BASIC BUILDING MEASUREMENT

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CHAPTER 1

INTRODUCTION

This book is a basic introductory text for students studying the measurement of building works and is designed to be used in conjunction with the *Australian Standard Method of Measurement of Building Works*, 5th Edition, 1990 (SMM).

The sequence of this book is different from most other quantity surveying text books in that the material is not presented in trade order, but follows an approach of starting with simple tasks and then proceeding to the more difficult areas. This aligns with the traditional method of training staff adopted by most quantity surveying practices.

1.01. TERMINOLOGY

There are a number of terms and phrases used by the quantity surveying profession when measuring quantities and it is essential that these are fully understood by the student before measurement begins. Many of the terms and phrases are unique to the construction industry and have a different meaning from that which is listed in the dictionary. The following terminology is used in this book and as such students should become familiar with these terms.

Bill of Quantities: A trade order list of materials, labour and services necessary to construct a particular project.

Billing: The quantity surveying process of writing or drafting Bill of Quantities descriptions and presenting the quantity for each description.

Billing Units: The unit of measurement used when billing. For example:

	BILLING UNIT	SYMBOL
LENGTH	metre	m
AREA	square metre	m^2
VOLUME	cubic metre	m^3
MASS	tonne	t
NUMBER	number	no

Measure: The quantity surveying process of measuring or "taking off" the quantities from the drawings.

Extend: The quantity surveying process of carrying out all the mathematical calculations to arrive at a total quantity for each description in the Bill of Quantities.

Bill, measure and extend [b.m.e.]: The total quantity surveying process of writing a description, measuring the quantity from the drawings, carrying out all the necessary calculations and, finally, billing the answer. This total process is explained in Chapters 3 and 4.

Ditto [do.]: A term meaning "all as above described", that is, in the preceding description. This is illustrated in the following example:

a	Internal flush hollow core doors each 2040 x 820 x 35 thick, veneered for paint finish and hung on a pair of 100mm steel butt hinges to timber frames.	no	10
b	Ditto, each 2340 x 820 x 35 thick, and hung on three 100mm steel butt hinges.	no	6

The *"Ditto"* used in the second description means *Internal flush hollow core doors*, each 2340 x 820 x 35 thick, *veneered for paint finish* and hung on three 100mm steel butt hinges *to timber frames*.

Ditto is used very frequently in a Bill of Quantities and saves the quantity surveyor a lot of time when writing Bill of Quantities descriptions.

Item: A term used in the Bill of Quantities to signify a description involving a cost to the builder but where no quantity is required to be given. For example:

a	Allow for the preparation of shop drawings.	Item

Note: A term used in the Bill of Quantities to signify a description involving no direct cost to the builder but which will influence the pricing of subsequent descriptions. For example:

a	Refer to the Specification for particulars of woodwork.	Note

1.02. ABBREVIATIONS

Quantity surveyors often use standard abbreviations when billing and it is essential that the student has a knowledge of these abbreviations. The following abbreviations have been used in this text and students are advised to familarise themselves with these terms.

a.b.d.	as before described
a.b.s.	as before specified
b.m.e.	bill, measure and extend
c.p.	chromium plated
cts	centres
ddt	deduction

diam.	diameter
d.p.c.	damp proof course
E.o.	extra over
ex	out of
F.F.L.	finished floor level
F.L.	floor level
f.s.	finished size
ftgs	footings
galvd	galvanised
G.F.A.	gross floor area
G.L.	ground level
GPO	general purpose outlet
HDUPVC	heavy duty unplasticised polyvinyl chloride
HE	fitment hook end allowance
I.L.	invert level
in-situ	in position
O.T.R.	other than rock
P.C.	prime cost
P.C.A.	plumb cut allowance
p.v.a.	polyvinyl acetate
p.v.c.	polyvinyl chloride
rebar	bar reinforcement
R.L.	reduced level
R.O.Z.C.	red oxide zinc chromate
SMM	*Australian Standard Method of Measurement of Building Works* (5th Edition)
t.c.	terracotta
T & G	tongue and groove
UPVC	unplasticised polyvinyl chloride
v.c.	vitrified clay

1.03. METRIC UNITS

It has been assumed that students using this text will have a basic knowledge of the S.I. metric system. The construction industry does not use all the S.I. metric units but is restricted to the following units:

LENGTH	**metre**	**m**	
	millimetre	mm	1000mm = 1m
	kilometre	km	1000m = 1km
AREA	**square metre**	**m^2**	
	hectare	ha	1ha = 10,000m^2
VOLUME	**cubic metre**	**m^3**	
	litre	L	1000L = 1m^3
MASS	**tonne**	**t**	
	kilogram	kg	1000kg = 1t

Except for the hectare, the construction industry is restricted to using only the following metric prefixes:

Prefix	Symbol	Magnitude
mega	M	10^6
kilo	k	10^3
milli	m	10^{-3}
micro	μ	10^{-6}

CHAPTER 2

BILLS OF QUANTITIES AND THE SMM

2.01. BILL OF QUANTITIES

A Bill of Quantities is a trade order list of materials, labour and services necessary to complete a given project.

For large building projects the client may employ a professional quantity surveyor to prepare a Bill of Quantities. However, on small building works it is normal for the builder to prepare his own Bill of Quantities.

When a professional quantity surveyor is employed by the client to prepare the Bill of Quantities, each tenderer is issued with several copies of the Bill of Quantities. The Bill of Quantities is then used to assist the builder in arriving at his tender figure by pricing each item in the Bill of Quantities.

2.02. BILL OF QUANTITIES FORMAT

The traditional Bill of Quantities is arranged in trade order. The order of trades is normally in the same order as the Specification.

Apart from being arranged in trade order, each trade has the facility for each description to be priced and totalled to give the total cost of each trade. The total trade cost is then transferred to a General Summary to obtain the total project cost.

In order to be able to refer to any section in the Bill of Quantities, each description is given a separate and distinct reference. It is also normal practice for each page to be numbered and labelled with the project name and trade.

A Bill of Quantities prepared by a professional quantity surveyor is prepared in accordance with the rules set out in the *Australian Standard Method of Measurement of Building Works* (SMM) and is measured **NET**, and as such is not an order list.

Other Bill of Quantity formats include:

Specification and Bill of Quantities: As the name implies, this document contains both the Specification and the Bill of Quantities rather than having two separate documents.

Specified Bill of Quantities: This document is similar to the Specification and Bill of Quantities except that the Specification is incorporated with the Bill of Quantities in the form of preamble notes and the Bill of Quantity descriptions. The quantities do not normally form part of the contract but the preambles and descriptions are part of the contract.

Elemental Bill of Quantities: A Bill of Quantities prepared in elemental format rather than the traditional trade order sequence.

Provisional Bill of Quantities: A Bill of Quantities containing provisional quantities and issued to tenderers on the basis that the billed quantities will be adjusted during construction where they differ from the actual quantity. This type of Bill of Quantities is normally used where the drawings and specification cannot be finalised prior to calling tenders. It has the advantage of reducing the documentation period and allows the builder to commence work earlier.

Operational Bill of Quantities: This type is rarely used and is simply a Bill of Quantities presented in site operational sequence rather than the traditional trade order sequence.

Builder's Bill: An abbreviated Bill of Quantities where the quantities have NOT been prepared in accordance with the SMM, but often contain bulked quantities and incorporate sub-contract quotations where appropriate. They are used by builders when they are not issued with a Bill of Quantities by the client and serve as a quick and convenient method when preparing a tender. There are no formal rules covering their preparation and format. The amount of detail is the prerogative of each particular builder.

2.03. SAMPLE PAGES

Following are typical pages from a traditional trade order sequence Bill of Quantities.

Page 7 is a typical trade section page. Note that each description has an alphabetical prefix, measurement details are not shown, specific locations are not given in the descriptions, and the unit rate column and monetary column are left blank. The builder would estimate the cost of each item, total all the items on the page and transfer the total to the Trade Collection.

Page 8 is a typical Trade Collection where the builder collects all the page totals for the particular trade to arrive at the total cost of the trade section.

This total trade cost is then transferred to a General Summary (refer page 9) where all the trade sections are totalled to arrive at the total amount of tender.

Bills of Quantities prepared using computer software packages are presented in the same format as noted above. However, they are more convenient for the builder to price during the tender stage since the builder is only required to enter the unit rates for each description. The multiplication of the unit rate by the quantity, monetary additions, trade totals and the General Summary total are automatically carried out and are a function of the software. This saves the builder time when preparing a tender.

2.03.01. SAMPLE PAGE FROM WOODWORK TRADE

	Door Frames					
a	125 x 50 dressed select Coachwood single rebated internal door frames to suit 2040 x 820 x 40 thick internal doors, comprising jambs and head framed together and fixed to timber wall framing.	no	2			
b	150 x 50 ditto.	no	6			
	Doors					
c	Internal doors type A, each 2040 x 820 x 40 thick hollow core doors lined on both faces with Coachwood veneer for clear finish; include for hanging to timber frames with two 100mm steel butt hinges.	no	8			
	Skirtings					
d	75 x 25 dressed select Coachwood splayed skirting fixed to timber framed walls.	m	120			
	Architraves					
e	50 x 25 dressed select Coachwood splayed architraves fixed to door frames.	m	84			
	Shelving					
f	300 wide, 300 high gallows brackets to support shelving, framed up having 50 x 25 wrot Oregon members, plugged and screwed to brick walls.	no	18			
g	450 wide, 450 high ditto.	no	6			
h	300 wide, 15 thick edge stripped Pyneboard shelving fixed to gallows brackets.	m	15			
i	450 wide ditto.	m	5			
				To Collection:		$
	SAMPLE BILL WOODWORK 140					

2.03.02. SAMPLE TRADE COLLECTION PAGE

WOODWORK COLLECTION:

Page 138 $

Page 139 $

Page 140 $

Page 141 $

WOODWORK TO GENERAL SUMMARY: $

2.03.03. SAMPLE GENERAL SUMMARY PAGE

GENERAL SUMMARY

PRELIMINARIES	11	$	
DEMOLITION	16	$	
GROUNDWORKS	22	$	
CONCRETE	26	$	
MASONRY	55	$	
STRUCTURAL STEEL	75	$	
METALWORK	101	$	
WOODWORK	142	$	
GLAZING	144	$	
HARDWARE	150	$	
ROOFING	160	$	
WINDOWS	170	$	
DOORS	180	$	
FINISHES	185	$	
PAINTING	205	$	
FURNITURE	215	$	
HYDRAULICS	224	$	
DRAINAGE	236	$	
ELECTRICAL INSTALLATIONS	242	$	
TOTAL AMOUNT OF TENDER:		**$**	

This Bill of Quantities contains 243 pages numbered consecutively from 1 to 243. Please see that no page is missing nor any in duplicate and that all trades have been carried to General Summary.

SAMPLE BILL
GENERAL SUMMARY 243

2.04. AUSTRALIAN STANDARD METHOD OF MEASUREMENT (SMM)

The SMM states that the *"purpose of the Standard Method of Measurement is to provide a uniform basis for the measurement of building works"*. It is a book of measurement rules and like most other rule books does not instruct you how to measure quantities but rather lists the principles and conventions that apply when measuring quantities. After perusing the SMM you will notice that it is broken into a number of sections commencing with Section 1, Introduction, General Rules and Recommendations, which is followed by a number of trade sections. These trade sections generally align with the NATSPEC Specification sections.

After reading Section 1 you should have noted the following major points:

1. Unless otherwise stated, all work is measured net as fixed in position.

2. Minimum deduction requirements.

3. Unless otherwise stated, descriptions in Bills of Quantities are deemed to include:

   (a) materials and goods including materials required for lapping, jointing and the like and all costs in connection therewith such as conveyance, delivery, unloading, storing, returning packings, handling, hoisting and lowering;

   (b) square, raking, splay and circular cutting;

   (c) waste of materials;

   (d) labour and all costs in connection therewith including the labour in drilling, setting, fitting and fixing of materials and goods in position;

   (e) establishment costs, overhead costs and profit;

   (f) plant and equipment;

   (g) taxes, overtime, bonus and incentive payments, duties and royalties;

   (h) protection of work against damage except where specific means of protection are stated in the contract documents in which case items shall be given in the appropriate sections.

4. The importance of the Measurement and Prices Clauses.

Refer to Chapter 4 for further information regarding Bill of Quantities descriptions.

CHAPTER 3

THE MEASUREMENT PROCESS

3.01. MEASUREMENT RULES

The first step to be undertaken when preparing a Bill of Quantities is the measurement process or "taking off" the quantities from the drawings.

The SMM, Section 1, Introduction, General Rules and Recommendations, Part 3, Measurement, Clause 3.2, states that:

> *In calculating the cubic content of members with specifically designed dimensions, such dimensions (e.g. thickness of concrete slabs and walls, cross-sectional sizes of beams and columns) shall be taken exactly. In all other cases, measurements before calculation shall be taken to the next 0.01 metre except as required in Section 9 Structural Steel.*

Except for the cubic content of members with specifically designed dimensions and Structural Steel, all other take-off figures should be in metres to two decimal places. Since architectural drawings are dimensioned in millimetres it is necessary to convert the plan dimensions to metres to two decimal places when transposing dimensions to the quantity surveying paper.

Drawing Dimension (mm)	Take-off Figure (m)
2229	2.23
2314	2.32
2400	2.40

EXERCISE 3.01.01 Convert the following drawing dimensions to take-off figures:

Drawing Dimension (mm)	Take-off Figure (m)
2000	_____
200	_____
16342	_____
1114	_____
38	_____
9991	_____
772	_____

3.02. STANDARD RULED QUANTITY SURVEYING PAPER

The traditional method of measuring quantities is to manually write all the take-off figures on standard ruled quantity surveying paper. Unfortunately, there is no national standard ruled paper and each office has its own customised ruling. To further complicate the issue, a growing number of practices no longer use paper but input the take-off figures directly into a computer. Nevertheless, this text adopts a vertical format quantity surveying paper with a traditional manual set out of take-off figures. Whilst individual offices may vary, the measurement principles involved should be the same including where computerised methods are employed.

Refer to the following page for a sample of the quantity surveying paper used in this text.

The paper is divided into six major vertical columns. The first column, "ITEM", is used for the description reference; the second column, "DESCRIPTION", is used for the billing; the third column, "UNIT", is used for the billing unit; the fourth column, "QUANTITY", is used for the billed quantity; the fifth column, "RATE", is used for the estimated unit rate (i.e. cost per billing unit); and the sixth column is a money column.

ITEM	DESCRIPTION					UNIT	QUANTITY	RATE	$	c
1			2			3	4	5	6	

The second column, "DESCRIPTION", is subdivided into five vertical sub-columns which are used for the measurement process. The first sub-column is used as a factor column, the second for take-off figures, the third for extensions, the fourth for locations, and the fifth for sidecasts.

ITEM	DESCRIPTION					UNIT	QUANTITY	RATE	$	c
	1	2	3	4	5					
	Factor	Take-	Exten-	Location	Side-					
		Off	sions		casts.					
		Figures								

The paper also has facility for the project name, trade and page number to be listed on the top right hand corner. This is important as it acts as a control to avoid missing or misplaced pages and confusion with other projects. It is essential that this information is filled in on every sheet when measuring the quantities.

PROJECT: _____

TRADE: _____

PAGE: _____

3.03. SAMPLE QUANTITY SURVEYING PAPER

PROJECT:
TRADE:
PAGE:

ITEM	DESCRIPTION					UNIT	QUANTITY	RATE	$	c

3.04. SET OUT OF TAKE-OFF FIGURES

Following are examples of linear, area, volume and number take-off. Note the following points:

1. Except for number take-off, all take-off figures are expressed in metres to two decimal places, and NO metric symbol is used after each take-off figure. In the case of number take-off, integer numbers are used.

2. Take-off figures are written down the page and not across the page.

3. A horizontal line is placed under take-off figures to signify the difference between linear, area and volume take-off. No multiplication signs are used.

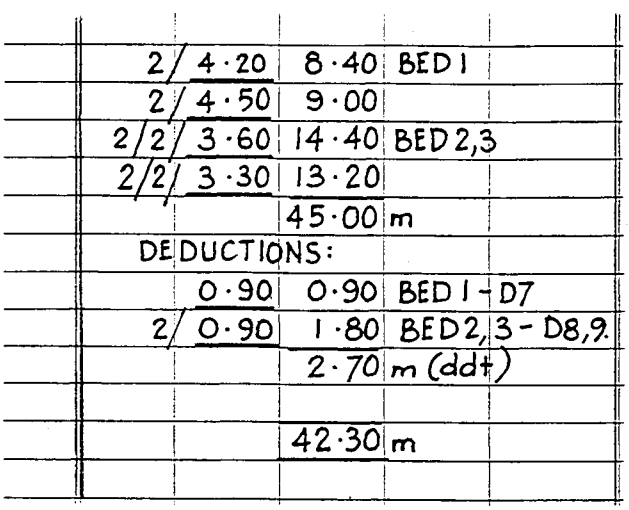
4. All extensions, except for number take-off, are calculated to the closest second decimal place.

5. All take-off figures are referenced back to the drawings in the location sub-column. This allows work to be identified and checked at a later date.

6. The factor column is used to multiply take-off figures by common factors, e.g. 2/ in the case of two identical floors, etc.

7. The fifth column is used to calculate a take-off figure where the take-off figure cannot be taken directly from the drawings. Such calculations are termed *sidecasts*. This column is also used to list supplementary information and location keys.

3.04.01. SET OUT: LINEAR TAKE-OFF



	2/ 4·20	8·40	BED 1		
	2/ 4·50	9·00			
2/2/	3·60	14·40	BED 2,3		
2/2/	3·30	13·20			
		45·00	m		
DEDUCTIONS:					
	0·90	0·90	BED 1 - D7		
2/	0·90	1·80	BED 2,3 - D8,9		
		2·70	m (ddt)		
		42·30	m		

3.04.02. SET OUT: AREA TAKE-OFF

	4·20		BED 1	
	4·50	18·90		
2 /	3·60		BED 2,3	
	3·30	23·76		
3 /	0·90		D7, 8, 9.	
	0·10	0·27		
		42·93	m^2	

3.04.03. SET OUT: VOLUME TAKE-OFF

	LENGTH			
	WIDTH			
	DEPTH			
	16·00		FB1, 3	
2 /	0·40			
	0·60	7·68		
	8·00		FB2, 4	
2 /	0·40			
	0·60	3·84		
	7·60		FB5	8000
	0·40			400-
	0·60	1·82		7600
		13·34	m^3	
	ALTERNATIVE		SET OUT:	
2 /	16·00	32·00	FB1, 3	
2 /	8·00	16·00	FB2, 4	
	7·60	7·60	FB5	
		55·60	m x 0·40 x 0·60 =	13·34 m^3

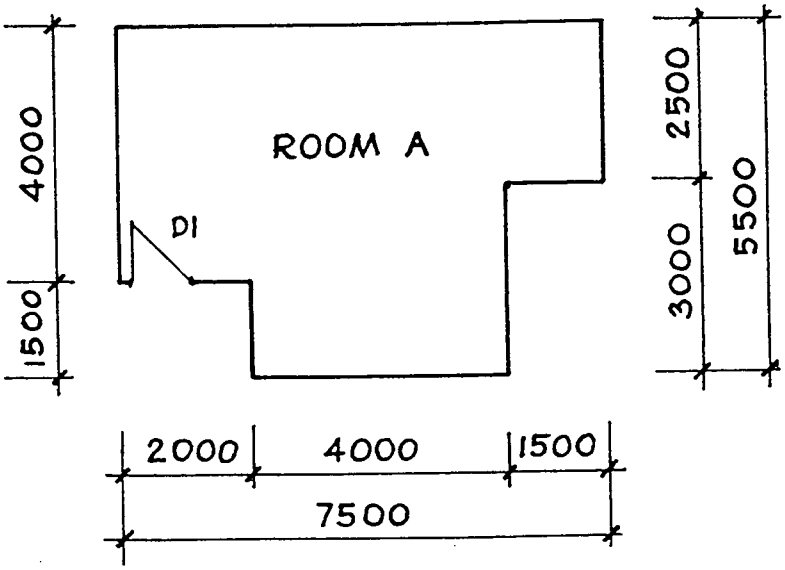
3.04.04. SET OUT: NUMBER TAKE-OFF

2	2	W1, 2	
3	3	W5-7	
	5		

3.05. LINEAR TAKE-OFF

3.05.01. PERIMETER MEASUREMENT

When measuring quantities it is often necessary to calculate the perimeter length of rooms, buildings, etc. When carrying out this basic task it is important that you use overall measurements rather than individual component lengths. Refer to the plan of Room A shown below. The correct method is to measure twice times the overall length and twice times the overall width rather than the incorrect method of measuring the eight individual wall lengths. Apart from being quicker, there is less likelihood of making an error and often individual wall lengths are not dimensioned on the plan. It is also essential to colour the plans as you write down each take-off figure to ensure that you have not missed lengths which should be included. The correct solution for the measurement of skirtings to Room A is shown below. Note that the total perimeter length is calculated first, then the door opening is deducted.

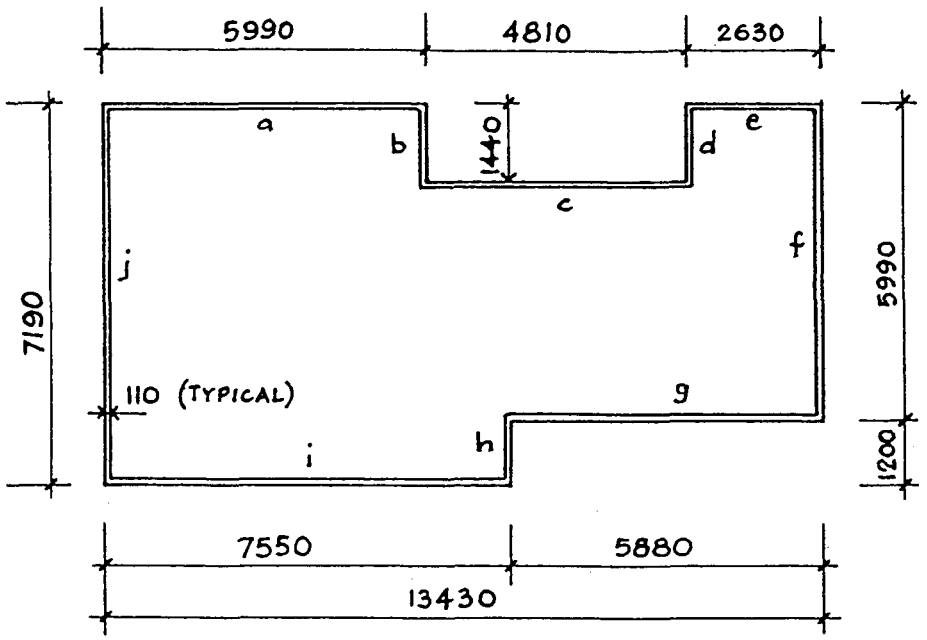


PLAN

2 / 7.50		Rm.A
2 / 5.50		"
	26.00	
Deductions:		
0.90	0.90	Rm.A / D1
	25.10m	

3.05.02. CENTRE LINE MEASUREMENT

Another type of linear measurement is the centre line or under-to-over measurement. This is used for measurement of brick walls, trench excavation, strip footings, etc. Shown below is a Foundation Brickwork Plan. In order to measure the 110mm thick enclosing brick walls it is necessary to calculate the centre line length of the walls. The method adopted is to start at the top left hand corner and work in a clockwise direction. The centre line length of each wall is equal to the overall length of the wall minus the thickness of the wall, or the under-to-over length. It is normal practice to label each wall with an alphabetical notation in order to locate take-off figures (see below).

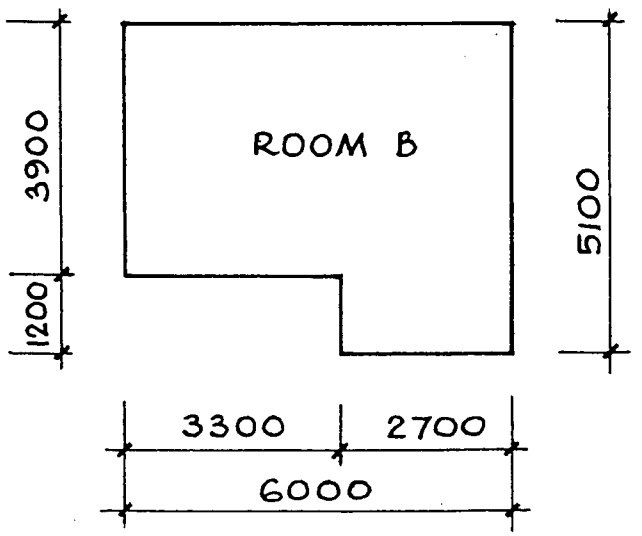


FOUNDATION BRICKWORK PLAN

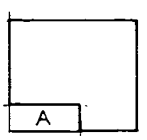
5.88		a
1.44		b
4.92		c
1.44		d
2.52		e
5.88		f
5.88		g
1.20		h
7.44		i
7.08	_____	j
	43.68m	

3.06. AREA TAKE-OFF

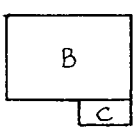
Area take-off is a simple procedure, requiring the measurer to determine length and width take-off figures. Consider the plan shape shown below. There are two methods of determining the area. Firstly, to measure overall and deduct the corner rectangle. Secondly, to divide the room into two separate rectangles. The overall method is the preferred option; however, the other method is acceptable. Both methods are shown below.



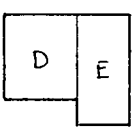
PLAN



OR:



OR:



6.00				6.00					3.30		
5.10	30.60	Rm.B		3.90	23.40	Rm.B	(B)		3.90	12.87	Rm.B (D)
				2.70					2.70		
Deductions:				1.20	3.24	Rm.B	(C)		5.10	13.77	Rm.B (E)
3.30					26.64m^2					26.64m^2	
1.20	3.96	Rm.B (A)									
	26.64m^2										

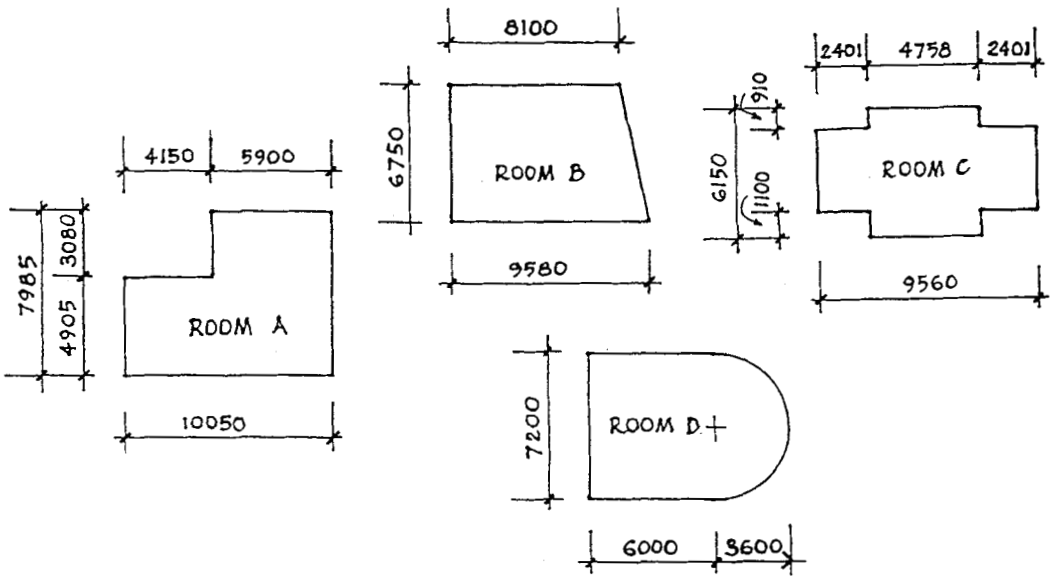
3.07. VOLUME TAKE-OFF

Most volume take-off uses previously calculated centre line lengths or total areas when determining volume quantities, e.g. concrete strip footings, concrete floor slabs, etc. In these cases the lengths can be repeated and multiplied by the cross-sectional areas or the total area repeated and multiplied by the thickness.

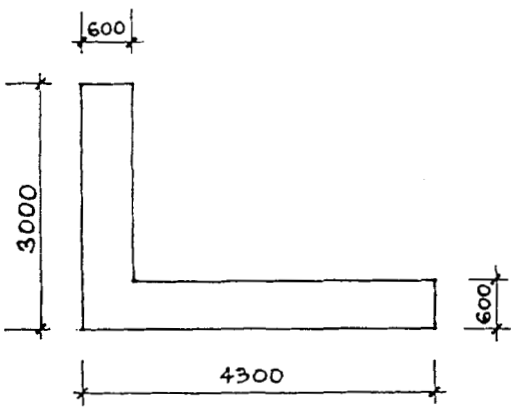
3.08. MEASUREMENT EXERCISES

3.08.01. EXERCISE 1 Measure and extend the perimeter, area and volume of a concrete floor slab 7070mm x 5630mm x 150mm thick.

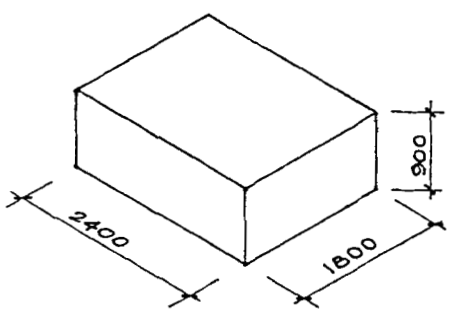
3.08.02. EXERCISE 2 Measure and extend the perimeter and area of the rooms shown below.



3.08.03. EXERCISE 3 Measure and extend the volume of the footings shown below.



FTG. PLAN (600 x 300 FTGS.)



PAD FTG. P1 (P2-6 SIMILAR)

CHAPTER 4

THE BILLING PROCESS

4.01. BILLING

There is no set format for drafting Bill of Quantities descriptions and each office adopts its own particular style. Basically, there are two different formats. The traditional approach is to draft a full description incorporating all essential information, whilst the second approach is typified by the use of sub-headings together with very short descriptions. Both methods are equally acceptable and the method adopted is usually dictated by office policy. This text will mainly use the traditional method. Following is an example of each style:

Traditional Method:

Reinforced concrete F'c 20 MPa in strip footings poured into trenches.	m^3	10

Alternative Method:

IN-SITU REINFORCED CONCRETE

F'c 20 MPa Concrete

Strip footings poured into trenches.	m^3	10

Regardless of which method is adopted the same basic principles still apply. In addition to giving the billing unit and total quantity, each Bill of Quantities description should:

NAME

SIZE

DESCRIBE and

FIX.

For example, consider the following description for cement render.

Internal cement render, 12mm thick, composed of 4 parts sand to 1 part cement, finished off a sponge faced trowel to brick wall surfaces.	m^2	100

NAME: Name the subject, that is, what does the quantity represent? In the above case, there is no doubt that *"Internal cement render"* is the subject and the total quantity is 100 m^2

SIZE: *"12mm thick"*

DESCRIBE: *"composed of 4 parts sand to 1 part cement, finished off a sponge faced trowel"*

FIX: *"to brick wall surfaces"*.

Finally, each description should have sufficient information for the estimator to be able to price it.

One major difference between a Bill of Quantities description and a Specification is that specific locations are not given in the Bill of Quantities description. Whilst the descriptions contain sufficient information to price them, they do not contain sufficient information to construct the works.

4.02. SMM REQUIREMENTS

It is normal practice when preparing a Bill of Quantities to work from the Specification and drawings, lining off each Specification clause and colouring the drawings after the specified work has been measured. Students often have difficulty in knowing how much detail from the Specification should be included in the Bill of Quantities. The Bill of Quantities does not duplicate all the information contained in the Specification, but lists only the essential information as required by the SMM. At the commencement of each trade section in the SMM, it states that a note is to be included in the Bill of Quantities to *"Refer to relevant Specification sections containing particulars of..."* Also, reference should be inserted in each section drawing attention to the measurement and prices clause in the relevant section of the SMM. Detailed information regarding what measurement and prices are to include for is not required to be listed in the Bill of Quantities, unless it is different from that contained in the SMM. It is therefore essential that the estimator has a thorough knowledge of the SMM.

In addition, SMM, Section 1, Introduction, General Rules and Recommendations, Clause 4, Descriptions, contains instructions, details and inclusions regarding Bill of Quantity descriptions. (Refer SMM page 4.)

4.03. BILLING UNITS

After completion of the measurement process and after all extensions have been carried out, it is necessary to bill the final total quantity. SMM, Section 1, Clause 6, Billing Units, contains the rules for billing quantities. Clause 6.1 states:

> *Where the unit of billing is the metre, square metre, or cubic metre, quantities shall be billed to the full unit, any part of a unit being regarded as a full unit.*

For example:

261.88m would be billed as	m	262
100.24m^2 would be billed as	m^2	101
19.00m^3 would be billed as	m^3	19

Clause 6.2 states:

> *Where the unit of billing is the tonne, quantities shall be billed to the full one hundredth of a unit, any part of a unit less than one hundredth of a unit being regarded as one hundredth of a unit. Such parts shall be expressed as decimals. In all cases where there are no whole units, a zero (0) shall be placed immediately before the decimal point.*

For example:

9.010t would be billed as	t	9.01
10.632t would be billed as	t	10.64
.089t would be billed as	t	0.09

4.03.01. EXERCISE 1 In accordance with the SMM, bill the following quantities:

190.01m _____

190.01t _____

190.01kg _____

CHAPTER 5

DOORS, FRAMES AND HARDWARE

5.01. GENERALLY

After the basic knowledge contained in the previous chapters has been fully understood, the next step is the billing and measurement of elementary work which essentially involves abstracting simple information from the drawings and specification. Typical examples would involve billing and measuring: doors, frames and hardware; windows; and furniture.

5.02. SMM REQUIREMENTS

Refer to the SMM for the rules governing the measurement of doors, frames, architraves and hardware:

Doors:	Section 19, page 119
Timber door frames:	Section 11, cl. 15, page 91
Timber architraves:	Section 11, cl. 29, page 93
Hardware:	Section 13, page 101

5.03. EXAMPLE—DOORS, FRAMES AND HARDWARE

Following is a worked example illustrating the measurement of timber doors, frames, architraves and hardware.

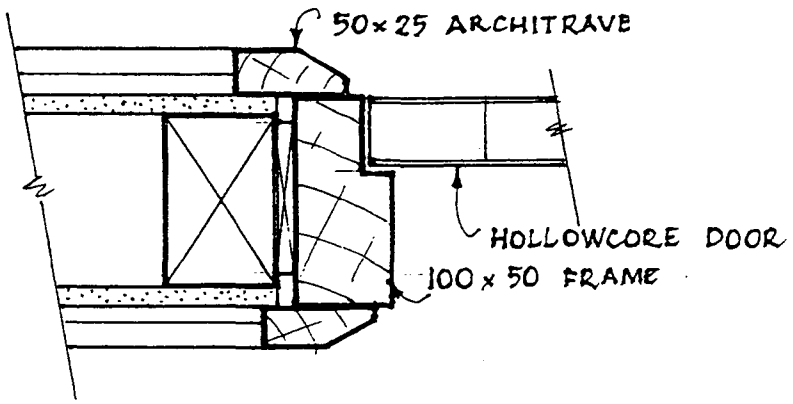
QUESTION: B.m.e. the doors, frames, architraves and hardware as specified and detailed in Drawing 5.1.

SPECIFICATION NOTES

INTERNAL DOORS, FRAMES AND HARDWARE

INTERNAL DOORS D1–5 incl. shall be 2040 x 820 x 35 thick hollowcore doors veneered for paint finish. Door frames shall be ex 100 x 50 solid rebated Pacific maple. Architraves shall be ex 50 x 25 splayed Pacific maple, mitred at corners. Hang each door on a pair of 100mm steel butt hinges and fit c.p. mortice latch set complete with all necessary lever furniture.

INTERNAL DOORS D6 and D7 shall be a.b.s. but shall be 2040 x 770 x 35 thick and in addition shall each be fitted with one 75mm c.p. brass barrel bolt.



SECTION THROUGH FRAME—DOORS D1–D7 incl.

DRAWING 5.1

Internal Doors, Frames and Hardware

a	Internal hollowcore doors, each 2040 x 820 x 35 thick, veneered for paint finish and hung on a pair of 100mm steel butt hinges to timber frames.	no	5
	5 5 D1–5		
	5		
b	Ditto each 2040 x 770 x 35 thick.	no	2
	2 2 D6,7		
	2		
c	Ex 100 x 50 solid rebated Pacific maple door frames to suit 2040 x 820 x 35 thick doors comprising jambs and head framed together and fixed to timber wall framing.	no	5
	5 5 D1–5		
	5		
d	Ditto to suit 2040 x 770 x 35 thick doors.	no	2
	2 2 D6,7		
	2		

e	Ex 50 x 25 splayed Pacific maple architraves fixed to timber door frames and mitred at corners.			m	73
	5/2/2/ 2.12	42.40	D1–5		
	5/2/ 0.94	9.40			
	2/2/2/ 2.12	16.96	D6,7		
	2/2/ 0.89	3.56			
		72.32m			
f	C.p. mortice latch set complete with all necessary lever furniture.			no	7
	7	7	D1–7		
		7			
g	75mm c.p. brass barrel bolt.			no	2
	2	2	D6,7		
		2			

5.04. EXERCISE—DOORS, FRAMES AND HARDWARE

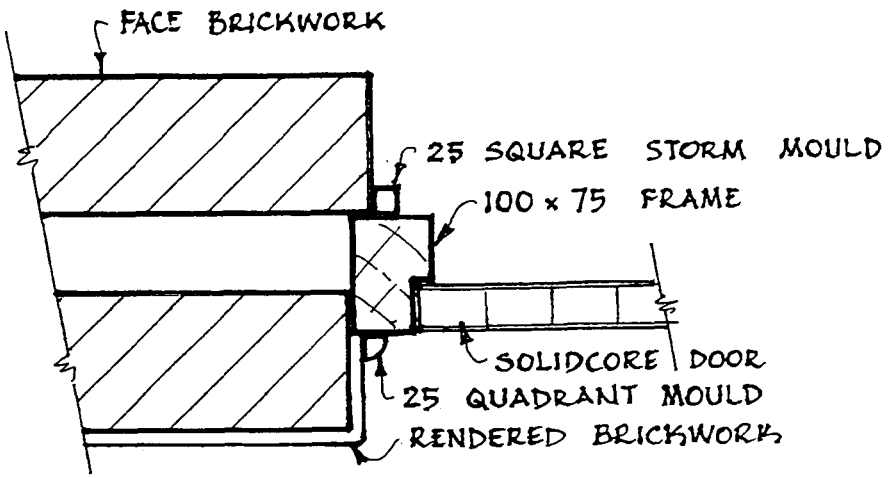
QUESTION: B.m.e. the doors, frames, trims and hardware as specified and as detailed in Drawing 5.2.

