

Walls 2/200 400 = 88 800

FOUL WATER PIPEWORK				DEPTH CLASSIFICATION			
RUN	TYPE	DIA	2·5-3	3-3·5	3·5-4	4-4·5	4·5-5
FNMH 2-MH3	CLAY	350			24·84	36·21	7·75

CALCS

1ST dep. 75450 − 71293 = 4157
Less road 500 = 3657

2ND dep. 75650 − 70543 = 5107
Less road 500 = 4607

total dep. 4607 − 3657 = 950

Total pipe length 260 000 − 190 000 = 70 000
MH 2/3/1600 1 600 = 68 400
Nells 2/200 400 = 68 800

Length: $\frac{4-3.657}{0.95} \times 68.80$ = 24.84

Length: $\frac{4.5-4}{0.95} \times 68.80$ = 36.21

Length: $\frac{4.607-4.5}{0.95} \times 68.80$ = 7.75

SURFACE WATER APENORK

RUN	TYPE	DIA	n.c. 1·5	DEPTH CLASSIFICATION 1·5-2	2-2·5	2·5-3	3-3·5
SNMH1-MH2	CONC	150	47·65	41·15			

CALCS

1ST dep. 75275 − 73825 = 1450
Less road 500
950

2ND dep. 75400 − 72925 = 2475
Less road 500
1975

Total dep. of fall 1975 − 950 = 1025

Total pipe length 105000 − 90000 = 15000
MH 2/3/1600 1600
32400
Walls 2/200 400
32800

Length: $\frac{1{\cdot}5-0{\cdot}95}{1{\cdot}025} \times 32{\cdot}8 = 47{\cdot}65$

Length: $\frac{1{\cdot}975-1{\cdot}5}{1{\cdot}025} \times 32{\cdot}8 = 41{\cdot}15$

SURFACE WATER PIPEWORK				DEPTH CLASSIFICATION			
RUN	TYPE	DIA	n.c. 1·5	1·5 - 2	2 - 2·5	2·5 - 3	3 - 3·5
SWMH 2 - MH 3	CONC	225		1·69	32·11		

CALCS

1st dep. 76400 − 72925 = 2476
Less road 500
1975

2ND dep. 75550 − 72575 = 2975
Less road 500
2475

total dep. of fall 2475 − 1975 = 500

Total pipe length 230000 − 195000 = 35000
MH 2/3/1600 1600
33400
Walls 2/200 400
33800

Length: $\frac{2 \cdot 1.975}{0.50} \times 33.80$ = 1·69

Length: $\frac{2.475 - 2}{0.50} \times 33.80$ = 32·11

SURFACE WATER PIPEWORK				DEPTH CLASSIFICATION			
RUN	TYPE	DIA	n.e. 1·5	1·5 - 2	2 - 2·5	2·5 - 3	3 - 3·5
SWMH 3 - MH4	CONC	300			1·99	31·81	
CALCS							
1st dep.	75550				Length:	Length:	
	72575				$\frac{2.5-2.475}{0.425} \times 3380$	$\frac{2.9-2.5}{0.425} \times 3380$	
	2975						
400 road	500						
	2475				• 1·99	• 31·81	
2ND dep.	75625						
	72225						
	3400						
400 road	500						
	2900						
total dep. of fall	2900						
	2475						
	425						
Total pipe length	265000						
	230000						
	35000						
MH 2/3/1600	1600						
	33400						
Walls 2/200	400						
	33800						

SURFACE WATER DRAINAGE - GULLY CONNECTIONS

– N.B. it is assumed that the inverts of adjacent gully connections are the same because there will be very little difference between them as they are so close together.

Depth at gully

	invert from wearing course		700
Less	road construction	40	
		60	
		100	
		300	500
			200

Commencing surface levels at sewer

G1/G5	75400 - 75275	× 24·4/38·8 + 76275		75309
		Less road		500
				74809
G2/G6	75400 - 76275	× 64·4/38·8 + 75275		76366
		Less road		500
				74866
G3/G7	75550 - 76400	× 14·4/23·8 + 75400		75464
		Less road		500
				74964
G4/G8	75625 - 75550	× 19·4/33·8 + 75550		75693
		Less road		500
				75093

Inverts at sewer

G1/G5	75325 -	(24·4/38·8 × 1026)	= 73543
G2/G6	73325 -	(64·4/38·8 × 1026)	= 73082
G3/G7	72925 -	(14·4/33·8 × 500)	= 72712
G4/G8	72575 -	(19·4/38·8 × 425)	= 72331

Depths at sewer

G1/G5	74809 -	73543	= 1266
G2/G6	74866 -	73082	= 1784
G3/G7	74964 -	72712	= 2252
G4/G8	75093 -	72331	= 2762

Pipe lengths

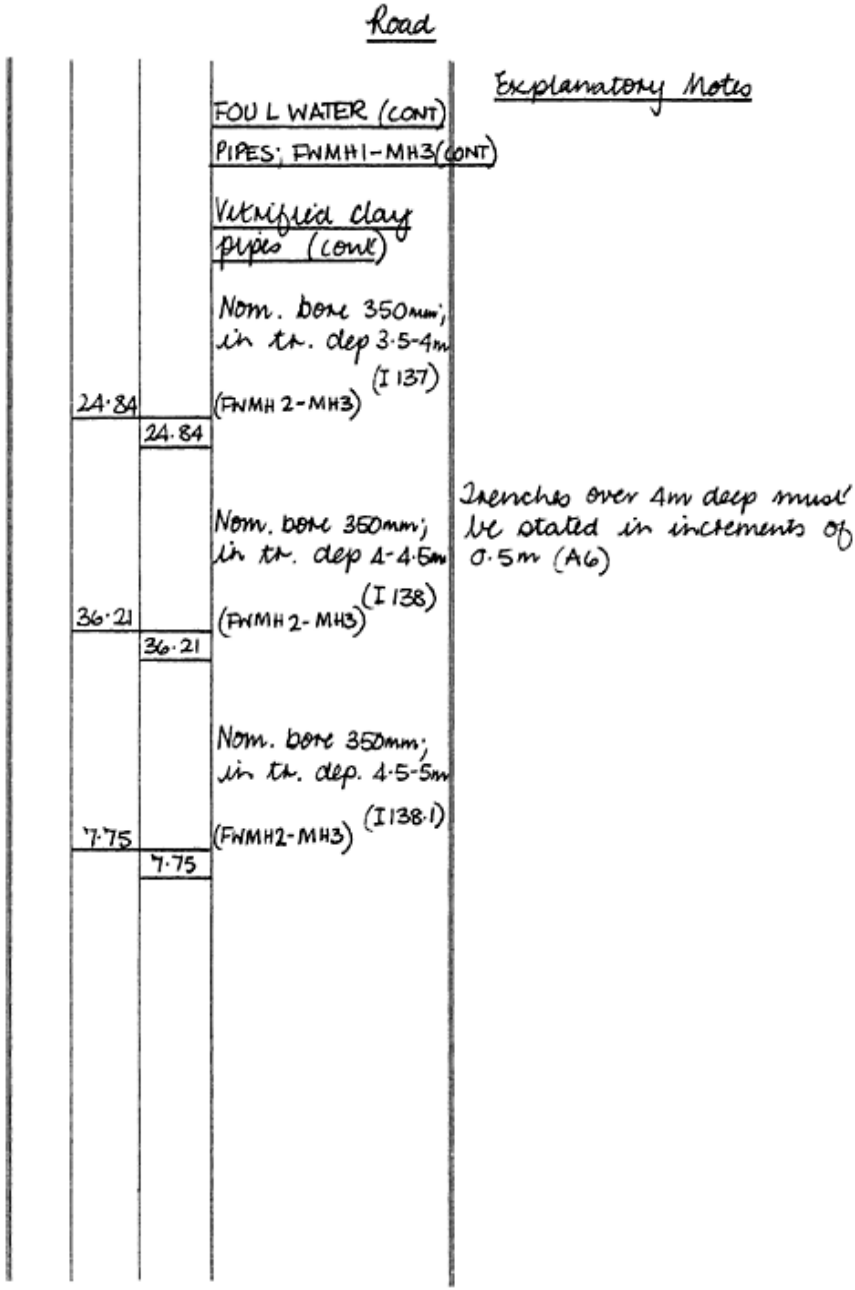
G1, G2, G3, G4.	5000	G5, G6, G7, G8.	7000		
	gully 850		5000		
	4150		2000		
			gully	850	
				1150	

SURFACE WATER DRAINAGE – GULLY CONNECTIONS

GULLY RUN	TYPE	DIA	DEPTH CLASSIFICATION n.e. 1·5	1·5 – 2	2 – 2·5	2·5 – 3
G1/G5	CONC	150	1·15 4·15			
G2/G6	CONC	150	1·5 – 0·2 / 1·784 – 0·2 × 4·15 × 1·15 = 3·41 = 0·94	1·784 – 1·5 / 1·784 – 0·2 × 4·15 × 1·15 = 0·74 = 0·21		
G3/G7	CONC	150	1·5 – 0·2 / 2·252 – 0·2 × 4·15 × 1·15 = 2·63 = 0·73	2·0 – 1·5 / 2·252 – 0·2 × 4·15 × 1·15 = 1·01 = 0·28	2·252 – 2·0 / 2·252 – 0·2 × 4·15 × 1·15 = 0·51 = 0·14	
G4/G8	CONC	150	1·5 – 0·2 / 2·742 – 0·2 × 4·15 × 1·15 = 2·11 = 0·55	2·0 – 1·5 / 2·742 – 0·2 × 4·15 × 1·15 = 0·81 = 0·22	2·5 – 2·0 / 2·742 – 0·2 × 4·15 × 1·15 = 0·81 = 0·22	2·742 – 2·5 / 2·742 – 0·2 × 4·15 × 1·15 = 0·42 = 0·12

