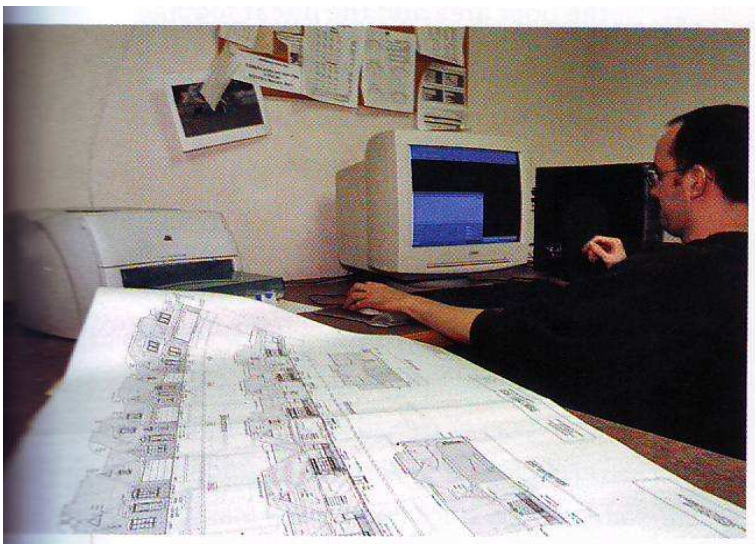
UNESCO-NIGERIA TECHNICAL &
VOCATIONAL EDUCATION
REVITALISATION PROJECT-PHASE II

NATIONAL DIPLOMA IN QUANTITY SURVEYING



BUILDING MEASUREMENT & SPECIFICATION

COURSE CODE: QUS 201

YEAR II - SE MESTER I

THEORY/PRACTICAL

Version 1: December 2008

GENERAL OBJECTVES:

1.0	Take-off quantities for work involved in traditional domestic buildings and simple industrial buildings of not more than two storeys
2.0	Know the purposes of preparing a bill of quantities using various methods of processing dimensions
3.0	Write simple specifications

CONTENT

Week 10

3.3 Reinforced concrete flat roof measurement activity II

Week 11

4.0 The Bill of Quantities

4.1 Introduction

4.2 Basic components of the bill of quantities

Week 12

5.0 NON traditional methods of bill preparation

5.1 Billing procedures

Week 13

6.0 Specification

6.1 Introduction

6.2 The Purpose and Use of Specifications

6.3 Drafting of Specification Clauses

6.4 Sources of information

6.5 Excavation and earthworks

Week 14

6.6 Sample specifications for a Simple Building

Week 15

6.7 Further Sample Specification for a Simple Building

WEEK 1: FOUNDATIONS ON SLOPING SITES I

1.0 Foundation Sloping Sites

1.1 Sloping site excavation and earthworks

When a building is sited on sloping ground, both the floors and the foundations must maintain the horizontal in order to ensure stability of the structure. In such cases, however, strip foundations are maintained at one level throughout will tend to be either needlessly deep at one end, or dangerously shallow at the other.

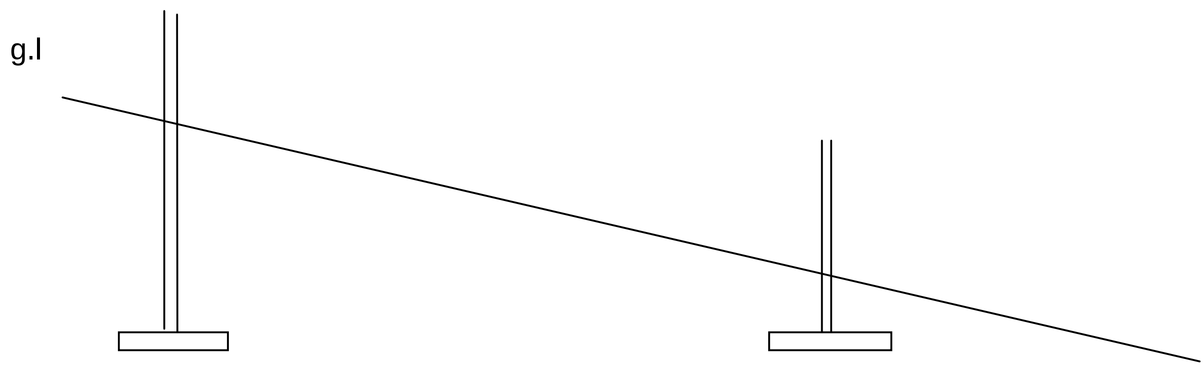


Fig. 1.1 Needlessly deep at one end and dangerously shallow at the other end

In construction, the problem is dealt within the following ways:

(a) Cutting and filling: This involves reduced level excavation on some parts of the site and filling of other parts to reach formation level

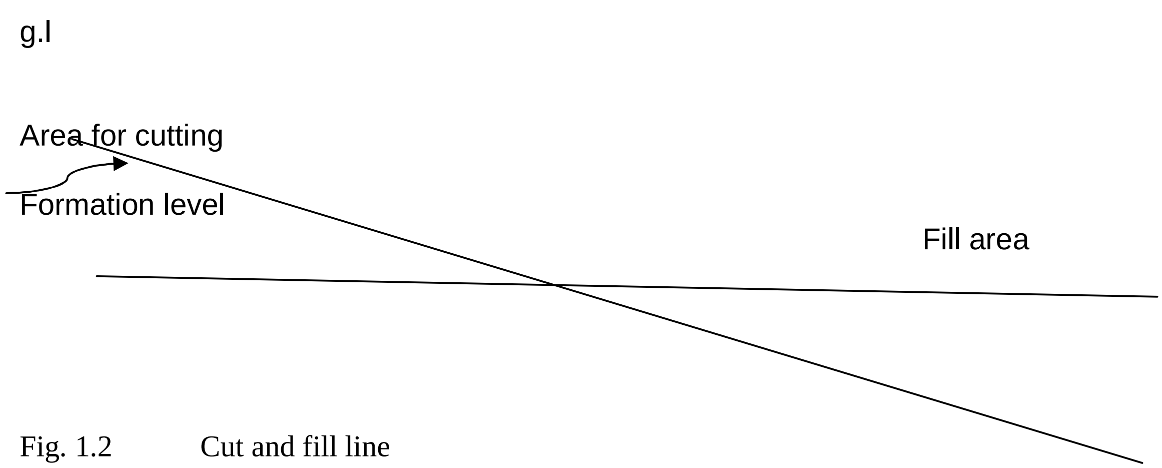


Fig. 1.2 Cut and fill line

(b) Introduction of stepped foundations

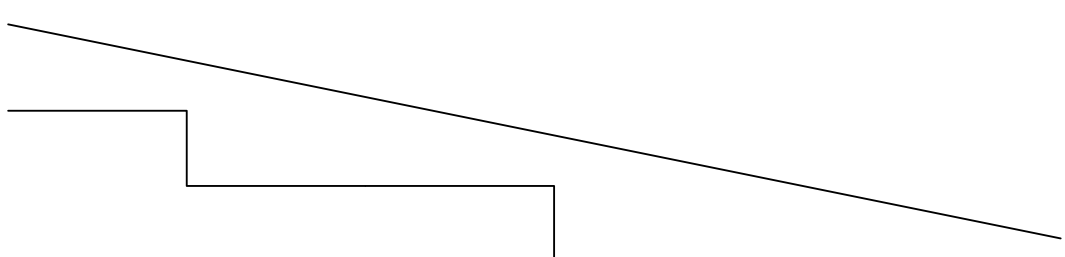


Fig.1.3 Stepped foundation

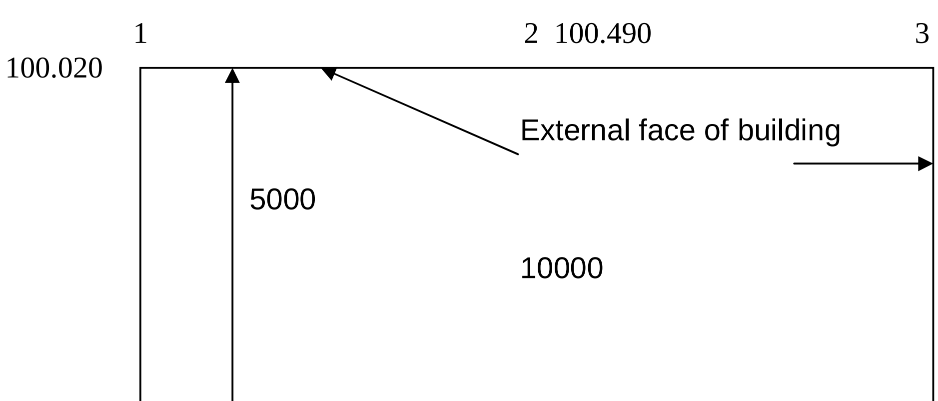
(c) Lowering the floor level below ground level in some areas and in the extreme formation of basements