SPECIFICATION NOTES

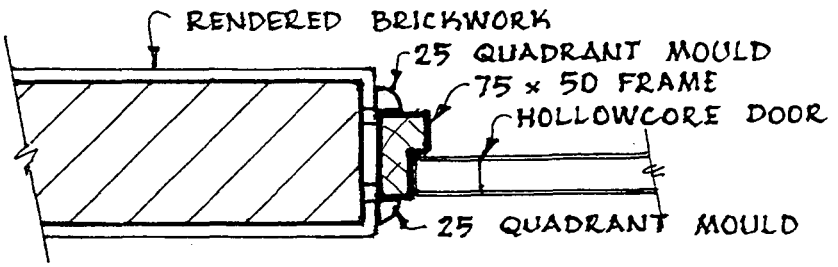
DOORS, FRAMES AND HARDWARE

Provide and fix doors, frames, trims and hardware of the types and sizes as set out in the schedule below. Door frames to be plugged and fixed to brickwork. All frames to be solid rebated Oregon. Provide and fix 25mm Oregon quadrant mould to door frames at junction with render and 25mm Oregon square section storm moulds externally. All moulds to be mitred at corners.

REF.	DOOR	FRAME	FURNITURE	HINGES
D1	2040 x 820 x 40mm thick solid core w/proof ext. door, veneered both sides for paint finish.	100 x 75	C.p. deadlock C.p. door closer 100mm c.p. push plate	3 x 100mm loose pin brass butt hinges
D2–4	2040 x 820 x 35mm thick flush hollow door veneered for paint finish.	75 x 50	C.p. mortice latch set with lever furniture	2 x 100mm steel butt hinges.
D5–6	2040 x 820 x 35mm thick flush hollow door veneered for paint finish.	75 x 50	C.p. mortice lock set with lever furniture C.p. door closer	2 x 100mm steel butt hinges.



SECTION THROUGH FRAME—DOOR D1



SECTION THROUGH FRAME—DOORS D2–D6 incl.

DRAWING 5.2

CHAPTER 6

FINISHES

6.01. GENERALLY

After mastery of the elementary work contained in the previous chapters, the next task normally assigned to trainees is the measurement of the finishes trades. These trades include paving, tiling, plastering, terrazzo work, resilient finishes and carpet. They are relatively simple to measure since they mainly involve area and linear measurements which can be taken directly from the drawings.

6.02. SMM REQUIREMENTS

Refer to the SMM, Section 20, Finishes, for the rules governing the measurement of floor, wall and ceiling finishes.

6.03. EXAMPLE—FLOOR FINISHES

Following is a worked example illustrating the measurement of selected floor finishes.

QUESTION: B.m.e. the floor finishes as specified and as shown in Drawings 6.1 and 6.2.

SPECIFICATION NOTES

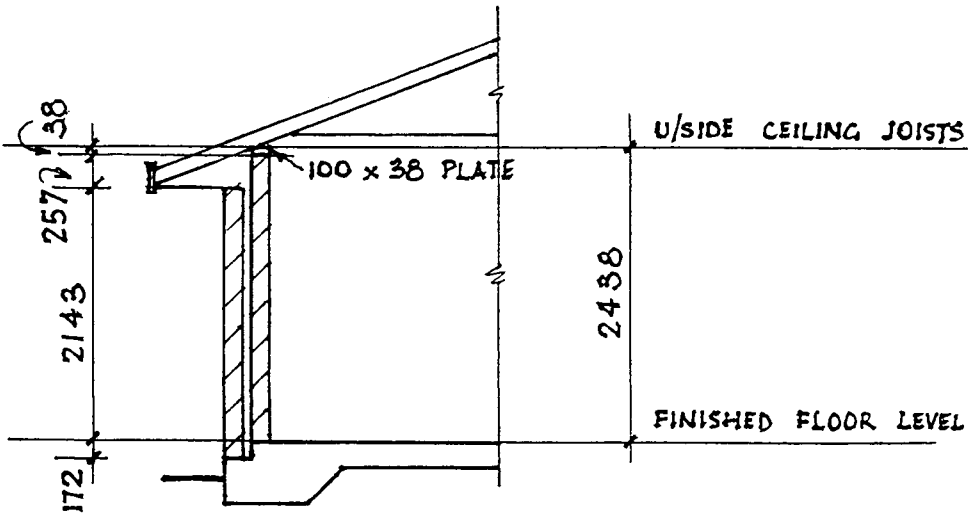
FLOOR FINISHES

***FINISHES AS LAID—CONCRETE** Steel trowel finish slab surface suitable to receive carpet.*

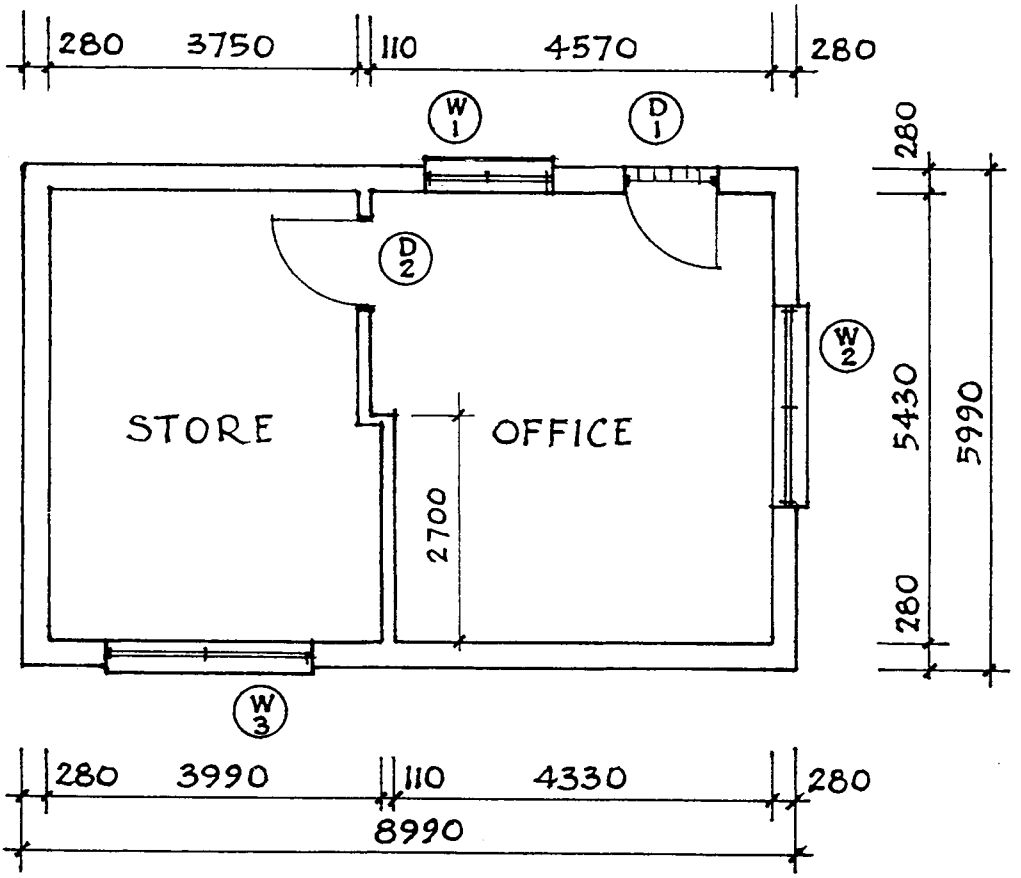
***CARPET** Finish all internal rooms with Ajax 101 carpet laid on Ajax commercial quality rubber underlay in accordance with AS 2455.*

***QUARRY TILE THRESHOLD** Provide 200 x 200mm selected colour Australian manufacture quarry tile threshold to Door 1. Bed tiles in cement on a bed of cement mortar, point up joints and set tiles to weather.*

***TIMBER TRIM—SKIRTINGS** Provide 100 x 25mm Pacific maple splayed skirtings at junctions of walls with floors. Fix to wall plugs in brickwork.*

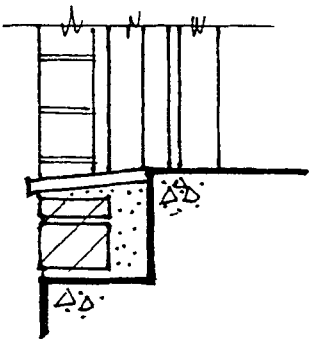


TYPICAL SECTION

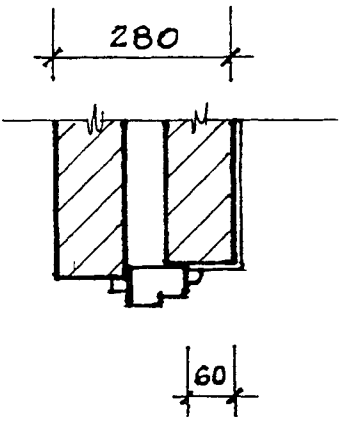


PLAN

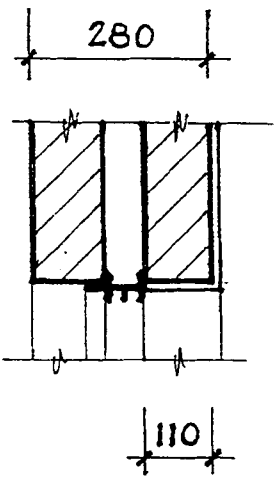
DRAWING 6.1



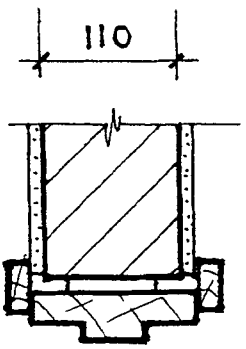
DOOR D1—THRESHOLD DETAIL



DOOR D1—JAMB AND HEAD DETAIL



TYPICAL WINDOW HEAD SILL AND JAMB DETAIL



DOOR D2—JAMB AND HEAD DETAIL

SCHEDULE OF DOOR AND WINDOW OPENINGS		
TYPE	WIDTH (mm)	HEIGHT (mm)
D1,2	970	2143
W1	850	943
W2,3	1610	1372

DRAWING 6.2

FLOOR FINISHES

Finishes as Laid—Concrete

a Steel trowel finish to concrete floor slab suitable to receive carpet. m² 49

8.65		
5.65	48.87	Store, Office
	48.87m²	

Carpet

b Ajax 101 carpet laid on Ajax commercial quality rubber underlay in accordance with AS 2455 to concrete floor slabs. m² 46

3.99		
5.43	21.67	Store
4.57		
5.43	24.82	Office
2 /0.97		
0.11	0.21	D1,2
	46.70	
Deductions:		
0.24		
2.84	0.68	Store (5430 - 2700 + 110)
0.24		
2.70	0.65	Office
	1.33m²	(ddt)
	45.37m²	

Quarry Tile Threshold

c 200 x 200mm selected colour Australian manufacture quarry tiles forming 200mm wide threshold to external door, bedded in cement on a bed of cement mortar, joints pointed with cement mortar and set to weather. m 1

0.97	0.97	D1
	0.97m	

Timber Trim—Skirting

d	100 x 25mm Pacific maple splayed skirting fixed to wall plugs in brickwork.	m	37

2/3.99	7.98	Store
2/5.43	10.86	
2/4.57	9.14	Office
2/5.43	10.86	
	38.84m	
Deductions:		
0.85	0.85	D1 (970 - 60 - 60 = 850)
2/0.97	1.94	D2
	2.79m (ddt)	
	36.05m	

MEASUREMENT NOTES—FLOOR FINISHES

Item b Carpet: All rooms are measured separately and the extra at doorways added at the end.

Item d Skirting: Perimeter length of all rooms is measured then all doorways are deducted. Note that Door D2 is deducted twice since skirting has been previously measured to both sides of the opening.

6.04. EXAMPLE—CEILING FINISHES

Following is a worked example illustrating the measurement of selected ceiling finishes.

QUESTION: B.m.e. the ceiling finishes as specified and as shown on Drawing 6.1.

SPECIFICATION NOTES

CEILING FINISHES

PLASTERBOARD CEILING LINING Ceilings to all internal rooms shall be 10mm thick recessed edge gypsum plasterboard lining finished with flush joints and fixed direct to timber ceiling framing.

PLASTERBOARD CORNICE Cornice to all internal rooms shall be 90mm coved gypsum plasterboard cornice, mitred at angles and fixed in accordance with AS 2589.

CEILING FINISHES

Plasterboard Ceiling Lining

a 10mm thick recessed edge gypsum plasterboard ceiling lining, finished with flush joints and fixed direct to timber ceiling framing. m² 46

3.99		
5.43	21.67	Store
4.57		
5.43	24.82	Office
	46.49	

Deductions:

0.24		
2.84	0.68	Store (5430 - 2700 + 110)
0.24		
2.70	0.65	Office
	1.33m²	(ddt)
	45.16m²	

Plasterboard Cornice

b 90mm coved gypsum plasterboard cornice mitred at angles and fixed in accordance with AS 2589. m 40

2/3.99	7.98	Store
2/5.43	10.86	
2/4.57	9.14	Office
2/5.43	10.86	
2/2/0.09	0.36	Ext. angles
	39.20m	

MEASUREMENT NOTES—CEILING FINISHES

Item b – Cornice: Extra added for external angles since the SMM requires cornices to be measured their "extreme length".

6.05. EXAMPLE—WALL FINISHES

Following is a worked example illustrating the measurement of solid plaster wall finishes.

QUESTION: B.m.e. the wall finishes as specified and as shown in Drawings 6.1 and 6.2.

SPECIFICATION NOTES

WALL FINISHES

***CEMENT RENDER** Finish all internal brick wall surfaces with 10mm minimum thickness cement render. Render to be composed of 4 parts sand to 1 part cement. Finish render off a sponge faced trowel. Return render into all window and Door D1 reveals and round all salient angles.*

Prior to applying render prepare brick wall surfaces by removing all dust and loose material and apply one coat of approved bonding agent.

WALL FINISHES

Internal Cement Render

a	Preparation of brick wall surfaces to receive cement render by removing all dust and loose material and applying one coat of approved bonding agent.			m^2	82

2/ 3.99			
2.40	19.15		Store
2/ 5.43			
2.40	26.06		Store
2/ 4.57			
2.40	21.94		Office
2/ 5.43			
2.40	26.06		Office
	93.21m^2		(gross area)
Deductions:			
0.97			
2.15	2.09		D1
2/ 0.97			
2.15	4.17		D2
0.85			
0.95	nil		W1
2/ 1.61			
1.38	4.44		W2,3
2/ 0.24			
2.40	1.15		Store, Office < 250mm wide
	11.85m^2		(ddt)
	81.36m^2		(net area)

b Ditto 0–250mm wide. (m 26) m² 4

	0.97	0.97	D1
2/	2.15	4.30	
		5.27m x 0.06m =	0.32m²
2/	0.85	1.70	W1
2/	0.95	1.90	
2/2/	1.61	6.44	W2,3
2/2/	1.38	5.52	
		15.56m x 0.11m =	1.71m²
2/	2.40	4.80	Store Office
		4.80m x 0.24m =	1.15m²
		25.63m	3.18m²

c Cement render, 10mm minimum thickness, composed of 4 parts sand to 1 part cement, finished off a sponge faced trowel to prepared brick wall surfaces. m² 82

Repeat area, Item a

d Ditto 0–250mm wide. (m 26) m² 4

Repeat length and area, Item b

MEASUREMENT NOTES—WALL FINISHES

Items a and c: First calculate the gross area, ignoring openings, then deduct all the openings and surfaces less than 250mm wide included in the gross area. Note that Door D2 is deducted twice since both sides of the opening have been included in the gross area.

Items b and d: Work to surfaces equal to or less than 250mm is given separately. (Refer SMM, Section 20, Finishes M.7, page 121.) These areas are traditionally referred to as "narrow widths".

6.06. EXERCISE—FLOOR FINISHES

QUESTION: B.m.e. the floor finishes as specified and as shown in Drawings 6.3, 6.4 and 6.5.

SPECIFICATION NOTES

FLOOR FINISHES

CARPET Finish all internal rooms with Ajax 101 carpet laid on Ajax commercial quality rubber underlay in accordance with AS 2455.

TIMBER TRIM—SKIRTINGS Provide 100 x 25mm Pacific maple splayed skirtings at junctions of walls with floors. Fix to wall plugs in brickwork.

6.07. EXERCISE—CEILING FINISHES

QUESTION: B.m.e. the ceiling finishes as specified and as shown on Drawings 6.3, 6.4 and 6.5.

SPECIFICATION NOTES

CEILING FINISHES

PLASTERBOARD CEILING LINING Ceilings to all internal rooms shall be 10mm thick recessed edge gypsum plasterboard lining finished with flush joints and fixed direct to timber ceiling framing.

PLASTERBOARD CORNICE Cornice to all internal rooms shall be 90mm coved gypsum plasterboard cornice, mitred at angles and fixed in accordance with AS 2589.

6.08. EXERCISE—WALL FINISHES

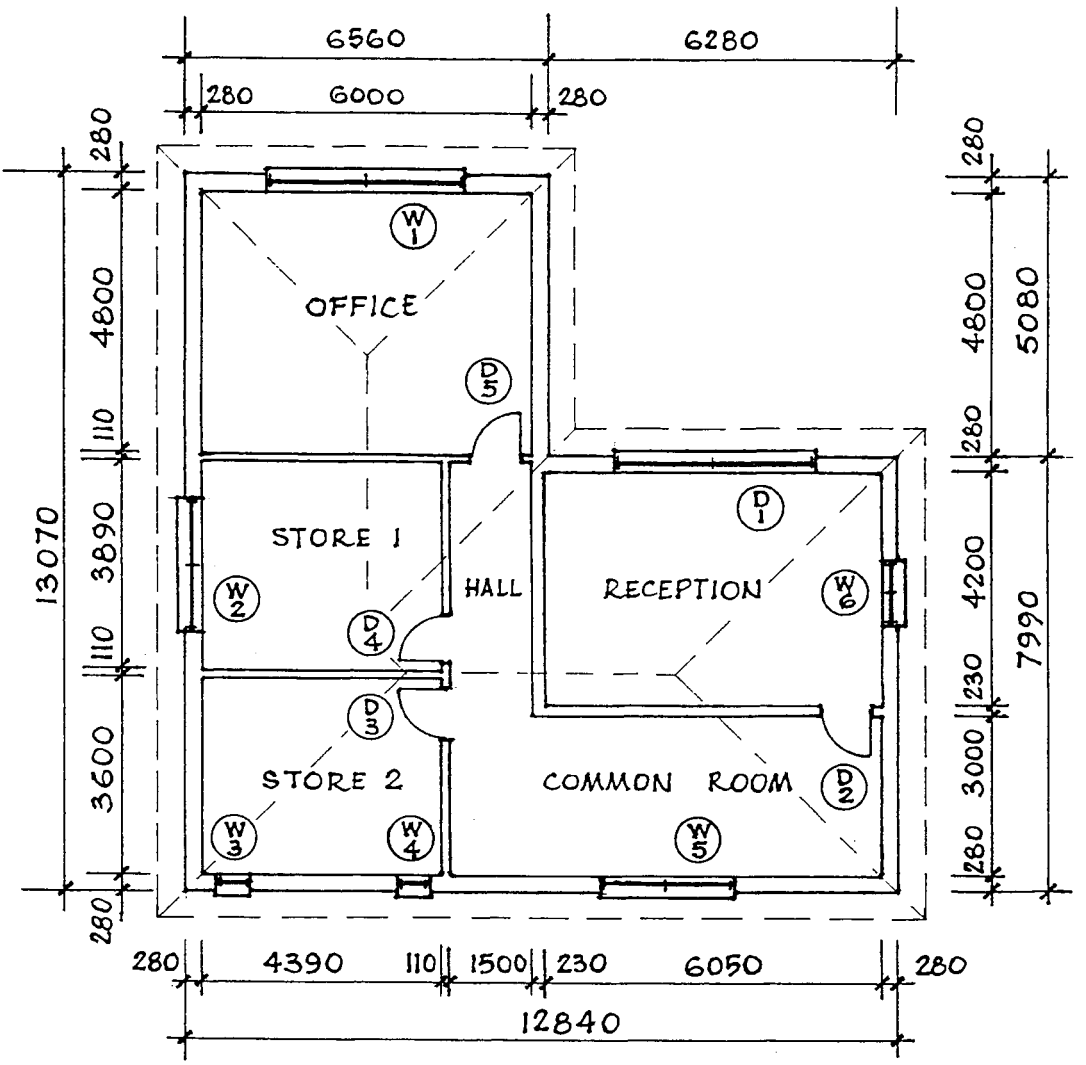
QUESTION: B.m.e. the wall finishes as specified and as shown in Drawings 6.3, 6.4 and 6.5.

SPECIFICATION NOTES

WALL FINISHES

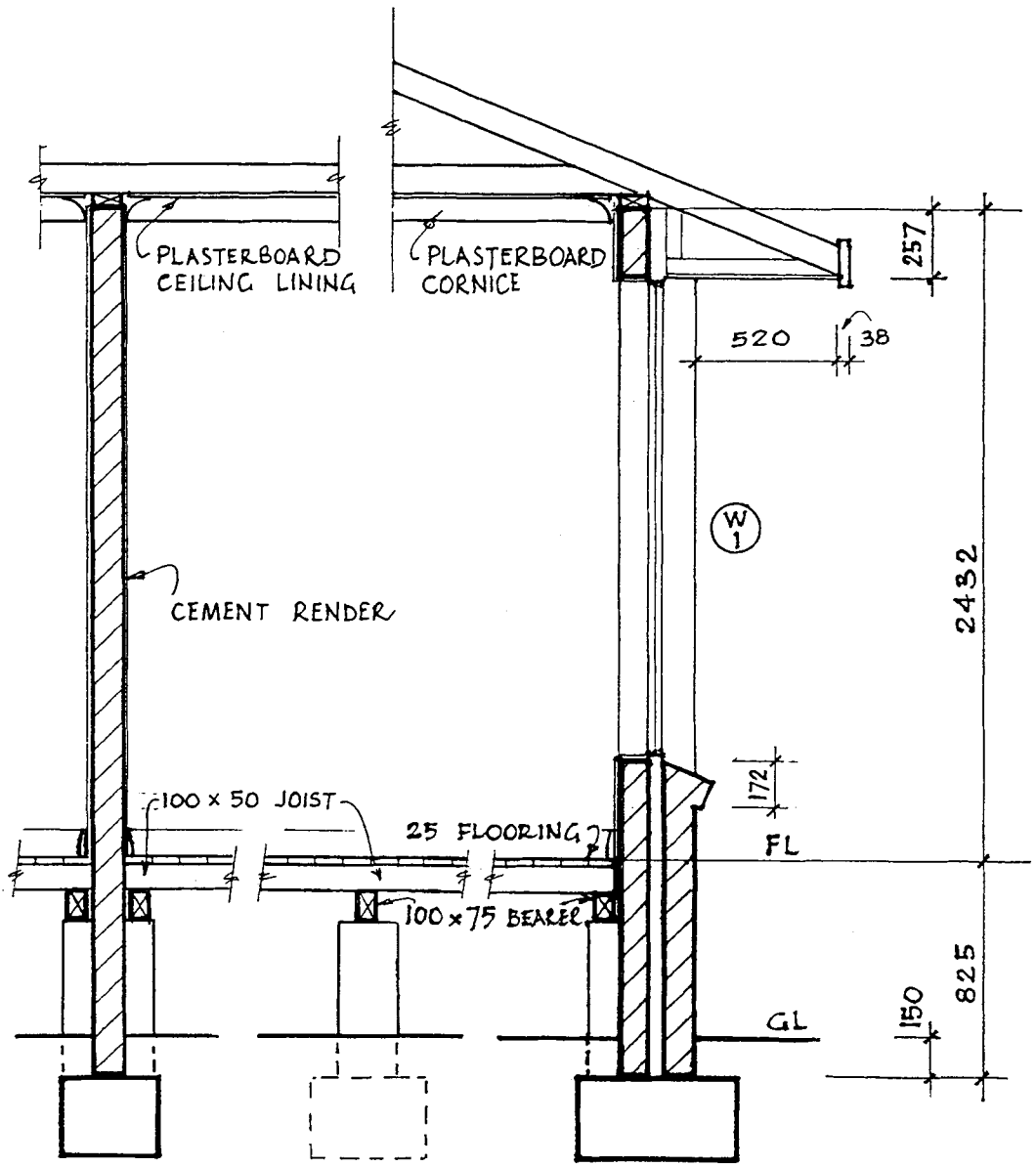
CEMENT RENDER Finish all internal brick wall surfaces with 10mm minimum thickness cement render. Render to be composed of 4 parts sand to 1 part cement. Finish render off a sponge faced trowel. Return render into window and door reveals and round all salient angles.

Prior to applying render prepare brick wall surfaces by removing all dust and loose material and apply one coat of approved bonding agent.



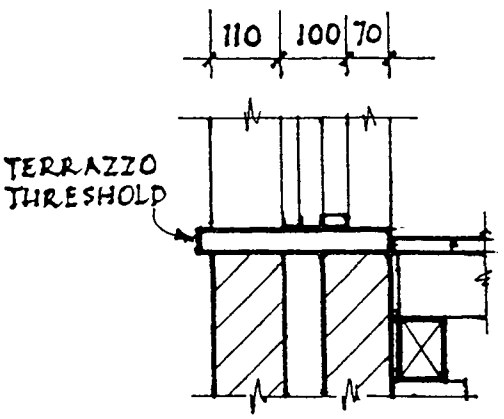
PLAN

DRAWING 6.3

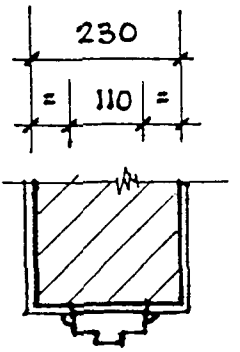


SECTION

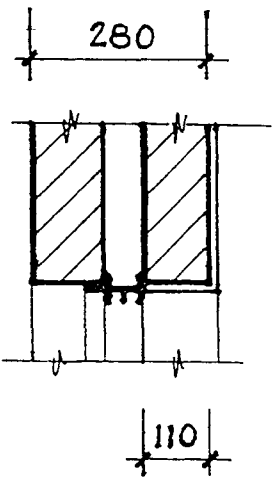
DRAWING 6.4



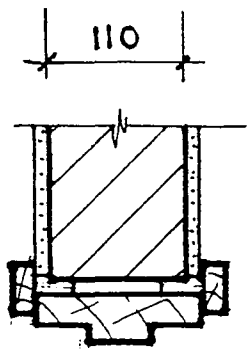
DOOR D1—THRESHOLD DETAIL



DOOR D2—JAMB AND HEAD DETAIL



TYPICAL WINDOW JAMB DETAIL



DOORS D3–D5—JAMB AND HEAD DETAIL

SCHEDULE OF DOOR AND WINDOW OPENINGS					
DOOR	WIDTH	HEIGHT	WINDOW	WIDTH	HEIGHT
D1	3600	2175	W1	3600	1800
D2–5	900	2100	W2	2400	1200
			W3,4	600	1500
			W5	2400	1800
			W6	1200	1800

DRAWING 6.5

CHAPTER 7

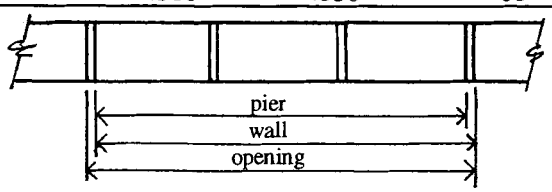
MASONRY

7.01. METRIC STANDARD BRICKWORK

This chapter will be confined to the measurement of metric standard brickwork. The following brick chart may be helpful when measuring metric standard brickwork.

Metric Standard Brickwork
(230 x 110 x 76 nominal brick size)

No. of bricks	Wall	Pier	Opening	No. of courses	Height
1	240	230	250	1	86
1.5	360	350	370	2	172
2	480	470	490	3	257
2.5	600	590	610	4	343
3	720	710	730	5	429
3.5	840	830	850	6	514
4	960	950	970	7	600
4.5	1080	1070	1090	8	686
5	1200	1190	1210	9	772
5.5	1320	1310	1330	10	857
6	1440	1430	1450	11	943
6.5	1560	1550	1570	12	1029
7	1680	1670	1690	13	1114
7.5	1800	1790	1810	14	1200
8	1920	1910	1930	15	1286
8.5	2040	2030	2050	16	1372
9	2160	2150	2170	17	1457
9.5	2280	2270	2290	18	1543
10	2400	2390	2410	19	1629
10.5	2520	2510	2530	20	1714
11	2640	2630	2650	21	1800
11.5	2760	2750	2770	22	1886
12	2880	2870	2890	23	1972
12.5	3000	2990	3010	24	2057
13	3120	3110	3130	25	2143
13.5	3240	3230	3250	26	2229
14	3360	3350	3370	27	2314
14.5	3480	3470	3490	28	2400
15	3600	3590	3610	29	2486
15.5	3720	3710	3730	30	2572
16	3840	3830	3850	31	2657
16.5	3960	3950	3970	32	2743
17	4080	4070	4090	33	2829
17.5	4200	4190	4210	34	2914
18	4320	4310	4330	35	3000

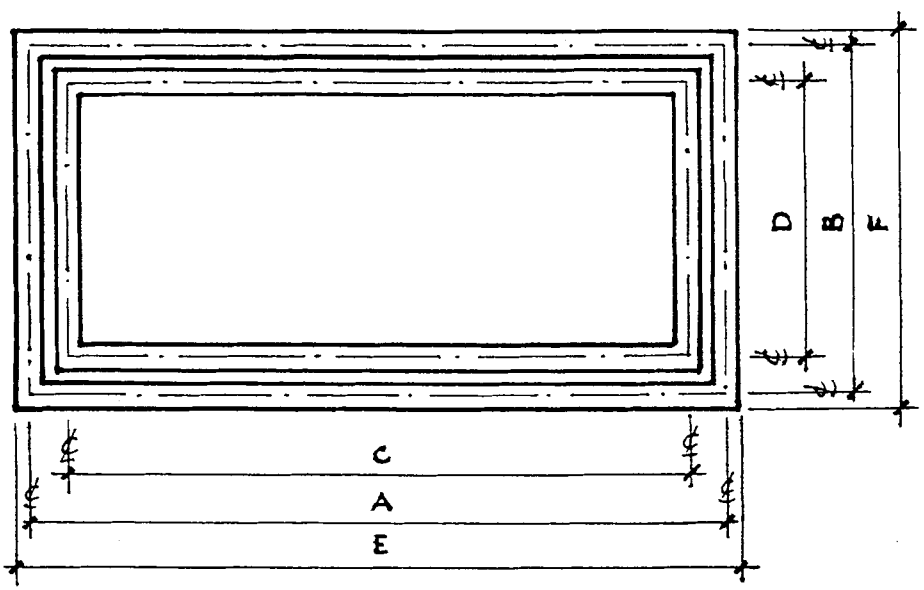


7.02. SMM REQUIREMENTS

Refer to SMM Section 7, Masonry, pages 53–62 for the rules governing the measurement of brickwork. In particular the following basic requirements should be noted:

1. Common brickwork, fair face common brickwork and face brickwork are measured separately. Consider the case of a 280mm cavity brick wall comprising an outer 110mm thick face brick skin and an inner 110mm thick common brick skin; the face brick skin of the cavity wall is measured separately from the inner common brick skin of the cavity wall. As illustrated in the following example it is necessary to calculate the centre line length of both skins in order to determine the area of the walls.

2. Cleaning down on completion of face brickwork is measured under a separate description in m^2. The area to be measured is the exposed face area (including the area of sills, corbels, etc. but excluding the area of reveals) and is different from the area measured for the face brick wall skin as outlined in 1.



PLAN

Length of face brick outer skin = 2[A+B]
Length of common brick inner skin = 2[C+D]
Length for cleaning down face brickwork = 2[E+F]

3. Brickwork is classified separately by levels.

7.03. EXAMPLE—BRICKWORK

Following is a worked example illustrating the measurement of brickwork.

QUESTION: B.m.e. the brickwork as specified and as shown in Drawings 6.1. and 6.2.

SPECIFICATION NOTES

BRICKWORK

***BRICKS** All brickwork exposed externally shall be constructed with selected calcium silicate face bricks. All other brickwork to be constructed with calcium silicate common bricks.*

***MORTAR** All brickwork shall be laid in 1 : 5 cement mortar.*

***BOND** All brickwork shall be constructed in stretcher bond.*

***JOINTS** Joints in facework shall be raked. Leave all other surfaces rough.*

***CLEANING DOWN** Clean down all face brickwork on completion with 5% hydrochloric acid solution and wash off with clean water.*

***CAVITY TIES** Provide and build in 4mm diam. galvd wire wall ties to all cavity walls spaced 900 apart every fourth course in height and staggered.*

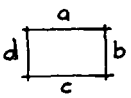
***SILLS** Sills to windows shall be snapped header face brick on edge sills, set to weather.*

BRICKWORK

Ground Floor Brickwork in 1 : 5 cement mortar

a 110 thick face brick skins of cavity walls in stretcher bond comprising selected calcium silicate face bricks having joints raked on one face. m^2 62

2/	8.88			
	2.32	41.20	a,c	
2/	5.88			
	2.32	27.28	b,d	
		68.48m^2	(Gross Area)	



Deductions:

	0.97		
	2.15	2.09	D1
	0.85		
	1.12	nil	W1
2/	1.61		
	1.55	4.99	W2,3
		7.08m^2	(ddt)
		61.40m^2	(Net Area)

b 110 thick calcium silicate common brick skins of cavity walls. m^2 62

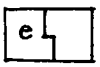
2/	8.54			
	2.40	40.99	a,c	
2/	5.54			
	2.40	26.59	b,d	
		67.58m^2	(Gross Area)	

Deductions:

	0.97		
	2.15	2.09	D1
	0.85		
	0.95	nil	W1
2/	1.61		
	1.38	4.44	W2,3
		6.53m^2	(ddt)
		61.05m^2	(Net Area)

c 110 thick calcium silicate common brick walls. m^2 12

	5.43		
	2.40	13.03	e
	0.24		
	2.40	0.58	e
		13.61m^2	(Gross Area)
Deductions:			
	0.97		
	2.15	2.09	D2
		2.09m^2	(ddt)
		11.52m^2	(Net Area)



Sills

d Snapped header face brick on edge sills to windows, comprising selected calcium silicate face bricks laid in 1 : 5 cement mortar and set to weather. m 5

	0.85	0.85	W1
2/	1.61	3.22	W2,3
		4.07m	

Cavity Ties

e 4mm diam. galvd wire wall ties to cavity walls spaced 900 apart every fourth course in height and staggered. m^2 62

61.40m^2 (Repeat area of item a)

Sundries

f Clean down face brickwork on completion with 5% hydrochloric acid solution and wash off with clean water. m^2 64

2/	8.99		
	2.32	41.71	a,c
2/	5.99		
	2.32	27.79	b,d
	4.07		
	0.30	1.22	sills
		70.72m^2	(Gross Area)
Deductions:			
		7.08m^2	(ddt) Repeat area of ddt from item a
		63.64m^2	(Net Area)

MEASUREMENT NOTES—BRICKWORK

Item a – Face brick skins: Use centre line measurements multiplied by wall height to determine the gross wall area. Deduct openings to determine the net area. W1 is not deducted since it is less than $1m^2$. (Refer SMM, 3.4, page 4.) The height of all window openings includes an additional 172mm to allow for the brick on edge sill course which is measured separately. (Refer SMM, M1 and 2, page 53.)

Item b – Common brick skins: Same technique as item a but centre line measurements and wall heights are different.

Item d – Sills: Include all window openings, including those openings less than $1m^2$.

Item e – Cavity Ties: Purely for practical reasons the net area of the outer face brick skin is repeated. This area ($61.40m^2$) is slightly greater than the area of the cavity and is used in order to avoid having to take off new quantities. Also, the unit rate for this type of work is relatively low in cost.

Item f – Sundries: Exposed area measured excluding the area of reveals. Pointing and cleaning down reveals is deemed to be included in the price. (Refer SMM, P1, page 53.)

7.04. EXERCISE—BRICKWORK

QUESTION: In accordance with Drawings 6.3, 6.4 and 6.5 and the following specification notes, measure and extend the following Bill of Quantities, Brickwork section.