Road

			Explanatory Notes
		FOUL WATER DRAINAGE	
		PIPES; FWMH 1 - FWMH 3	It is normal to measure and bill pipework separately according to its function. In this case this means measuring the foul and surface water separately
		Vitrified clay pipes; B.S. 65 normal quality; spigot & socket flexible joints; Comm. Surf underside of road construction	
		Nom. bore 300mm; in tr. dep. 2·5-3m (I 125)	A1 requires the location of the pipework to be stated and in this case it forms part of the general heading. The Commencing Surface is stated as it is not also the Original Surface (A4)
24·48		(FWMH 1 - MH 2)	
	24·48		
		Nom. bore 300mm; in tr. dep 3 - 3·5m (I 126)	
48·96		(FWMH 1 - MH 2)	
	48·95		
		Nom. bore 300mm; in tr. dep 3·5-4m (I 127)	
15·37		(FWMH 1 - MH 2)	
	15·37		


Road
Explanatory Notes
FOUL WATER (CONT)
PIPES: FWMH1-MH3 (CONT)
Vitrified clay pipes (cont)
Nom. bore 350mm; in tr. dep 3·5-4m
(I 137)
24·84
(FWMH 2-MH3)
24·84
Trenches over 4m deep must be stated in increments of 0·5m (A6)
Nom. bore 350mm; in tr. dep 4-4·5m
(I 138)
36·21
(FWMH 2-MH3)
36·21
Nom. bore 350mm; in tr. dep. 4·5-5m
(I 138·1)
7·75
(FWMH2-MH3)
7·75

Road

FOUL WATER (CONT)

MANHOLES AND PIPEWORK ANCILLARIES

Precast conc. manholes with in-situ cutt.; as dwg no. RD/GJN/3; cover & fr. to B.S. 497 grade A Ref. MA 56

dep
75293
72043
3250
100
3350

dep. 3-3.5m; FWMH1 (K155)

1 1

dep
75450
71293
4157
100
4257

dep. 4.26m; FWMH2 (K157)

1 1

dep
75450
70543
5107
100
5207

dep. 5.21m; FWMH3 (K157.1)

1 1

Explanatory Notes

A1 requires that the type or mark numbers be given in the item descriptions. This is done by giving their actual reference. The type and loading duty must be stated (A2) and this is given in the general heading. As an alternative to enumerating the manholes they could have been measured in detail in accordance with other classes of CESMM (see note at bottom of page 55)

The actual depth of the manhole must be stated where this exceeds 4m. It is recommended that this be kept to 2 places of decimals. The depth of the manholes is measured to the top of the base slab, which in this case is 100mm below the invert (D2)

Road

			Explanatory Notes
		FOUL WATER (CONT)	
		MHs. AND PIPEWK. ANCILL. (CONT)	
		Crossings	
1		300 dia. gas main, pipe bore n.e. 300mm (K681) (FWMH1-MH2)	Although not a specific requirement, the diameter of the gas main is stated in order to assist the estimator.
	1		
		Electric main; pipe bore 300-900mm (K682)	
1		(FWMH2-MH3)	
		PIPEWORK-SUPPORTS	
		FWMH1 72043 FWMH2 71293 750 Rockhead 71750 71293 457 ∴ rock meets invert at chainage 190-(90x457/750) = 135.16	In order to calculate the quantity of rock excavation, the point at which the rock head crosses the invert of the pipe must be determined. This will give the total length of trench in rock. It must be borne in mind that the inverts on the section are pipe inverts, and that there is also a 150mm bed underneath the pipe which must be accounted for.

Road

FOUL WATER (CONT)

PIPEWORK - SUPPORTS (CONT)

Total pipe length FWMH1 - MH2 in rock

	190000
	135160
	54840
Less ½ x FWMH2	800
	54040

Av. dep. FWMH1 - MH2 in rock

1st.		0000
2nd.	71750	
	71293	457
		2) 457
		229

Nom. th. Wid.

pipe	300
	500
	800

Total pipe length FWMH 2 - MH3 in rock

		260000
		190000
		70000
Less ½ x FWMH2	800	
½ x FWMH3	800	1600
		68400

Av. dep. FWMH 2 - MH3 in rock

1st.	71750	
	71293	457
2nd	71750	
	70543	1207
		2) 1664
		832

Nom. th. Wid.

pipe	350
	500
	350

Explanatory Notes

Although the pipes are measured to the inside face of the manhole walls, the volumes of extras to excavation are based on the trench length which is shorter by the width of the manhole walls. Extras to excavation must distinguish between those in trenches and those in manholes, and the length of the manhole is therefore deducted from the pipe length.

The nominal trench width is 500mm greater than the nominal bores of the pipes (DI).

Road

FOUL WATER (CONT)

PIPEWORK SUPPORTS (CONT)

Extras to exc. in pipe tr.; exc. of rock

(L111)

54.04		
0.80		
0.23	9.94	(FHMH 1-MH2)
54.04		
0.80		
0.15	6.48	(ditto for bed)
68.40		
0.85		
0.83	48.26	(FH MH 2-MH3)
68.40		
0.85		
0.15	8.72	(ditto for bed)
	73.40	

		dep
rock level		71750
invert		71293
		457
base	100	
	200	300
		757
rock level		71750
invert		70543
		1207
base	100	
	200	300
		1507

Explanatory Notes

All the foregoing calculations are based on the invert of the pipe. The volume occupied by the bed underneath the pipe is also in rock and is included in the dimensions separately.

The depth of rock excavation in manholes must take into account the depth of the base below the invert.

Road

FOUL WATER (CONT)

PIPEWORK SUPPORTS (CONT)

Extras to exc. in mhs; exc. of rock (L121)

11/ 0.80
0.80
0.76 — 1.53 (FWMH2)

11/ 0.80
0.80
1.51 — 3.04 (FWMH3)

Beds 150dp in type B gran. mat.; with surr. in type A gran. mat.

	Len
	190000
	100000
	90000
2/½/manhole	1600
	88400

pipe nom. bore 300mm (L332)

88.40 (FWMH1-MH2) — 88.40

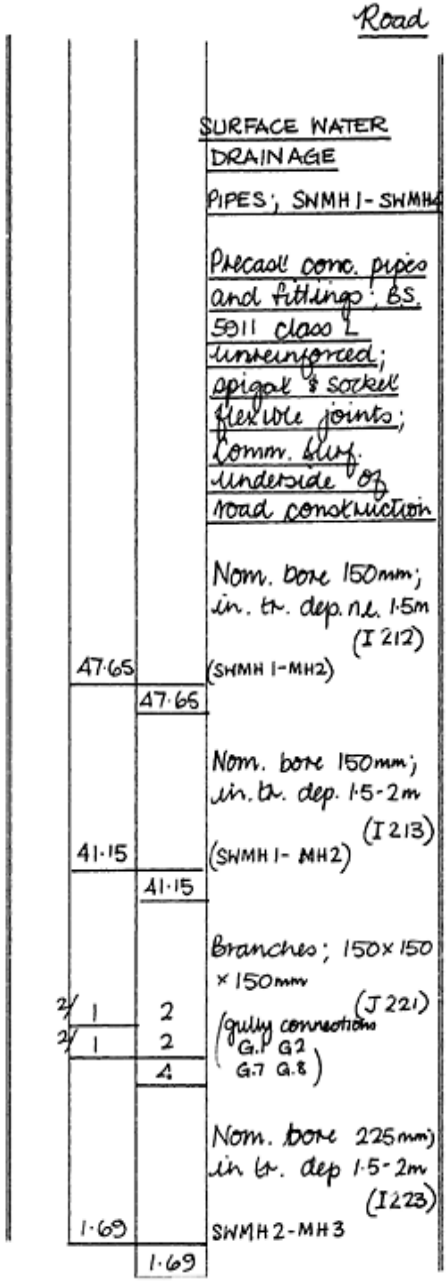
	Len
	260000
	190000
	70000
2/½/manhole	1600
	68400