Fig. 1.4 Formation of basement

1.2 Cut & Fill Excavations

During the measurement, the following calculations need to be made:

1. Calculate the position of the ‘cut and fill’ line and plot on the drawing. From this the amount of cut or fill from existing ground levels and the required formation level can be ascertained. See figure 1.5



6 5 4

Fig 1.5: Plan of Building

	Position 1			Position 2	
Existing ground level	100.020			100.490	
Less site strip	0.150			0.150	
	99.870	= 99.870		100.340	
Floor level	100.450				
Less concrete	0.150				
Less minimum hardcore	0.150	0.300			
Required formation level	100.150	= 100.150		100.150	
		0.280	Fill	0.190	Cut

At station 1, the required formation level is 0.28m above the after strip level. Therefore 0.28 is the amount of additional filling required to get to formation level, i.e. the underside of the hardcore bed. Thus, given a hardcore bed of 150mm, a total depth of filling of 430mm (0.280 + 0.150) will be required. At station 2, the required formation level is 0.19m below the after strip level. Therefore, 0.19m is the depth of reduced level digging at station 2.

2. Calculate the position of the cut and fill line and plot on the drawing. It can be seen that one end of the cut and fill line must occur between stations 1 & 2 because station 1 is in fill and station 2 is in cut. Therefore, the position of the cut and fill line can be calculated by interpolation. See figure 1.6

3. Calculate the position of line (PQ) where the trench excavation exceeds 0.25m, below existing ground level and plot on drawing. See figure 1.7

   Line occurs where 0.1m of reduce level excavation occurs (0.250 – 0.150 site strip = 0.100) see fig. 1. 7

4. Calculate the depth of trenches, including steps, to find maximum depth of trench excavation, in this case, position 5.

After strip level		99.960
Bottom of standard trench	= 99.300	
Step	= 0.225	99.075
Maximum depth of trench		0.885

Therefore description will include '… maximum depth ≤ 1.00 metres'

Fig.1.6 Section

$\triangle$ABC is similar to $\triangle$XBY, therefore the distance AC can be found by interpolation

$$AC = \frac{0.190}{0.470} \times 5.000 = 2.021\text{m}$$

Or: 5.000 – 2.021 = 2.979m from position 1 to position 2

Fig. 1. 7

Sometimes the average depth may be calculated by a weighted method as follows:

Example:

	1	2	3	4
A	1.020	1.070	1.050	1.100
B	1.050	1.060	1.070	1.150
C	1.100	1.100	1.110	

	Average
A1	1.020
A2	1.070
A3	1.050
A4	1.150
B1	1.050
B2	1.060
B3	1.070
B4	1.150
C1	1.100
C2	1.100
C3	1.110
	11)11.880
Average depth	1.080

Weighted average70

Weighting	x 1	x 2	x 3	x 4
	A1 1.020	A2 1.070	B3 1.070	B2 1.060
	A4 1.100	A3 1.050		
	B4 1.150	B1 1.050		
	C1 1.100	C2 1.100		
	C2 1.110			
	5 = 5.480	4 = 4.270	1 = 1.070	1 = 1.060
		x 2wgt	x 3 wgt	x 4wgt
		8 = 8.540	3 = 3.210	4 = 4.240

Summary

5 = 5.480
8 = 8.450
3 = 3.210
4 = 4.240
20)21.470

Weighted average depth 1.074

Note: Never average ground levels across a cut and fill line as this could give an answer of no reduce level excavation and no additional filling which is obviously incorrect. Average ground levels either side of the cut and fill line to give an amount of reduce level excavation and an amount of additional filling.