SPECIFICATION NOTES

BRICKWORK

***BRICKS** All brickwork exposed externally shall be constructed with selected face bricks P.C. $600.00 per thousand delivered to the site. All other brickwork to be constructed with sound common bricks.*

***MORTAR** All brickwork shall be constructed with 1:1:6 composition mortar.*

***BOND** All 110mm thick walls shall be constructed in stretcher bond. All 230mm thick walls shall be constructed in English bond.*

***JOINTS** Joints in face brickwork shall be ironed.*

***CLEANING DOWN** Clean down all face brickwork on completion with 5% hydrochloric acid solution and wash off with clean water.*

***CAVITY TIES** Provide and build in 4mm diam. galvd wire wall ties to all cavity walls spaced 900mm apart every fourth course in height and staggered.*

***SILLS** Sills to all windows shall be snapped header face brick on edge sills set to weather.*

***AIR BRICKS** Air bricks shall be 230 x 150 louvred pattern terracotta air bricks of colour to match the face bricks. Build air bricks into outer skin of cavity walls below floor level as required to ventilate the sub floor space and form opening in inner skin behind air brick.*

***ANT CAPS** Ant caps shall be 0.5mm thick galvd steel in accordance with AS1694. Provide and build in ant caps at underside of floor frame as follows:*

- *i. to all isolated piers*
- *ii. to all engaged piers*
- *iii. to all foundation brick walls to provide a continuous barrier*

***GALVANISED STRAPS** Build in 1500mm long, 25mm wide, 1.6mm thick galvd steel straps to hold down wall plates. Straps to be spaced at 1800mm max cts and be not less than 1200mm down cavity with ends turned 75mm into brickwork.*

***DAMP PROOF COURSES AND FLASHINGS** Provide and build in 0.45mm thick bitumen coated aluminium dpc and flashing in the following locations:*

- *i. all foundation walls and piers*
- *ii. sills to all windows*
- *iii. heads of all windows and external doors extending 150mm at each side of opening*

***CAVITY INFILLING** Infill cavity to all cavity walls below ground level with F'c 15MPa concrete and finish top with an outward splay.*

	BRICKWORK			
a	Refer to the Brickwork section of the Specification for details of brickwork.	Note		
b	Refer to the SMM for details regarding measurement and prices of brickwork.	Note		
	Brickwork Below Floor Level in 1:1:6 Composition Mortar			
c	110 thick face brick skins of cavity walls in stretcher bond comprising selected face bricks P.C. $600.00 per thousand delivered, and having joints ironed on one face.	m^2		
d	110 thick common brick skins of cavity walls in stretcher bond.	m^2		
e	110 thick common brick walls ditto.	m^2		
f	230 ditto in English bond.	m^2		
g	120 thick common brick attached piers.	m^2		
h	230 x 230 common brick isolated piers.	m		
	Brickwork Above Floor Level in 1:1:6 Composition Mortar			
i	110 thick face brick skins of cavity walls in stretcher bond comprising selected face bricks P.C. $600.00 per thousand delivered, and having joints ironed on one face.	m^2		
j	110 thick common brick skins of cavity walls in stretcher bond.	m^2		
k	110 thick common brick walls ditto.	m^2		
l	230 ditto in English bond.	m^2		
	Sills			
m	Snapped header face brick on edge sills to windows, comprising selected face bricks P.C. $600.00 per thousand, bedded in 6:1:1 composition mortar and set to weather.	m		

	Cavity Ties			
a	4mm diam. galvd wire wall ties to 280mm thick cavity walls spaced 900mm apart every fourth course in height and staggered.	m^2		
	Cavity Infilling			
b	F'c 15 MPa concrete as infilling to 60mm wide cavities below ground level, finished on top with an outward splay. (m^2)	m^3		
	Damp Proof Courses and Flashings			
c	0.45mm thick bitumen coated aluminium dpc built into walls in positions directed, 0–250 girth.	m		
d	Ditto sill flashing to windows, fixed behind metal window sill, turned down two courses across cavity and built into outer skin, 251–500 girth.	m		
e	Ditto head flashing to windows and doors, built into inner skin, turned down two courses across cavity and taken full width of outer skin, 251–500 girth.	m		
	Ant Caps			
f	240 x 240 x 0.5mm thick galvd steel ant caps to isolated piers.	no		
g	240 x 120 ditto to attached piers.	no		
h	Half continuous 0.5mm thick galvd steel ant capping, lapped and soldered at joints and built into brickwork.	m		
i	Full continuous ditto.	m		
	Sundries			
j	Clean down face brickwork on completion with 5% hydrochloric acid solution and wash off with clean water.	m^2		
k	230 x 150 louvred pattern terracotta air bricks of colour to match the face bricks, built into outer skin of 280 cavity wall and include for forming opening in inner skin behind air brick.	no		
l	1500 long, 25 wide, 1.6mm thick galvd steel straps securing wall plates, built 75mm into brickwork and turned up cavity.	no		

CHAPTER 8

WOODWORK

8.01. SMM REQUIREMENTS

Refer to SMM, Section 11, Woodwork, pages 87–96 for the rules governing the measurement of woodwork. In particular the following basic requirements should be noted:

1. Structural timbers and joinery timbers including frames, linings, skirtings, trims, etc. are measured their NET length with no allowance for joints and 0.3m order length requirements.

2. Structural timbers exceeding 3.60m long are given separately in increments as noted. (Refer SMM, page 88.) However, in the following examples, this rule has been interpreted to apply only to structural timbers specified or shown to be in a single length.

   For example, 100 x 75mm timber floor bearers are grouped together in the same description, irrespective of their length, since there is no specific requirement for them to be in single lengths. However, a 4.00m long timber beam spanning between two supports would be given separately and described in increments of exceeding 3.60m not exceeding 6.00m long.

   In accordance with the SMM if this measurement procedure is adopted, a note should be inserted at the commencement of the trade section in the Bill of Quantities. (Refer SMM, 2.2, page 3.)

8.02. CENTRE CALCULATIONS

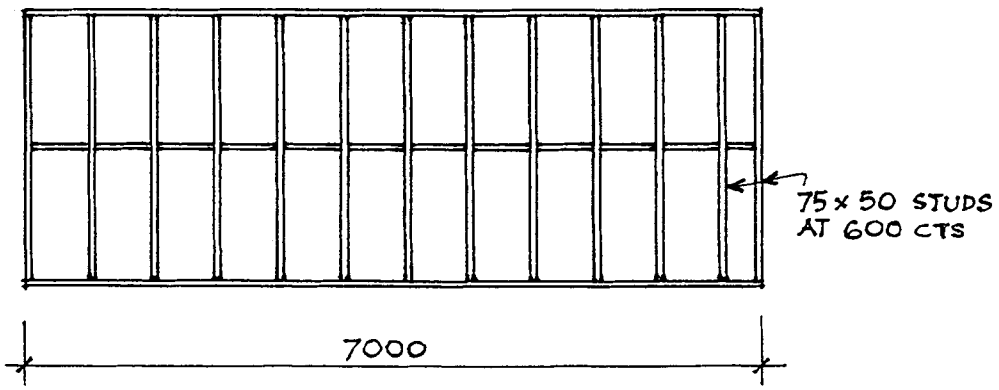
Structural timbers are often specified to be spaced at maximum centre spacings. In order to measure the quantity of those timbers it is necessary to calculate the number of members. This is an easy mathematical process involving the following basic steps:

1. Calculate the spacing distance (i.e. the distance between the centre of the first member and the centre of the last member).

2. Divide the spacing distance by the specified centre spacing and convert the answer to an integer number.

3. Add 1 to arrive at the answer.

EXAMPLE 8.02.01. Calculate the number of studs for the wall frame as detailed in Drawing 8.1 below.



ELEVATION—WALL FRAME

DRAWING 8.1

No. of studs:

Step 1: Spacing distance = 7000 - 50 = 6950

Step 2: 6950 / 600 = 11.5833 = 12

Step 3: 12 + 1 = 13 studs.

8.03. EXAMPLE—GROUND FLOOR FRAMING AND FLOORING

Following is a worked example illustrating the measurement of ground floor framing and flooring.

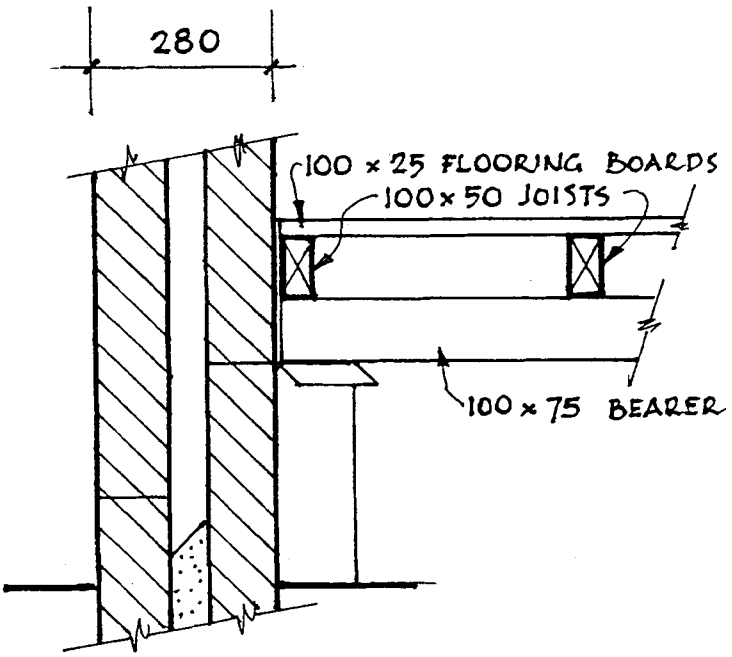
QUESTION: B.m.e. the ground floor framing and flooring as specified and as shown in Drawing 8.2.

SPECIFICATION NOTES

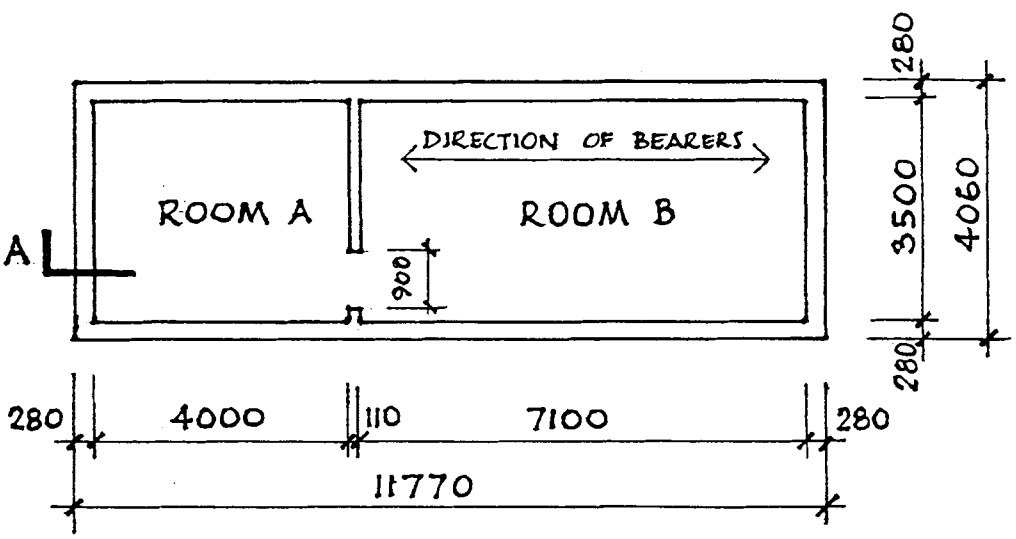
WOODWORK

GROUND FLOOR FRAMING Floor framing to be F8 grade sawn hardwood. Bearers to be 100 x 75 spaced at 1800mm maximum centres. Floor joists to be 100 x 50 spaced at 450mm maximum centres.

FLOORING Flooring boards to be 100 x 25 T & G Cypress pine. Closely cramp boards, double nail, punch and sand smooth on completion.



SECTION A



PLAN

DRAWING 8.2

WOODWORK

Ground Floor Framing

a 100 x 75 F8 grade sawn hardwood floor bearers. m 34

No. of bearers:
Rooms A,B = 3425 / 1800 = 2 + 1 =3

3/ 4.00	12.00	Room A
3/ 7.10	21.30	Room B
	33.30m	

b 100 x 50 ditto floor joists. m 95

No. of joists:
Room A = 3950 / 450 = 9 + 1 = 10
Room B = 7050 / 450 = 16 + 1 = 17

10/ 3.50	35.00	Room A
17/ 3.50	59.50	Room B
	94.50m	

Flooring

c 100 x 25 Cypress pine T & G flooring boards, closely cramped, double nailed and punched. m^2 39

4.00		
3.50	14.00	Room A
7.10		
3.50	24.85	Room B
0.90		
0.11	0.10	doorway
	38.95m^2	

d On completion smooth sand flooring boards. m^2 39

38.95m^2 Repeat area Item c

MEASUREMENT NOTES—GROUND FLOOR FRAMING AND FLOORING

Item a–Bearers: When there is no sub floor framing plan provided, the first step is to prepare a floor framing plan and determine the direction of the bearers and joists. This is usually done in pencil on the floor plan. If the direction of the bearers is not clearly indicated on the drawings, it is normal trade practice to run the bearers in the longest direction in order to reduce cutting waste, particularly in cases where flooring boards are used.

Item c–Flooring: The net sight area is measured including extra at doorways.

Item d–Sanding: Sanding is given as a separate description from the flooring. The area is the same as the flooring.

8.04. EXERCISE—GROUND FLOOR FRAMING AND FLOORING

QUESTION: B.m.e. the ground floor framing and flooring as specified and as shown in Drawings 6.3, 6.4 and 6.5.

SPECIFICATION NOTES

WOODWORK

***GROUND FLOOR FRAMING** Floor framing to be F8 grade sawn hardwood. Bearers to be 100 x 75 spaced at 1800mm maximum centres. Floor joists to be 100 x 50 spaced at 450mm maximum centres.*

***FLOORING** Flooring boards to be 100 x 25 T & G Cypress pine. Closely cramp boards, double nail, punch and sand smooth on completion.*

8.05. EXAMPLE—PITCHED ROOF FRAMING

Following is a worked example illustrating the measurement of pitched roof framing.

QUESTION: B.m.e. the roof framing as specified and as shown in Drawings 8.3 and 8.4.

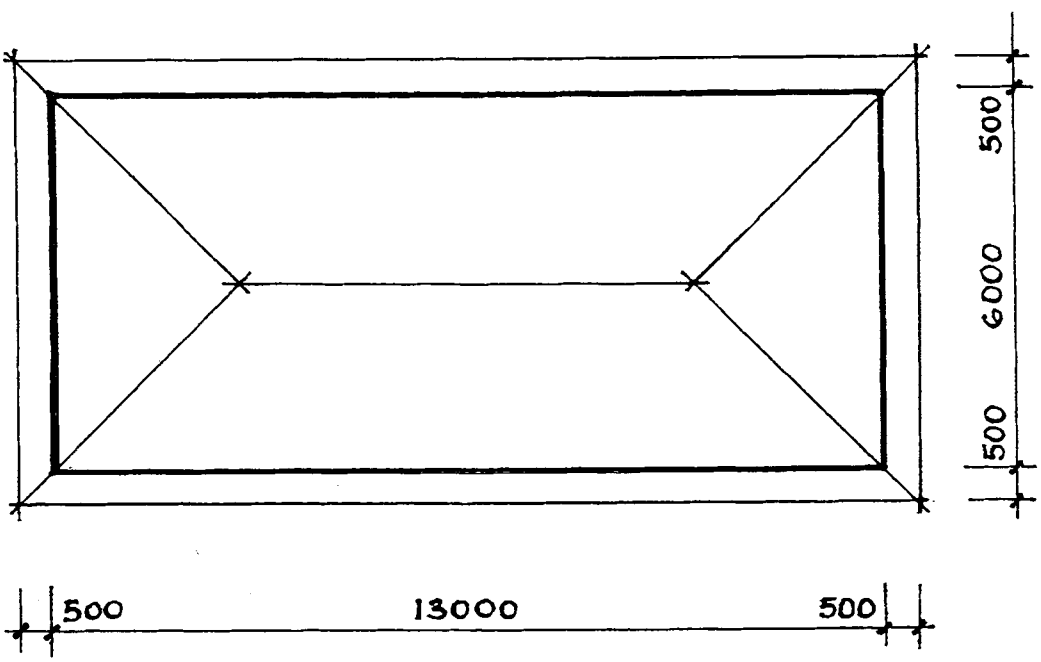
SPECIFICATION NOTES

WOODWORK

ROOF FRAMING All roof framing to be seasoned F5 Oregon.

Frame up roof with members of the following sizes:

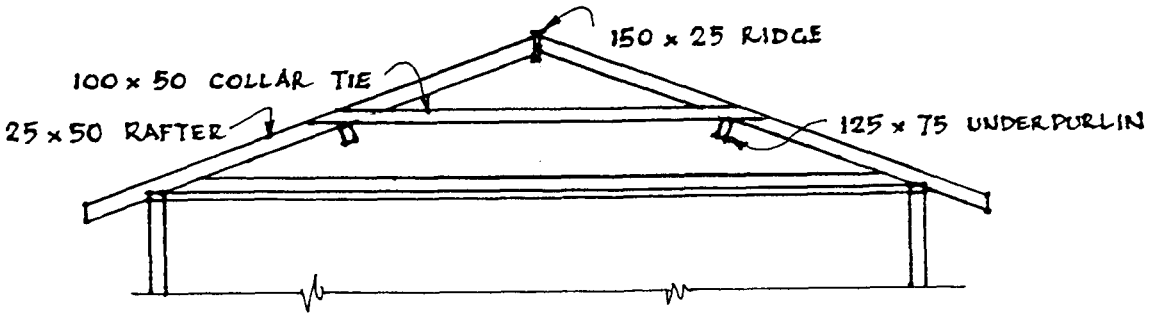
125 x 50 rafters spaced at 600mm maximum centres.
150 x 25 ridge and hip rafters.
125 x 75 underpurlins.
100 x 50 collar ties fixed to rafters with 10mm diam. galvd bolts.



Eaves width = 500mm
Roof pitch = 20 degrees

PLAN

DRAWING 8.3



SECTION

DRAWING 8.4

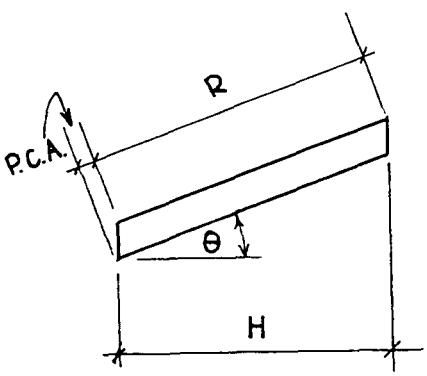
WOODWORK

Roof Framing

a 125 x 50 seasoned F5 Oregon rafters. m 194

Number of Rafters:

Building length	13000
+ 2 x eaves width	1000
Overall roof length	14000
Divide cts spacing	÷ 600
	24
Add 1	+1
Rafters to one side	25
Both sides	x2
Number of rafters =	50



Length of Common Rafter:

Half building width	3000
+ eaves width	500
less half ridge	-12
Horizontal Distance [H]	3488mm

Net rafter length [R] $= H / \cos \theta$
$= 3488 / \cos 20^{o}$
$= 3712mm$

Rafter length = R + plumb cut allowance (P.C.A.)
= 3712 + 150
= 3862mm

50/ 3.87 193.50

193.50m

b 150 x 25 ditto ridge and hip rafters. m 29

Length of Ridge:

Roof length	14000
less roof width	-7000
plus rafter thickness	50
Ridge length =	7050mm

Length of Hip:

Net hip length $= \sqrt{H^2 + R^2}$

$= \sqrt{3488^2 + 3712^2}$

$= 5094$mm

Hip length = net hip length + P.C.A.
= 5094 + 150
= 5244mm

7.05	7.05	Ridge
4/ 5.25	21.00	Hips
	28.05m	

c 125 x 75 ditto underpurlins. m 26

2/13.00	26.00
	26.00m

d 100 x 50 ditto collar ties. m 25

Number of Collar Ties:

Spacing distance =	7000
Divide cts spacing	÷1200
	6
Add 1	+1
Number of collar ties =	7

Length of Collar Tie:

7000 / 2 = 3500mm

7/ 3.50	24.50
	24.50m

e 10mm diam. galvd bolts securing collar ties to rafters, 101–200 long. no 28

4/ 7 28 (4 per collar tie)
28

MEASUREMENT NOTES—PITCHED ROOF FRAMING

Item a–Rafters: The total quantity of timber in rafters in a hipped end pitched roof is the same as a gable end pitched roof given the same plan dimensions and pitch. Therefore, when measuring the rafters, in the first instance, ignore the hipped ends and measure as a gable end pitched roof. First calculate the number of rafters, then the length of a common rafter. Use simple trigonometry to determine the net rafter length and add an allowance for the plumb cuts at each end of the rafter. It is recommended that 150mm be added for the plumb cut allowance (P.C.A.).

Item b–Ridge: For this simple rectangular plan the length of the ridge is equal to the length of the roof less the width of the roof plus the thickness of one rafter.

Item b–Hips: The net length of the hip is calculated by applying Pythagoras's theorem and using the horizontal distance (H) and net rafter length (R) previously calculated for the rafters. It is recommended that 150mm be added to the net hip length for the plumb cut allowance (P.C.A.).

Item c–Underpurlins: In this case the total length of the underpurlins is approximately equal to twice the length of the building.

Item d–Collar Ties: Allow for collar ties to each alternate pair of common rafters. Therefore the spacing distance is equal to the ridge length less one rafter thickness (7050 - 50 = 7000), and the centre spacing is twice the rafter centre spacing (2 x 600 = 1200).

Item e–Bolts: Bolt length = 50 + 50 + 10 + 5 = 115mm. (Refer SMM 11.37, Bolts, page 96 and SMM 9.18, Bolts, M20, page 77.)

8.06. EXERCISE—PITCHED ROOF FRAMING

QUESTION: B.m.e. the roof framing as specified and as shown on Drawings 6.3 and 6.4, given that the roof pitch is 22.5 degrees and the eaves width is 520mm.

SPECIFICATION NOTES

WOODWORK

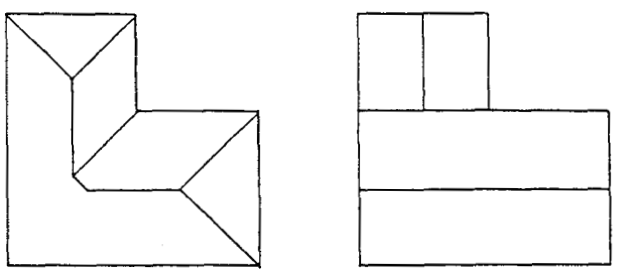
***ROOF FRAMING** All roof framing to be F8 grade sawn hardwood.*

Frame up roof with members of the following sizes:

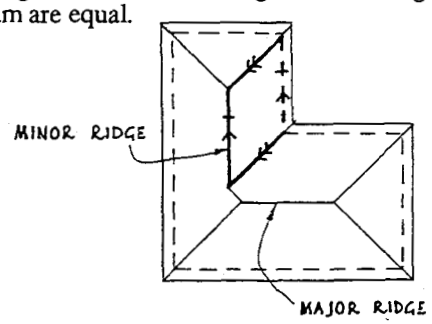
100 x 38 rafters spaced at 450mm maximum centres.
150 x 25 ridge and hip rafters.
150 x 38 valley rafter.
100 x 75 underpurlins.
100 x 50 collar ties fixed to rafters with 10mm diam. galvd bolts.

MEASUREMENT NOTES—PITCHED ROOF FRAMING

Rafters: Divide the roof into two rectangles starting with the greatest span. Treat each rectangle as in Example 8.05.



Ridges: Use the same method as Example 8.05 to calculate the major ridge length. The length of the minor ridge is determined using the knowledge that the opposite sides of a parallelogram are equal.



Hips and Valley Rafters: Use the same method as the hips in Example 8.05.

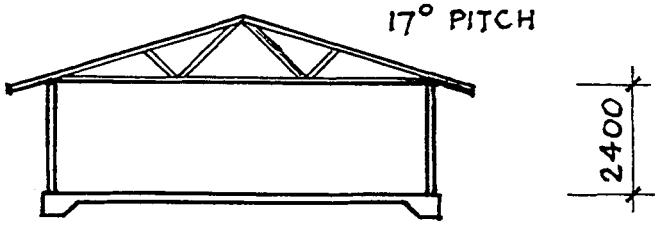
8.07. EXERCISE—ROOF TRUSSES

QUESTION: In accordance with Drawing 8.5 and the following specification notes, measure and extend the following Bill of Quantities extract for the roof trusses.

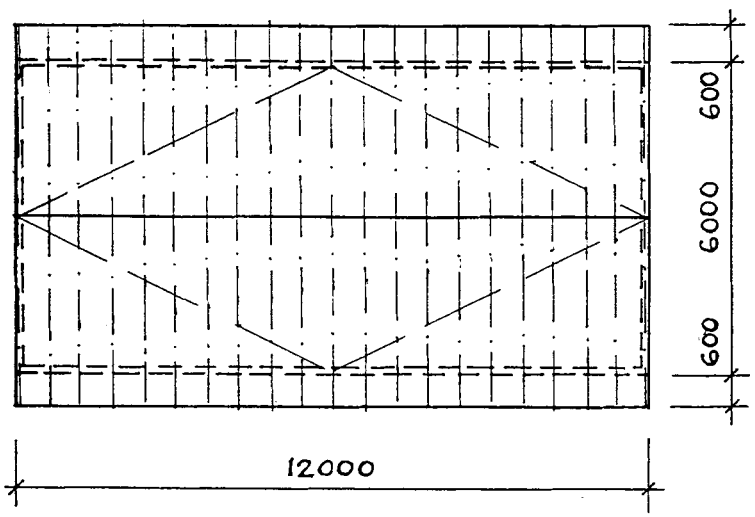
SPECIFICATION

WOODWORK

***ROOF TRUSSES** Frame up roof with Type A proprietary prefabricated timber roof trusses spaced at 600mm maximum centres. Secure trusses to wall plates with Trip-L-Grip framing anchors. Provide two 75 x 50 Oregon wind braces at each gable end truss and brace trusses with 75 x 25 Oregon diagonal braces nailed to underside of top chords.*



SECTION



ROOF PLAN

DRAWING 8.5

WOODWORK

Roof Trusses

a	Type A proprietary prefabricated timber roof trusses to suit concrete roof tiles, spaced at 600mm maximum centres, nominal 6000mm span, 17 degrees pitch, 600mm horizontal overhang each side, and include for hoisting and fixing approx. 2.50m high above ground level.	no
b	Trip-L-Grip framing anchors securing trusses to timber wall plates.	no
c	75 x 50 Oregon wind bracing.	m
d	75 x 25 ditto diagonal bracing.	m

MEASUREMENT NOTES—ROOF TRUSSES

Item a–Roof Trusses: Refer SMM 11.2 Prefabricated Roof Trusses, page 88. Calculate the number of trusses using the centre calculation method as described in clause 8.02 Centre Calculations.

Items c and d–Bracing: Since Drawing 8.5 has been photographically reduced it will be necessary to redraw the plan and elevation to scale, plot the position of the braces, and measure the true length of the braces using geometrical methods. Alternatively, the length of the braces can be calculated mathematically.

8.08. EXAMPLE—EAVES

Following is a worked example illustrating the measurement of fascias, barges, eaves soffit linings and associated trims.

QUESTION: B.m.e. the fascias, barges, eaves lining and trims as specified and as shown in Drawing 8.6, given that the roof pitch is 22.5 degrees.

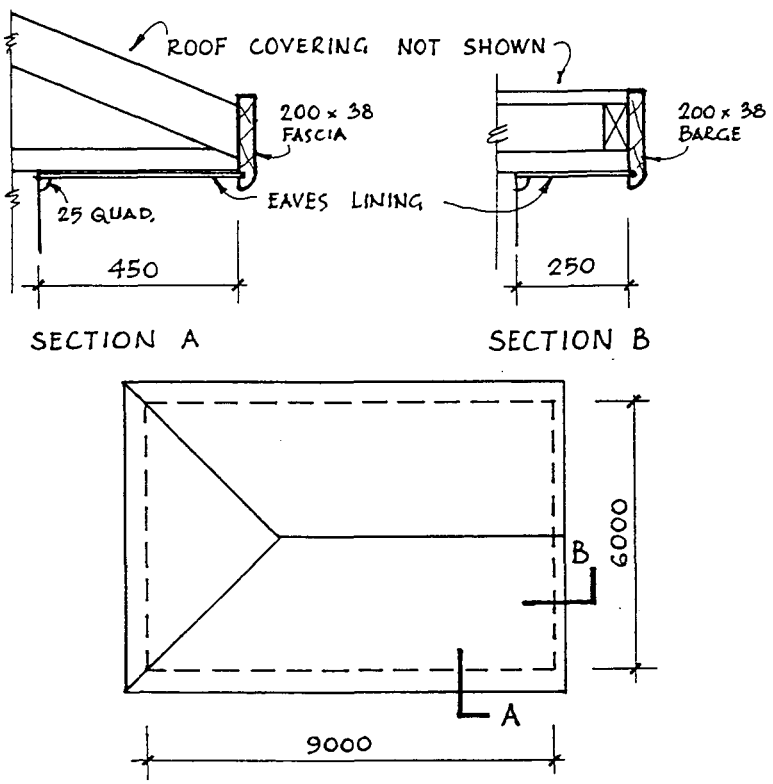
SPECIFICATION

WOODWORK

***FASCIAS AND BARGE BOARDS** to be ex. 200 x 38 dressed and grooved bullnosed Oregon fixed in long lengths and mitred at external corners and joints.*
Provide matching infill panel at junction of fascia and barge board at gable ends.

***EAVES SOFFIT LINING** Line eaves with 4.5mm thick fibre cement sheeting nailed direct to timber soffit framing and finished at joints with extruded plastic H section moulding.*

***TRIMS** Finish junction of eaves soffit lining and brickwork with 25mm Pacific maple quadrant mould mitred at external corners and joints.*

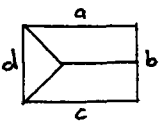


DRAWING 8.6

WOODWORK

Fascias and Barge Boards

a Ex 200 x 38 dressed and grooved bullnosed Oregon fascia, fixed in long lengths and mitred at external corners and joints. m 27



2/ 9.74	19.48	a,c (250+9000+450+38)
6.98	6.98	d (38+450+6000+450+38)
	26.46m	

b Ex 200 x 38 ditto barge boards. m 8

Length of Barge:

Half building width	3000
+ eaves width	450
+ fascia thick	38
Horizontal Distance [H]	3488mm

Net barge length [B] = H / cos Roof Pitch
= 3488 / cos 22.5^{o}
= 3775mm

Barge length = B + plumb cut allowance (P.C.A.)
= 3775 + 150
= 3925mm

2/ 3.93	7.86	b
	7.86m	

c Ex 38 thick dressed Oregon infill panel at junction of barge board and exposed end of 450mm wide eaves, cut to triangular shape and set flush with barge board. no 2

2	2	gable ends
	2	

Eaves Soffit Lining

d 4.5mm thick fibre cement sheeting as eaves soffit lining nailed direct to underside of timber soffit framing and finished at joints with and include for extruded plastic H section moulding. m^2 12

2/ 9.70		a,c (250 + 9000 + 450 = 9700)
0.45	8.73	
6.00		d
0.45	2.70	
	11.43m^2	

e Ditto to raking and vertical eaves at gable end, 0–250mm wide. m 8

2/ 4.00*	8.00	c, *approx. quantity
	8.00m	

Trims

f 25mm Pacific maple quadrant mould fixed at the junction of eaves soffit lining and brickwork, and mitred at external corners and joints. m 33

2/ 9.05	18.10	a,c
6.05	6.05	d
2/ 4.00*	8.00	b *approx. quantity
	32.15m	

MEASUREMENT NOTES—EAVES

Item a–Fascias: Fascias have been measured their extreme length.

Item b–Barge Boards: Calculate barge length using the same method used for the calculation of the common rafter length previously.

Item d–Eaves Soffit Lining: Net area measured. Joint cover strips between the sheets included in the description. (Refer SMM 11.12, page 90.)

Item e–Eaves Soffit Lining: Measure in metres. (Refer SMM 11.12, M18, page 90.) Approximate quantity given since the cost of the moulding is minimal and it does not justify the time required to calculate the precise length mathematically.

CHAPTER 9

ROOFING

9.01. SMM REQUIREMENTS

Refer to SMM, Section 16, Roofing, pages 107–114, for the rules governing the measurement of roofing. In particular the following basic requirement should be noted:

1. Roofing is measured to the net area to be covered, unless stated otherwise, including under ridges, flashings and similar items.

9.02. EXAMPLE—CONCRETE ROOF TILING

Following is a worked example illustrating the measurement of roof tiling.

QUESTION: B.m.e. the roof tiling as specified and as shown in Drawing 8.3, given that the fascia thickness is 25mm.

SPECIFICATION NOTES

ROOFING

***CONCRETE ROOF TILING** Cover all roof slopes with selected colour Roman pattern concrete roof tiles. Fix tiles to 38 x 25 Oregon battens spaced to suit the tiles. Finish ridge and hips with matching cappings and accessories bedded in cement mortar and point up with coloured mortar. On completion sweep down all roof slopes and clean out all gutters.*

ROOFING

Concrete Roof Tiling

a Selected colour Roman pattern concrete roof tiles fixed to and include for 38 x 25 Oregon battens spaced to suit the tiles. Roof pitch 20 degrees. Single storey work. m^2 108

Roof Area = 2LS

Roof Length (L):

Building length	13000
+ 2 x eaves width	1000
+ 2 x fascia thickness	50
+ 2 x 50mm oversail	100
Roof length (L) =	14150mm

Slope Height (S):

Half building width		3000
+ eaves width		500
+ fascia thickness		25
+ 50mm oversail		50
Horizontal (H)	=	3575mm
Slope height (S)	=	H / cos Roof Pitch
	=	$3575 / \cos 20^0$
Slope height (S)	=	3804mm

2/ 14.15
3.81 107.82
107.82m^2

b Matching concrete ridge capping bedded in cement mortar and pointed up in coloured mortar. m 7

Length of Ridge:

Building length	13000
less building width	-6000
Ridge length =	7000mm

7.00 7.00
7.00m

c Ditto hip capping. m 21

Length of Hip:

Hip length $= \sqrt{H^2 + S^2}$

$= \sqrt{3575^2 + 3804^2}$

= 5220mm

4 / 5.22 20.88 hips
20.88m

d Ditto three-way apex tiles. no 2

2 2
2

e Ditto hip starter tiles. no 4

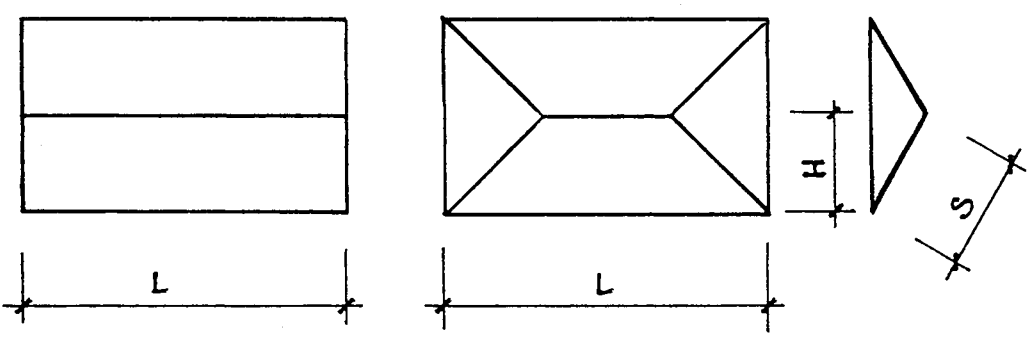
4 4

4

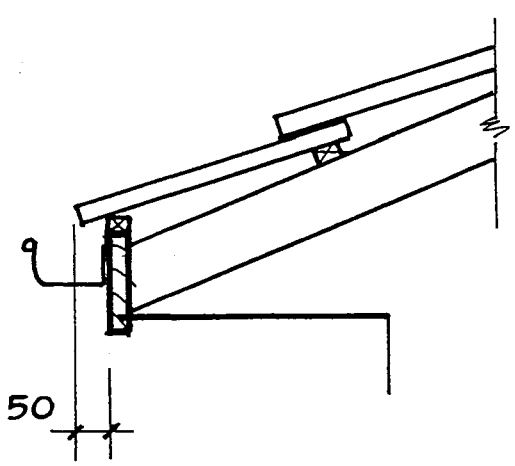
MEASUREMENT NOTES—ROOF TILING

The area of a hipped end pitched roof is the same as a gable end pitched roof, given that the plan dimensions and pitch are identical.

The area of a pitched roof is calculated using the formula A = 2LS. Where A is the surface area, L is the overall roof length and S is the slope height.



Where roof tiles finish at an eaves gutter allow 50mm oversail into the gutter.



9.03. EXAMPLE—TERRACOTTA ROOF TILING

Following is a worked example illustrating the measurement of terracotta roof tiling.

QUESTION: B.m.e. the roofing as specified and as shown in Drawing 9.1.

SPECIFICATION NOTES

ROOFING

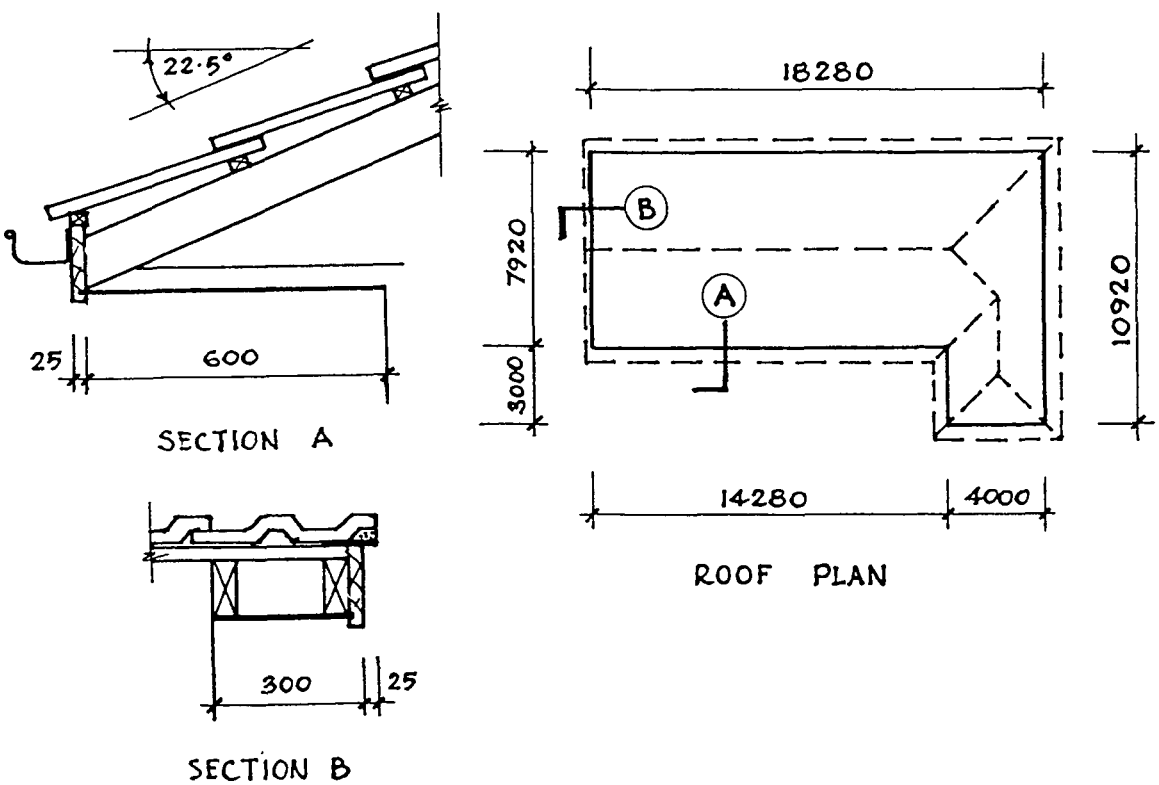
TERRACOTTA ROOF TILING Cover all roof slopes with selected colour glazed Modern French pattern terracotta roof tiles. Fix tiles to 38 x 25 pine battens spaced to suit the tiles.

Finish ridge and hips with matching terracotta cappings and accessories bedded in cement mortar and point up with coloured mortar.

Bed verge tiles in cement mortar on 100mm wide fibre cement strip and point up with coloured mortar as detailed.

On completion sweep down all roof slopes and clean out all gutters.

SARKING Prior to fixing roof battens, sark the roof with double-sided aluminium foil sarking, lapped and fixed in accordance with the manufacturer's instructions.