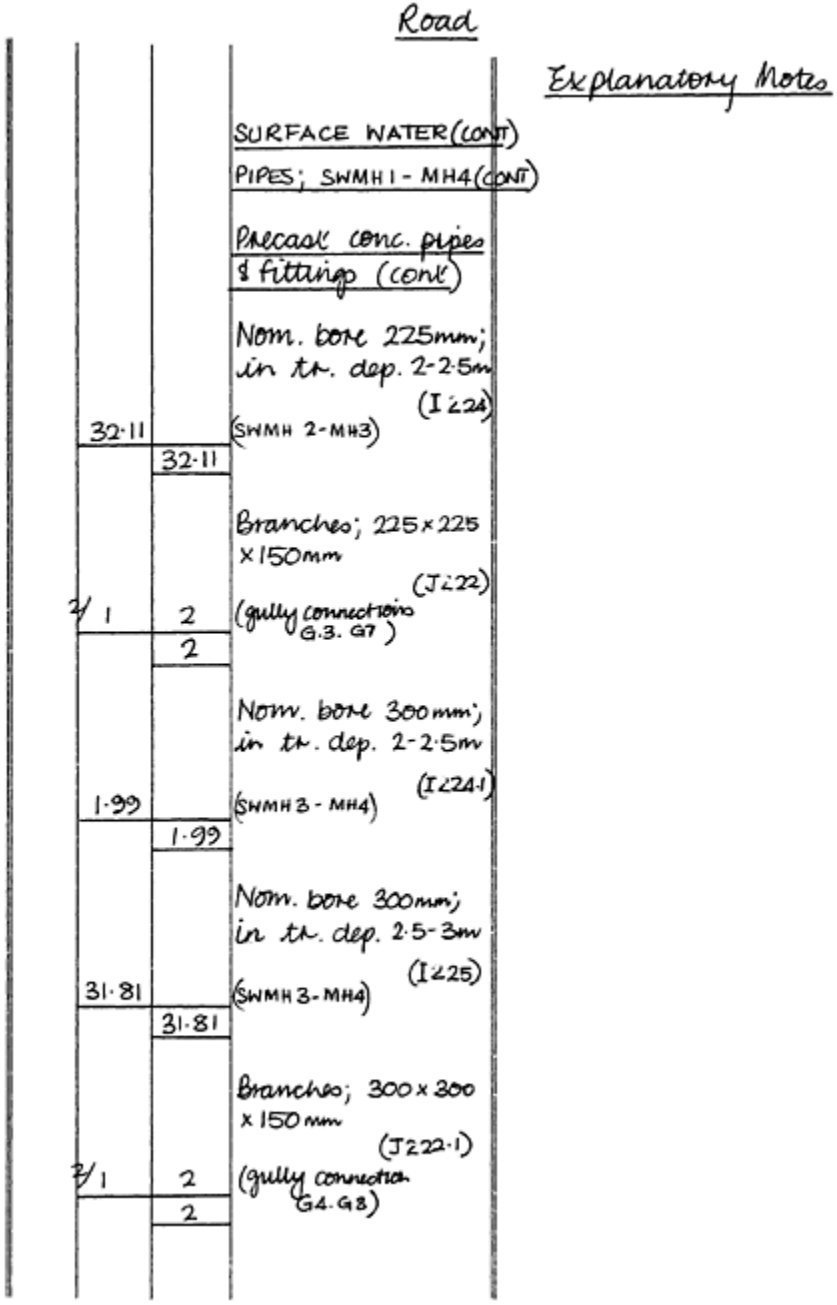
pipe nom. bore 350mm (L333)

68.40 (FWMH2-MH3) — 68.40

Explanatory Notes

Because the surround is in a different material to the bed, the item description must so state. The actual nominal bore of the pipe is given because this is considered to be more helpful to the estimator than the ranges given in the Third Division. Note that the total length of the bed is slightly shorter than the pipe length because of the manhole walls.


Road
Explanatory Notes
SURFACE WATER DRAINAGE
PIPES; SNMH 1 - SWMH4
Precast conc. pipes and fittings; BS. 5911 class L unreinforced; spigot & socket flexible joints; Comm. bldg. underside of road construction
In order to prevent undue repetition, the fittings to the surface water pipework are included with the general measurements of the pipes rather than being classified under a seperate heading.
Nom. bore 150mm; in. tr. dep. n.e. 1.5m (I 212)
47.65
(SWMH 1-MH2)
47.65
Nom. bore 150mm; in. tr. dep. 1.5-2m (I 213)
41.15
(SWMH 1- MH2)
41.15
Branches; 150 x 150 x 150mm (J 221)
2/ 1 2
2/ 1 2
(gully connections G.1 G2 G.7 G.8)
4
Nom. bore 225mm; in tr. dep 1.5-2m (I 223)
1.69
SWMH 2-MH3
1.69


Road
Explanatory Notes
SURFACE WATER (CONT)
PIPES; SWMH 1 - MH4 (CONT)
Precast conc. pipes & fittings (cont)
Nom. bore 225mm; in tr. dep. 2-2.5m
(I224)
32.11
(SWMH 2-MH3)
32.11
Branches; 225 x 225 x 150mm
(J222)
2/1
2
(gully connections G.3. G7)
2
Nom. bore 300mm; in tr. dep. 2-2.5m
(I224.1)
1.99
(SWMH 3 - MH4)
1.99
Nom. bore 300mm; in tr. dep. 2.5-3m
(I225)
31.81
(SWMH 3-MH4)
31.81
Branches; 300 x 300 x 150 mm
(J222.1)
2/1
2
(gully connection G4.G8)
2

Road

Explanatory Notes

SURFACE WATER (CONT)

PIPES; SWMH 1-MH4 (CONT)

Precast conc. pipes & fittings (cont)

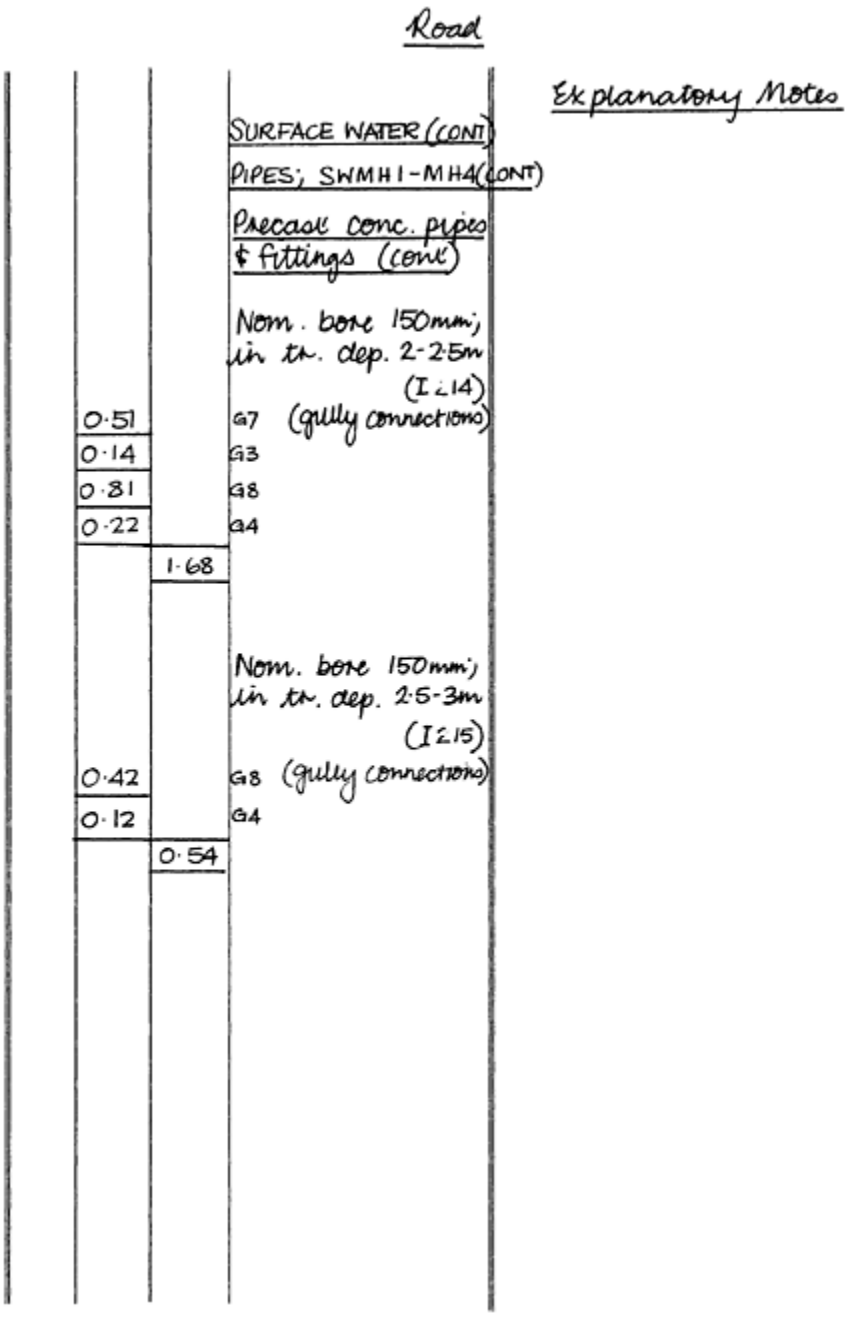
Nom. bore 150mm; in tr. dep. n.e 1·5m (I<12)

1·15		G5 (gully connections)
4·15		G1
3·41		G6
0·94		G2
2·63		G7
0·73		G3
2·11		G8
0·58		G4
	15·70	

The length of the gully connections is measured from the centreline of the sewer (M3). Although not specifically stated the pipe is not measured through the gully itself as this is not a fitting (M3)

Nom. bore 150mm; in tr. dep. 1'5-2m (I<13)

0·74		G6 (gully connections)
0·21		G2
1·01		G7
0·28		G3
0·81		G4
0·22		G8
	3·27	


Road
Explanatory Notes
SURFACE WATER (CONT)
PIPES; SWMH1-MH4 (CONT)
Precast conc. pipes & fittings (cont)
Nom. bore 150mm; in tr. dep. 2-2.5m (I 14)
0.51 G7 (gully connections)
0.14 G3
0.81 G8
0.22 G4
1.68
Nom. bore 150mm; in tr. dep. 2.5-3m (I 15)
0.42 G8 (gully connections)
0.12 G4
0.54