DRAWING 9.1

ROOFING

Terracotta Roof Tiling

a Selected colour glazed Modern French pattern terracotta roof tiles fixed to and include for 38 x 25 pine battens spaced to suit the tiles. Roof pitch 22.5 degrees. Single storey work. m^2 211

Roof Area $A = 2L_A S_A$

Roof Length (L_A):

Building length	18280
+ eaves width	600
+ fascia thickness	25
+ 50mm oversail	50
+ gable	325
Roof length (L_A) =	19280mm

Slope Height (S_A):

Half building width	3960
+ eaves width	600
+ fascia thickness	25
+ 50mm oversail	50
Horizontal (H_A) =	4635mm

Slope height (S_A) $= H_A / \cos$ Roof Pitch

$= 4635 / \cos 22.5^0$

Slope height (S_A) = 5017mm

Roof Area $B = 2L_B S_B$

Roof Length (L_B):

Roof length (L_B) = 3000mm

Slope Height (S_B):

Half building width	2000
+ eaves width	600
+ fascia thickness	25
+ 50mm oversail	50

Horizontal (H_B) = 2675mm

Slope height (S_B) $= H_B / \cos$ Roof Pitch

$= 2675 / \cos 22.5^0$

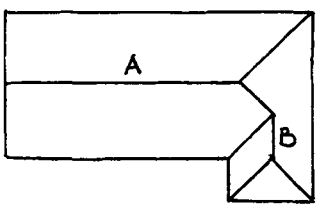
Slope height (S_B) = 2895mm

2/ 19.28		
5.02	193.57	Roof A
2/ 3.00		
2.90	17.40	Roof B
	210.97m^2	

b Matching terracotta ridge capping bedded in cement mortar and pointed up in coloured mortar. m 18

Length of Ridge A:

Building length	18280
+ gable	325
less half building width	-3960
Ridge A length =	14645mm



Length of Ridge B:

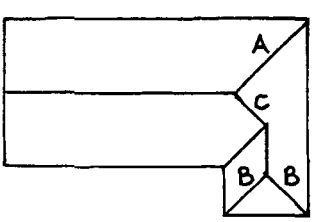
Ridge B length = 3000mm

14.65	14.65	Ridge A
3.00	3.00	Ridge B
	17.65m	

c Ditto hip capping. m 18

Length of Hip A:

$$\text{Hip A Length} = \sqrt{H_A^2 + S_A^2}$$
$$= \sqrt{4635^2 + 5017^2}$$
$$= 6830\text{mm}$$



Length of Hip B:

$$\text{Hip B Length} = \sqrt{H_B^2 + S_B^2}$$
$$= \sqrt{2675^2 + 2895^2}$$
$$= 3942\text{mm}$$

Length of Hip C (Broken Hip):

Hip C Length = Hip A less Hip B

= 6830 - 3942

= 2888mm

6.83	6.83	Hip A
2 / 3.95	7.90	Hip B
2.89	2.89	Hip C
	17.62m	

d Ditto three-way apex tiles. no 2

2	2
	2

e Ditto hip starter tiles. no 3

3	3
	3

f Verge treatment comprising bedding verge tiles in cement mortar on 100mm wide fibre cement strip and pointing up with coloured mortar as detailed; include for all necessary cutting. m 11

2 / 5.02	10.04	Repeat S_A
	10.04m	

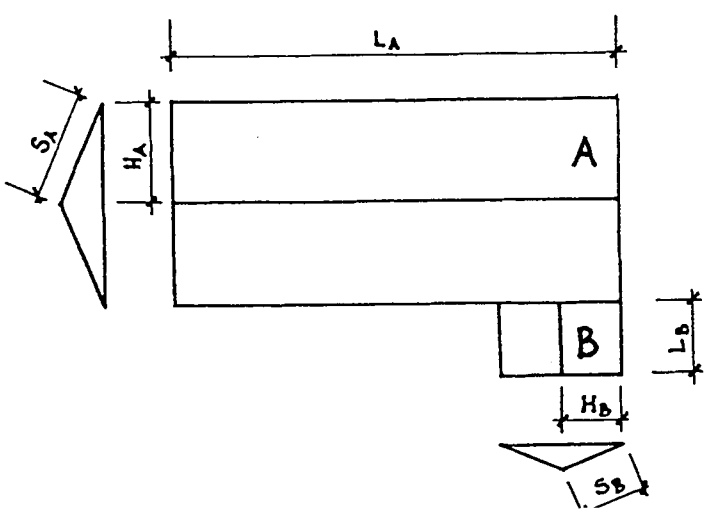
Sarking

g Double-sided aluminium foil sarking, lapped and fixed in accordance with the manufacturer's instructions. m^2 211

211m^2	Repeat area of tiling

MEASUREMENT NOTES—TERRACOTTA ROOF TILING

Item a–Roof Tiling: Divide the roof into rectangles, starting with the greatest span. Treat each rectangle as in Example 9.02.



9.04. EXERCISE—ROOF TILING

QUESTION: B.m.e. the roofing as specified and as shown in Drawing 6.3, given that the roof is a hipped end pitched roof having a pitch of 17.5 degrees, with 520mm eaves width and 38mm thick fascia.

SPECIFICATION NOTES

ROOFING

***TERRACOTTA ROOF TILING** Cover all roof slopes with selected colour glazed Swiss pattern terracotta roof tiles. Fix tiles to 38 x 38 pine battens spaced to suit the tiles.*

Finish ridge and hips with matching terracotta cappings and accessories bedded in cement mortar and point up with coloured mortar.

On completion sweep down all roof slopes and clean out all gutters.

***SARKING** Prior to fixing roof battens, sark the roof with double-sided aluminium foil sarking, lapped and fixed in accordance with the manufacturer's instructions.*

9.05. EXAMPLE—METAL ROOFING, GUTTERS AND DOWNPIPES

Following is a worked example illustrating the measurement of metal roofing, gutters and downpipes.

QUESTION: B.m.e. the roofing as specified and as shown in Drawing 9.2.

SPECIFICATION NOTES

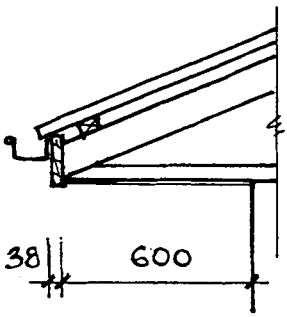
ROOFING

***METAL ROOFING** shall be Lysaght's Brownbuilt 305 manufactured from 0.75mm min. total thickness zincalume coated steel sheet. Fix roof sheeting in single lengths and secure with snap-in clip fixings side fixed to roof members. Roofing to be installed in accordance with AS 1562.*

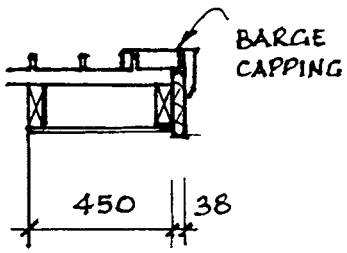
Cappings, flashings and other accessories shall be 0.75mm min. total thickness zincalume coated steel sheet and shall be fixed with monel blind pop rivets.

***GUTTERS** Provide and fix 115mm wide, 0.60mm thick zincalume coated steel quadrant section eaves gutters. Gutters to be supported on gutter brackets spaced at 1200mm max. cts. Gutters to be lapped, riveted and silicone sealed at joints. Provide all necessary mitred angles, stop ends and outlets.*

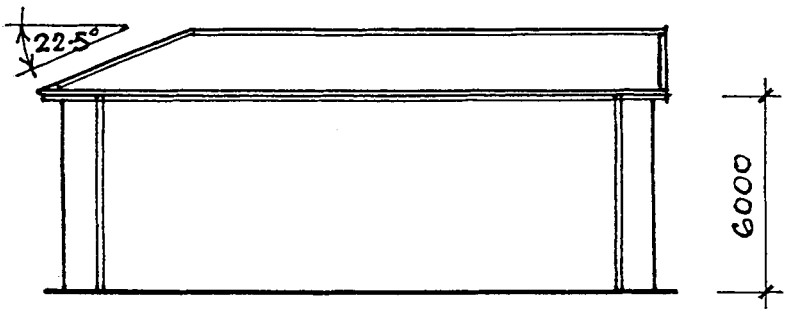
***DOWNPIPES** Provide and fix 100 x 50 x 0.60mm thick zincalume coated steel downpipes. Downpipes to be well entered, riveted and silicone sealed at joints. Downpipes to be fixed to brickwork with matching astragals spaced at 2700mm max. cts, minimum 3 per stack. Provide all necessary bends, offsets, etc. and connect to p.v.c. drains.*



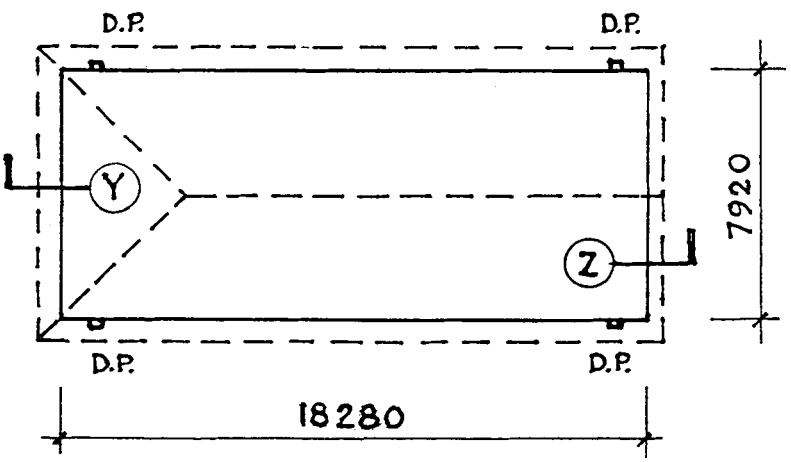
SECTION Y



SECTION Z



ELEVATION



PLAN

DRAWING 9.2

ROOFING

Metal Roofing

a Lysaght's Brownbuilt 305 manufactured from 0.75mm min total thickness zincalume coated steel sheet, fixed in single lengths, and secured with snap-in clip fixings side fixed to roof members; all installed in accordance with AS 1562. Roof pitch 22.5 degrees. Two-storey work. m^2 199

Roof Area A = 2LS

Roof Length (L):

Building Length	18280
+ eaves width	600
+ fascia thickness	38
+ 50mm oversail	50
+ gable	450
+ barge	38
Roof length (L) =	19456mm

Slope Height (S):

Half building width	3960
+ eaves width	600
+ fascia thickness	38
+ 50mm oversail	50
Horizontal (H) =	4648mm

Net slope height = H / cos Roof Pitch
= 4648 / cos 22.5^0
= 5031

+ turn up = 50
Slope height (S) = 5081mm

2/ 19.46
5.09 198.10
198.10m^2

b Raking cutting to roof sheeting at hips. m 28

Length of Hip:

Hip Length $= \sqrt{H^2 + \text{net } S^2}$

$= \sqrt{4648^2 + 5031^2}$

= 6849mm

2 / 2 / 6.85 27.40 hips
27.40m

c Turn up roof trays and form stop ends in roof sheeting at ridge and hips. m 58

Length of Ridge:

Building length	18280
+ gable eaves	450
+ barge	38
less half building width	-3960
Ridge length =	14808mm

2 / 2 / 6.85 27.40 Hips
2 / 14.81 29.62 Ridge
57.02m

d Turn down trays of roof sheeting at eaves gutters. m 49

2 / 19.46 38.92 repeat L
9.30 9.30 repeat 2xH (2 x 4648)
48.22m

e 0.75mm min. total thickness zincalume coated steel sheet stock pattern ridge capping fixed with monel blind pop rivets. m 15

14.81 14.81 Repeat ridge length, Item c
14.81m

f Ditto hip cappings. m 14

2 / 6.85 13.70 Repeat hip length, Item b
13.70m

g Ditto 3 way apex piece. no 1

1 1

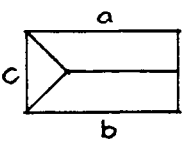
1 .

h Ditto barge capping. m 11

2 / 5.04 10.08 Repeat net slope ht., Item a (5031)
10.08m

Gutters

i 115mm wide 0.60mm thick zincalume coated steel quadrant section eaves gutter, lapped riveted and silicone sealed at joints, and supported on and include for gutter brackets spaced at 1200mm max. centres. m 49



	a,b	c
building	18280	7920
eaves width	600	1200
fascia	38	76
gutter	115	230
gable	450	-
barge	38	
total	19521	9426

2 /19.53 39.06 a,b
9.43 9.43 c
48.49m

j Stop ends to gutters. no 2

2 2
2 .

k Mitred angles ditto. no 2

2 2
2 .

l Spigot outlets to suit 100 x 50 downpipes ditto. no 4

4 4
4

Downpipes

m 100 x 50 x 0.60mm thick zincalume coated steel downpipes, well entered, riveted and silicone sealed at joints, and fixed to brickwork with matching astragals spaced at 2700mm maximum centres, minimum 3 per stack. m 28

4 / 6.85 27.40 (200+700+5700+250)
27.40m

n Bends to downpipes. no 8

4/ 2 8
8 .

o Shoes ditto. no 4

4 4
4 .

p Make connection of downpipes to p.v.c. drains. no 4

4 4
4 .

MEASUREMENT NOTES—METAL ROOFING, GUTTERS AND DOWNPIPES

Metal Roofing: Refer SMM 16.5, page 109.

Item a–Roofing: Allow 50mm oversail into gutters as for tile roofing with an additional allowance of 50mm for turn up at ridge.

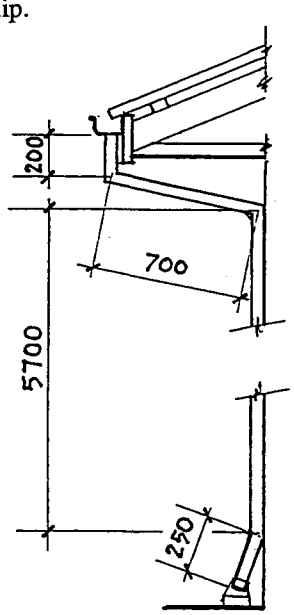
Item b–Raking Cutting: Measure to both sides of each hip.

Gutters: Refer SMM 16.22, page 112.

Item i–Gutters: Bead length of gutter measured.

Downpipes: Refer SMM 16.23, page 113.

Item m–Downpipes: Net centre line measured, viz. [200 fascia + 700 offset + 5700 wall + 250 shoe]



CHAPTER 10

CONCRETE

10.01. SMM REQUIREMENTS

Refer to SMM, Section 6, Concrete, pages 31–52, for the rules governing the measurement of concrete. In particular the following basic requirements should be noted:

1. Section 6, Concrete, is divided into a number of sub-sections, viz.:

   In-situ Concrete
   Formwork
   Permanent Metal Formwork System
   Reinforcement
   Prestressing
   Slip Formed Construction
   Precast Concrete
   Tanking

   The SMM requires that all of the above categories are measured separately.

2. Formwork is measured to the net contact surface between formwork and concrete.

3. Calculate mass of bar reinforcement as the net theoretical mass with no allowance for rolling margin.

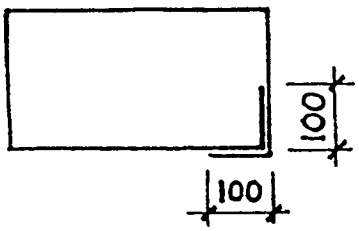
10.02. BAR REINFORCEMENT

10.02.01 **Mass Per Unit Length**
Steel Bar and Round Rod Reinforcement

Diameter (mm)	Mass per unit length (kg/m)
6	0.222
8	0.395
10	0.616
12	0.887
16	1.58
20	2.46
24	3.55
28	4.84

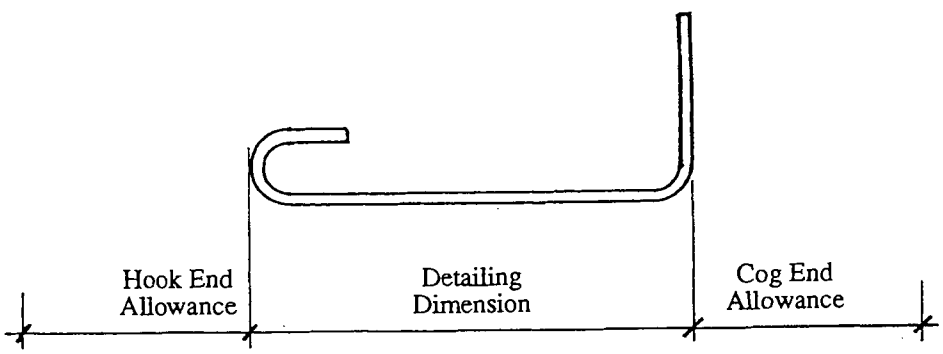
10.02.02 **Fitment Hook End Allowance** (Refer AS 1480)

Allow 100mm for each fitment hook end.



10.02.03 **Hook and Cog Allowance** (Refer AS 1480)

Diameter (mm)	Hook / Cog Allowance (mm)
10	130
12	160
16	180
20	220
24	260



10.03. REINFORCEMENT DRAWING NOTATION

Reinforcement Types

Y denotes hot rolled deformed bar to AS 1302
R denotes hot rolled plain round bar to AS 1302
F denotes hard drawn wire fabric to AS 1304
W denotes hard drawn plain wire to AS 1303
TM denotes hard drawn wire trench mesh to AS 1304

Structural Drawing Convention

6 - Y12 signifies six 12mm diam. hot rolled deformed reinforcing bars conforming to AS 1302.

R6 - 600 signifies 6mm diam. plain round bar reinforcement conforming to AS 1302 spaced at 600mm maximum centres.

10.04. EXAMPLE 1—REINFORCED CONCRETE STRIP FOOTINGS

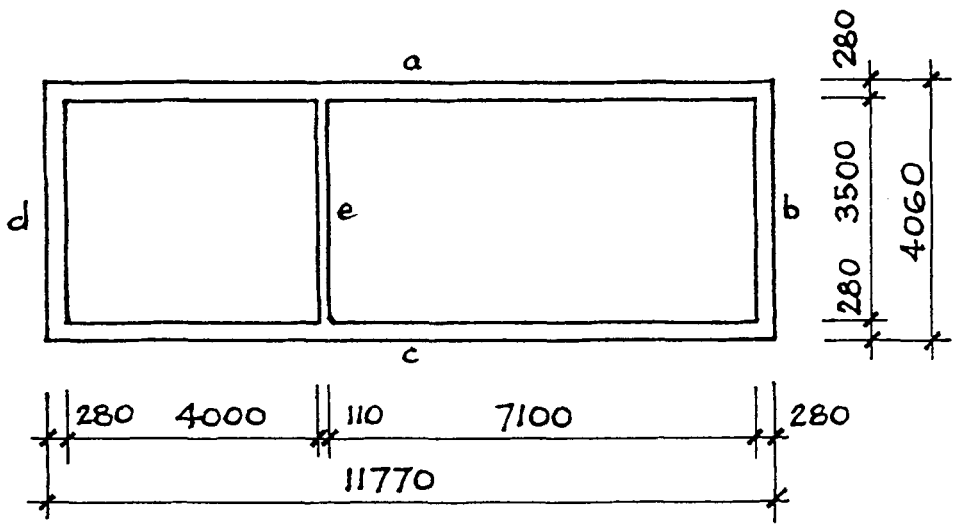
Following is a worked example illustrating the measurement of reinforced concrete strip footings.

QUESTION: B.m.e. the reinforced concrete strip footings as specified and as shown in Drawing 10.1.

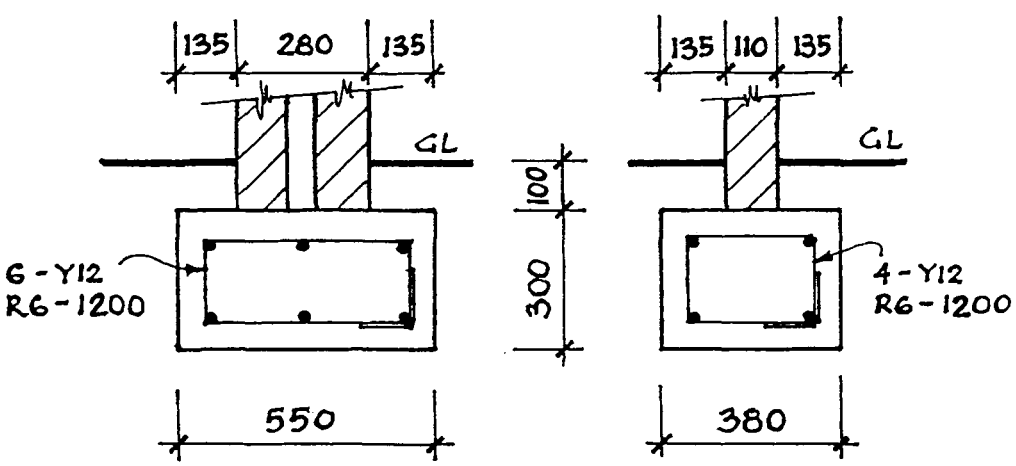
SPECIFICATION NOTES

CONCRETE

***REINFORCED CONCRETE STRIP FOOTINGS** Concrete to be F'c 20 MPa mix. Provide concrete strip footings to the extent as shown, reinforced with bar reinforcement as detailed. Provide 50mm concrete cover to all reinforcement.*



BRICKWORK FOUNDATION PLAN



DRAWING 10.1

CONCRETE

IN-SITU CONCRETE

Footings

a F'c 20 MPa reinforced concrete strip footings poured in trenches. m^3 6

Footing lengths:

ftg a,c: 11770 - 280 = 11490
ftg b,d: 4060 - 280 = 3780
ftg.e: 3500 - 270 = 3230

		550 x 300 ftgs:	
2 /	11.49	22.98	a,c
2 /	3.78	7.56	b,d
		30.54m x 0.55 x 0.30 =	5.04
		380 x 300 ftgs:	
	3.23	3.23	e
		3.23m x 0.38 x 0.30 =	0.37
		total:	$5.41m^3$

REINFORCEMENT

Footings

b Y12 to strip footings. t 0.19

	a,c	b,d,e
Brickwork o/all	11770	4060
+ 2 x offsets	270	270
Ftg o/all length	12040	4330
less 2 x cover	100	100
Rebar length	11940	4230

2 / 6 /	11.94	143.28	a,c
2 / 6 /	4.23	50.76	b,d
4 /	4.23	16.92	e
		210.96m x 0.887kg/m = 187.12kg	

c R6 fitments ditto. t 0.02

Fitment length:

$L = 2A + 2B + 2HE$

where A = width of fitment
B = depth of fitment
and HE = fitment hook end allowance

550 x 300 ftgs:

$L = 2 \times 450 + 2 \times 200 + 2 \times 100$
$= 1500mm$

380 x 300 ftgs:

$L = 2 \times 280 + 2 \times 200 + 2 \times 100$
$= 1160mm$

Number of fitments:

Ftgs a,c 11940 / 1200 = 10 + 1 = 11

Ftgs b,d,e 4330 - 1100 = 3230 / 1200 = 3 + 1 = 4

2 / 11 / 1.50	33.00	a,c
2 / 4 / 1.50	12.00	b,d
4 / 1.16	4.64	e
	49.64m x 0.222kg/m = 11.02kg	

MEASUREMENT NOTES—REINFORCED CONCRETE STRIP FOOTINGS

Item a–Concrete: Calculate lengths of footings a–d inclusive using the centre line measurement method as previously described in clause 3.05.02. Note that since the brick cavity wall is centrally located over the footing, the centre line length of the wall is the same as the centre line length of the footing. Thus brickwork dimensions can be used to calculate the concrete footing length, e.g. in the case of footing a, 11770 - 280 = 11490.

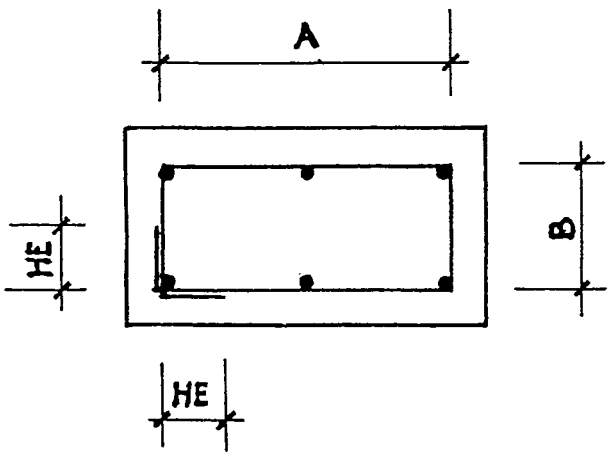
The length of footing e is the distance from the inside face of footing a to the inside face of footing c.

Multiply the centre line lengths by the cross-section size to obtain the concrete volume.

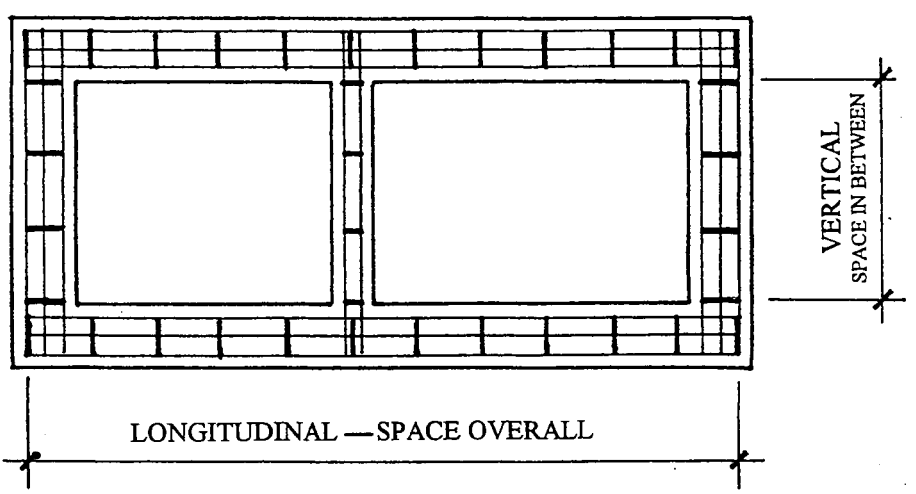
All strip footings are included in the one description even though they may be of different cross-sectional size.

Item b–Main Reinforcement: Find the length of each reinforcement bar by calculating the overall footing length and deducting the concrete cover. Allow for laps in reinforcement at corners and intersections. In this case, all other laps are deemed to be included in the price, refer to SMM clauses M4 and P1, page 44.

Item c–Fitments: Calculate the length of the fitments for each different size footing using the formula L = 2A + 2B + 2HE. A is equal to the width of the footing less the concrete cover, similarly B is equal to the depth of the footing less the concrete cover, and HE is 100mm. (Refer 10.02.02).



Unless the locations of the fitments are shown on the engineer's drawings, there is no set method for locating the fitments to strip footings. The method adopted above is to space the fitments to the longitudinal footings overall, and to space the fitments to the vertical footings in between as shown below.



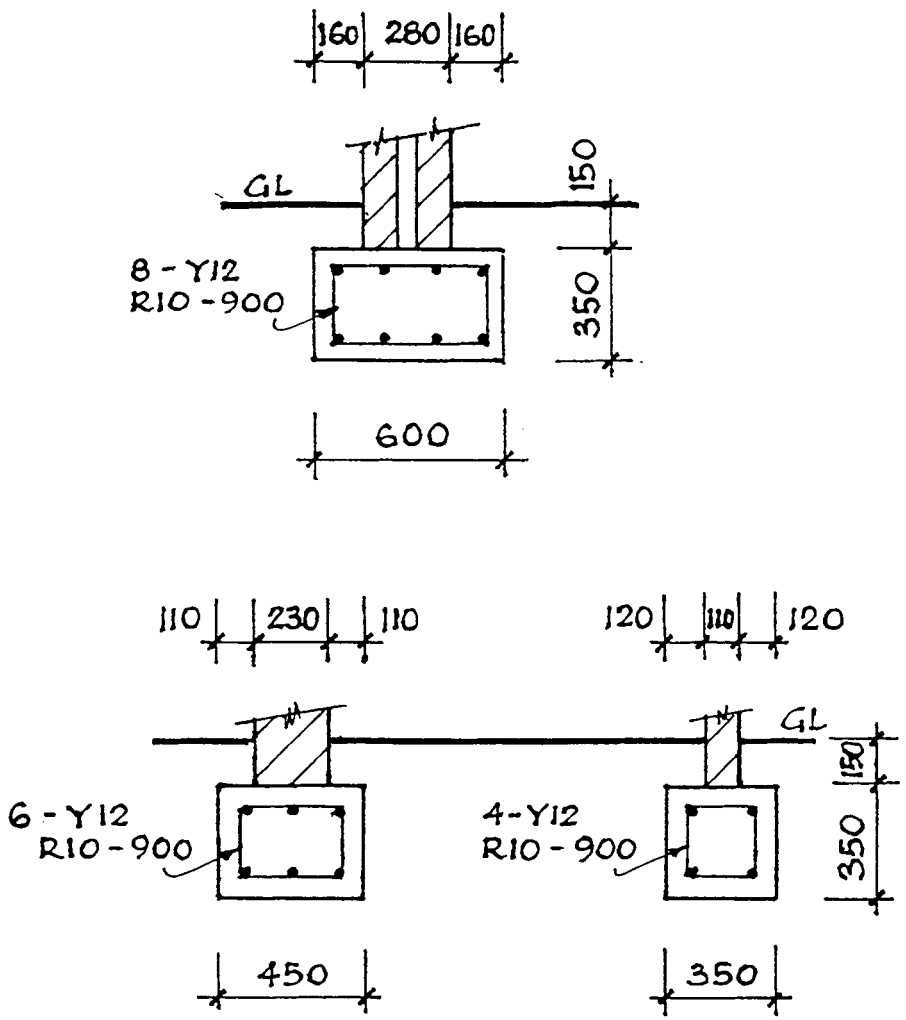
10.05. EXERCISE—REINFORCED CONCRETE STRIP FOOTINGS

QUESTION: In accordance with the accompanying specification notes, b.m.e. the reinforced concrete strip footings for the building plan shown in Drawing 6.3 and as detailed below in Drawing 10.2.

SPECIFICATION NOTES

CONCRETE

***REINFORCED CONCRETE STRIP FOOTINGS** Concrete to be F'c 20 MPa mix. Provide concrete strip footings to the extent as shown, reinforced with bar reinforcement as detailed. Provide 40mm concrete cover to all reinforcement.*



DRAWING 10.2

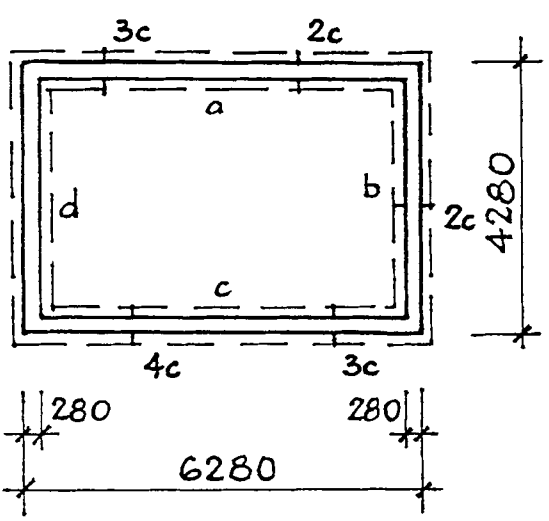
10.06. EXAMPLE 2—REINFORCED CONCRETE STRIP FOOTINGS

QUESTION: In accordance with the accompanying specification notes, b.m.e. the in-situ concrete and formwork for the strip footings shown in Drawing 10.3 below.

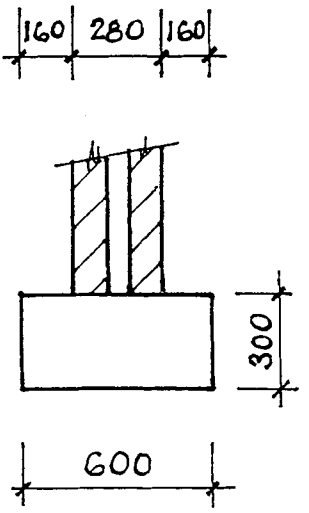
SPECIFICATION NOTES

CONCRETE

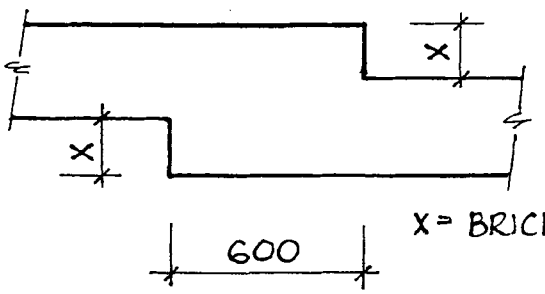
***REINFORCED CONCRETE STRIP FOOTINGS** Concrete to be F'c 20 MPa mix. Provide concrete strip footings to the extent as shown.*



BRICKWORK PLAN



SECTION



X = BRICK COURSES

ELEVATION - TYPICAL STEP

DRAWING 10.3

CONCRETE

IN-SITU CONCRETE

Footings

a F'c 20 MPa reinforced concrete strip footings poured in trenches. m^3 5

		600 x 300 ftgs:
2 / 6.00		a,c (6280 - 280 = 6000)
0.60		
0.30	2.16	
2 / 4.00		b,d (4280 - 280 = 4000)
0.60		
0.30	1.44	
2 / 0.60		2c steps (172mm)
0.60		
0.18	0.13	
2 / 0.60		3c steps (257mm)
0.60		
0.26	0.19	
0.60		4c steps (343mm)
0.60		
0.35	0.13	
	4.05m^3	

FORMWORK

Footings

b Formwork to vertical face of steps in strip footings. m^2 1

2 / 0.60		3c steps
0.26	0.31	
0.60		4c steps
0.35	0.21	
	0.52m^2	

c Ditto, 0–250 high. m 2

2 / 0.60	1.20	2c steps
	1.20m	

MEASUREMENT NOTES—STEPPED REINFORCED CONCRETE STRIP FOOTINGS

Item a–Concrete: When measuring stepped strip footings, in the first instance ignore the steps and measure as level footings. Then measure the additional concrete in the steps.

10.07. EXAMPLE—REINFORCED CONCRETE SLAB ON GROUND

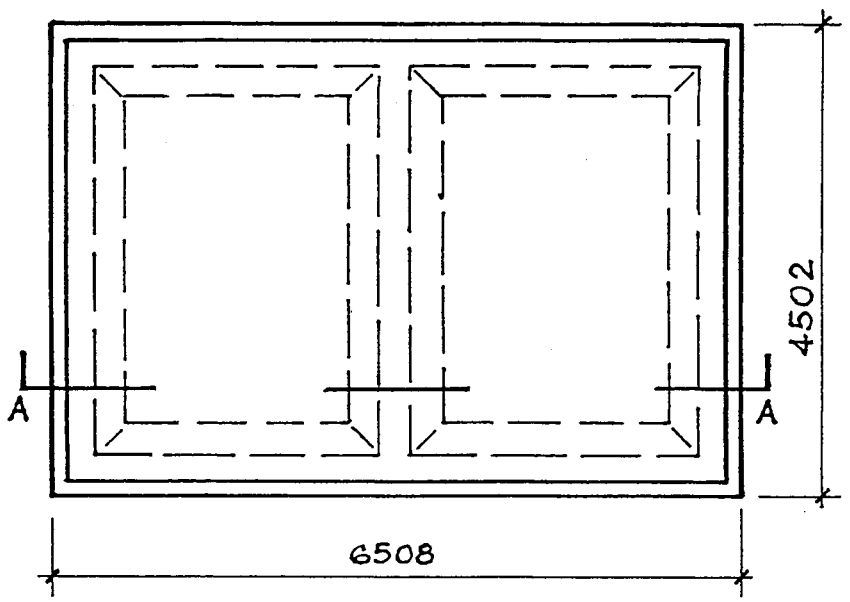
Following is a worked example illustrating the measurement of a reinforced concrete slab on ground.

QUESTION: B.m.e. the reinforced concrete slab on ground as specified and as shown in Drawings 10.4 and 10.5.

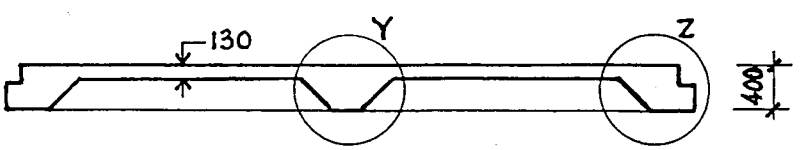
SPECIFICATION NOTES

CONCRETE

***REINFORCED CONCRETE SLAB ON GROUND** Concrete to be F'c 20 MPa mix. Form for, reinforce and pour concrete floor slab and attached beams as detailed. Concrete cover to be 50mm, except for fabric reinforcement to slab, which is to be located 25mm from the top of the slab. Properly cure concrete and finish slab with a steel trowel.*

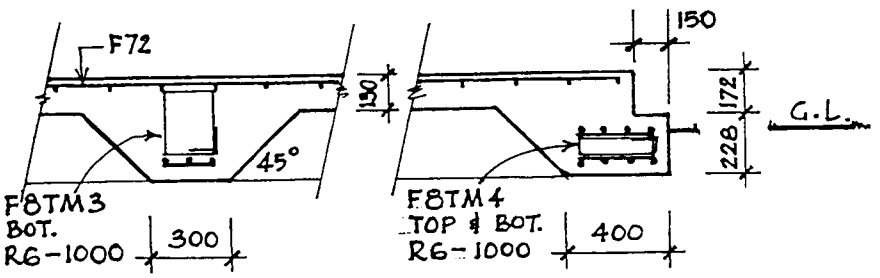


PLAN



SECTION AA

DRAWING 10.4



DRAWING 10.5

CONCRETE

IN-SITU CONCRETE

Slabs

a F'c 20 MPa reinforced concrete in floor slab poured on ground, 101–200mm thick. (m^2 27) m^3 4

6.21			
4.21	26.14	plan area	
	26.14m^2 x 0.130m = 3.40 m^3		

b Ditto in attached floor beams poured in ground. m^3 4

2 / 5.98		Edge beams:
0.54		
0.27	1.74	a,c
2 / 3.97		
0.54		
0.27	1.16	b,d
3.44		Internal beam:
0.57		
0.27	0.53	e
	3.43m^3	
Deductions:		
2 / 6.36		Edge Rebate:
0.15		
0.05	0.10	a,c
2 / 4.36		
0.15		
0.05	0.07	b,d
	0.17m^3	(ddt)
	3.26m^3	net volume

Integral Finishes

c Steel trowel finish to floor slab. m^2 27

26.14m^2 Repeat area of slab Item a

FORMWORK

Slabs

d Formwork to vertical face of attached floor beam, partially above ground, measured full depth, 0–250 high. m 23

2 / 6.51	13.02	a,c
2 / 4.51	9.02	b,d
	22.04m	

e Ditto to vertical face of rebate formed in edge of floor slab, 0–250 high. m 21

2 / 6.21	12.42	a,c
2 / 4.21	8.42	b,d
	20.84m	

REINFORCEMENT

Slabs

f F72 to floor slab. m^2 26

6.11	
4.11	25.11
	25.11m^2

g F8TM4 to attached floor beams. m 44

F8TM4 = 310mm wide

2 / 2 / 6.41	25.64	a,c (6508 - 100)
2 / 2 / 4.41	17.64	b,d (4502 - 100)
	43.28m	

h F8TM3 ditto. m 5

F8TM3 = 210mm wide

4.41	4.41	e (4502 - 100)
	4.41m	

i R6 ties ditto. t 0.01

Fitment (tie) length:

$$L = 2A + 2B + 2HE$$

400 x 228 edge beams (a,b,c,d):

$$L = 2 \times 310 + 2 \times 128 + 2 \times 100$$
$$= 1076mm$$

300 x 400 int. beam (e):

$$L = 2 \times 210 + 2 \times 325 + 2 \times 100$$
$$= 1270mm$$

Number of fitments (ties):

Beams a,c 6408 / 1000 = 7 + 1 = 8
Beams b,d,e 4502 - 800 = 3702 / 1000 = 4 + 1 = 5

2 / 8 / 1.08	17.28	a,c
2 / 5 / 1.08	10.80	b,d
5 / 1.27	6.35	e
	34.43m x 0.222kg/m = 7.64kg	

j Allow for the preparation of bending schedules for 26m^2 of fabric reinforcement, 49m of trench mesh and 0.01t of bar reinforcement. Item

---

MEASUREMENT NOTES—REINFORCED CONCRETE SLAB ON GROUND

Item d–Formwork: Free edge of slab is partially above ground level, therefore formwork is measured full height to slab edge. (Refer SMM 6.2.1, M8, page 38.)

Items g and h–Trench Mesh: Trench mesh is billed in metres stating the width. (Refer SMM 6.4.5, page 45.) Length of trench mesh includes for design laps at corners and intersections.

Note: F8TM3 indicates trench mesh having three 8mm diam. structural grade round bar main reinforcement rods. The nominal width of F8TM3 trench mesh is 210mm.

10.08. EXAMPLE—PIER AND BEAM FOOTINGS

Following is a worked example illustrating the measurement of concrete pier and beam footings.

QUESTION: B.m.e. the concrete pier and beam footings as specified and as shown in Drawing 10.6.

SPECIFICATION NOTES

CONCRETE

PIER AND BEAM FOOTINGS Concrete to be F'c 20 MPa mix. Form for, reinforce and pour concrete pier and beam footings as detailed.

All piers are to be 600mm diam.

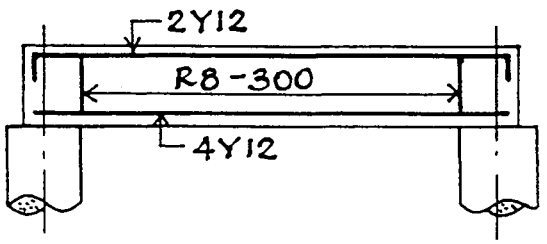
Existing ground level is R.L. 10.000.

Top of footing beams is R.L. 9.900.

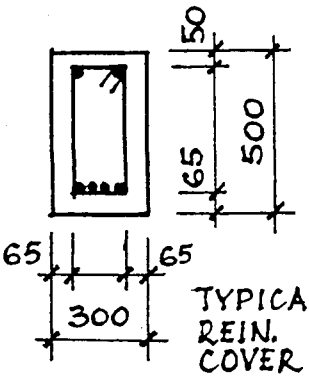
Schedule of Pier Depths:

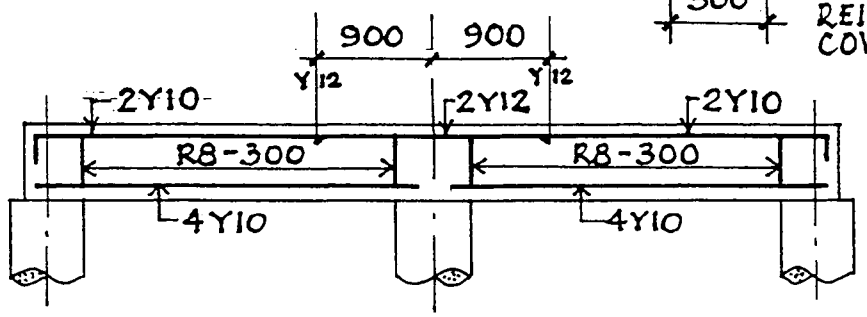
Pier	*R.L. at bottom of Pier*
P1	*3.300*
P2	*3.150*
P3	*2.780*
P4	*4.100*
P5	*3.000*
P6	*2.340*

Scabble top of concrete piers prior to pouring beams.

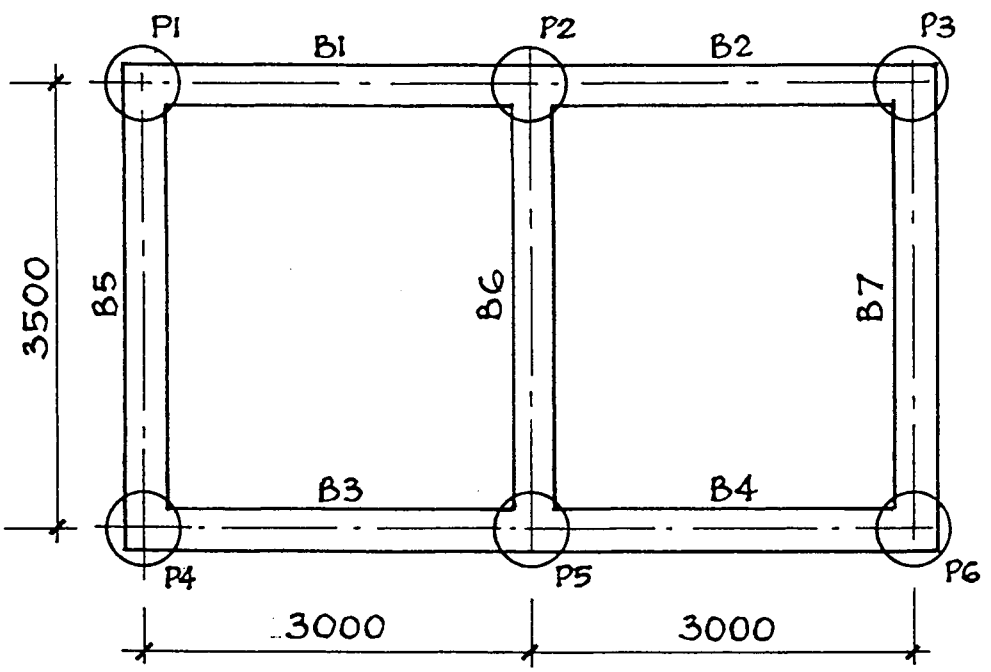


B5, 6, 7 (500 x 300)





B1, 3 (500 x 300) B2, 4 (500 x 300)



FOOTING PLAN

DRAWING 10.6

CONCRETE

IN-SITU CONCRETE

Footings

a F'c 20 MPa unreinforced concrete in piers poured in ground. m^3 11

6.10		P1
6.25		P2
6.62		P3
5.30		P4
6.40		P5
7.06		P6

37.73m x 0.30 x 0.30 x π = 10.67m^3

b F'c 20 MPa reinforced concrete in footing beams poured in ground. m^3 4

2 / 6.00		B1–2, B3–4
0.30		
0.50	1.80	
2 / 3.50		B5, 7
0.30		
0.50	1.05	
3.20		B6
0.30		
0.50	0.48	
	3.33m^3	

c Scabble top of 600mm diam. concrete piers prior to pouring beams. m^2 2

6 / π / 0.30	
0.30	1.70
	1.70m^2

FORMWORK

Footings

d Formwork to sides of footing beams above piers. m^2 3

6 / 1.00		P1–6
0.50	3.00	
	3.00m^2	

REINFORCEMENT

Footings

e Y10 and Y12 to footing beams. t 0.12

	Y10:	
2 / 2 / 6.43	B1,2; B3,4 T	
4 / 4 / 3.04	B1,2,3,4 B	
	74.36m x 0.616 kg/m =	45.81kg
	Y12:	
2 / 2 / 1.80	B1,2; B3,4 T	
3 / 2 / 3.99	B5,6,7 T	
3 / 4 / 3.67	B5,6,7 B	
	75.18m x 0.887 kg/m =	66.68kg
	Total:	112.49kg

f R8 fitments to ditto. t 0.04

Fitment (tie) length:

$$L = 2A + 2B + 2HE$$

500 x 300 beams (B1-6):

$$L = 2 \times 170 + 2 \times 385 + 2 \times 100$$
$$= 1310mm$$

Number of fitments (ties):

Beams B1–4 2400 / 300 = 8 + 1 = 9
Beams B5–7 2900 / 300 = 10 + 1 = 11

4 / 9 / 1.31	B1-4
3 / 11 / 1.31	B5-7
90.39m x 0.395kg/m = 35.70kg	

g Allow for the preparation of bending schedules for 0.16t of bar reinforcement. Item

---

MEASUREMENT NOTES—PIER AND BEAM FOOTINGS

The rules governing the measurement of cast in-situ bored concrete piers are contained in SMM, Section 5, Piling, clause 5.2, pages 29–30. This clause states that concrete and reinforcement are to be measured in accordance with Section 6, Concrete.

10.09. EXERCISE—SLABS AND STAIRS

QUESTION: In accordance with Drawings 10.7, 10.8 and 10.9 and the following specification notes, measure and extend the following Bill of Quantities' Concrete section.

SPECIFICATION NOTES

CONCRETE

SLABS AND STAIR

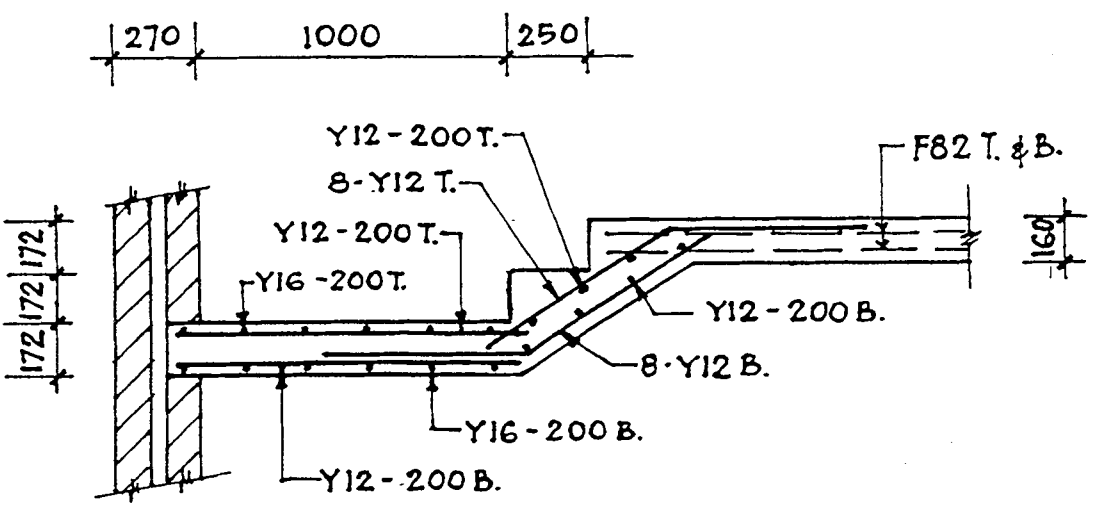
Concrete to be F'c 25 MPa mix.

The minimum standard of finishes to formed surfaces based on AS1510, shall be as follows:

Slab and stair soffits—Class 2
Surfaces not otherwise specified—Class 4

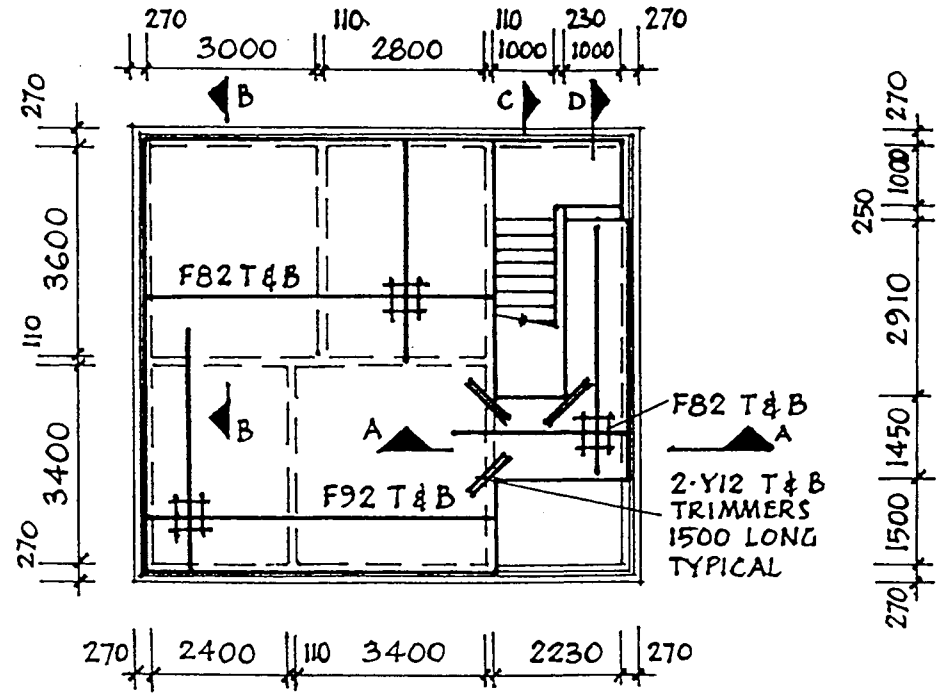
Reinforce, form as necessary and pour concrete slabs, stairs and landing, including all associated thicknessings, haunchings, etc., all as detailed on the accompanying drawings.

Finish all floor slab surfaces with a steel trowel.



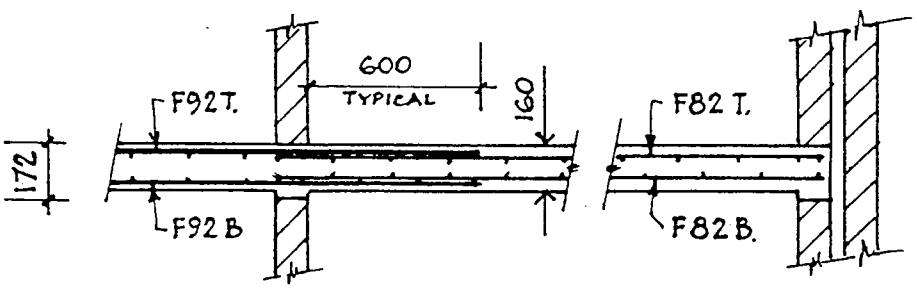
SECTION D

DRAWING 10.7

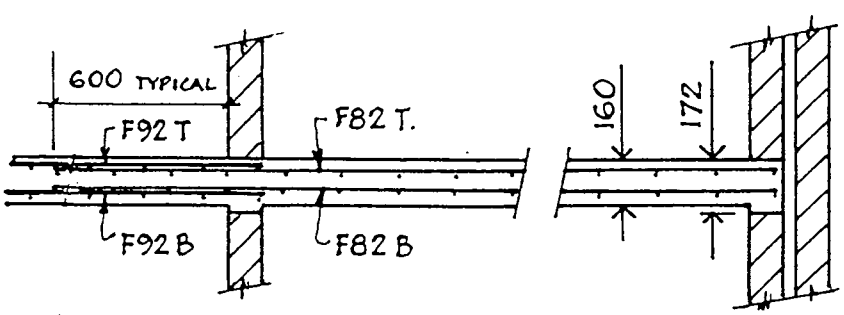


FIRST FLOOR SLAB PLAN

SLAB TO BE 160mm THICK UNLESS NOTED OTHERWISE.

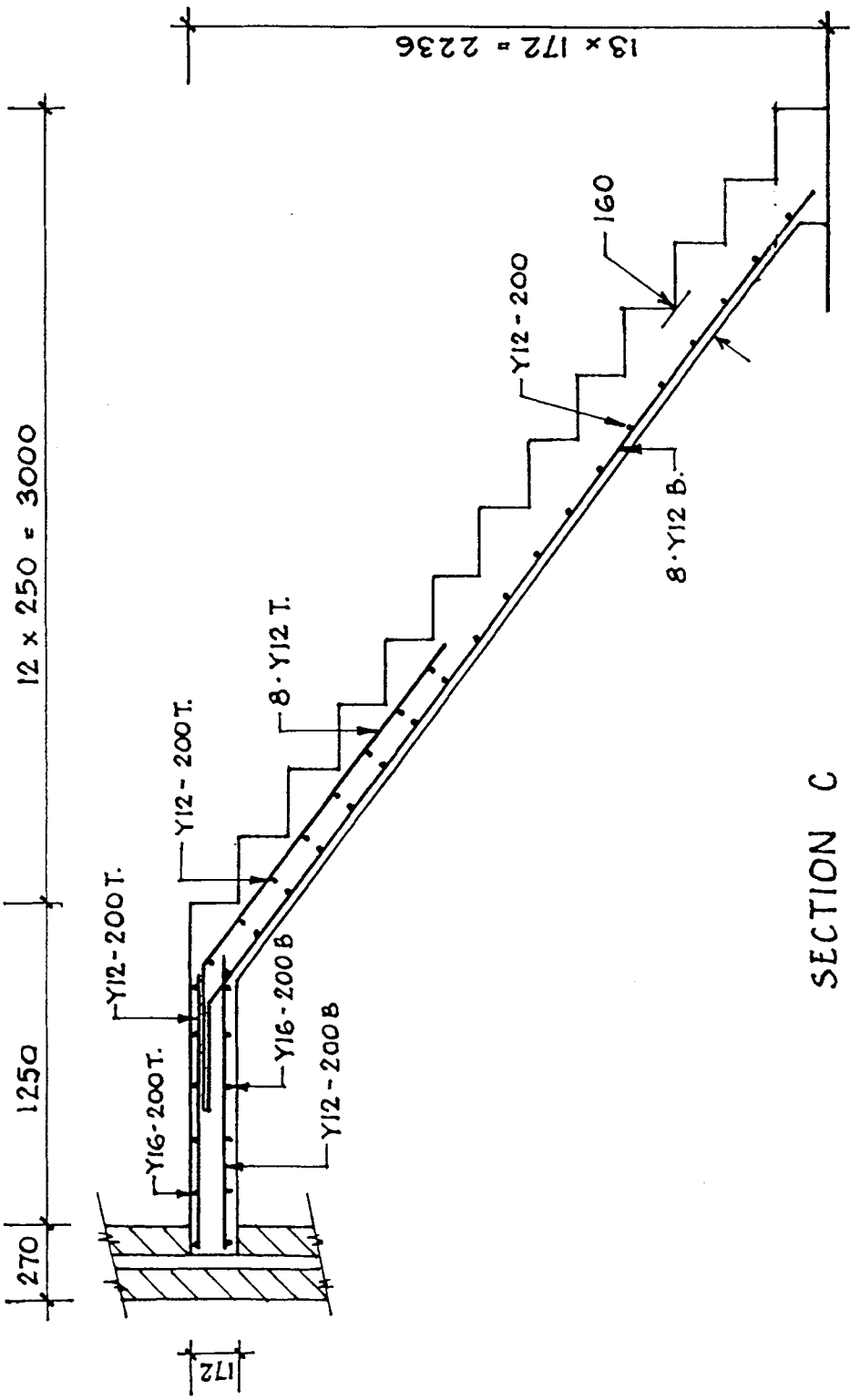


SECTION BB



SECTION AA

DRAWING 10.8


13 x 172 = 2236
12 x 250 = 3000
1250
270
172
Y12-200 T.
Y16-200 T.
Y12-200 T.
8·Y12 T.
Y16-200 B
Y12-200 B
Y12-200
160
8·Y12 B.
SECTION C

DRAWING 10.9

	CONCRETE			
a	Refer to the SMM for details regarding Measurement and Prices of Concrete.	Note		
	IN-SITU CONCRETE			
b	Refer to the Concrete section of the Specification for particulars of in-situ concrete.	Note		
c	Allow for providing samples of materials or finishes.	Item		
d	Allow for testing of materials, concrete specimens and similar.	Item		
e	Allow for protecting and curing concrete. (m^2)	Item		
	Slabs and Stair			
	F'c 25 MPa reinforced concrete in:			
f	Suspended floor slabs poured on formwork, 101–200mm thick. (m^2)	m^3		
g	Suspended stair flights and landing.	m^3		
	Integral Finish			
h	Steel trowel finish to floor slabs.	m^2		
	FORMWORK			
i	Refer to the Concrete section of the Specification for particulars of formwork.	Note		
	Slabs and Stair			
	Class 2 finish formwork to:			
j	Horizontal soffit of suspended floor slabs not exceeding 200mm thick, with struts not exceeding 3.00m high.	m^2		
k	Ditto suspended stair landing slab.	m^2		
l	Raking soffit of suspended stair flights.	m^2		
	Class 4 finish formwork to:			
m	Free edges of floor slabs, 0–250mm high.	m		
n	Vertical face of thicknessings in soffit of suspended floor slabs at wall bearings, 0–250 high.	m		

	Class 4 finish formwork to:			
a	Vertical face of stair strings.	m^2		
b	Vertical face of stair risers, 0–250 high.	m		
c	Free edges of stair landing slab, 0–250 high.	m		
	REINFORCEMENT			
d	Refer to the Concrete section of the Specification for particulars of reinforcement.	Note		
e	Allow for the preparation of bending schedules for _____t of bar reinforcement and _____m^2 of fabric reinforcement.	Item		
	Slabs and Stair			
f	F82 to suspended floor slabs.	m^2		
g	F92 to ditto.	m^2		
h	Y12 trimmers to ditto.	t		
i	Y12 and Y16 to suspended stair flights and landing slab.	t		

CHAPTER 11

GROUNDWORKS

11.01. SMM REQUIREMENTS

Refer to SMM, Section 4, Groundworks, pages 15–20, for the rules governing the measurement of Excavation; Filling and Hardcore; and Paper and Plastic Membranes. In particular the following basic requirements should be noted:

1. Measure all excavation and subsequent disposal before excavation. (Refer SMM 4.1, M1, page 15.)

2. Measure filling, hardcore and similar after consolidation. (Refer SMM 4.2, M1, page 19.)

11.02. EXAMPLE—TRENCH EXCAVATION

Following is a worked example illustrating the measurement of trench excavation for strip footings.

QUESTION: B.m.e. the trench excavation as specified and as shown in Drawing 10.1.

SPECIFICATION NOTES

EXCAVATION

***TRENCH EXCAVATION** All excavation is to be allowed for in material other than rock (O.T.R.). Excavate for strip footings, part backfill with the best of the excavated material and spread surplus spoil on site where directed.*

GROUNDWORKS

EXCAVATION

Trench Excavation

a	The commencing level for excavation is natural ground level.	Note	
b	Trench excavation for strip footings, in material O.T.R., not exceeding 1.00m total depth, part backfilled with the best of the excavated material and surplus spoil spread on site where directed.	m^3	8

30.54		repeat c/l length, Item a, page 79
0.55		ftg a,b,c,d.
0.40	6.72	
3.23		repeat c/l length, Item a, page 79
0.38		ftg e
0.40	0.49	
	7.21m^3	

Working Space and/or Maintaining Faces

c Working space and/or maintaining sides of trench excavation not exceeding 1.00m total depth. m^2 28

2 / 30.54		repeat c/l length
0.40	24.43	ftg a,b,c,d
2 / 3.23		repeat c/l length
0.40	2.58	ftg e
	27.01m^2	

MEASUREMENT NOTES—TRENCH EXCAVATION

Item b–Trench excavation: It is normal practice to measure the excavation section after the concrete section. In order to save time previous measurements may be reused where applicable. In this case, since the centre line of the footing is the same as the trench, the total centre-line lengths can be repeated from the in-situ concrete.

Item c–Working space and/or maintaining faces: The SMM requires that working space and/or maintaining faces of excavation is *"measured in all cases including to excavation in rock whether any is required or not in order that the risk may be priced."* (Refer SMM, Section 4.1, Excavation, Clause 10 page 18.)

11.03. EXERCISE—TRENCH EXCAVATION

QUESTION: B.m.e. the trench excavation as specified and as shown in Drawings 6.3 and 10.2.

SPECIFICATION NOTES

EXCAVATION

***TRENCH EXCAVATION** All excavation is to be allowed for in material other than rock (O.T.R.). Excavate for strip footings, part backfill with the best of the excavated material and spread surplus spoil on site where directed.*

11.04. EXERCISE—EXCAVATION FOR SLAB ON GROUND

QUESTION: In accordance with Drawings 10.4 and 10.5 and the following specification notes, measure and extend the following Bill of Quantities' Groundworks section.

SPECIFICATION NOTES

GROUNDWORKS

***EXCAVATION** All excavation is to be allowed for in material other than rock (O.T.R.).*

Clear the area of the building of all rubbish and vegetable matter and cart away spoil.

Excavate for floor slab and attached floor beams to the profiles as shown and spread spoil on site where directed.

Trim and level/batter ground and leave ready to receive hardcore filling and concrete.

***HARDCORE FILLING** Provide 100mm thick layer of hardcore filling under floor slab as detailed, thoroughly consolidate and blind over with sand.*

***WATERPROOF MEMBRANE** Cover the area under the floor slab and attached floor beams with 0.2mm thick coloured polythene film sheet, lap 150mm at joints and seal with pressure sensitive tape. Turn membrane up outside face of edge beams to base of rebate.*

	GROUNDWORKS			
	Preambles omitted			
	EXCAVATION			
a	Clear the area of the building of all vegetable matter and cart away spoil.	m^2		
b	The commencing level for excavation is natural ground level.	Note		
c	Surface excavation to reduce levels in material O.T.R. and spread spoil on site where directed. (m^2)	m^3		
d	Trench excavation for attached floor beams, not exceeding 1.00m total depth, ditto.	m^3		

e	Working space and/or maintaining vertical sides of trench excavation not exceeding 1.00m total depth.	m^2		
f	Trim and level excavated ground and leave ready to receive hardcore filling.	m^2		
g	Trim and batter sloping sides of excavated trenches exceeding 30 degrees from the horizontal.	m^2		
	HARDCORE FILLING			
h	100mm thick layer of hardcore filling under floor slab, thoroughly consolidated and blinded with sand.	m^2		
i	Trim and level surface of hardcore filling and leave ready to receive concrete.	m^2		
j	Trim and batter sloping sides of hardcore filling exceeding 30 degrees from the horizontal.	m^2		
	WATERPROOF MEMBRANE			
k	Waterproof membrane to underside of concrete floor slab including attached beams, comprising 0.2mm thick coloured polythene film sheet, lapped 150mm at joints and sealed with pressure sensitive tape and turned up at edges.	m^2		

11.05. EXAMPLE—PIER AND BEAM FOOTINGS

Following is a worked example illustrating the measurement of excavation for pier and beam footings.

QUESTION: B.m.e. the excavation as specified and as shown in Drawing 10.6.

SPECIFICATION NOTES

GROUNDWORKS

***EXCAVATION** All excavation is to be allowed for in material O.T.R. All surplus excavated material is to be spread on site where directed.*

All piers to be 600mm diam.

The site has been previously levelled and existing ground level is R.L. 10.000.

Top of footing beams is R.L. 9.900.

Schedule of Pier Depths:

Pier	*R.L. at bottom of Pier*
P1	*3.300*
P2	*3.150*
P3	*2.780*
P4	*4.100*
P5	*3.000*
P6	*2.340*

GROUNDWORKS

EXCAVATION

a	Refer to the Groundworks section of the Specification for details of excavation.	Note
b	Refer to the SMM for details regarding measurement and prices of excavation.	Note
c	Allow for establishing the pier boring equipment on site.	Item

d Allow for removal of pier boring equipment from site on completion. Item

e Allow for test loading piers. Item

f Allow for any trial piers as necessary. Item

g Set up the boring rig for 600mm diam. piers. no 6

6	6	P1-6
	6	

h 600mm diam. bored pier holes, singularly excavated in material O.T.R., varying in depth from 5.90m to 7.66m; include for the provision and subsequent extraction of temporary liners, for spreading surplus excavated material on site where directed. The commencing level of excavation taken as existing ground level R.L. 10.00.
(no 6, m^3 12) m 42

6.70		P1	(10.00-3.30 = 6.70)
6.85		P2	(10.00-3.15 = 6.85)
7.22		P3	(10.00-2.78 = 7.22)
5.90		P4	(10.00-4.10 = 5.90)
7.00		P5	(10.006-3.00 = 7.00)
7.66		P6	(10.00-2.34 = 7.66)

41.33m x 0.30 x 0.30 x π = 11.69m^3

i Clean out bottom of 600mm diam. pier holes. no 6

6	6	P1–6
	6	

i Test bottom of 600mm diam. pier holes. no 6

6	6	P1–6
	6	

j Trench excavation for footing beams, in material O.T.R., not exceeding 1.00m total depth, part backfilled and surplus spoil spread on site where directed. m^3 4

2 / 6.00		B1–2, B3–4
0.30		
0.60	2.16	
2 / 3.50		B5,7
0.30		
0.60	1.26	
3.20		B6
0.30		
0.60	0.58	
	4.00m^3	
Deductions:		
6 / 0.55		P1–6 (550mm taken as an average)
0.30		
0.60	0.59	
	0.59m^3	(ddt).
	3.41m^3	

k Working space and/or maintaining sides of trench excavation not exceeding 1.00m total depth. m^2 27

2 / 2 / 6.00		B1–2, 3–4
0.60	14.40	
2 / 2 / 3.50		B5,6
0.60	8.40	
2 / 3.20		B7
0.60	3.84	
	26.64m^2	

l Ditto sides of bored pier hole excavations, varying in depth from 5.90m to 7.66m. m^2 78

41.33m x 0.60 x π = 77.91m^2 (repeat Item h)

MEASUREMENT NOTES—PIER AND BEAM FOOTINGS

The SMM states that pier hole bored excavations are to be measured in accordance with cast in-situ bored concrete piling within Section 5.2, Cast In-Situ Piling. (Refer SMM, pages 29–30; and M.9, page 17.)

Item j–Trench excavation: Repeat trench lengths and widths from the in-situ concrete section. Remember that the depth of the trench is usually different from the depth of the concrete footing beam and a different take-off figure needs to be calculated. In this case the depth of the trench is 600mm and the depth of the footing beam is 500mm. Also, since the bored excavation is carried out before the trench excavation the volume of the pier hole excavation occurring in the trench needs to be deducted. In this case an average length of 550mm has been estimated as an average length and multiplied by the trench width and depth for each pier.

CHAPTER 12

METALWORK

12.01. SMM REQUIREMENTS

Refer to SMM, Section 10, Metalwork, pages 79–85, SMM, Section 18, Windows, pages 117–118, and SMM, Section 19, Doors, page 119, for the rules governing the measurement of Metalwork, Windows and Doors. In particular the following basic requirements should be noted:

1. The rules governing the measurement of some metalwork items are not contained in SMM, Section 10, Metalwork. For example, metal framed windows are contained in Section 18, Windows; and metal door frames and metal framed glazed doors are contained in Section 19, Doors.

2. Glazing to metal framed windows and doors is included in the description for the windows and doors and is not given separately.

12.02. EXAMPLE—ALUMINIUM SLIDING DOORS AND WINDOWS

Following is a worked example illustrating the measurement of aluminium sliding doors and windows.

QUESTION: B.m.e. the aluminium sliding door and windows as specified and as shown in Drawings 6.3, 6.4 and 6.5.

SPECIFICATION NOTES

DOORS

***ALUMINIUM SLIDING DOOR UNIT** Where indicated on Drawings, supply and install Ajax Type X clear anodised aluminium sliding door unit inclusive of factory glazing, flashings, fixings, furniture and other trims.*

Extent: D1

WINDOWS

***ALUMINIUM SLIDING WINDOWS** Where indicated on Drawings, supply and install Ajax Type X clear anodised aluminium sliding windows inclusive of factory glazing, flashings, fixings, furniture and other trims.*

Extent: W1–6 incl.

DOORS

Aluminium Sliding Door Unit

a	Ajax Type X clear anodised aluminium sliding door unit inclusive of factory glazing, flashings, fixings, furniture and other trims; to suit opening 3600 wide, 2175 high and include for building into brick cavity wall.		no	1
	1 1 1	D1		

WINDOWS

Aluminium Sliding Windows

b	Ajax Type X clear anodised aluminium sliding windows inclusive of all factory glazing, flashings, furniture and other trims: to suit opening 3600 wide, 1800 high, and include for building into brick cavity wall.		no	1
	1 1 1	W1		
c	Ditto 2400 wide, 1800 high.		no	1
	1 1 1	W5		
d	Ditto 2400 wide, 1200 high.		no	1
	1 1 1	W2		
e	Ditto 1200 wide, 1800 high.		no	1
	1 1 1	W6		
f	Ditto 600 wide, 1500 high.		no	2
	2 2 2	W3, 4		

12.03. EXAMPLE—ARCH BARS AND ANGLES

Following is a worked example illustrating the measurement of steel arch bars and angles.

QUESTION: B.m.e. the steel arch bars and angles as specified and as shown in Drawings 6.3, 6.4 and 6.5.

SPECIFICATION NOTES

METALWORK

***ARCH BARS AND ANGLES** Support each 110mm thickness of brickwork over all openings on galvd steel arch bars and angles of the sizes as specified below:*

Maximum Span mm	*Lintel mm*	*Bearing at each end mm*
1050	*75 x 10 bar*	*150*
1200	*76 x 76 x 10 angle*	*150*
2400	*127 x 76 x 10 angle*	*230*
3600	*152 x 89 x 10 angle*	*230*

METALWORK

Arch Bars and Angles

a 75 x 10 galvanised steel bar as lintel, built into brickwork at ends. (no 7) m 8

2/ 1.20	2.40	D2	(900 + 300 = 1200)
3/ 1.20	3.60	D3, 4, 5	
2/ 0.90	1.80	W3, 4	(600 + 300 = 900)
	7.80m		

b 76 x 76 x 10 galvanised steel angle ditto. (no 1) m 2

1.50	1.50	W6	(1200 + 300 = 1500)
	1.50m		

c 127 x 76 x 10 ditto. (no 2) m 6

2.86	2.86	W2	(2400 + 460 = 2860)
2.86	2.86	W5	
	5.72m		

d	152 x 89 x 10 ditto. (no 2)			m	9
	4.06	4.06	W1	(3600 + 460 = 4060)	
	4.06	4.06	D1	(do.)	
		8.12m			

MEASUREMENT NOTES—ARCH BARS AND ANGLES

Item a–Arch Bars: Two 75 x 10 steel arch bars are required to D2 since the opening occurs in a 230mm thick brick wall.

It has been assumed that all window and external door heads are at eaves soffit level and there is only necessity to support the inner 110mm thick skin above these openings. Each project has its own peculiarities and the elevations and details should be studied carefully to avoid mistakes being made.

12.04. EXAMPLE—BALUSTRADES

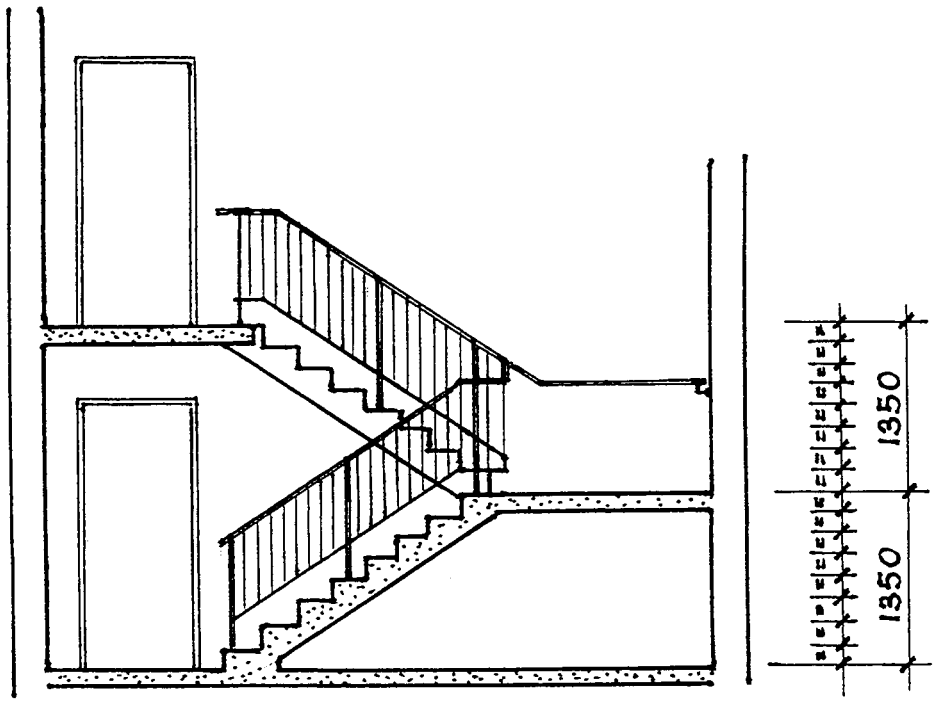
Following is a worked example illustrating the measurement of balustrades.

QUESTION: B.m.e. the balustrades as specified and as shown in Drawing 12.1.