Road

Explanatory notes

SURFACE WATER (CONT)

MANHOLES AND PIPEWORK ANCILLARIES

Precast conc. manholes with in-situ cover; as dwg no. RD/GJN/3; cover & fr. to BS 497 grade A ref MA 55

			dep
			75275
			73825
			1450
			100
			1550
			dep. 1·5–2m; SWMH1 (K152)
1			
	1		
			dep
			75400
			72925
			2476
			100
			2576
			dep. 2·5–3m; SWMH2 (K154)
1			
	1		
			dep
			75550
			72575
			2975
			100
			3076
			dep. 3–3.5m; SWMH3 (K155)
1			
	1		

Road

Explanatory Notes

SURFACE WATER (CONT)

MHS. AND. PIPEWORK ANCILL (CONT)

Precast conc. mhs (cont)

dep

75625
72225
3400
100
3500

dep. 3-3.5m; SWMH4

(K155)

1

1

Gullies

Precast conc. trapped; as dwg. no. RD/GJN/3; cover & fr. to B.S. 497 grade A ref. GA 1250

(K360)

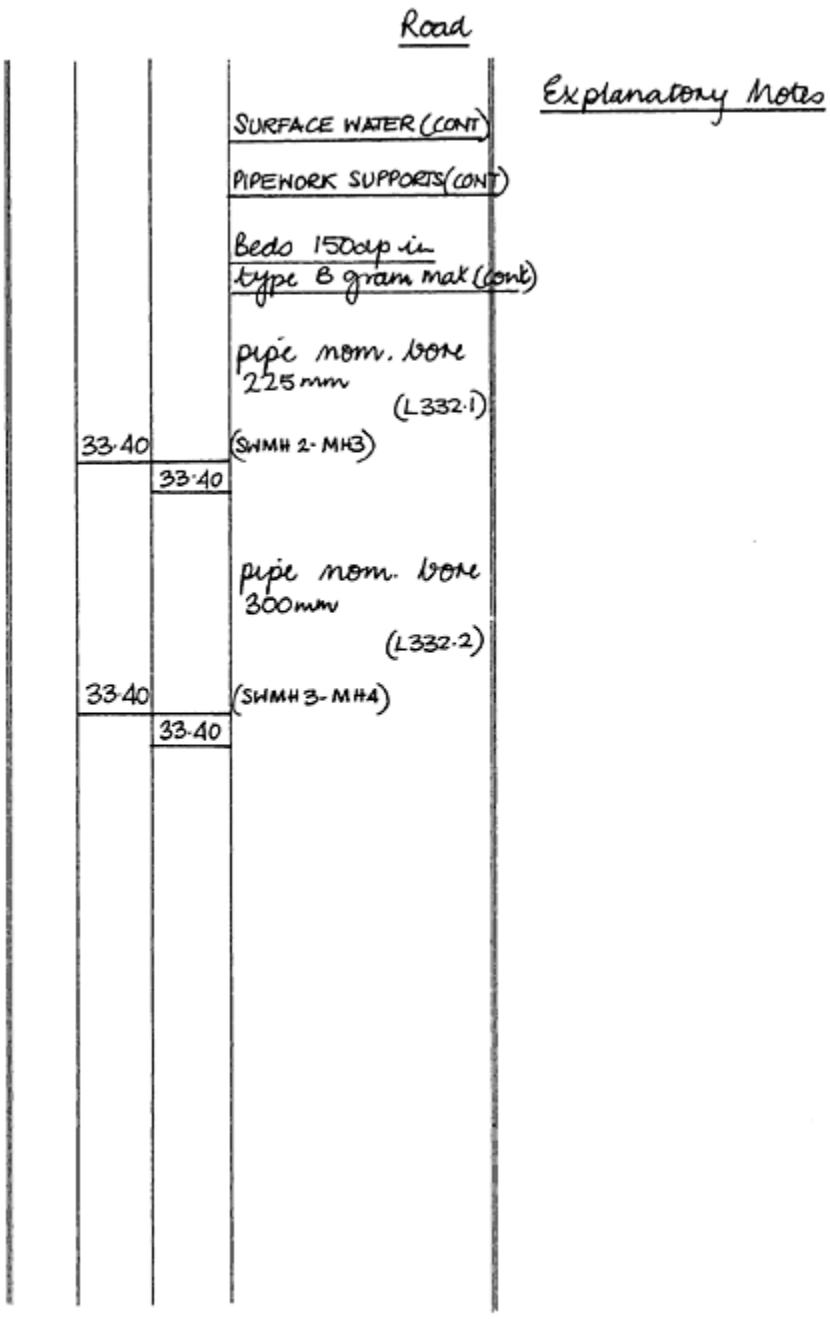
8/ 1 (all gullies)

8

The type and loading duty of gully covers must be stated in item descriptions

Road

				Explanatory Notes
			SURFACE WATER (CONT)	
			MHs AND PIPEWK ANCILL (CONT)	
			Crossings	Note that the surface water sewer passes above the gas main and does not have to be measured as a crossing.
			Electric main; pipe bore n.e. 300mm (K681·1)	
	1			Also note that the lowest invert of the pipe including its bed (72075) or manhole to the underside of its base (SWMH4 at 71925) are both higher than the level of rock and hence there will not be any rock excavation for surface water drainage.
		1		
			PIPEWORK SUPPORTS	
			Beds 150dp in type B gran. mat; with surr. in type A gran. mat.	Note that the length of the bed and surround is measured along the pipe centre line (M11). Although not specifically stated, the length occupied by the gully is deducted as this is not classified as a fitting or valve.
			pipe nom. bore 150mm (L331)	
	88·40	88·40	(SWMH 1 - MH2)	
4/	4·15	16·60	(gully runs)	
4/	1·15	4·60		
		109·60		


Road
Explanatory Notes
SURFACE WATER (CONT)
PIPEWORK SUPPORTS (CONT)
Bedo 150dp in
type B gram mat (cont)
pipe nom. bore
225 mm
(L332.1)
33.40
(SWMH 2 - MH3)
33.40
pipe nom. bore
300mm
(L332.2)
33.40
(SWMH 3 - MH4)
33.40

Road

				Explanatory Notes
			SERVICE TRENCH FOR STATUTORY AUTHORITIES	
			PIPEWORK - MANHOLES	
			In. for pipes or cables not laid by contractor; backfilling above bed & surr. with selected Exc. mat. after install. of services by others	Although not specifically required, details of backfilling requirements (if any) should always be given in item descriptions for service trenches
			Cross-sect. area 0.5 - 0.75 m^2 (K483)	
210.00				
	210.00			
			PIPEWORK SUPPORTS	This is a rogue item as it is not classified strictly in accordance with the Third Division, and is therefore coded 9. Also, the size of the bed and surround has been stated because it is not particularly related to the bore of the services or pipes.
			Sand bed & surr. 750 x 300mm around services	
210.00			(L34419)	
	210.00			

Road

		ROADS AND PAVINGS	Explanatory Notes
		Sub-bases, flexible road bases and surfacing.	
210·00 7·60		Gran. mat. D.Tp. specified type 1; dep. 350 mm (R117) Wid 7000 Rnd fndn 2/300 600 7600 (sub base)	MI states the width of each course to be measured at the top surface. In the case of the sub base this is taken as extending under the kerb foundation. It is not necessary to state the depth in bands as the actual depth is given (Paragraph 3.10)
	1596·00		
210·00 7·00		Dense tarmacadam; D.Tp. clause 810; dep. 100mm (R253) (road base) $	It is not necessary to state the size of aggregate as there there is only one size in the specification. No deductions are made for the areas of manholes and gullies as there plan size does not exceed $1m^2$ (MI).
	1470·00	Rolled asphalt; D.Tp. clause 902; 28mm nom. size agg.; dep. 60mm (R322) (base course) $	It is necessary to state the aggregate size for both the base course and wearing course as there are several sizes in the specification
		Rolled asphalt; D.Tp. clause 907; 14mm nom. size agg.; dep. 40mm (R322·1) (wearing course)	

Road

				Explanatory Notes
			KOADS AND PAVINGS (CONT)	
			Kerbs, channels and edgings	
			Precast. conc. Kerb to BS.7263 Part 1, Fig 1(F) straight; incl. fndn & haunch as dwg no. RD/GJN/1 (R631)	It is not necessary to state the dimensions in the item description in accordance with A7 as all the relevant information is contained on the drawing.
3	210·00			
		420·00	&	
			Precast conc. Edging to BS.7263 Part 1, Fig (in) straight; incl. fndn & haunch. (R661)	The length of the edging is exactly the same as the kerb, hence the use of the ampersand.

Road

Explanatory Notes

ROADS AND PAVINGS (CONT)

Light duty pavements

Hardcore base; dep. 150mm (R724)

wid 1800

Kerb haunch 300 - 150 = 150

Edging haunch (150 - 50)/2 = 50

200

1600

As the width is defined as the width along the top surface, the haunch to both the kerb and edging must be deducted.

2/210.00 1.60 (footpath)

672.00

Sand base (R712)

(blinding)

Although the bottom of the sand layer is the same as the hardcore width the top surface is wider and it is this width upon which the measurement is based.

2/210.00 1.80

&

756.00

Precast conc. flags as spec. clause 22.12 (R782)

Chapter 7
REINFORCEMENT

REV.