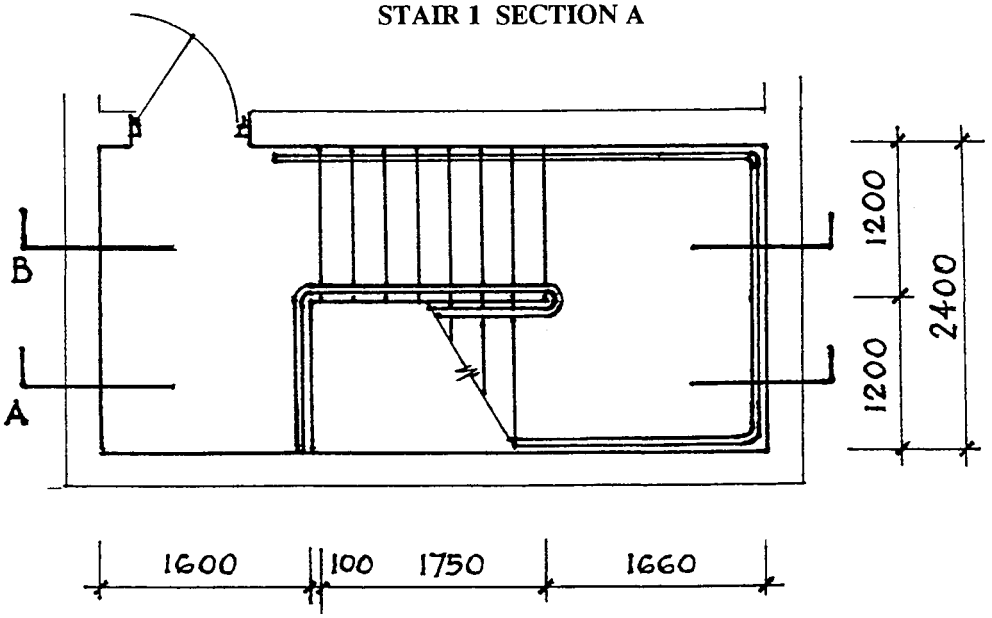
SPECIFICATION NOTES

METALWORK

BALUSTRADES ***Provide and fix balustrades to Stair 1 as detailed. Balustrades to be anodised aluminium balustrades as manufactured by Ajax, Catalogue No. 101, consisting of Series X handrail, bottom rail, posts and having evenly spaced balusters spaced at 120mm maximum centres. Posts to be secured to concrete with countersunk head bolts and masonry anchors as recommended by the manufacturer.***



STAIR 1 SECTION A



STAIR 1 FIRST FLOOR PLAN

DRAWING 12.1

METALWORK

Balustrades

a Horizontal anodised aluminium balustrade to Stair 1, 900mm high, as manufactured by Ajax, Catalogue No. 101, comprising Series X handrail, bottom rail, posts and balusters spaced evenly between posts at 120mm maximum centres; include for fixing posts to concrete with countersunk head bolts and masonry anchors as recommended by the manufacturer. All to detail. m 2

1.30	1.30	top landing
0.40	0.40	top landing return
0.25	0.25	mid landing
	1.95m	

b Raking balustrade, 900mm high above line of nosings, ditto. m 5

2.10	2.10	lower flight
0.20	0.20	mid landing
2.10	2.10	upper flight
	4.40m	

c Form 90 degree bends in foregoing balustrades. no 1

1	1	top landing
	1	

d Ramps ditto. no 2

2	2	flights
	2	

e Wreath ditto. no 1

1	1	mid landing
	1	

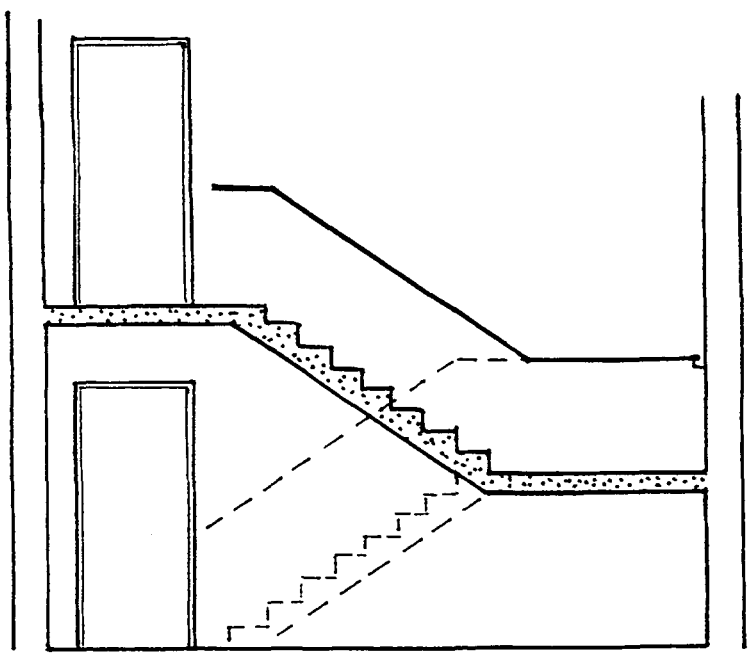
12.05. EXERCISE—HANDRAILS

QUESTION: In accordance with Drawings 12.1 and 12.2 and the following specification notes, measure and extend the handrails.

SPECIFICATION NOTES

METALWORK

***HANDRAIL** Provide and fix handrails to Stair 1 as detailed. Handrail to be Series X anodised aluminium handrail as manufactured by Ajax, Catalogue No. H1. Secure handrail brackets to brickwork with countersunk head bolts and masonry anchors as recommended by the manufacturer.*



STAIR 1 SECTION B

DRAWING 12.2

METALWORK

Handrails

a	Horizontal Series X anodised aluminium handrail to Stair 1, as manufactured by Ajax, Catalogue No. H1; include for stop ends and for fixing handrail brackets to brickwork with countersunk head bolts and masonry anchors as recommended by the manufacturer. All to detail.	m	
b	Raking handrail ditto.	m	
c	Form 90 degree bends in foregoing handrails.	no	
d	Ramps ditto.	no	

12.06. EXAMPLE—METAL DOOR FRAMES

Following is a worked example illustrating the measurement of metal door frames.

QUESTION: B.m.e. the metal door frames as specified for Doors D1–6 incl., given that the doors are 2040 x 820 x 35 thick single leaf doors.

SPECIFICATION NOTES

DOORS

METAL DOOR FRAMES DOORS D1–6 incl. shall be Ajax single rebated prime coated steel door frames. Frames to be supplied complete with a pair of 100mm steel butt hinges, latch keep and striking plate. Build frames into brick walls in accordance with the manufacturer's instructions.

DOORS

Metal Door Frames

a	Ajax single rebated prime coated steel door frames, to suit 2040 x 820 x 35 thick single leaf doors, complete with a pair of 100mm steel butt hinges, latch keep and striking plate; include for building into brick walls in accordance with the manufacturer's instructions.	no	6

6 6 D1-6
6

CHAPTER 13

STRUCTURAL STEEL

13.01. SMM REQUIREMENTS

Refer to SMM, Section 9, Structural Steel, pages 73–78, for the rules governing the measurement of structural steel. In particular the following basic requirements should be noted:

1. Generally, structural steel is billed in tonnes. The net theoretical mass is calculated with NO allowance for rolling margin or for welding materials.

2. All steel sections and plates are measured in multiples of 0.10m in length when determining the mass of structural steel. (Refer SMM, M6, page 73.) For example, a column shaft with an exact length of 2341mm would be taken off as 2.40m and multiplied by the mass per unit length to determine the net theoretical mass. Similarly, a base plate with plan dimensions of 650mm x 730mm would be taken off as 0.70m x 0.80m.

3. Measurement and prices are deemed to include for black bolts, nuts and any type of washer. Bolts other than black bolts in connections are billed in number stating the length in increments of 100mm. Refer SMM, M20, page 77, for calculation of bolt length.

13.02. STRUCTURAL STEEL MASS DETAILS

Before the measurement of structural steel can be completed it is essential to have structural steel mass tables. Following are the net theoretical mass details for steel plate, universal beam sections, universal column sections and angles. Students should supplement the following information by obtaining a copy of AS 1131-1979 *Dimensions of Hot Rolled Structural Steel Sections.*

13.02.01 STEEL PLATE

Thickness mm	Mass kg/m^2	Thickness mm	Mass kg/m^2
3	23.6	12	94.2
4	31.4	16	126
5	39.3	20	157
6	47.1	25	196
8	62.8	28	220
10	78.5	32	252

13.02.02 UNIVERSAL BEAMS

Designation	Mass per m kg	Depth of Section mm	Flange Width mm	Flange Thickness mm	Web Thickness mm
760UB	244	781	272	31.3	19.3
	220	776	270	28.3	17.4
	197	770	268	25.4	15.6
	173	762	267	21.6	14.3
	147	754	265	17.5	12.9
690 UB	140	684	254	19.0	12.4
	125	678	253	16.2	11.7
610 UB	125	612	229	19.6	11.9
	113	607	228	17.3	11.2
	101	602	228	14.8	10.6
530 UB	92.4	533	209	15.6	10.2
	82.0	528	209	13.2	9.6
460 UB	82.1	460	191	16.0	9.9
	74.6	457	190	14.5	9.1
	67.1	454	190	12.7	8.5
410 UB	59.7	406	178	12.8	7.8
	53.7	403	178	10.9	7.6
360 UB	56.7	359	172	13.0	8.0
	50.7	356	172	11.5	7.3
	44.7	352	171	9.7	6.9
310 UB	46.2	307	166	11.8	6.7
	40.4	304	165	10.2	6.1
250 UB	37.3	256	146	10.9	6.4
	31.4	252	146	8.6	6.1
200 UB	29.8	207	134	9.6	6.3
	25.4	203	133	7.8	5.8

13.02.03 UNIVERSAL COLUMNS

Designation	Mass per m kg	Depth of Section mm	Flange Width mm	Flange Thickness mm	Web Thickness mm
310 UC	283	365	322	44.1	26.9
	240	353	318	37.7	23.0
	198	340	314	31.4	19.2
	158	327	311	25.0	15.7
	137	320	309	21.7	13.8
	118	315	307	18.7	11.9
	96.8	308	305	15.4	9.9
250 UC	89.5	260	256	17.3	10.5
	72.9	254	254	14.2	8.6
200 UC	59.5	210	205	14.2	9.3
	52.2	206	204	12.5	8.0
	46.2	203	203	11.0	7.3
150 UC	37.2	162	154	11.5	8.1
	30.0	158	153	9.4	6.6
	23.4	152	152	6.8	6.1
100UC	14.4	97	99	7.0	5.0

13.02.04 UNEQUAL ANGLES

Nominal Size mm	Mass per m kg	Nominal Size mm	Mass per m kg
152 x 102 x 13	24.0	102 x 76 x 10	12.5
152 x 102 x 10	18.3	102 x 76 x 8	10.6
		102 x 76 x 6.5	8.59
152 x 89 x 16	28.0	76 x 51 x 8	7.45
152 x 89 x 13	22.8	76 x 51 x 6.5	5.96
152 x 89 x 10	17.3	76 x 51 x 5	4.62
152 x 89 x 8	14.4		
127 x 76 x 13	18.9	64 x 51 x 8	6.56
127 x 76 x 10	14.4	64 x 51 x 6.5	5.36
127 x 76 x 8	12.1	64 x 51 x 5	4.01
127 x 76 x 6.5	9.87		

13.02.05 EQUAL ANGLES

Nominal Size mm	Mass per m kg	Nominal Size mm	Mass per m kg
203 x 203 x 25	76.0	64 x 64 x 10	8.78
203 x 203 x 22	67.1	64 x 64 x 8	7.45
203 x 203 x 19	57.9	64 x 64 x 6.5	5.96
203 x 203 x 16	48.7	64 x 64 x 5	4.64
203 x 203 x 13	39.6		
152 x 152 x 19	42.7	57 x 57 x 8	6.55
152 x 152 x 16	36.1	57 x 57 x 6.5	5.35
152 x 152 x 13	29.1	57 x 57 x 5	4.01
152 x 152 x 10	22.0		
127 x 127 x 16	29.7	51 x 51 x 8	5.80
127 x 127 x 13	24.0	51 x 51 x 6.5	4.77
127 x 127 x 10	18.3	51 x 51 x 5	3.58
127 x 127 x 8	15.5	51 x 51 x 3	2.50
102 x 102 x 13	18.9	44 x 44 x 6.5	4.02
102 x 102 x 10	14.4	44 x 44 x 5	3.13
102 x 102 x 8	12.1	44 x 44 x 3	2.17
102 x 102 x 6.5	9.88		
89 x 89 x 10	12.5	38 x 38 x 6.5	3.50
89 x 89 x 8	10.6	38 x 38 x 5	2.68
89 x 89 x 6.5	8.49	38 x 38 x 3	1.85
76 x 76 x 10	10.6	32 x 32 x 6.5	2.83
76 x 76 x 8	8.93	32 x 32 x 5	2.16
76 x 76 x 6.5	7.16	32 x 32 x 3	1.49
76 x 76 x 5	5.56		

13.02.06 EXAMPLE. In accordance with SMM, b.m.e. six 460UB74 roof beams (RB1–6) each having an exact length of 5825mm.

Roof Beams

a 460UB74 beams. (6 / 5.90) t 2.65

6/5.90 35.40 RB1–6
35.40m
x 74.60kg/m
2640.84kg

13.03. EXAMPLE—COVERED WAY FRAMING

Following is a worked example illustrating the measurement of a simple steel framed covered way.

QUESTION: B.m.e the structural steel as specified and as shown in Drawings 13.1 and 13.2.

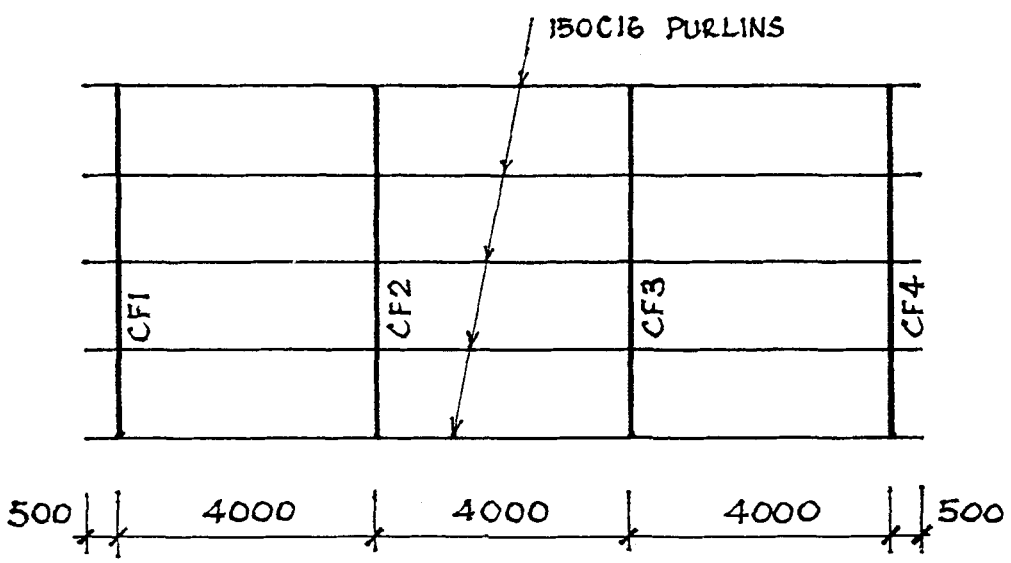
SPECIFICATION NOTES

STRUCTURAL STEEL

Provide and erect all steelwork including galvanised steel purlins as detailed.

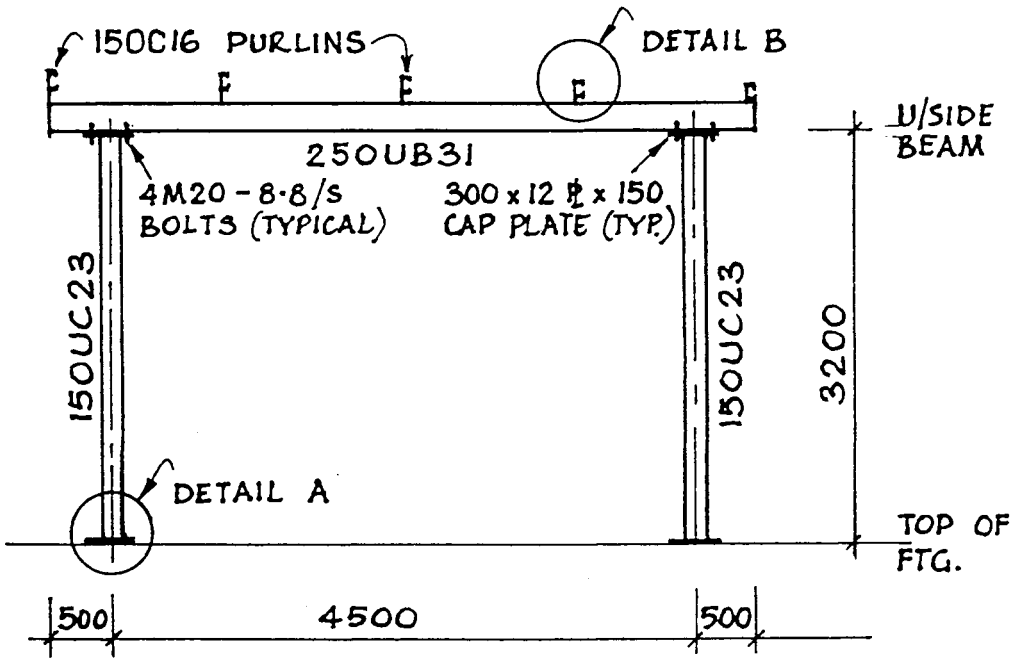
All steelwork, excluding purlins, to be given a shop priming coat of R.O.Z.C. (red oxide zinc chromate) primer.

Grout up under base plates with cement grout composed of 2 parts sand to 1 part cement.

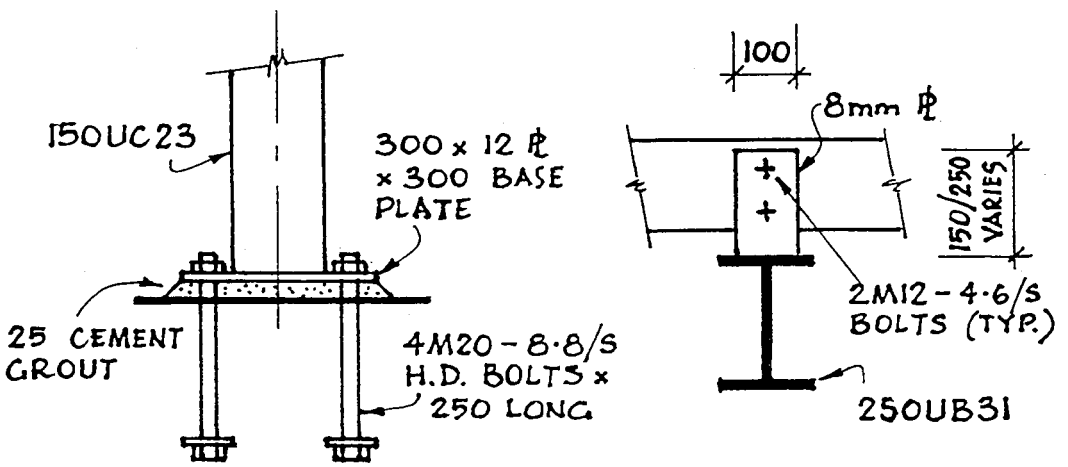


FRAMING PLAN

DRAWING 13.1



COVERED WAY FRAME CF1
(CF2—CF4 SIMILAR)



DETAIL A DETAIL B

DRAWING 13.2

STRUCTURAL STEEL

a	Refer to the Structural Steel section of the Specification for details of structural steel.	Note	
b	Refer to SMM for details regarding measurement and prices of structural steel.	Note	
	Shop Drawings		
c	Allow for the preparation of shop drawings.	Item	
	Temporary Bracing		
d	Allow for the provision of all necessary temporary bracing and similar items required for erection.	Item	
	Samples and Tests		
e	Allow for any samples and tests.	Item	
	Inspection of Welds		
f	Allow for inspection of welds including the use of any special techniques.	Item	
	Heaviest and Highest Lift		
g	The heaviest and highest lift is a 250UB31 beam of 0.19t mass and the height above ground level is approx. 3.20m.	Note	
	Covered Way Frames		
h	150UC23 columns. (8 / 3.20)	t	0.60

4 / 2 / 3.20 25.60 CF1–4
25.60m
x 23.40kg/m
599.04kg

i	Base plates welded to columns. (no 8)	t	0.07

12mm plate:
4 / 2 / 0.30
0.30 0.72 CF1–4
0.72m^2
x 94.20kg/m^2
67.82kg

j	Cap plates ditto. (no 8)	t	0.05

12mm plate:
4 / 2 / 0.30
0.20 0.48 CF1–4
0.48m^2
x 94.20kg/m^2
45.22kg

k	250UB31 roof beams. (4 / 5.50)	t	0.70

4 / 5.50 22.00 CF1–4
22.00m
x 31.40kg/m
690.80kg

l	Attached connections. (no 20)	t	0.03

8mm plate:
4 / 5 / 0.10
0.20 0.40 CF1–4 (average ht. = 200mm)
0.40m^2
x 62.80kg/m^2
25.12kg

m	M20 8.8/S bolts in connections, 0–100mm long.	no	32

4 / 2 / 4 32 Col./Beam
32

n	M20 8.8/S holding down bolts, include for casting into concrete, 201–300mm long.	no	32

4 / 2 / 4 32 CF1–4
32

o	25mm thick cement grout to underside of column base plates, composed of 2 parts sand to 1 part cement; include for all necessary wedging and levelling. (no 8)	m^2	1

8/ 0.30
0.30 0.72 CF1–4
0.72m^2

Shop Priming

p One coat red oxide zinc chromate primer on foregoing covered way columns and attachments. t 0.72

0.60t	Columns, Item h
0.07t	Base plates, Item i
0.05t	Cap plates, Item j
0.72t	

q Ditto on foregoing covered way beams and attachments. t 0.73

0.70t	Roof Beams, Item k
0.03t	At. connect., Item l
0.73t	

Proprietary Purlins

r 150C16 galvd steel roof purlins bolted to covered way frames spaced at 4.00m centres; include for bolts. m 65

5 / 13.00	65.00	CF1-4
	65.00m	

MEASUREMENT NOTES—COVERED WAY FRAMING

The above work is reasonably straightforward and is simply a matter of complying with the SMM requirements. The only work likely to cause any concern is the measurement of the bolts. Prices for structural steel include for the cost of all black bolts, which are also termed "commercial bolts". Commercial bolts are notated on the drawings as "4.6/S". High strength structural bolts are notated as "8.8/S or 8.8/TF or 8.8/TB".

Structural Steel Drawing Convention—Bolts:

4M20 4.6/S = four 20mm diam. commercial grade bolts (400 MPa nom. tensile strength) tensioned to a snug fit.

6M24 8.8/TF = six 24mm diam. high strength structural bolts (friction type joint, 830 MPa nom. tensile strength) fully tensioned to AS 4100.

Refer to the *Australian Engineering Handbook*, Part 2, Structural Drawing, 1987, for further notes on structural drawing notation.

13.04. EXERCISE—STEELWORK

QUESTION: B.m.e. the structural steelwork as specified and as shown in Drawings 13.3, 13.4 and 13.5.

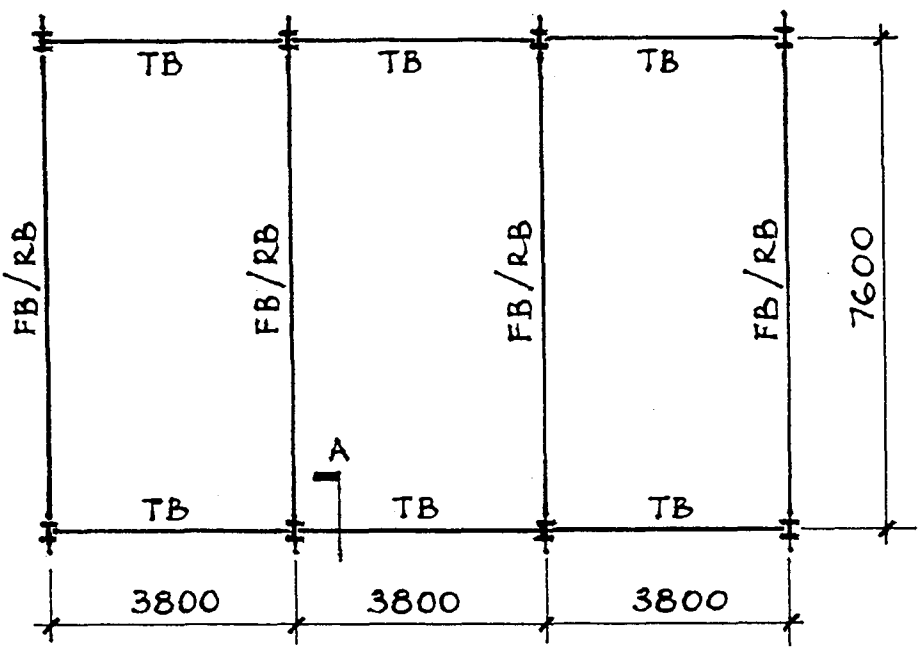
SPECIFICATION NOTES

STRUCTURAL STEEL

Provide and erect all steelwork as detailed.

All steelwork is to be given a shop priming coat of R.O.Z.C. (red oxide zinc chromate) primer.

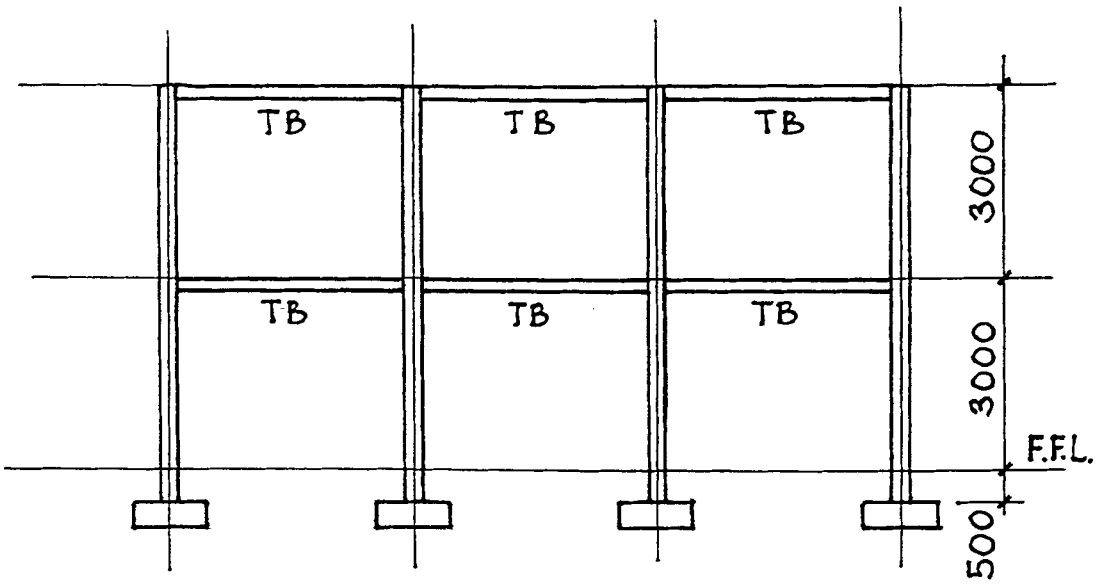
Grout up under base plates with 25mm thick cement grout composed of 2 parts sand to 1 part cement.



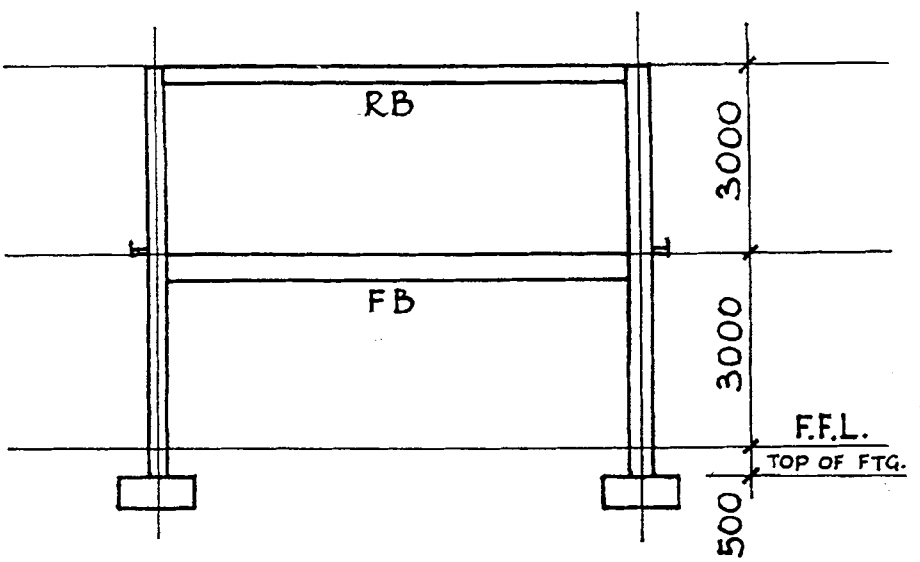
FRAMING PLAN

COLUMNS 200UC46 FLOOR BEAMS [FB] 410UB53 ROOF BEAMS [RB] 310UB40 TIE BEAMS [TB] 200UB25

DRAWING 13.3

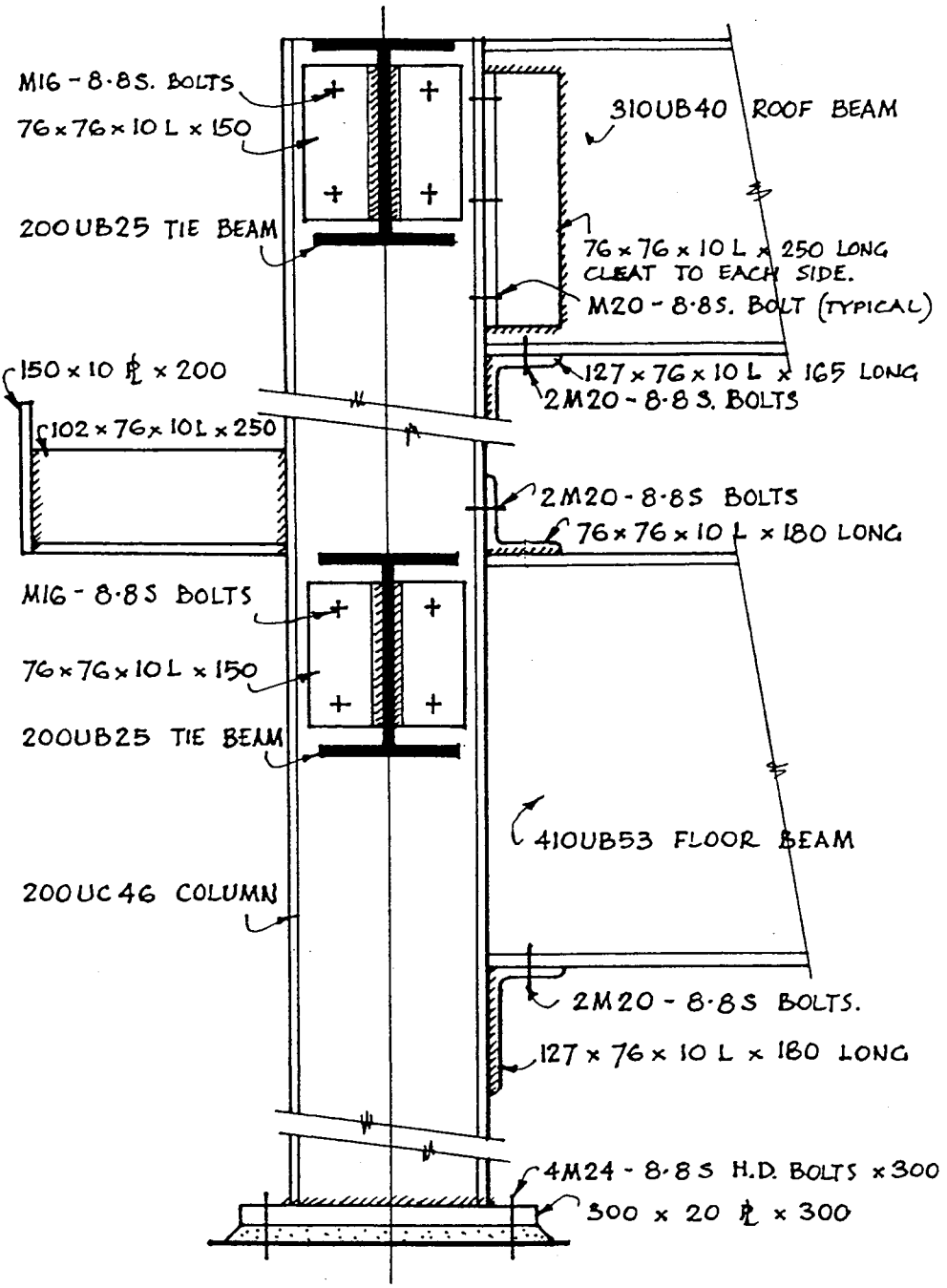


SIDE ELEVATION



END ELEVATION

DRAWING 13.4



SECTION A

DRAWING 13.5

CHAPTER 14

DRAINAGE

14.01. SMM REQUIREMENTS

Refer to SMM, Section 24, Drainage, pages 145–148, for the rules governing the measurement of drainage. In particular the following basic requirements should be noted:

1. Pipework is measured net length along the centre lines of the pipes over all bends, junctions and similar pipe fittings.

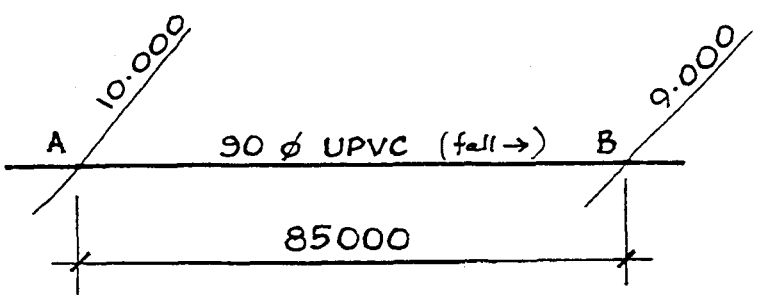
2. Pipework in trenches includes excavation with the trench depth stated in 1.00m total depth increments.

3. Measurement and prices of drainage are deemed to include for maintaining faces of drainpipe trenches and pits, backfilling, disposal of surplus spoil, forming pockets beneath collars, and all jointing and other incidental materials.

14.02. EXAMPLE 1—INTERPOLATION OF DRAINAGE LEVELS

Prior to measuring any pipework in trenches it is essential to be able to interpolate drainage levels using the specified pipe gradients and the existing ground levels as shown on the drawings. Following is a worked example illustrating the determination of drainage levels.

QUESTION: Given that the specified minimum drainage pipe gradient is 1:60 and the minimum cover to drainage pipes is 300mm, determine the invert level at points A and B as shown in Drawing 14.1.



DRAINAGE PLAN

DRAWING 14.1

Invert level at A:

Existing Ground Level =	10.000
Less min. cover =	.300
Less pipe diam. =	.090
Invert level at A =	9.610

Invert level at B:

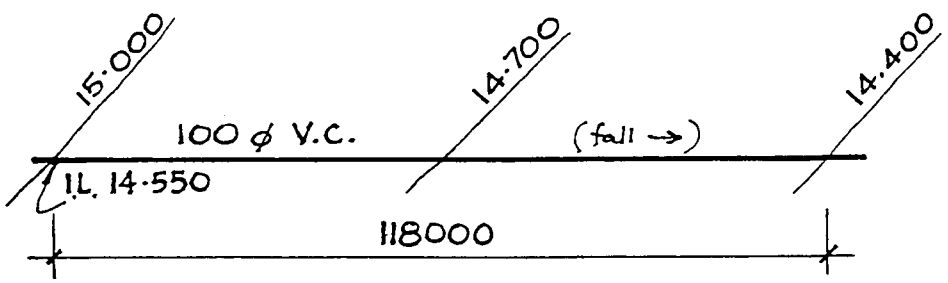
Min. fall is 85.00m / 60 = 1.417m
Using min. fall, invert level at B is 9.610-1.417 = 8.193
[Check cover at B: 9.000-8.1936-0.090 = 0.717m, i.e. satisfactory, since greater than 300mm.]
Therefore, invert level at B is 8.193.

14.03. EXERCISE 1—INTERPOLATION OF DRAINAGE LEVELS

Determine the invert levels at A and B using the same information as Example 1, except that the distance between A and B is 45.00m

14.04. EXERCISE 2—INTERPOLATION OF DRAINAGE LEVELS

QUESTION: Given that the specified minimum drainage pipe gradient is 1:60 and the minimum cover to drainage pipes is 300mm, determine the point where the total depth of the drainage trench exceeds 1.00m deep as shown in Drawing 14.2.



DRAINAGE PLAN

DRAWING 14.2

14.05. EXAMPLE 1—STORMWATER DRAINAGE

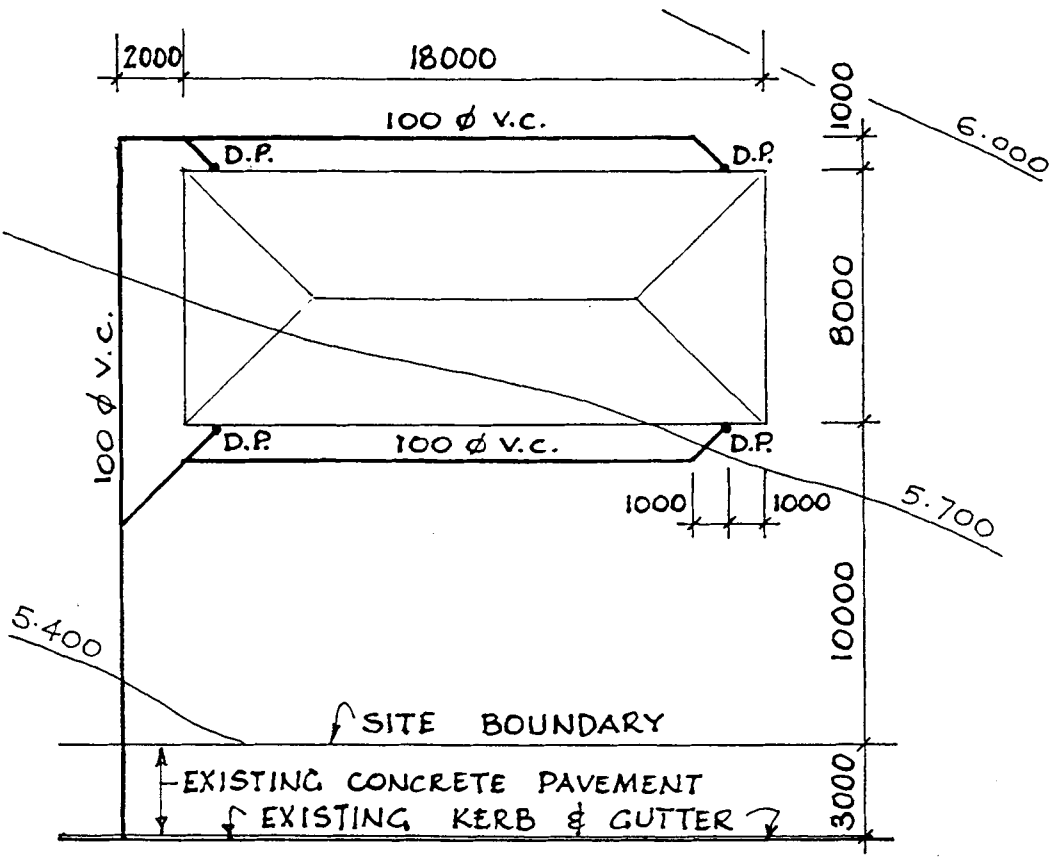
Following is a worked example illustrating the measurement of stormwater drainage.