BAR SCHED. REF. BBS 21 A

DATE JAN. 1986

MEMBER	BAR MARK	TYPE & SIZE	No. OF MBRS.	No. IN EACH	TOTAL No.	LENGTH OF EACH BAR	SHAPE CODE	A	B	C	D	E/r
COMPONENT 'A'	24	T16	2	24	48	1450	37	1290				
	25	T10	1	86	86	1675	37	1205				
	26	T10	3	108	324	5075	20	STRAIGHT				
	27	T12	1	8	8	3000	38	1370	330			
COMPONENT 'B'	21	T10	2	20	40	5550	37	5385				
	22	T10	1	72	72	5425	37	5260				
	23	T12	6	36	216	2150	38	1000	215			
	24a	T12	1	4	4	2675	37	2515				
	24b	T12	10	4	40	2175	37	2010				
	24c	T10	5	8	40	1925	37	1755				
	24d	T16	1	8	8	1750	37	1580				
	24e	T16	8	8	64	1625	37	1455				
	24f	T10	1	24	24	1450	37	1290				
	25a	T10	10	78	780	1675	37	1205				
	26a	T20	1	100	100	5075	20	STRAIGHT				
	27a	T20	4	4	16	3000	38	1370	330			
	28	T10	4	8	32	2600	20	STRAIGHT				
	29	T10	4	8	32	1225	37	1055				
	30	T12	6	32	192	4350	38	2050	330			
	31a	T16	2	4	8	2075	38	920	330			

ALL BENDING DIMENSIONS ARE IN ACCORDANCE WITH BS 4466

Reinforcement

					Explanatory Notes
				Bar bending schedule BBS-21	Reinforcement quantities may be prepared by one of three methods. 1) By direct taking off from the drawings. 2) From bar bending schedules 3) From average weights of steel per m^3 of concrete, divided into various diameters. This method should only be used for the tender quantities and never for the final account. The following is an example of the calculation of reinforcement weights from a typical bar bending schedule. The schedule gives the total number and girth of each bar as calculated in accordance with BS4449. The measurement involves abstracting the bar lengths according to their diameter and type, multiplying them by the total number of each and applying the conversion factor to arrive at the gross weight. The schedules are normally prepared by the Engineer.

Reinforcement

Explanatory Notes

Deformed High Yield Steel bars to BS. 4449

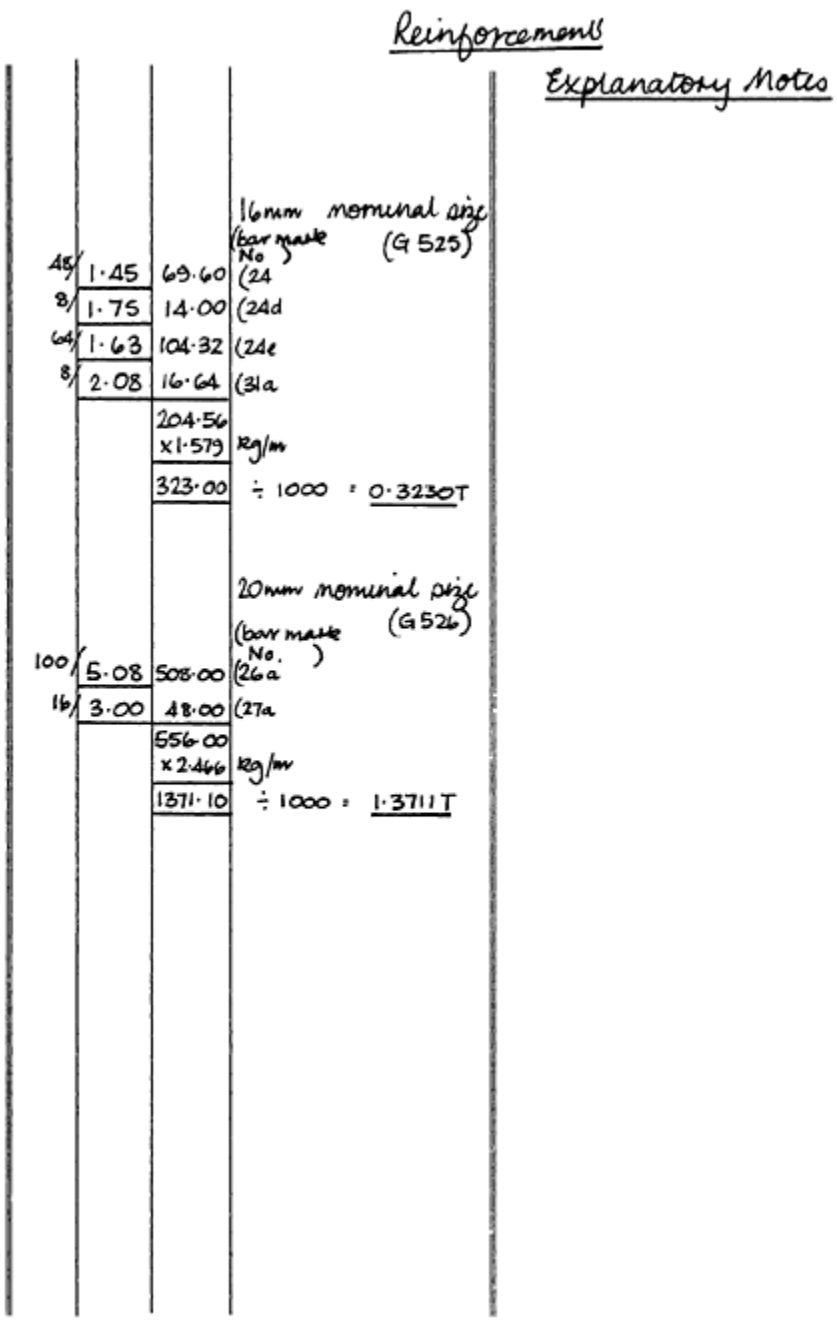
10mm nominal size (G523)

			(bar mark No)
86	1·68	144·48	(25
324	5·08	1645·92	(26
40	5·55	222·00	(21
72	5·43	390·96	(22
40	1·93	77·20	(24b
24	1·45	34·80	(24f
780	1·68	1310·40	(25
32	2·60	83·20	(28
32	1·23	39·36	(29
		3948·32	
	x 0·616	kg/m	
		2432·17	÷ 1000 = 2·43217T

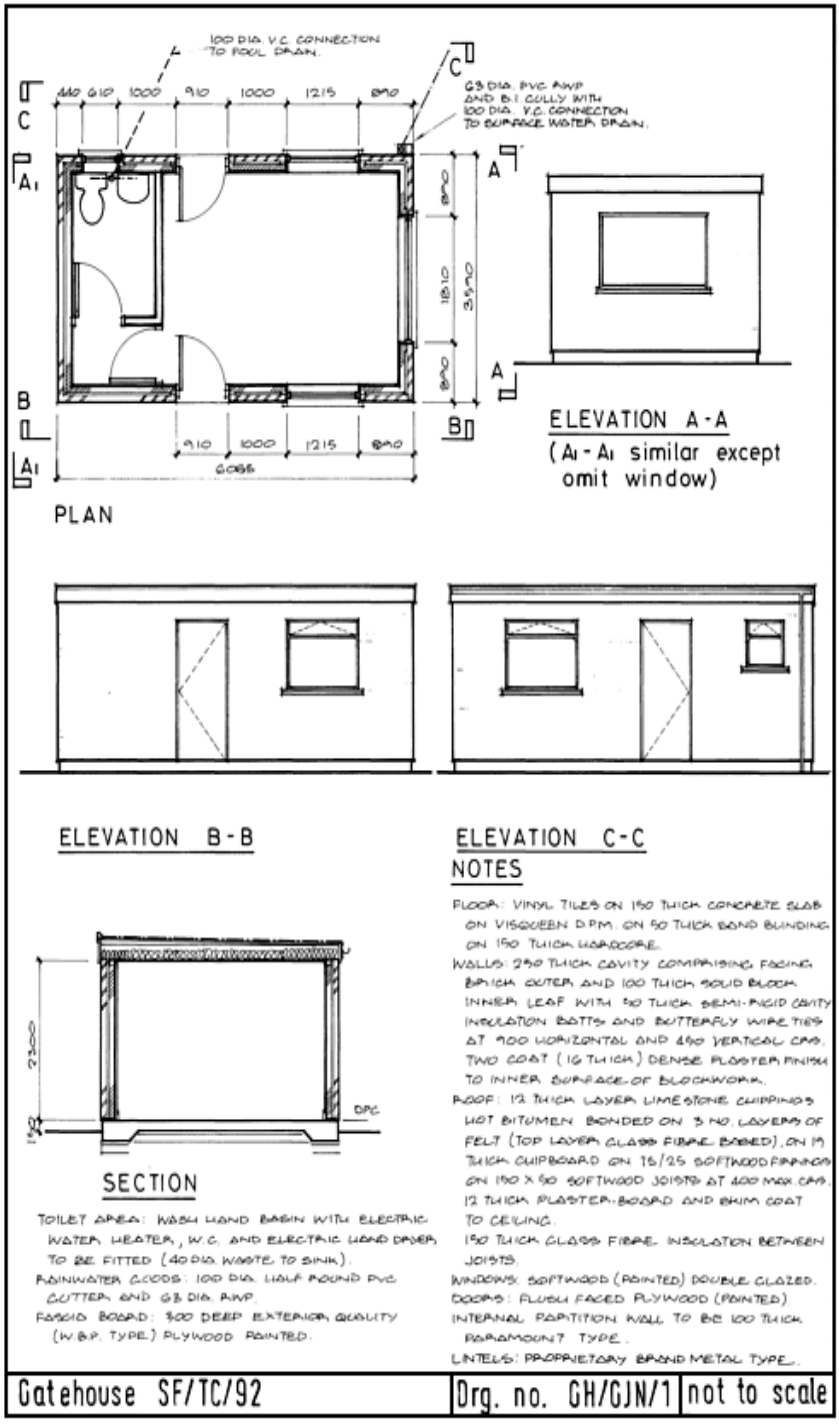
The weights of reinforcement per mm^2 of cross-sectional area are given in kg/m in the British Standard. The total weight of reinforcement must therefore be divided by 1000 to convert it to tonnes.

12mm nominal size (G524)

			(bar mark No)
8	3·00	24·00	(27
216	2·15	464·40	(23
4	2·68	10·72	(24a
40	2·18	87·20	(24b
192	4·35	835·20	(30
		1421·52	
	x 0·888	kg/m	
		1262·31	÷ 1000 = 1·26231T


Reinforcement
Explanatory Notes
16mm nominal size
(bar mark No)
(G 525)
45/ 1·45 69·60 (24
8/ 1·75 14·00 (24d
64/ 1·63 104·32 (24e
8/ 2·08 16·64 (31a
204·56
x1·579 kg/m
323·00 ÷ 1000 = 0·3230T
20mm nominal size
(G 526)
(bar mark No.)
100/ 5·08 508·00 (26a
16/ 3·00 48·00 (27a
556·00
x2·466 kg/m
1371·10 ÷ 1000 = 1·3711T

Chapter 8
GATEHOUSE



TOILET AREA: WASH HAND BASIN WITH ELECTRIC WATER HEATER, W.C. AND ELECTRIC HAND DRYER TO BE FITTED (40 DIA. WASTE TO SINK).
RAINWATER GOODS: 100 DIA. HALF ROUND PVC GUTTER AND G3 DIA. RWP.
FASCIA BOARD: 300 DEEP EXTERIOR QUALITY (W.B.P. TYPE.) PLYWOOD PAINTED.

NOTES

FLOOR: VINYL TILES ON 150 THICK CONCRETE SLAB ON VISQUEEN D.P.M. ON 50 THICK SAND BLINDING ON 150 THICK HARDCORE.
WALLS: 290 THICK CAVITY COMPRISING FACING BRICK OUTER AND 100 THICK SOLID BLOCK INNER LEAF WITH 50 THICK SEMI-RIGID CAVITY INSULATION BATTS AND BUTTERFLY WIRE TIES AT 900 HORIZONTAL AND 450 VERTICAL CRS. TWO COAT (16 THICK) DENSE PLASTER FINISH TO INNER SURFACE OF BLOCKWORK.
ROOF: 12 THICK LAYER LIMESTONE CHIPPINGS HOT BITUMEN BONDED ON 3 NO. LAYERS OF FELT (TOP LAYER GLASS FIBRE BASED), ON 19 THICK CHIPBOARD ON 75/25 SOFTWOOD FIXINGS ON 150 X 50 SOFTWOOD JOISTS AT 400 MAX. CRS. 12 THICK PLASTERBOARD AND SKIM COAT TO CEILING.
150 THICK GLASS FIBRE INSULATION BETWEEN JOISTS.
WINDOWS: SOFTWOOD (PAINTED) DOUBLE GLAZED.
DOORS: FLUSH FACED PLYWOOD (PAINTED)
INTERNAL PARTITION WALL TO BE 100 THICK PARAMOUNT TYPE.
LINTELS: PROPRIETARY BRAND METAL TYPE.

Gatehouse SF/TC/92	Drg. no. GH/GJN/1	not to scale

GATEHOUSE

Drawing No. GH/GJN/1

Explanatory Notes.

The following example shows a typical simple building which is often found on a water or sewage treatment works and is 'incidental to civil engineering works' and should be measured in accordance with the provisions of Class Z.

It is assumed that the foundations have been measured under Classes E, F and G, the brickwork under classes U and W and the decorating under Class V.

GATEHOUSE

CARPENTRY AND JOINERY

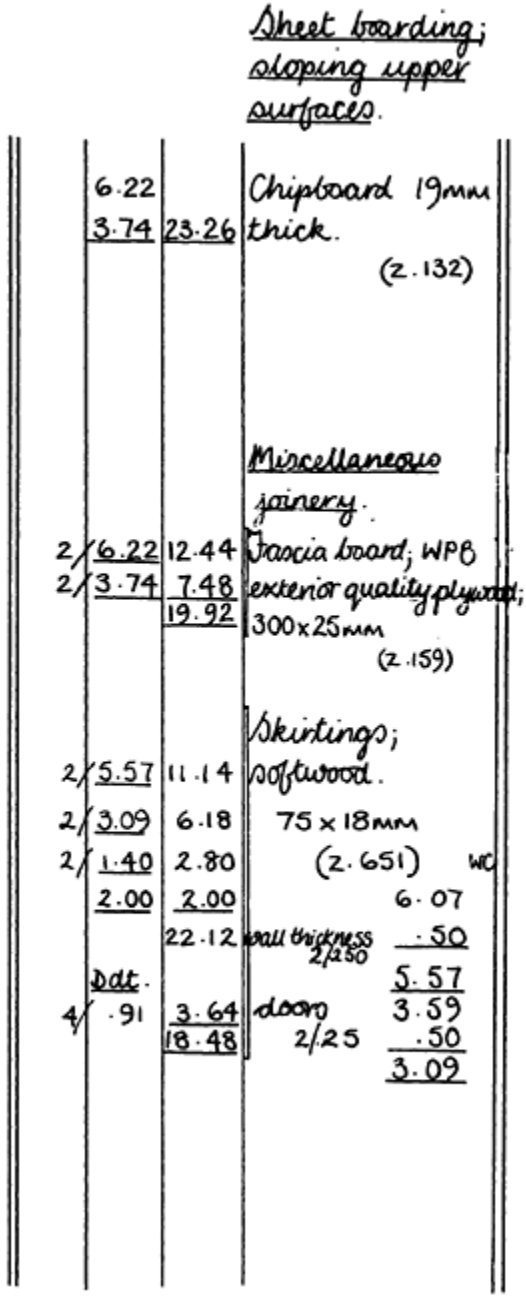
Structural and carcassing timber; flat roofs.

6.07
overhang 2/0.75 .15
400 | 6.22
15.55 + 1
= 17

Divide the length of building by the joist centres to calculate the number of joists required.

3.59
overhang 2/0.75 .15
3.74

17	3.74	63.58	Softwood joists; 150 x 50 mm (Z.113.1)	
			&	
			Firring pieces; 75 to 25 x 50mm (Z.113.2)	These tapered pieces (maximum height 75mm, minimum 25mm) create the slope to the roof.



Sheet boarding; sloping upper surfaces.

	6.22		Chipboard 19mm
	3.74	23.26	thick.
			(Z.132)

Miscellaneous joinery.

2/	6.22	12.44	Fascia board; WPB
2/	3.74	7.48	exterior quality plywood;
		19.92	300x25mm
			(Z.159)

Skirtings; softwood.

2/	5.57	11.14	75 x 18mm
2/	3.09	6.18	(Z.651) WC
2/	1.40	2.80	
	2.00	2.00	
		22.12	wall thickness 2/250
	Ddt.		
4/	.91	3.64	doors 2/25
		18.48	

6.07
.50
5.57
3.59
.50
3.09

Insulation.

16/	3.74		Glass fibre quilt 150mm thick, (aid between joists) (Z.229)
	.40	23.93	
			Windows, doors and glazing.
	1		Standard softwood window type 107v size 630×750mm (Z.311.1)
2/	1	2	Standard softwood window type 210w size 1200×1050mm (Z.311.2)
	1		Special observation window consisting of softwood members as specification clause 27.9; size 1810 × 1050mm. (Z.311.3)