QUESTION: B.m.e. the stormwater drainage as specified and as shown in Drawing 14.3.

SPECIFICATION NOTES

DRAINAGE

***STORMWATER DRAINAGE** All stormwater drainage is to be carried out in 100mm diameter second quality vitrified clay drainpipes and fittings with rubber ring joints. All excavation is to be allowed for in material other than rock. Backfill drainage trenches with the best of the excavated material and spread surplus spoil on site where directed.*



DRAINAGE PLAN

DRAWING 14.3

DRAINAGE

Stormwater Drainage

a	100mm diam. second quality v.c. drainpipes, rubber ring jointed, laid in trenches not exceeding 1.00m total depth; include for excavation in material other than rock, backfilling with the best of the excavated material and spreading surplus spoil on site where directed.	m	62

2 / 1.42	2.84	
18.00	18.00	
19.00	19.00	
1.42	1.42	
16.00	16.00	
4.25	4.25	
	61.51m	

b	100mm diam. ditto in vertical risers.	m	2

4 / 0.50	2.00	DPs average say 500mm
	2.00m	

c	100mm diam. v.c. bends set on back at downpipe stacks.	no	4

4	4	DPs
	4	

d	100mm diam. v.c. bends.	no	3

3	3
	3

e	100mm diam. v.c. junctions.	no	3

3	3
	3

f	100mm diam. v.c. inspection branches complete with plug and clamp.	no	2

2	2
	2

Stormwater Drainage Outside the Site Boundary

g	100mm diam. second quality v.c. drainpipes, rubber ring jointed, laid in trenches not exceeding 1.00m total depth; include for cutting through concrete pavement and making good, excavation in material other than rock, backfilling with the best of the excavated material and spreading surplus spoil on site where directed.	m	3

3.00 3.00
3.00m

h	Break into existing concrete kerb and gutter, connect end of 100mm diam. v.c. drainpipe and make good.	no	1

1 1
1

MEASUREMENT NOTES—STORMWATER DRAINAGE

Item a–V.c. drainpipes: Examination of the given ground R.L.s and the specified falls and minimum cover for drainage pipes indicates that no drainage trenches will exceed 1.00m deep in this case. The net length of pipework is measured along the centre lines of the pipes over all bends and junctions.

Item b–Vertical pipes: Vertical pipes are given separately. An average depth of 500mm has been estimated as the requirement at each downpipe.

Item g–Stormwater drainage outside the site boundary: Work outside the boundary of the property is given separately. (Refer SMM, M2, page 145.) Describe work under public footpaths including making good. (Refer SMM, M3, page 145.)

Item h–Drain connection: Refer SMM, clause 8, page 147.

14.06. EXERCISE 1—DRAINAGE

QUESTION: In accordance with Drawing 14.4 and the following specification notes, measure and extend the following Bill of Quantities, Drainage section.

SPECIFICATION NOTES

DRAINAGE

EXCAVATION: Excavate drainage trenches in material other than rock, backfill with sand and spread spoil on site where directed.

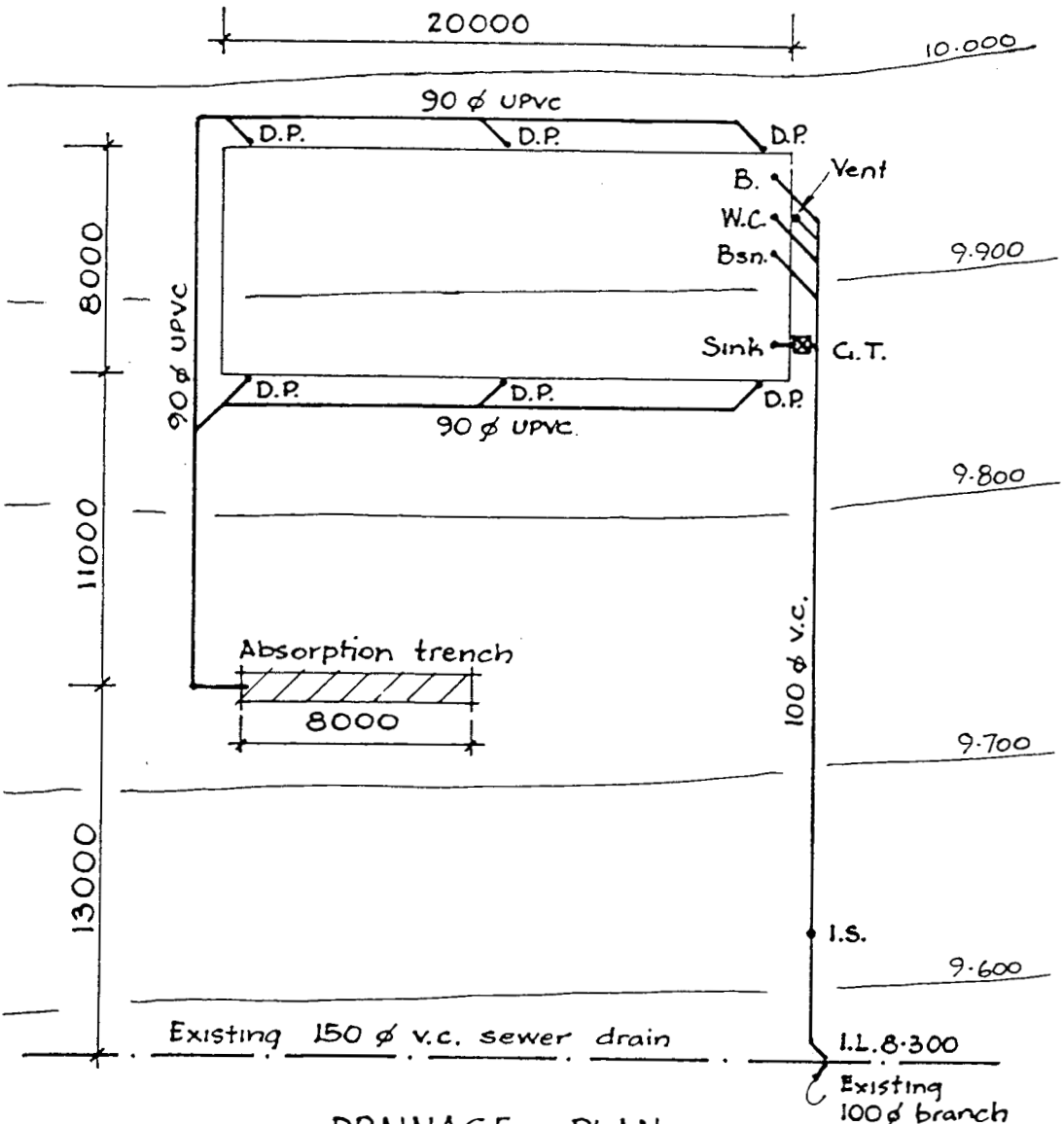
SEWER DRAINAGE: All sewer drainage is to be carried out in 100mm diameter first quality vitrified clay pipes and fittings to AS 1741 with rubber ring joints.

Connect and extend drainage from existing 100mm diam. v.c. sewer main branch to building as detailed with required bends, junctions, gully trap, risers, etc. All pipes to have a minimum cover of 300mm with a minimum fall of 1:60. Provide 100mm diam. vertical inspection shaft where shown and fit airtight cast iron cover and frame at ground level and surround with concrete. Fit cast iron grate to top of 100mm diam. riser above gully trap and surround with concrete.

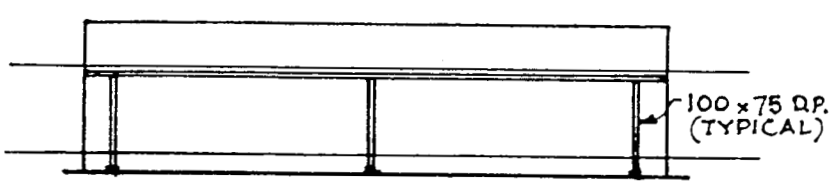
STORMWATER DRAINAGE All stormwater drainage is to be carried out in 90mm diameter UPVC drainpipes and fittings complying with AS 1254.

Connect from downpipes to absorption trench as detailed with required bends, junctions, risers, etc. All pipes to have a minimum cover of 300mm and a minimum fall of 1:100.

Absorption trench to be minimum 600mm wide and filled with a 600mm minimum deep layer of coarse rubble covered with galvd steel sheeting and a minimum 300mm deep layer of soil.



DRAINAGE PLAN



FRONT ELEVATION

DRAWING 14.4

	DRAINAGE			
a	Refer to the Drainage section of the Specification for details of drainage.	Note		
b	Refer to the SMM for details regarding measurement and prices of drainage.	Note		
c	Allow for giving notices, obtaining permits, paying fees, and obtaining certificates of satisfactory completion issued by a local authority or similar, in connection with the installations.	Item		
d	Allow for testing installations.	Item		
e	Allow for keeping excavations free from rain and percolating water by pumping or otherwise.	Item		
	Sewer Drainage			
f	100mm diam. first quality v.c. drainpipes, rubber ring jointed, laid in trenches not exceeding 1.00m total depth; include for excavation in material other than rock, backfilling with sand and spreading spoil on site where directed.	m		
g	100mm diam. ditto exceeding 1.00m not exceeding 2.00m total depth.	m		
h	100mm diam. ditto in vertical risers.	m		
i	100mm diam. v.c. stack bends set on back.	no		
j	100mm diam. v.c. bends.	no		
k	100mm diam. v.c. slope junctions.	no		
l	100mm diam. v.c. square junctions.	no		
m	100mm diam. v.c. inspection branches complete with plug and clamp.	no		

	Sewer Drainage cont.			
a	100mm diam. v.c. P trap.	no		
b	Cast iron grating fitted to top of 100mm diam. v.c. riser above gully trap and surrounded with concrete.	no		
c	Airtight cast iron cover and frame fitted to top of 100mm diam. v.c. inspection shaft and surrounded with concrete.	no		
d	Excavate approx. 1.30m deep, locate existing 100mm diam. v.c. sewer main branch and connect new 100mm diam. v.c. service.	no		
	Stormwater Drainage			
e	90mm diam. UPVC drainpipes, laid in trenches not exceeding 1.00m total depth; include for excavation in material other than rock, backfilling with sand and spreading spoil on site where directed.	m		
f	90mm diam. ditto in vertical risers.	m		
g	90mm diam. UPVC bends set on back at downpipe stacks.	no		
h	90mm diam. UPVC bends.	no		
i	90mm diam. UPVC junctions.	no		
j	90 diam. x 100 x 75mm UPVC downpipe adaptors.	no		
k	Absorption trench, 600mm min. wide, not exceeding 1.00m total depth comprising 600mm min. layer of coarse rubble covered with galvd steel sheeting and 300mm min. deep layer of soil.	m		

CHAPTER 15

HYDRAULICS

15.01. SMM REQUIREMENTS

Refer to SMM, Section 23, Hydraulics, pages 139–143, for the rules governing the measurement of hydraulic services. In particular the following basic requirements should be noted:

1. "Measurement and prices deemed to include for: sockets, running joints, connectors, back nuts, nipples, connections, incidental fittings, clips, saddles, brackets, straps, hangers, screws, nails, explosive and low velocity tool fasteners and other metal fastening anchors and/or systems and fixings complete including cutting and forming holes, supplying and building in sleeves (other than fire rated)."

2. Pipework is measured "the net length along the centre lines of pipes over all bends, junctions, tees and similar fittings. Make no distinction as to the use to which the piping is put or whether piping is in main stacks or branches."

   State the "nominal diameter of pipes, class or table of pipe and method of jointing."

   For pipework less than 32mm nominal diameter include in the description of the pipework for "all expansion fittings, bends, junctions, inspection openings, reducers, and similar fittings other than glass fittings."

   Describe and measure separately fittings to pipework equal to or greater than 32mm nominal diameter.

15.02. EXERCISE—HYDRAULICS

QUESTION: In accordance with Drawings 15.1 and 15.2 and the following specification notes, measure and extend the following Bill of Quantities' Hydraulics section.

SPECIFICATION NOTES

HYDRAULICS

GENERALLY

Carry out all work in strict accordance with the rules and regulations of the Supply Authority and other authorities having jurisdiction over the works.

Ascertain from the supply authority before tendering, the position type and size of water main and allow for all charges and fees for connecting water service to main.

Make application to authorities for permits to carry out the work and pay all fees and charges in respect of work involved. On completion obtain "Certificate of Compliance" indicating satisfactory completion of services and submit to the supervising architect.

MATERIALS

Copper tubes shall be solid drawn copper tubes to AS 1432 and of the following types:

Water Service: Type B hard drawn copper tube.

Fittings to AS 1585: Approved capillary fittings manufactured from drawn copper tube, tested and stamped by the Supply Authority.

UPVC for waste, soil and vent pipes and fittings to AS 1415, of manufacture approved by Supply and Local Authorities.

WATER SERVICE RETICULATION

Connect service from mains to meter in accordance with Supply Authority's requirements. Include for all labour, materials, fees and charges. Supply and/or install a water meter and meter cock to Supply Authority's requirements.

Extend water service underground from meter to standpipes and fixtures using copper tube of the sizes indicated on the drawings.

Run water service underground in accordance with AS 3500. Backfill and consolidate trenches after inspection and approval.

Where possible, pipework serving taps and fixtures shall be concealed in saw cut chases in masonry walls. Copper tubing exposed to view inside the buildings shall be c.p. and installed in a workmanlike manner. Do not run pipework in cavities.

All copper tubing to be jointed with approved capillary fittings.

Thermal insulate all copper tubing where embedded in concrete and masonry walls with approved plastic coating.

On completion of cold and hot water service carry out hydrostatic pressure test as required by the Supply Authority.

HOT WATER HEATERS

Allow the P.C. sum of two thousand four hundred dollars ($2,400.00) for the supply and delivery only of four wall mounted model hot water heaters complete with all necessary valves, thermostats, cut-outs, etc.

Install hot water heaters and hot water service in accordance with the manufacturer's printed recommendations, the provisions of AS 1529 and as specified hereunder. Provide hot water heater to each unit where indicated. Thermal insulate all copper tubing where embedded in concrete and masonry walls with approved plastic coating.

Support each heater on approved wall brackets, 25mm thick fibre cement base and tray. Connect 15mm copper drainpipe to combined temperature/pressure relief valve, conceal in wall and discharge into copper tundish built into kerb. Extend 25mm copper drain line from tundish under floor and connect to UPVC floor waste.

TAPS AND OUTLETS

Terminate hot and cold water services with Ajax high pressure tested c.p. brass fittings complete with c.p. brass handles, covers and wall domes. Provide taps, etc. as follows all with fibre washers.

Laundry Tub. 15mm x 200mm long swivel outlet complete with breeching piece and a pair of hot and cold recess taps.

Washing Machine. 15mm hot and cold washing machine taps having threaded spouts to suit hose connection to washing machine.

Shower. 15mm hot and cold recess taps complete with breeching piece, c.p. brass shower arm, cover plate, and 75mm c.p. brass ball jointed shower rose.

Hand Basin. 15mm hot and cold pillar taps.

W.C. Suite. 15mm cistern stop.

Kitchen Sink. 15mm x 200mm swivel outlet complete with mixing piece and a pair of hot and cold recess taps; all mounted on sink.

Water Heater. 15mm control tap and check valve.

Full Way Cocks. At entry point to each unit provide 20mm c.p. recessed full way cock as detailed.

Standpipe. 20mm hose cock.

SANITARY FIXTURES

Where indicated on Drawings, supply and install the following sanitary fixtures and connect to services:

S.S. Sink and Drainer Unit. Ajax 1500mm long single centre bowl stainless steel sink and drainer unit complete with c.p. brass sink waste and stopper.

Hand Basin. Ajax 500 x 400mm white vitreous china hand basin complete with stainless steel flange, nylon tail piece, rubber washer, plug and necessary fixing brackets.

W.C. Suite. Ajax white vitreous china pedestal pan and cistern complete with plastic offset flush pipe and necessary fittings. Where vent pipes are detailed provide pedestal pans with vent horns to suit connection of 50mm vents as detailed.

Toilet Seat. Ajax white plastic toilet seat and cover with c.p. hinges and rubber buffers.

Laundry Tub. Ajax stainless steel single compartment 45L laundry tub and cabinet with single by-pass.

SANITARY PLUMBING

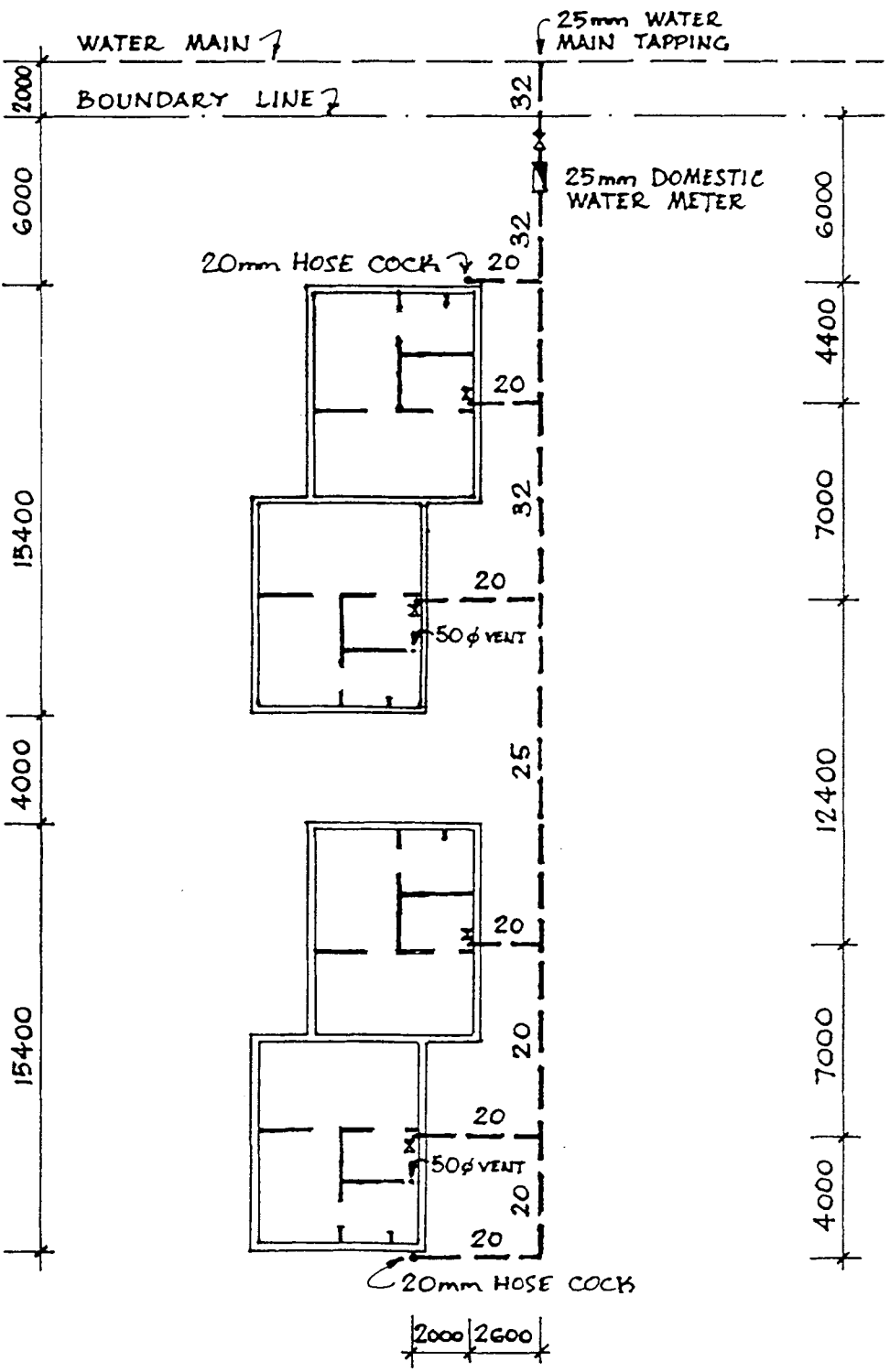
Provide and install approved UPVC pipes and fittings as required and as detailed on the drawings. All work to be in accordance with the requirements of the controlling authority.

All joints to be solvent welded.

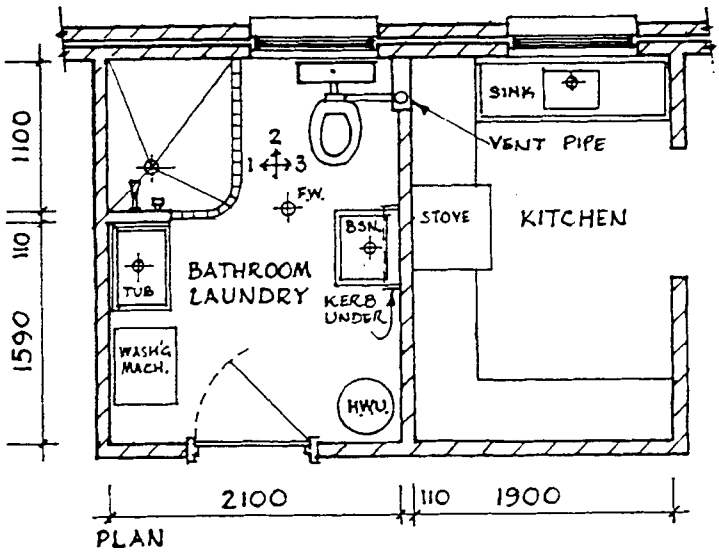
All traps to have minimum 75mm deep water seal.

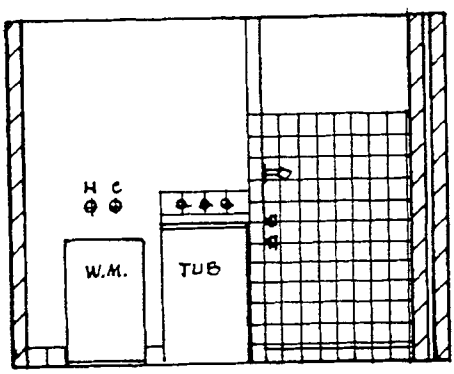
Floor wastes to be 80 x 50mm floor waste gully "S" trap complete with c.p. screw-in grate.

Where vent pipe passes through roof, provide UPVC stock pattern apron flashing set over upturned roof collar flashing (specified in Roofer) and solvent weld to vent pipe. Solvent weld UPVC stock pattern vent cowl to top of vent pipe.

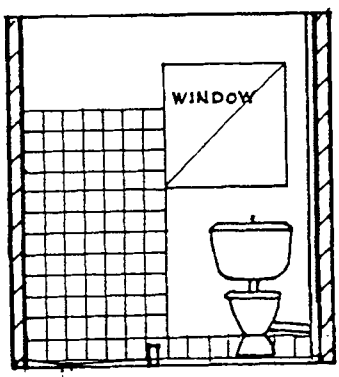

WATER MAIN
25mm WATER MAIN TAPPING
BOUNDARY LINE
25mm DOMESTIC WATER METER
20mm HOSE COCK
50ϕ VENT
50ϕ VENT
20mm HOSE COCKS
2000
6000
15400
4000
15400
32
32
20
20
20
20
20
20
20
20
25
6000
4400
7000
12400
7000
4000
2000
2600

DRAWING 15.1

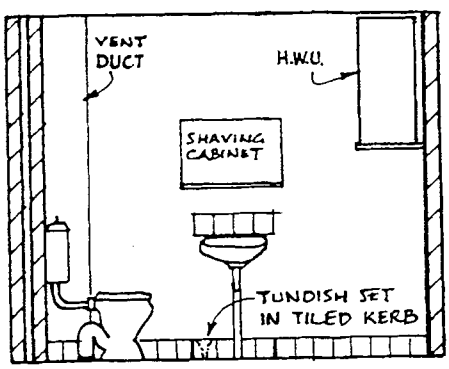




ELEVATION 1



ELEVATION 2



ELEVATION 3

DRAWING 15.2

	HYDRAULICS			
a	Refer to the SMM for details regarding measurement and prices of hydraulics	Note		
b	Refer to the Hydraulics section of the Specification for particulars of sanitary plumbing, cold water and hot water.	Note		
c	Allow for giving notices, obtaining permits, paying fees, obtaining Certificate of Compliance and similar, in connection with the installations.	Item		
d	Allow for testing installations.	Item		
e	Allow for sterilising of installations as necessary.	Item		
	Cold Water Service Outside the Site Boundary			
f	Excavate and locate existing water main and make 25mm main tapping to suit connection of 32mm copper water service; include for all necessary fittings.	no		
	Type B hard drawn copper piping to AS 1432:			
g	32mm piping laid in trenches not exceeding 1.00m total depth; include for all necessary excavation and backfill and for making good disturbed surfaces.	m		
	Cold Water Service			
h	25mm diam. water meter and meter cock installed complete and complying with the Supply Authority's requirements.	no		
	Type B hard drawn copper piping to AS 1432:			
i	32mm piping.	m		
j	32mm piping laid in trenches not exceeding 1.00m total depth; include for all necessary excavation and backfill.	m		
	Approved copper fittings to AS 1585:			
k	32mm bend.	no		
l	32 x 32 x 20mm tee.	no		
m	32 x 25 x 20mm tee.	no		

	Type B hard drawn copper piping to AS 1432 including approved copper fittings to AS 1585:			
a	25mm piping laid in trenches not exceeding 1.00m total depth; include for all necessary excavation and backfill.	m		
b	20mm ditto.	m		
c	20mm piping built into concrete.	m		
d	20mm ditto chased into brick walls.	m		
e	15mm ditto.	m		
f	20mm piping fixed to brick walls.	m		
g	15mm c.p. piping.	m		
h	20mm ditto.	m		
i	15mm piping	m		
	---			
j	Connect 20mm piping to hot water unit.	no		
k	Approved plastic thermal insulation coating to 20 and 15mm piping embedded in concrete and masonry walls.	m		
	Hot Water Service			
	Type B hard drawn copper piping to AS 1432 including approved copper fittings to AS 1585:			
l	20mm piping chased into brick walls.	m		
m	15mm ditto.	m		
n	15mm c.p. piping.	m		
o	20mm ditto.	m		
p	15mm piping.	m		
	---			
q	Connect 20mm piping to hot water unit.	no		
r	Approved plastic thermal insulation coating to 20 and 15mm piping embedded in masonry walls.	m		

	Hot Water Heaters			
a	Allow the P.C. Sum of Two Thousand Four Hundred Dollars ($2,400.00) for the supply and delivery only of four wall mounted model hot water heaters complete with all necessary valves, thermostats, cut-outs, etc.	Item		
b	Take delivery and install hot water heaters and include for mounting on approved wall brackets fixed to brick walls and having 25mm thick fibre cement base and tray; all in accordance with the manufacturer's printed recommendations.	no		
	Type B hard drawn copper piping to AS 1432 including approved copper fittings to AS 1585:			
c	15mm c.p. piping.	m		
d	15mm piping chased into brick walls.	m		
e	25mm piping embedded in concrete.	m		
f	25mm ditto to underside of concrete floor slab.	m		
g	Connect 15mm c.p. piping to combined temperature/pressure relief valve.	no		
h	Copper tundish fixed to 25mm drainpipe and built into concrete kerb.	no		
i	Connect 25mm piping to UPVC floor waste.	no		
j	Approved plastic thermal insulation coating to 25 and 15mm piping embedded in concrete and masonry walls.	m		
	Taps and Outlets			
	Ajax high pressure tested c.p. brass fittings complete with c.p. brass handles, covers and wall domes, fibre washers and include for screwed joint to copper piping:			
k	15mm control tap and check valve to suit hot water heaters.	no		
l	20mm recessed full way cock.	no		
m	15mm cistern stop.	no		
n	15mm pillar tap marked "cold".	no		
o	15mm ditto "hot".	no		

a	15mm washing machine tap with threaded spout, marked "cold".	no		
b	15mm ditto "hot".	no		
c	Laundry set comprising 15mm x 200mm long swivel outlet complete with breeching piece and a pair of hot and cold recessed taps.	no		
d	Shower set comprising 15mm hot and cold recessed taps complete with breeching piece, c.p. brass shower arm, cover plate and 75mm c.p. brass ball jointed shower rose.	no		
e	Kitchen set comprising 15mm x 200mm swivel outlet complete with mixing piece and a pair of hot and cold recess taps to suit mounting on sink.	no		
f	20mm hose cock.	no		
	Sanitary Fixtures			
g	Ajax 1500mm long single centre bowl stainless steel sink and drainer unit complete with c.p. brass sink waste and stopper; include for fixing to bench unit.	no		
h	Ajax 500 x 400mm white vitreous china hand basin complete with stainless steel flange, nylon tail piece, rubber washer, plug and necessary fixing brackets; include for fixing to brick wall.	no		
i	Ajax white vitreous china w.c. suite comprising pedestal pan and cistern complete with plastic offset flush pipe and necessary fittings; include for fixing in place and for connecting to waste and water supply.	no		
j	Ditto but in addition having vent horn to pedestal pan.	no		
k	Ajax white plastic toilet seat and cover with c.p. hinges and rubber buffers; secured to w.c. pan.	no		
l	Ajax stainless steel single compartment 45L laundry tub and cabinet with single by-pass; include for fixing in place and for connecting to waste and water supply.	no		

	Sanitary Plumbing			
	UPVC pipes and fittings solvent welded at joints in:			
a	50mm vent stacks secured to brickwork inside duct.	m		
b	50mm stacks in roof space and above roof and branches.	m		
c	50mm bends.	no		
d	Pipe sleeve and flange at junction of 50mm vent pipe and duct cover.	no		
e	Stock pattern vent cowl fitted to top of 50mm vent pipe.	no		
f	Stock pattern apron flashing to 50mm vent pipe where passing through roof, set over upturned collar flashing. (Collar flashing measured in Roofer.)	no		
g	50mm waste piping in vertical pipes not exceeding 1.00m long connecting traps to drainage.	no		
h	32mm ditto.	no		
i	Connect end of 50mm pipes to v.c. drain.	no		
j	Ditto 32mm.	no		
k	50mm "S" traps complete with inspection plug and adaptors.	no		
l	32mm ditto.	no		
m	80 x 50mm floor waste gully "S" traps complete with screw-in grate; include for building into concrete floor slab and connecting to v.c. drainage.	no		

CHAPTER 16

ELECTRICAL INSTALLATIONS

16.01. SMM REQUIREMENTS

Refer to SMM, Section 25, Electrical installations, pages 149–155, for the rules governing the measurement of electrical installations. The following basic requirements should be noted:

1. Conduits and cables used for consumer mains and sub-mains are described and billed separately in metres.

2. Conduits and cabling used in circuits and sub-circuits are included in the description for the circuit or sub-circuit and each circuit or sub-circuit billed by number.

16.02. EXERCISE—ELECTRICAL INSTALLATIONS

QUESTION: In accordance with Drawings 16.1–16.4 and the following specification notes, measure and extend the following Bill of Quantities' Electrical Installations section.

SPECIFICATION NOTES

ELECTRICAL INSTALLATIONS

GENERALLY

Extent: Provide an electrical service installation, including consumer mains, switchboard(s), consumer distribution board(s), wiring and equipment (accessories, appliances, and luminaries) connecting the Supply Authority's service to each point of use including the connection of permanently connected equipment.
Standards: To AS 3000 and to the requirements of the Supply and regulatory authorities.
Installation to AS 3000 and AS 3006.
Work-as-executed drawings: At practical completion submit work-as-executed drawings.

QUALITY AND WORK PRACTICES

Testing: Test all installations prior to the start of the Defects Liability Period.
Commissioning: On finishing clean faceplates, luminaries reflectors and diffusers, and the like, replace faulty lamps, reinstate ground surfaces and finishes disturbed by trenching, and hand over the completed installation in working order.
Balancing of load: Balance the load as evenly as possible over all phases.

UNDERGROUND SERVICES

General: To be in accordance with AS 3000 with PVC marker tape over all lengths of underground conduit and provide 600mm minimum cover to underground conduits.
Underground conduits to be 40mm HDUPVC conduit.

MATERIALS

TPI and TPS cables: To AS 3147 and AS 3008.1: 0.61/1 kV range, 75°C temperature rated cable delivered to site in the original packages.
Conductors: Provide stranded copper conductors throughout a minimum of 1.5mm^2 for lighting and 2.5mm^2 for power sub-circuits. Take into account voltage drop when determining final size.
Conduit: Rigid or flexible non-metallic conduit to AS 3000:
Minimum size 20mm generally, 25mm in floor slabs
Conceal all conduits chased into masonry walls or cast into concrete.
Heavy duty type rigid non-metallic conduits and fittings to AS 2053.
Consumer mains conduit to be 30mm HDUPVC conduit.

ELECTRICAL DISTRIBUTION

General: Supply electricity underground to each unit.
Point of Attachment: as required by the Supply Authority.
Switchboards and Metering: Provide a recessed, weatherproof, galvanised painted steel meter cupboard enclosing all switchboard and metering equipment as required by the Supply Authority.
Consumer Distribution Boards: Email LC86FD recessed moulded PVC enclosures with window hinged cover mounted on walls in positions directed.
Residual current device (safety switches): To AS 3190.

WIRING INSTALLATION

General : To AS 3000.
Cable routes: Routes shown on drawings are diagrammatic only. Determine the final route of run to the approval of the Supply Authority.

ACCESSORIES

General: Install flush-mounted accessories, in wall boxes in masonry walls, located as specified and/or as shown on the drawings.
Switches: Install 900mm above floor.
General Purpose Outlets: To AS 3112, install at 600mm above floor level generally, 1500mm in laundry/bathroom, 1050mm in kitchen.