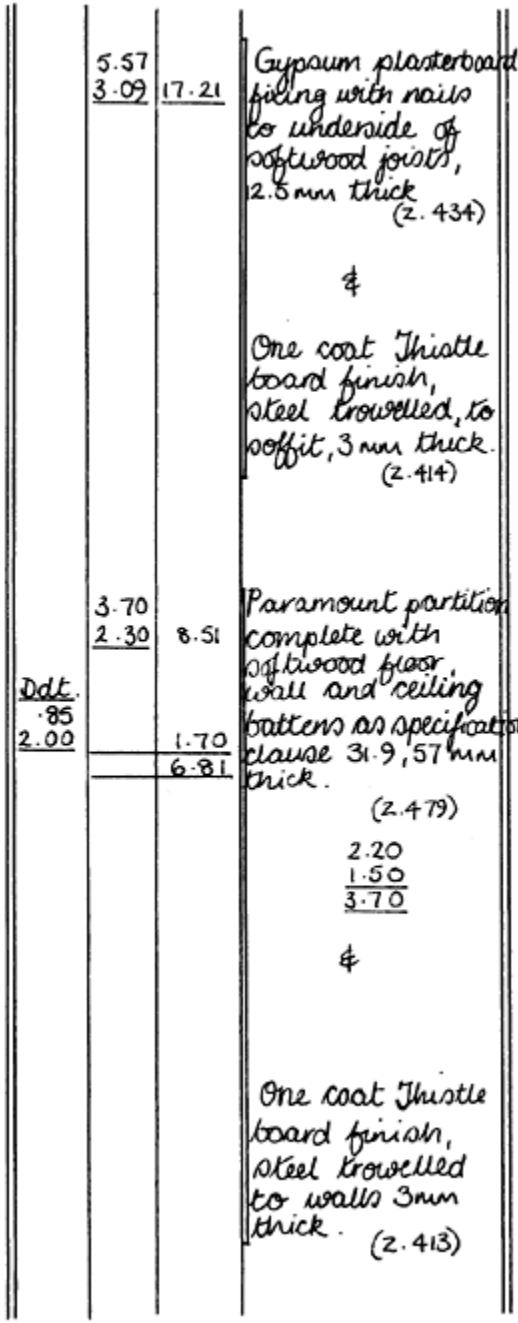
	1	1	Standard flush plywood faced internal flush door, 40mm thick, size 1981 x 762 mm (Z.313.1)
2/	1	2	Standard flush plywood faced external quality door, 44mm thick, size 1981 x 838 mm (Z.313.2)
	1	1	Standard softwood door lining size 27 x 94 mm for door size 1981 x 762 mm (Z.314.1)
2/	1	2	Standard softwood door frame size 33 x 64 mm for door size 1981 x 838 mm (Z.314.2)

2/	4.87 4.95 4.95	9.74 4.95 4.95 19.64	Miscellaneous joinery; softwood architraves once chamfered; size 75 x 18mm (Z.152)	
			Intl door 2/1.98 3.96 2/.075 .15 .76 4.87	
			Extl doors 2/1.98 3.96 2/.075 .15 .84 4.95	
			Ironmongery.	
3/	1 pr	3 pr	Steel butt hinges; 100mm (Z.341)	Note deviation from CESMM. Hinges are usually bought and sold in pairs not enumerated. The change should be listed in the Preamble.
2/	1	2	Yale cylinder night nin latch (Z.343.1)	
	1	1	SAA mortice latch with lever handles (Z.343.2)	SAA is an abreviation for satin anodised aluminium

	1	1	SAA wc indicating bolt (Z.343.3)	
2/	2	4	SAA Casement stay and fastener. (Z.349)	It is assumed that the windows are supplied without any ironmongery.
	1	1		
		5		
			Glazing	
2/	1.15		Standard plain glass; clear float, to wood frames in putty; 6mm thick. (Z.351.1)	
	.70	1.61		
2/	1.15			
	.18	.41		
	1.70			
	.95	1.61		
		3.94		
	.55		Standard plain glass; white patterned; to wood frames in putty 6mm thick (Z.351.2)	
	.40	.22		
	.55			
	.18	.09		
		.31		

Surface finishes, linings and partitions.

	5.57 3.09	17.21	In-situ finishes, cement and sand (1:3) floor screed, steel trowelled finish, 25mm thick. (Z.41.1) & Vinyl 'Polyflex' floor tiles, 2mm thick, fixed with adhesive (Z.42.1)	The screed and floor tiling has been measured under the partition although it may not be done this way on site.
	17.32 2.30 17.55 .10	39.83 1.75 41.58	In-situ finishes, one coat cement and sand (1:3) backing coat, one coat Thistle class B plaster to blockwork, steel trowelled finish 16mm thick.	The plaster is measured overall and the doors and windows are then deducted. CESMM does not mention work to reveals so these areas are added in.
Ddt. .63 .75 1.20 1.05 1.81 1.05 26.91 2.00	0.47 2.52 1.90 3.64	8.53 32.95	(Z.41.3) 2/5.57 11.14 2/3.09 6.18 17.32 Reveals Windows 2/.75 1.50 .63 2/2/1.05 4.20 2/1.20 2.40 2/1.05 2.10 1.81 Doors. 2/2.00 4.00 .91 17.55	



	5.57 3.09	17.21	Gypsum plasterboard ceiling with nails to underside of softwood joists, 12.5 mm thick (Z.434) & One coat Thistle board finish, steel trowelled, to soffit, 3 mm thick. (Z.414)
Ddt. .85 2.00	3.70 2.30	8.51 1.70 6.81	Paramount partition complete with softwood floor, wall and ceiling battens as specification clause 31.9, 57 mm thick. (Z.479) 2.20 1.50 3.70 & One coat Thistle board finish, steel trowelled to walls 3mm thick. (Z.413)

Piped building services.

		Pipework, copper pipe to BS2871, Table X lead free pre-soldered capillary joints, 15 mm diameter.	It is unusual for the pipework for the plumbing services to be shown on a drawing and the take off usually has to prepare an isometric sketch for his own use
1.00	1.00	to softwood skirting (Z.511.1)	
1.00 1.75		to plastered wall	
	2.75	(Z.511.2)	
		Extra over for	
1	1	15 mm equal tee (Z.512.1)	
4	4	15 mm elbow (Z.512.2)	
1	1	tap connector (Z.512.3)	
1	1	WC connector (Z.512.4)	
1	1	water heater connector (Z.512.5)	

	1	1	Stopcock to BS1010, lead free pre-soldered capillary joints, gunmetal with brass headwork, 15mm diameter. (Z.512.6)
			Equipment.
	1	1	'Streamline' oversink water heater, 7 litre, 1kw, with spout and valve, fixed to plastered wall. (Z.529.1)
	1	1	'Handidry' electric hand drier, 1.4kw, fixed to wall. (Z.529.2)
			Sanitary appliances and fittings.
	1	1	Wash basin, vitreous china, complete with chromium plated waste, overflow with chain and plastic plug, polypropylene P trap 40mm, 560x430mm white, wall mounted on brackets. (Z.530.1)

	1	1	'Aztec' chromium plated pillar tap 15 mm (Z.512.7)
	1	1	WC suite washdown type, vitreous china with plastic seat and cover, 9 litre cistern, ball valve, flush pipe, pan, connection to S trap. (Z.530.2)
	1.30	1.30	Ultra ABS marley waste system, solvent-welded joints, to clips, 40 mm diameter. (Z.511.3)
			Extra over for
	1	1	bend (Z.512.8)

Drainage to structures above ground.

	6.07	6.07	UPVC Terrain system rainwater gutter, straight half round, joint bracket joints, to softwood fascia with support brackets at 1m maximum centres (x .331)
	1	1	Stop end (x .332.1)
	1	1	Stop end outlet (x .332.2)
	2.55	2.55	UPVC Terrain system rainwater pipe, straight, connector joints, to brickwork with clips at 2m centres, plugging (x .333)
	1	1	Shoe (x .334)

Roofing

			Three layers of bituminous felt roofing fibre based surface type 1B weighing 25 kg/10 m², limestone chipping to top surface.
	6.07		Upper surfaces inclined at an angle not exceeding 30° to the horizontal
	3.59	21.79	(w. 341)
2/	6.07	12.14	Surfaces at width 100 mm
2/	3.59	7.18	
		19.32	(w. 347)

Chapter 9
MENSURATION AND USEFUL DATA

The metric system

Linear

1 centimetre (cm)	=	10 millimetres (mm)
1 decimetre (dm)	=	10 centimetres (cm)
1 metre (m)	=	10 decimetres (dm)
1 kilometre (km)	=	1000 metres (m)

Capacity

1 millimetre (ml)	=	1 cubic centimetre (cm^3)
1 centilitre (cl)	=	10 millilitres (ml)
1 decilitre (dl)	=	10 centilitres (cl)
1 litre (1)	=	10 decilitres (dl)

Weight

1 centigram (cg)	=	10 milligrams (mg)		
1 decigram (dg)	=	10 centigrams (cg)		
1 gram (g)	=	10 decigrams (dg)		
1 decagram (dag)	=	10 grams (g)		
1 hectogram (hg)	=	10 decagrams (dag)		
1 kilogram (kg)	=	10 hectograms (hg)	=	1000 grams (g)

Imperial/metric conversions

Linear

1 in	=	25.4mm	1mm	=	0.03937in
1 ft	=	304.8mm	1cm	=	0.3937in
1 yd	=	914.4mm	1dm	=	3.937in
			1m	=	39.37in

Imperial/metric conversions (cont'd)

Square

1 in^2	=	645.16mm^2	1cm^2	=	0.155 in^2
1 ft^2	=	0.0929m^2	1m^2	=	10.7639 ft^2
1 yd^2	=	0.8361m^2	1m^2	=	1.196yd^2

Cube

1 in^3	=	16.3871cm^3	1cm^3	=	0.061 in^3
1 ft^3	=	0.0283m^3	1m^3	=	35.3148 ft^3
1 yd^3	=	0.7646m^3	1m^3	=	1.307954 yd^3

Capacity

1 fl oz	=	28.4ml	1ml	=	0.0353 fl oz
1 pt	=	0.568 ltr	1dl	=	3.52 fl oz
1 gallon	=	4.546 ltr	1 ltr	=	1.7598 pt

Weight

1 oz	=	28.35g	1g	=	0.035 oz
1 lb	=	0.4536kg	1kg	=	35.274 oz
1 st	=	6.35kg	1t	=	2204.6 lb
1 ton	=	1.016t	1t	=	0.9842 ton

Temperature equivalents

In order to convert Fahrenheit to Celsius deduct 32 and multiply by 5/9. To convert Celsius to Fahrenheit multiply by 9/5 and add 32.

Fahrenheit		Celsius
230		110.0
220		104.4
212	Boiling point	100.0
210		98.9
200		93.3
190		87.8
180		82.2
170		76.7
160		71.1

Fahrenheit		Celsius
150		65.6
140		60.0
130		54.4
120		48.9
110		43.3
90		32.2
80		26.7
70		21.1
60		15.6
50		10.0
40		4.4
32	Freezing point	0.0
30		−1.1
20		−6.7
10		−12.2
0		−17.8

General information

Bricks Number of bricks m^2 in half brick thick wall in stretcher bond

50×102.5×215mm	74
65×102.5×215mm	59
75×102.5×215mm	52

Blocks Number of blocks per square metre

450×225mm	10
450×300mm	7
450×225mm	7

Timber 1 standard=4.67227 cubic metres
1 cubic metre=35.3148 cubic feet
10 cubic metres=2.140 standards

Melting points of materials

Aluminium	658°C
Brass	927–1010°C
Bronze	912°C

Melting points of materials (cont'd)

Cast iron	1186°C
Copper	1083°C
Lead	327°C
Nickel	1452°C
Steel	1371°C
Tin	230°C
Zinc	419°C

Milled lead to BS1178

Code	Thickness	Weight	Colour code
3	1.32mm	14.97 kg/m^2	Green
4	1.80mm	20.41 kg/m^2	Blue
5	2.24mm	25.40 kg/m^2	Red
6	2.65mm	30.05 kg/m^2	Black
7	3.15mm	35.72 kg/m^2	White
8	3.55mm	40.26 kg/m^2	Orange

Soil properties

The study and classification of soils is clearly a subject of scientific investigation. The following information is provided as a guide only and should be used with caution. The figures given represent density in tonnes per m^3.

Soil	Loose	Compacted	Bearing capacity tonnes/m^2	Bulk* volume	Compacted* volume
Bog or peat	0.56	1.12	up to 2.0	1.1–1.3	-
Chalk	-	2.10	11–45	1.5–2.0	1.3–1.4
Clay—sandy	-	1.76	33–45	1.1–1.3	0.9–1.0
Clay—firm	-	1.92	45–65	1.3–1.4	0.9–1.0
Clay—stiff	-	2.08	65–75	1.5	1.0
Gravel	1.76	1.92	66–90	1.0–1.30	0.9–1.0
Rock—soft	-	2.20	50–100	1.5–2.0	1.3–1.4
Rock—hard	-	2.70	100–200	1.5–2.0	1.3–1.4
Sand	1.44	1.76	22–40	1.0–1.10	0.9–1.0

* These figures are factors that will increase or decrease the net volume of undisturbed soil.

Soil definitions

SOFT - can be readily excavated with a spade and easily moulded with the fingers.

FIRM - can be excavated with a spade and moulded with substantial pressure by the fingers.

STIFF - requires a pick or pneumatic tool for excavation and cannot be moulded with the fingers.

ManholesÐconcrete surrounds

The following figures are net m^3 of concrete surround per metre of standard circular manhole segment to BS556.

nominal diameter	outside diameter	150mm surround	300mm surround
675mm	800mm	0.448	1.037
900mm	1048mm	0.565	1.271
1050mm	1219mm	0.645	1.432
1200mm	1397mm	0.729	1.599
1350mm	1575mm	0.813	1.767
1500mm	1727mm	0.885	1.910

nominal diameter	outside diameter	150mm surround	300mm surround
1800mm	2032mm	1.028	2.198
2100mm	2388mm	1.196	2.533
2400mm	2692mm	1.339	2.820

Pipe beds and surrounds

The following are net quantities of material. Appropriate increases should be made for compaction, wastage and trench overbreak. All quantities are m^3 per metre of trench.

	Pipe diameter plus 300mm=trench width		Pipe diameter plus 600mm=trench width	
Pipe diameter (outside diameter)	150mm Bed	150mm Bed and surround	150mm Bed	150mm Bed and surround
100mm	0.060	0.152	0.105	0.272
150mm	0.068	0.185	0.113	0.320

Pipe beds and surrounds (cont'd)

	Pipe diameter plus 300mm=trench width		Pipe diameter plus 600mm=trench width	
Pipe diameter (outside diameter)	150mm Bed	150mm Bed and surround	150mm Bed	150mm Bed and surround
200mm	0.075	0.219	0.120	0.369
225mm	0.079	0.236	0.124	0.393
250mm	0.083	0.253	0.128	0.418
300mm	0.090	0.289	0.135	0.469
375mm	0.101	0.345	0.146	0.548
400mm	0.105	0.364	0.150	0.574
450mm	0.1125	0.403	0.158	0.628
500mm	0.120	0.444	0.165	0.684
600mm	0.135	0.527	0.180	0.797
750mm	0.158	0.661	0.203	0.976
900mm	0.180	0.804	0.225	1.164
1050mm	0.203	0.957	0.248	1.362
1200mm	0.225	1.119	0.270	1.569
1500mm	0.270	1.473	0.315	2.013

Velocity

To convert	Multiply by
Miles per hour into kilometres per hour	1.60934
Feet per second into metres per second	0.3048
Feet per minute into metres per second	0.00508
Feet per minute into metres per minute	0.30348
Inches per second into millimetres per second	25.4
Inches per minute into millimetres per second	0.42333
Inches per minute into centimetres per minute	2.54

Fuel consumption

To convert	Multiply by
Gallons per mile into litres per kilometre	2.825
Miles per gallon into kilometres per litre	0.354

Density

Tons per cubic yard into kilogrammes per cubic metre	1328.94
Pounds per cubic foot into kilogrammes per cubic metre	16.0185
Pounds per cubic inch into grammes per cubic centimetre	27.6799
Pounds per gallon into kilogrammes per litre	0.09978

Average plant outputs (cubic metres per hour)

Bucket size	Soil	Sand	Heavy clay	Soft rock
Face Shovel				
200	11	12	7	5
300	18	20	12	9
400	24	26	17	13
600	42	45	28	23
Backactor				
200	8	8	6	4
300	12	13	9	7
400	17	18	11	10
600	28	30	19	15
Dragline				
200	11	12	8	5
300	18	20	12	9
400	25	27	16	12

Bucket size	Soil	Sand	Heavy clay	Soft rock
600	42	45	28	21

Bulkage of excavation

	Multiply volume by %
Soil	25
Gravel	15
Sand	12.5
Chalk	50
Clay (heavy)	30
Rock	30

Reinforcement mass

Hot rolled bars		Stainless steel bars	
Size in mm	Mass per metre in kg	Size in mm	Mass per metre in kg
6	0.222	10	0.667
8	0.395	12	0.938
10	0.616	16	1.628
12	0.888	20	2.530
16	1.579	25	4.000
20	2.466	32	6.470
25	3.854		
32	6.313		
40	9.864		
50	15.413		

Mesh fabric

	Mesh size		Wire size		
	Main mm	Cross mm	Main mm	Cross mm	kg
A393	200	200	10	10	6.16
A252	200	200	8	8	3.95
A191	200	200	7	7	3.02
A142	200	200	6	6	2.22
A98	200	200	5	5	1.54
B1131	100	200	12	8	10.90

	Mesh size		Wire size		
	Main mm	Cross mm	Main mm	Cross mm	kg
B785	100	200	10	8	8.14
B503	100	200	8	8	5.93
B385	100	200	7	7	4.53
B283	100	200	6	7	3.73
B196	100	200	5	7	3.05
C785	100	400	10	6	6.72
C503	100	400	8	5	4.34
C385	100	400	7	5	3.41
C283	100	400	6	5	2.61
D98	200	200	5	5	1.54
D49	100	100	2.5	2.5	0.77

Standard wire gauge and metric equivalent

SWG	mm	SWG	mm
3	6.40	15	1.83
4	5.89	16	1.63
5	5.38	17	1.42
6	4.88	18	1.21
7	4.47	19	1.02
8	4.06	20	0.91
9	3.63	21	0.81
10	3.25	22	0.71
11	2.95	23	0.61
12	2.65	24	0.56
13	2.34	25	0.51
14	2.03	26	0.46

Paper sizes

Size	mm	Inches
A0	841×1189	33.11×46.81
Al	594×841	23.39×33.11
A2	420×594	16.54×23.39
A3	297×420	11.69×16.54
A4	210×297	8.27×11.69

Size	mm	Inches
A5	148×210	5.83×8.27
A6	105×148	4.13×5.83
A7	74×105	2.91×4.13
A8	52×74	2.05×2.91
A9	37×52	1.46×2.05
A10	26×37	1.02×1.46

Weights of materials

Material	tonnes per m^3
Ashes	0.68
Aluminium	2.68
Asphalt	2.31
Brickwork—engineering	2.24
Brickwork—common	1.86
Bricks—engineering	2.40
Bricks—common	2.00

Weights of materials

Cement—Portland	1.45
Cement—rapid hardening	1.34
Clay—dry	1.05
Clay—wet	1.75
Coal	0.90
Concrete	2.30
Concrete—reinforced	2.40
Earth—topsoil	1.60
Glass	2.60
Granite—solid	2.70
Gravel	1.76
Iron	7.50
Lead	11.50
Limestone—crushed	1.75
Plaster	1.28
Sand	1.90
Slate	2.80
Tarmacadam	1.57
Timber—general construction	0.70

Water	1.00

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