LIGHT FITTINGS

***General:** Provide in locations shown on the drawings complete with lamps, control gear and diffusers.*

***Batten holders / lamp holders:** Bayonet "electric white" heat-resistant type with body which cannot be extracted without first removing the base securing screws.*

***External bollard lights:** Pierlite Cat. No. BOL 50 MV with 50W mercury vapour lamp.*
***External wall mounted lights:** GEC Mediterranean R2 with 50W MBFU lamp.*
***External post top mounted light:** Associated Lighting SX2731 complete with post standard and 80W MBFU lamp.*
***Main Switchboard light:** Philips VL201 weatherproof vandal resistant fluorescent light.*
***Kitchen lights:** 1 x 18W HPF enclosed fluorescent light with TLD 18W/33 lamp.*
***External wall lights to all units:** Philips L1025 surface mounted weatherproof light.*

SMOKE DETECTORS

***General:** Provide one smoke detector to each unit as shown.*
***Installation:** To AS 3000 and connect to any continuous 240V Ac 50 Hz electrical circuit not protected by an RCD.*

APPLIANCES

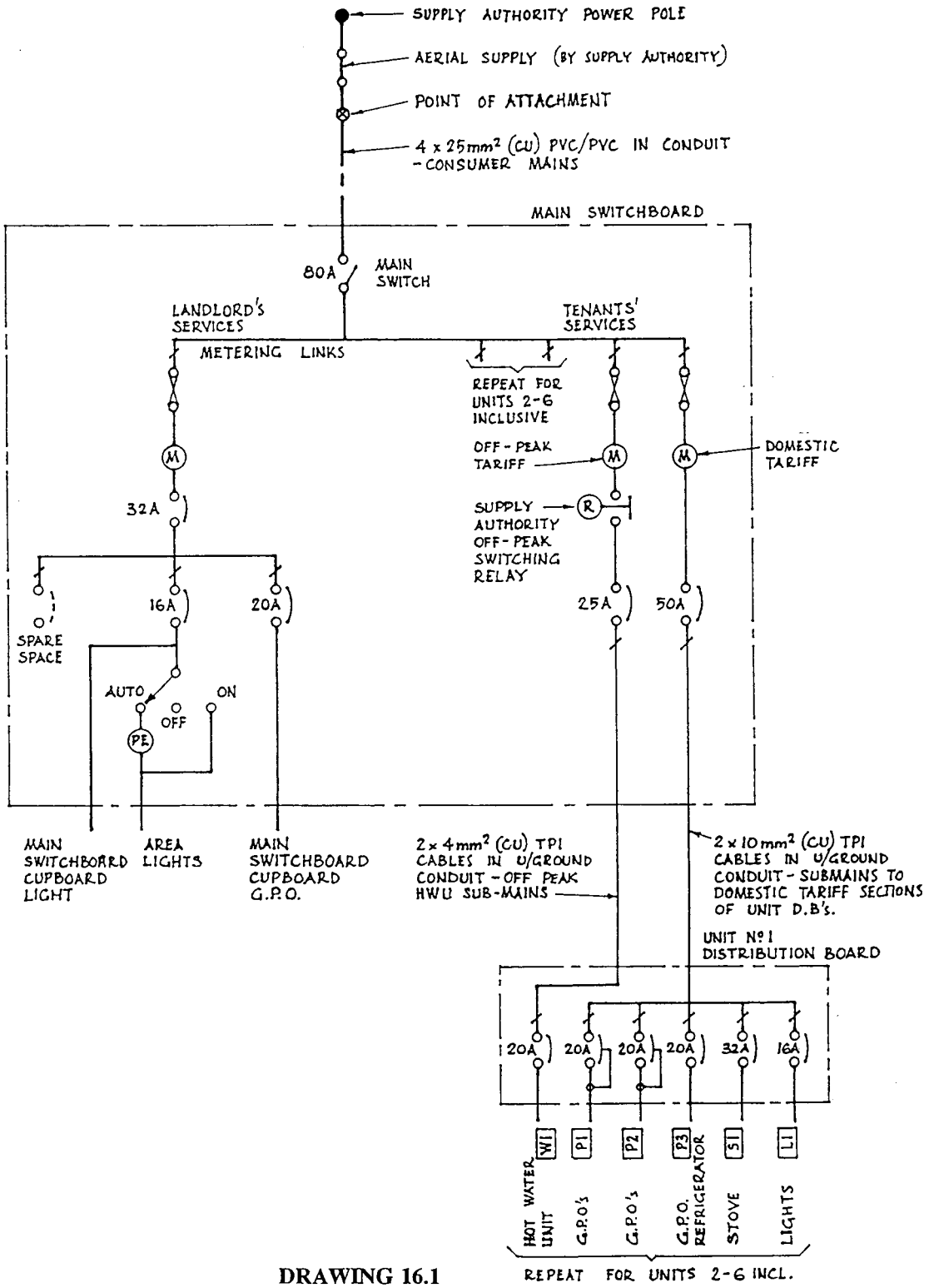
***Fixtures and Fittings:** Provide approved fixtures and fittings in the locations as shown on the drawings and/or as specified below:*

Power Outlets	*Lighting*	*Power Points*
Living Room	*1*	*3 x double 10A GPO*
Kitchen	*1*	*1 x double 10A GPO (fridge/freezer 10A marked unprotected)* *1 x double 10A GPO (above bench)*
Bedroom	*1*	*1 x double 10A GPO*
Bathroom / Laundry	*1*	*1 x single 10A GPO (adjacent to basin)* *1 x double 10A GPO (next to washing machine)*

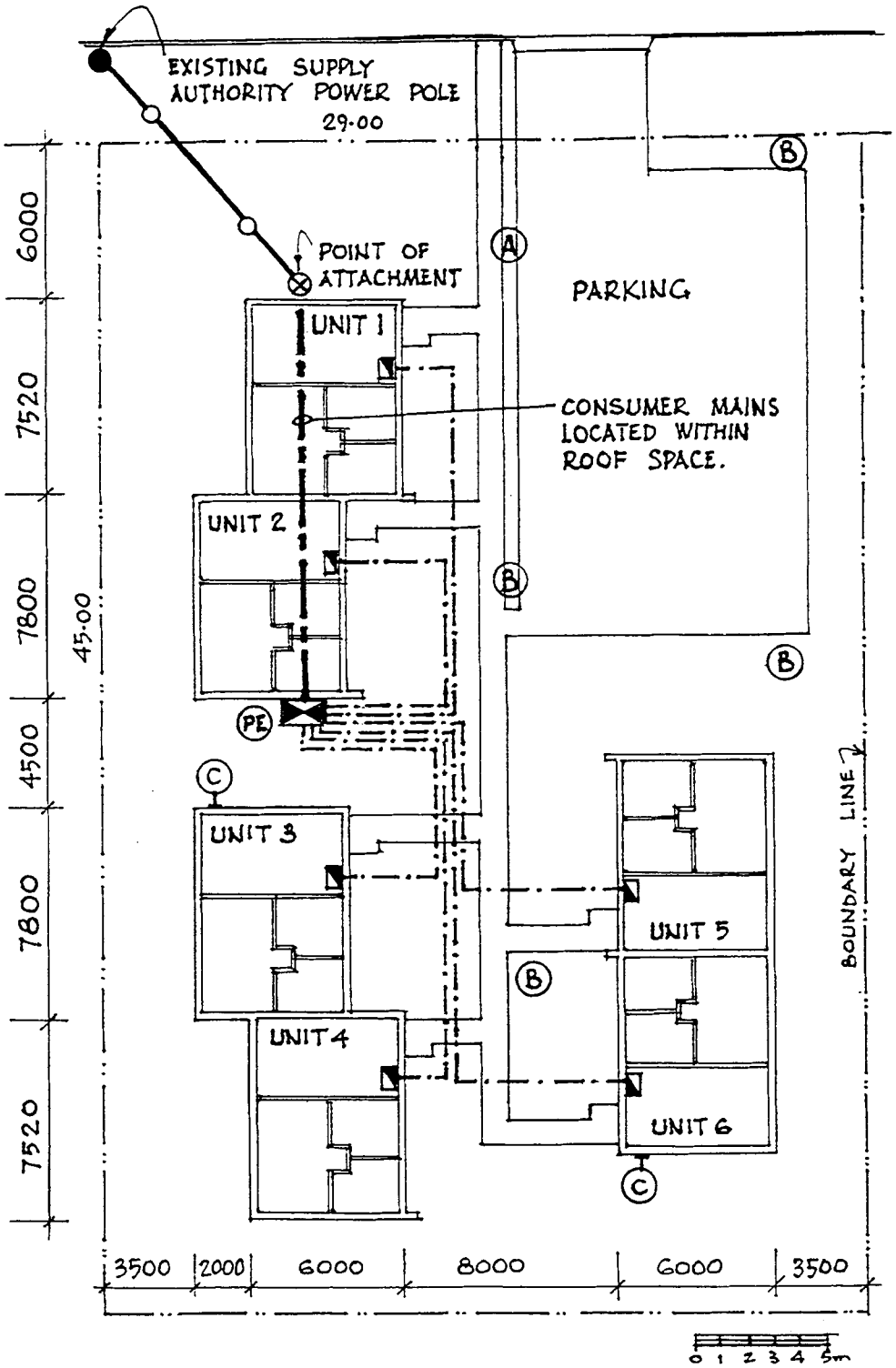
Appliances	*Extent*
Cooking ranges	*1 per kitchen*
Water heaters	*Hydraulic Services*

***Cooking range:** Email P.C.D. 506FB elevated range.*

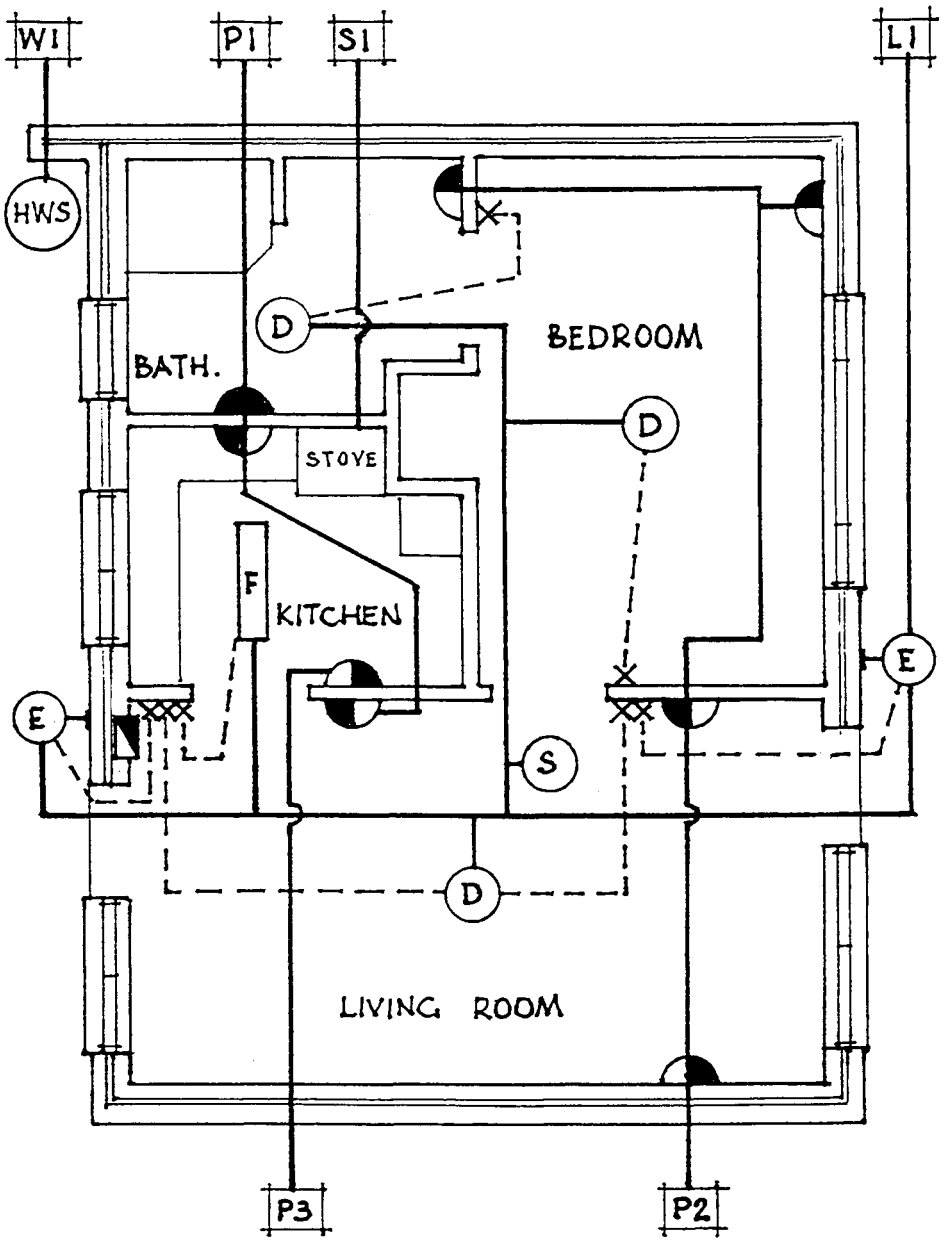
***Water heater:** 125L off-peak mains pressure water heater suitable for outdoor installation as specified in Hydraulic Services.*


SUPPLY AUTHORITY POWER POLE
AERIAL SUPPLY (BY SUPPLY AUTHORITY)
POINT OF ATTACHMENT
4 x 25mm² (CU) PVC/PVC IN CONDUIT - CONSUMER MAINS
MAIN SWITCHBOARD
80A MAIN SWITCH
LANDLORD'S SERVICES
METERING LINKS
TENANTS' SERVICES
REPEAT FOR UNITS 2-6 INCLUSIVE
OFF-PEAK TARIFF
DOMESTIC TARIFF
SUPPLY AUTHORITY OFF-PEAK SWITCHING RELAY
32A
16A
20A
25A
50A
SPARE SPACE
AUTO
ON
OFF
PE
M
R
MAIN SWITCHBOARD CUPBOARD LIGHT
AREA LIGHTS
MAIN SWITCHBOARD CUPBOARD G.P.O.
2 x 4mm² (CU) TPI CABLES IN U/GROUND CONDUIT - OFF PEAK HWU SUB-MAINS
2 x 10mm² (CU) TPI CABLES IN U/GROUND CONDUIT - SUBMAINS TO DOMESTIC TARIFF SECTIONS OF UNIT D.B's.
UNIT Nº1 DISTRIBUTION BOARD
20A
20A
20A
20A
32A
16A
W1
P1
P2
P3
S1
L1
HOT WATER UNIT
G.P.O's
G.P.O's
G.P.O. REFRIGERATOR
STOVE
LIGHTS
REPEAT FOR UNITS 2-6 INCL.

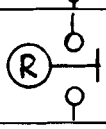
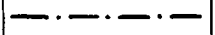
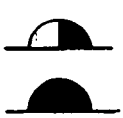
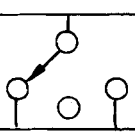
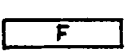
DRAWING 16.1


EXISTING SUPPLY AUTHORITY POWER POLE
29-00
POINT OF ATTACHMENT
PARKING
UNIT 1
CONSUMER MAINS LOCATED WITHIN ROOF SPACE.
UNIT 2
UNIT 3
UNIT 4
UNIT 5
UNIT 6
PE
A
B
C
BOUNDARY LINE
45-00
6000
7520
7800
4500
7800
7520
3500
2000
6000
8000
6000
3500
0 1 2 3 4 5m

DRAWING 16.2


W1
P1
S1
L1
HWS
D
BATH.
BEDROOM
D
STOVE
F
KITCHEN
E
E
S
D
LIVING ROOM
P3
P2

DRAWING 16.3

Symbol	Description	Symbol	Description
	Supply authority power pole		Busbar or cable Number of strokes denotes the number of phases
	Point of attachment		Circuit breaker
	Supply authority aerial supply		Circuit breaker with integral ELCB unit (safety switch)
	Consumer mains		Supply authority off-peak switching relay
	Route of underground conduits and cabling between MSB and distribution boards		Photo electric daylight switch GEC 2320A
	Main Switchboard (MSB)		Supply authority kilowatt hour meter
	Distribution Board		Post top mounted light
	Supply Authority Service fuses		Bollard light
	Switch		Wall mounted light with 50W MV lamp.
	General purpose outlet (GPO) – double – single		Incandescent batten holder
	Selector switch Clipsal PS35COA		Fluorescent light
	Smoke detector		Unit wall mounted light

DRAWING 16.4

	ELECTRICAL INSTALLATIONS			
a	Refer to the Specification for particulars of electrical services.	Note		
b	Allow for complying with relevant Acts, by-laws and regulations.	Item		
c	Allow for giving notices, obtaining permits and completion certificates, and paying fees and charges in connection with the installations.	Item		
d	Allow for testing installations.	Item		
e	Allow for providing samples.	Item		
f	Allow for providing work-as-executed drawings as specified.	Item		
	Mains Connection			
g	Allow for contacting the supply authority to arrange overhead supply from existing power pole to point of attachment, and allow for all costs and charges.	Item		
	Consumer Mains Between Point of Attachment and Main Switchboard			
h	4 x 25mm^2 (Cu) PVC / PVC cable in conduit (measured separately) from point of attachment to main switchboard, mainly located within roof space.	m		
i	30mm HDUPVC conduits including fittings fixed to building faces.	m		
j	Terminate consumer mains and connect to main switchboard.	no		
k	Ditto point of attachment located on timber barge board.	no		

	Main Switchboard			
a	Main switchboard all as detailed installed inside the electrical meter cupboard and having the following components: No.1 x 80 amp main switch No.28 single phase busbars No.13 service fuses No.13 meter bases No.6 bases for off-peak switching relay No.6 - 50 amp circuit breakers No.1 - 32 amp circuit breakers No.6 - 25 amp circuit breakers No.1 - 20 amp circuit breakers No.1 - 16 amp circuit breakers No.1 spare circuit breaker position No.1 photo electric daylight switch No. 1 selector switch And all necessary auxiliary equipment required by the supply authority.	no		
b	Allow for arranging with the supply authority to install the meters and off-peak switching relays.	Item		
	Sub-Mains Between Main Switchboard and Units			
c	2 x 4mm^2 (Cu) TPI cables drawn into underground conduits (measured separately).	m		
d	2 x 10mm^2 (Cu) TPI cables ditto.	m		
e	40mm HDUPVC conduits laid in trenches; include for all necessary fittings, excavation, PVC marker tape and backfill.	m		
f	Terminate foregoing underground sub-mains and connect to Main Switchboard by turning up conduit and cables through concrete floor slab inside Main Switchboard enclosure.	no		
g	Ditto at unit distribution boards located inside each unit.	no		

	Sub-Circuits			
a	Area lighting underground sub-circuit from main switchboard to no. 7 external light fittings comprising cabling sized to retain voltage drop within permissible limits; include for 25mm HDUPVC conduit, connections and fittings, excavation, PVC marker tape and backfill.	no		
b	Sub-circuit from main switchboard to GPO inside main switchboard cupboard; include for conduits, connections and fittings.	no		
c	Sub-circuit from main switchboard to No. 1 main switchboard cupboard light.	no		
	External Light Fittings			
d	Pierlite Cat. No. BOL 50 MV bollard light, with 50W mercury vapour lamp.	no		
e	GEC Mediterranean R2 wall mounted light, complete with 50W MBFU lamp; include for fixing to brickwork approx. 2.40m above ground level.	no		
f	Associated Lighting SX2731 post top mounted light complete with pipe standard and 80W MBFU lamp; installed complete.	no		
	Main Switchboard Light Fitting			
g	Philips VL201 weatherproof vandal resistant fluorescent light, fixed to brickwork inside main switchboard cupboard.	no		
	Unit Distribution Boards			
h	Email LC86FD recessed type unit distribution board complete with hinged door, fixed into brick walls and having: 1 x 32 amp circuit breaker for stove circuit 1 x 20 amp ditto hot water unit circuit 1 x 20 amp ditto power circuit. 2 x 20 amp circuit breakers with residual current device not exceeding 30mA. 1 x 16 amp circuit breaker for lighting circuit.	no		

	Unit Sub-Circuits			
	Sub-circuits including brick chasing, conduits, cables, cable terminators, wall boxes, junction boxes, connections and earthing:			
a	Sub-circuit from unit distribution board to four double GPOs.	no		
b	Ditto two double GPOs, one single GPO, and one door bell with single switch.	no		
c	Ditto one double GPO.	no		
d	Ditto hot water heater including flexible connection.	no		
e	Ditto stove including flexible connection.	no		
f	Ditto four internal light fittings, two external light fittings, five single switches, one two-way switch and one smoke detector.	no		
	Switches			
g	Single gang light switches with one-way switch built into brickwork in locations as shown on the drawings.	no		
h	Double gang light switches with one two-way switch and one one-way switch ditto.	no		
i	Triple gang light switches with two one-way switches and one two-way switch ditto.	no		
	General Purpose Outlets			
j	Double outlet GPO built into brick walls in positions directed.	no		
k	Single ditto.	no		
	Light Fittings			
l	White heat resistant incandescent batten lamp holder fixed to timber framed plasterboard ceilings.	no		
m	1 x 18W HPF enclosed fluorescent light fitting with TLD 18W/33 lamp.	no		

	Light Fittings cont.			
a	Philips L1025 surface mounted weatherproof light fitting fixed to brick wall.	no		
	Lamps			
b	60W, 240v pearl bayonet fitting lamps fixed in position.	no		
c	100W ditto.	no		
	Water Heaters			
d	Make permanent connection of electricity supply to water heater.	no		
e	Water heaters have been measured in Hydraulic Services.	Note		
	Cooking Range			
f	Email P.C.D. 506FB elevated electric range as specified, secured to concrete slab with approved clips and bolt fastenings and make connection to electricity supply.	no		
	Smoke Detectors			
g	Approved smoke detectors, fixed to timber framed plasterboard ceiling lining in position directed.	no		

CHAPTER 17

GLAZING AND PAINTING

17.01. SMM REQUIREMENTS—GLAZING

Refer to SMM, Section 12, Glazing, pages 97–99, for the rules governing the measurement of glazing. In particular the following point should be noted:

1. Section 12, Glazing encompasses the measurement of glass and glazing not covered in Sections 15. Partitions, 18. Windows and 19. Doors. Typically, for most building projects, the majority of glass and glazing is contained in windows and doors. Consequently, the Glazing section of the Bill of Quantities is usually only a minor section involving the measurement of leadlights, glazing bars, louvre blades, mirrors, etc.

17.02. EXAMPLE 1—GLAZING—MIRRORS

Following is a worked example illustrating the measurement of mirrors.

QUESTION: B.m.e. the mirrors as specified.

SPECIFICATION NOTES

GLAZING

MIRRORS to be 600 x 600 x 6mm thick clear float glass, of silvering quality, backed with a reflective surface layer and protective coating and having clear anodised proprietary aluminium frame all around, mitred at corners. Fix two mirrors to timber framed wall in bathroom in positions indicated.

GLAZING

Mirrors

a	600 x 600 mirrors, comprising 6mm thick clear float glass of silvering quality, backed with a reflective surface layer and protective coating and having clear anodised proprietary aluminium frame all around, mitred at corners; include for fixing to timber framed wall in position indicated.	no	2	
	2	2	Bathroom	
		2		

17.03. SMM REQUIREMENTS—PAINTING

Refer to SMM, Section 21, Painting, pages 133–136, for the rules governing the measurement of painting. In particular the following basic requirements should be noted:

1. Preparatory work, priming or sealing coats, undercoats and finishing coats and the nature of the base to which the work is carried out is included in the one description. (Refer SMM, M3, page 133.)

2. External and internal work are given separately. (Refer SMM, M5, page 133.)

3. Painting to surfaces equal to or less than 250mm wide or girth of a different specification from the surrounding work is billed separately in metres. (Refer SMM, M8, page 133.)

17.04. MEASUREMENT TECHNIQUE—PAINTING

The Painting section is usually the last trade section in the Bill of Quantities to be completed. The recommended measurement technique is, firstly, to carry out the billing process working from the Specification and lining off each clause after the billing is completed. When all the descriptions have been completed, the next task is to "paint" the project by working directly from the draft copy of each trade section. Starting with the Preliminaries and systematically working through each description in each section of the Bill of Quantities the measurement process can be completed. Naturally, many of the quantities can be repeated and no further measurement is required from the drawings.

This method ensures that all work included in the Bill of Quantities will be considered for painting and does not solely rely on the accuracy of the Painting specification. Often queries will arise concerning the painting and the Architect should be consulted if there is any doubt concerning the nature and extent of the painting work. Painting to some elements can often be overlooked by the Specification writer, such as paint on fair face brickwork, off-form concrete, service pipework and ducting, temporary works, etc.

Since many of the quantities are repeated from the previous measurements it is important to carry out bulk checks to detect obvious mistakes and avoid compounding errors. This is a good opportunity to exercise quality control and take a second look at your previous work. Ask yourself if the quantity seems realistic and carry out a bulk check if in doubt.

17.05. EXAMPLE 1—PAINTING

Following is a worked example illustrating the measurement of selected painting classifications.

QUESTION: B.m.e. the painting as specified and as shown in the relevant drawings.

SPECIFICATION NOTES

PAINTING

Paints shall be proprietary brand paints approved by the Commonwealth Paint Committee and shall comply with the relevant Australian Standard Codes.

STRUCTURAL STEELWORK

Application:	*Touch up priming coat* *One coat undercoat* *Two coats gloss enamel*
Extent:	*Covered way frames as detailed in Drawings 13.1 and 13.2. Galvd steel purlins to be left unpainted.*

PLASTERBOARD

Application:	*One coat wallboard sealer* *Two coats low gloss acrylic*
Extent:	*Plasterboard ceiling lining and cornice as detailed in Drawing 6.1*

CEMENT RENDER

Application:	*One coat sealer* *Two coats semi-gloss acrylic*
Extent:	*Cement rendered walls including rendered reveals as detailed in Drawing 6.1*

WOODWORK

Application:	*One coat pink primer* *Two coats gloss acrylic*
Extent:	*Internal doors, frames and trims as detailed in Drawing 5.1* *Skirtings as detailed in Drawing 6.1*
Application:	*One coat timber toned acrylic on all surfaces prior to fixing* *Two coats timber toned acrylic after fixing*
Extent:	*Fascias and barge boards as detailed in Drawing 8.6*

PAINTING

Preambles omitted

EXTERNAL WORK

Structural Steelwork

a Thoroughly degrease, touch up priming coat, one coat undercoat and two coats gloss enamel on covered way frames. m^2 50

25.60		Columns repeat length, Item h, page 119
0.92	23.55	(girth 6 x 152)
0.72		Base plates repeat area, Item i, page 119
1.00	0.72	
0.48		Cap plates repeat area, Item j, page 120
1.00	0.48	
22.00		Roof beams repeat length, Item k, page 120
1.09	23.98	(girth 2 x 252 + 4 x 146)
2 / 0.40		Attached connections, Item l, page 120
1.00	0.80	
	49.53 m^2	

Woodwork

b Properly prepare, one coat timber toned acrylic on dressed timber fascias prior to fixing. m^2 14

27.00		Fascias repeat length, Item a, page 61
0.50	13.50	(girth 2/200 + 2/38 + 2/10 = 496)
	13.50 m^2	

c Ditto barges and gable infills. m^2 5

8.00		Barges repeat length, Item b, page 61
0.50	4.00	(girth 2/200 + 2/38 + 2/10 = 496)
2 / 2 / 0.5 /0.45		Gable infills
0.20	0.18	
	4.18 m^2	

d Properly prepare, and two coats timber toned acrylic on pre-painted dressed timber fascias, 0–250mm girth. m 27

27.00	27.00	Fascias repeat length, Item a, page 61
	27.00m	(girth 125 + 38 + 10 = 173)

e Ditto on pre-painted dressed timber barges and gable infills, 0–250mm girth. m 9

8.00	8.00	Barges repeat length, Item b, page 61 (girth 200 + 38 + 10 = 248)
2 / 0.45	0.90	Gable infills
	8.90 m	

INTERNAL WORK

Plasterboard

f Properly prepare, one coat wallboard sealer, and two coats low gloss acrylic on plasterboard ceiling lining and cornice. m^2 53

46.00		Ceiling repeat area, Item a, page 32
1.00	46.00	
40.00		Cornice repeat length, Item b, page 32
0.16	6.40	(girth 160mm)
	52.40 m^2	

Cement Render

g Properly prepare, one coat sealer, and two coats semi-gloss acrylic on cement rendered walls. m^2 86

82.00		Cement render to walls
1.00	82.00	(Repeat area, Item c, page 34)
4.00		Ditto
1.00	4.00	(Repeat area, Item d, page 34)
	86.00 m^2	

Woodwork

h Properly prepare, one coat pink primer, and two coats gloss acrylic on timber doors. m^2 25

5 / 2 / 0.86		Int. doors (820 + 35 = 855)
2.08	17.89	(Item a, page 24) (2040 + 35 ≈ 2075)
2 / 2 / 0.81		Ditto (770 + 35 = 805)
2.08	6.74	(Item b, page 24)
	24.63 m^2	

i Ditto on timber door frames and architraves. m^2 12

5 / 5.10		D1–5
0.33	8.42	
2 / 5.05		D6,7
0.33	3.33	
	11.75 m^2	

j Ditto timber skirting, 0–250mm girth. m 37

37.00	37.00	Repeat length, Item d, page 31
	37.00 m	

MEASUREMENT NOTES—PAINTING

Item a–Structural Steelwork: Unlike the shop priming coat previously measured in the Structural Steel section (Refer items p and q, page 121) and billed in tonnes, the site painting to the steelwork is billed in m^2. The area measured is the exposed surface area. This area is obtained by repeating the lengths of the various structural members and multiplying by the appropriate section girth.

Items b-e–Woodwork: The priming coat applied prior to fixing is given separately to the finishing coats applied after fixing. Note that the priming coat is billed in m^2 since the girth exceeds 250mm, whereas the finishing coats, applied to the exposed surface area, are billed in m, since they are less than 250mm girth.

Items f and g–Plasterboard/Cement render: A simple case of repeating the appropriate areas and lengths from the Finishes section.

Item h–Doors: The exposed area of each type and size of door is calculated, (allowing for paint to all edges and both faces), and multiplied by the number of doors. The appropriate number is repeated from the Woodwork section.

Item i–Timber Door Frames and Architraves: Door frames, linings, architraves and other trims are grouped in the one description. Refer SMM, M10, page 134. Since the girth in this case is greater than 250mm the painting is billed in m^2.

17.06. EXERCISE 1—PAINTING

QUESTION: In accordance with Drawing 17.1 and the following specification notes, measure and extend the following Bill of Quantities' Painting section.

SPECIFICATION NOTES

PAINTING

Paints shall be proprietary brand paints approved by the Commonwealth Paint Committee and shall comply with the relevant Australian Standard Codes.

PLASTERBOARD

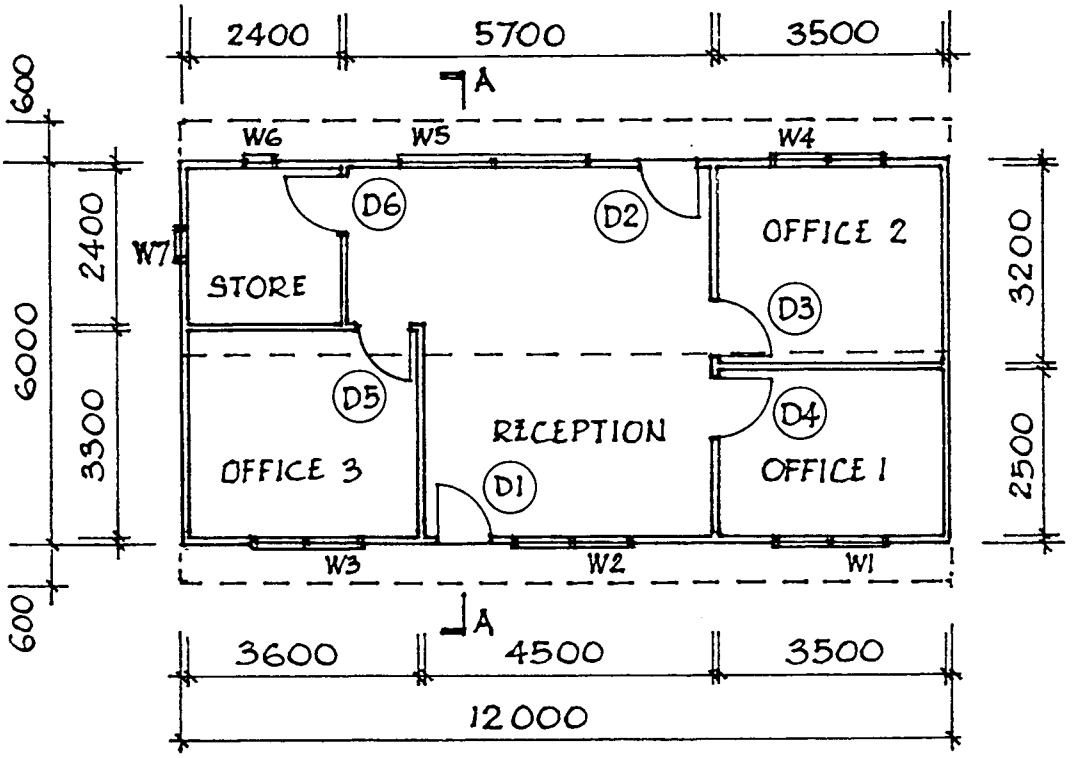
Application:	*One coat wallboard sealer* *Two coats low gloss acrylic*
Extent:	*Plasterboard ceiling lining* *Plasterboard cornice* *Plasterboard wall lining* *(Note: Wall, cornice and ceiling to be painted with different colours.)*

WOODWORK

Application:	*One coat pink primer* *Two coats gloss acrylic*
Extent:	*Timber doors, frames and trims; timber windows; and timber skirtings.*
Application:	*One coat timber toned acrylic on all surfaces prior to fixing* *Two coats timber toned acrylic after fixing*
Extent:	*Sawn finish timber fascias and barge boards.*

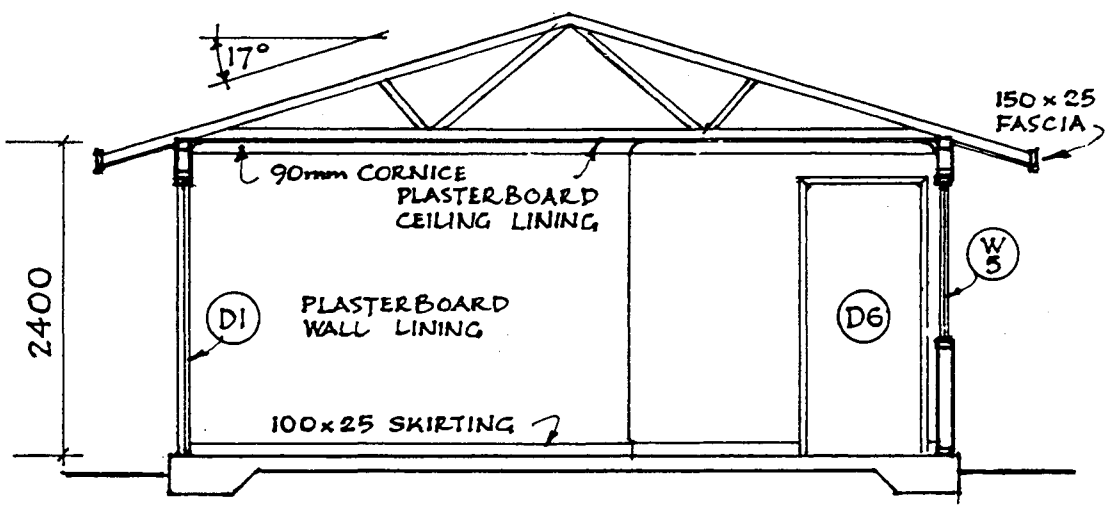
SCHEDULE OF DOOR AND WINDOW OPENINGS

DOOR	WIDTH	HEIGHT	WINDOW	WIDTH	HEIGHT
D1–6	900	2100	W1–4	1800	1200
			W5	3000	1200
			W6–7	600	900



PLAN

[NB: ALL WALLS TO BE 100mm NOM. THICK]



SECTION AA

DRAWING 17.1

	PAINTING			
	Preambles omitted			
	EXTERNAL WORK			
	Woodwork			
a	Properly prepare, one coat pink primer and two coats gloss acrylic on timber doors.	m^2		
b	Ditto on timber door frames and trims, 0–250mm girth.	m		
c	Ditto on timber windows and trims. (Measured flat overall, one side.)	m^2		
d	Properly prepare, one coat timber toned acrylic on sawn finish timber fascias prior to fixing.	m^2		
e	Ditto barges.	m^2		
f	Properly prepare, and two coats timber toned acrylic on pre-painted sawn finish timber fascias, 0–250mm girth.	m		
g	Ditto barges, 0–250mm girth.	m		
	INTERNAL WORK			
	Plasterboard			
h	Properly prepare, one coat wallboard sealer, and two coats low gloss acrylic on plasterboard ceiling lining.	m^2		
i	Ditto plasterboard wall lining.	m^2		
j	Ditto plasterboard cornice, 0–250mm girth.	m		
	Woodwork			
k	Properly prepare, one coat pink primer and two coats gloss acrylic on timber doors.	m^2		
l	Ditto on timber door frames and trims.	m^2		
m	Ditto, 0–250mm girth.	m		
n	Ditto on timber windows and trims. (Measured flat overall, one side.)	m^2		
o	Ditto timber skirting, 0–250mm girth.	m		

CHAPTER 18

PRELIMINARIES

QUALITY CONTROL PROCEDURES

18.01. SMM REQUIREMENTS—PRELIMINARIES

Refer to SMM, Section 2, Preliminaries, pages 9–12, for the rules governing the preparation of the Preliminaries section.

18.02. PRELIMINARIES

The Preliminaries section is the first section in the Bill of Quantities. Unlike the following trade sections it contains very few measured quantities and mainly consists of "Note" and "Item" descriptions. (Refer Chapter 1, 1.01 Terminology, page 2, for the definition of "Note" and "Item".)

The SMM clearly sets out the order and information to be included in the Preliminaries section of the Bill of Quantities. This is broadly divided into two categories. The first of these two categories is what I refer to as "global information" necessary for the estimator to understand the project. The information to be included is as follows:

Names of the parties
Description of the site
Description of the works
Conditions of contract
Tender conditions
Bill of quantities
Contingencies

Contingencies may be included in a building contract to allow for unforeseen costs and are usually in the form of a Provisional Sum. The contractor is directed to include the Contingency Sum in the Tender Sum. The Contingency Sum is used to pay for unforeseen costs that may arise during the contract period. The sum may only be used as directed by the supervising architect and any unexpended portion of the Contingency Sum at Practical Completion of the Works is deducted from the Contract Sum. Following is a typical Contingency Sum Specification clause.

> Tenderers are to allow for and include in their Tender Sum, the sum of Ten Thousand Dollars ($10,000.00) for Contingencies.

The second category in the Bill of Quantities' Preliminaries section contains the general particulars giving "Items" for the various contractual conditions and site

conditions as listed in the SMM. (Refer SMM, Preliminaries, clause 8, pages 11 and 12, for full details.) Three typical Bill of Quantities descriptions giving general particulars of site conditions are as follows:

Allow for all necessary charts and schedules.	Item
Allow for erecting and maintaining a site notice board and for removing same on completion of the works.	Item
Allow for setting out the works.	Item

Government Departments often insist that the Preliminaries section of the Bill of Quantities is not priced by the tenderers. Any costs required to comply with the conditions specified in the Preliminaries are to be allowed for in the various unit rates in the subsequent trade sections of the Bill of Quantities. This action is taken to assist contract administration. Following is a typical Bill of Quantities preamble clause for the Preliminaries section taken from a Government project.

Generally

The following clauses are given for the guidance of the tenderers. Any costs which the Tenderer may wish to allow for these clauses as well as any clauses or conditions not especially mentioned hereafter, shall be included in the unit rates and prices in the various Trade sections of the Bill of Quantities and shall not be shown as individual amounts in this Preliminaries section of the Bill of Quantities.

This clause is followed by the usual Preliminaries descriptions found in a typical Bill of Quantities except that the descriptions are in specification format with no provision for pricing.

18.03. QUALITY CONTROL PROCEDURES

Due to the involved nature of preparing Bills of Quantities, it is most important to exercise some form of quality control during the preparation stage.

The first step is to prepare a project programme before the work is commenced. This programme, usually in the form of a simple bar chart, is prepared by the "Job Captain" in consultation with the other team members responsible for the preparation of the Bill of Quantities. The programme lists all the trade sections and indicates who is responsible for each section of the work, the time allocated, the progress to date, the stage that the Bill of Quantities manuscript has reached, and the documentation (drawings and specification) that has been received from and returned to the design consultants. The programme is constantly updated and monitored throughout the duration of the work. At any given time during the progress of the work the team can

assess their progress and take any corrective action necessary to achieve the scheduled completion date.

Each member of the team should exercise individual quality control during the measurement of the various trade sections. This primarily involves:

1. Lining off each Specification clause and/or schedule after the billing and measurement has been completed.

2. Colouring the drawings after each particular component or finish has been measured.

3. On completion of each trade section, checking to ensure that all clauses in the Specification section and/or schedule have been lined off and that all trade work indicated on the drawings has been coloured in. Never assume that the Specification and drawings are perfect. Simple cross checking procedures as outlined in 1 and 2 above will often reveal errors and discrepancies in the drawings and specification.

4. Looking for obvious errors, such as: unusually large quantities; unusually low quantities; and major omissions.

5. Comparing with previous Bills of Quantities for similar type projects. Historic Bills of Quantities act as useful guides and can often be helpful when preparing the Bill of Quantities and assist in identifying possible omissions.

6. Keeping and maintaining written query sheets. A query sheet is a written record of questions and answers to problems that arise during the preparation of the Bill of Quantities. Whenever a doubt as to the nature and extent of the works arises during the measurement stage the responsible design consultant (Architect, Engineer, etc.) should be contacted and clarification sought. Answers to questions should be recorded together with other relevant information, such as date, sketch details, and the name of the consultant providing the information.

Quality control should also be exercised during the finalisation of each section and the associated printing stage. It is normal practice to double check all mathematical calculations and to proof read the typed draft where the Bill of Quantities is produced using a traditional typed documentation process. If an integrated computer software package is used to produce the Bill of Quantities, the checking of mathematical calculations and proof reading is not critical, but it is still important that the surveyor who measured the work checks the final computer printout.

After all the measurement has been completed by the team members, a total project check should be carried out. This consists of all team members marking up a final set of drawings and cross checking to ensure that all components have been measured. It is good practice to return a corrected set of drawings and corrected draft specification to the design consultants. This process improves the standard of documentation and should result in less variations during the construction period. The drawings and specification used to prepare the Bill of Quantities, work sheets, query sheets, computer disks, etc. should be safely stored in case of future inquiries regarding the accuracy of the Bill of Quantities during the construction period.

Prior to issuing the Bill of Quantities it is essential to carry out bulk checks to avoid possible major errors. This involves making comparative quantity checks, such as comparing the total areas of floor and ceiling finishes; comparing total soffit formwork area, total slab areas and the G.F.A. for the building; and checking that all trades have been printed in full. If an elemental cost plan has been prepared for the project the quantities in the bill should be compared with the quantities in the elemental cost plan.

Finally, it is good practice to price the Bill of Quantities and compare the final cost against previous estimates and elemental cost plans. The percentage cost of each trade section can be compared with similar projects and can often be a handy guide when trying to identify cost anomalies. After all of the above checks have been carried out the team should be relatively confident that a high standard of work has been achieved.

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