1.3 Stepped Foundations

Definition

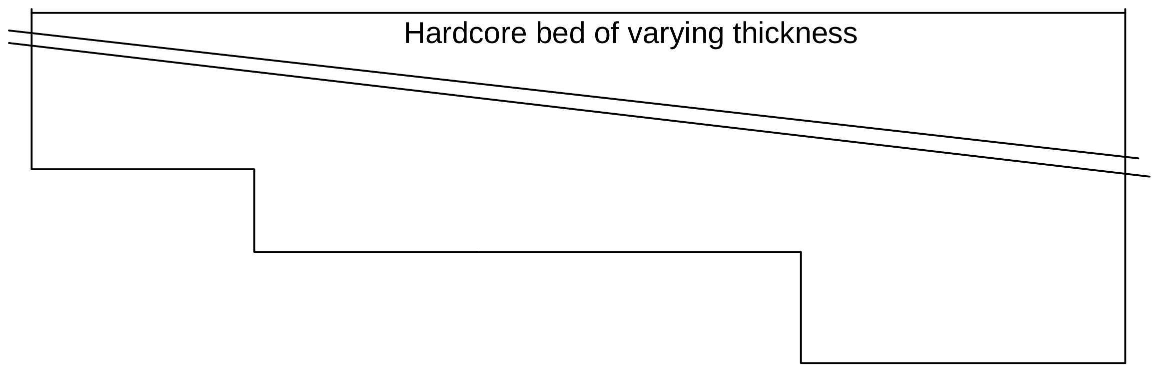
These are strip foundations on gently sloping sites where floor level is above ground level and the foundations are stepped to follow the contour of the ground

Order of Measurement

Order of measurement is the same as for strip foundations. Sequence remains the same, subject to the following special considerations:

1. Surface strip:

Although floor level is horizontal, underside of surface excavation will either follow slope of the ground or be stepped to conform to the foundation. The ground level does not carry any structural load. The ground floor can therefore be supported on a sloping surface. The space between ground floor construction and formation level is then filled with a hardcore bed of varying thickness.



Surface strip is measured superficial and is measured over the plan of the building including concrete projections for foundations. Since the slope is defined as gentle, the difference in surface area is negligible. The volume of earth removed remains the same, therefore in taking-off for surface strip, no allowance is made for the sloping surface

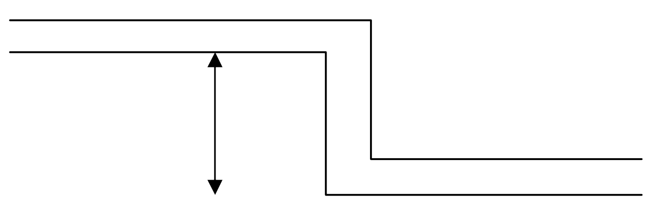
2. Foundation trenches

If the foundations are stepped to follow the contour of the ground, the average depth at the midpoint of the step will be constant. If this average depth can be either calculated or scaled from drawings for the whole of the foundation or for sections of it at a time then measurement can proceed as usual bearing in mind that:

Certain areas may not conform to the average depth calculated and these have to be dealt with separately

Care must be taken to measure sections falling within separate depth ranges separately as required by the SMM.

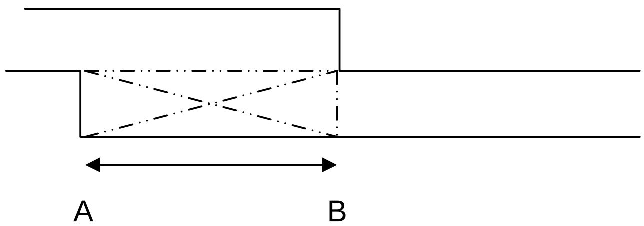
3. Earthwork support



An additional quantity of earthwork support may be required at the point where a “step” occurs. This runs across the trench to support the “riser” to the step in the trench bottom. This bit is only measurable where the riser exceeds 0.25m. (D20:M9)

4. Concrete foundations

The concrete will follow exactly as for strip foundations subject to an addition fro extra concrete where each step occurs and formwork to the concrete riser. An overlap is always provided at each step to maintain adequate strength and unless otherwise shown is taken to be equal in length to the thickness of concrete or 300mm which ever is greater.

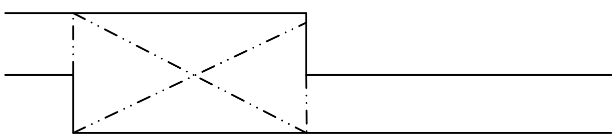


Length = Thickness of concrete or 300mm whichever is greater (A-B)

Width = width of trench

Depth = Step height

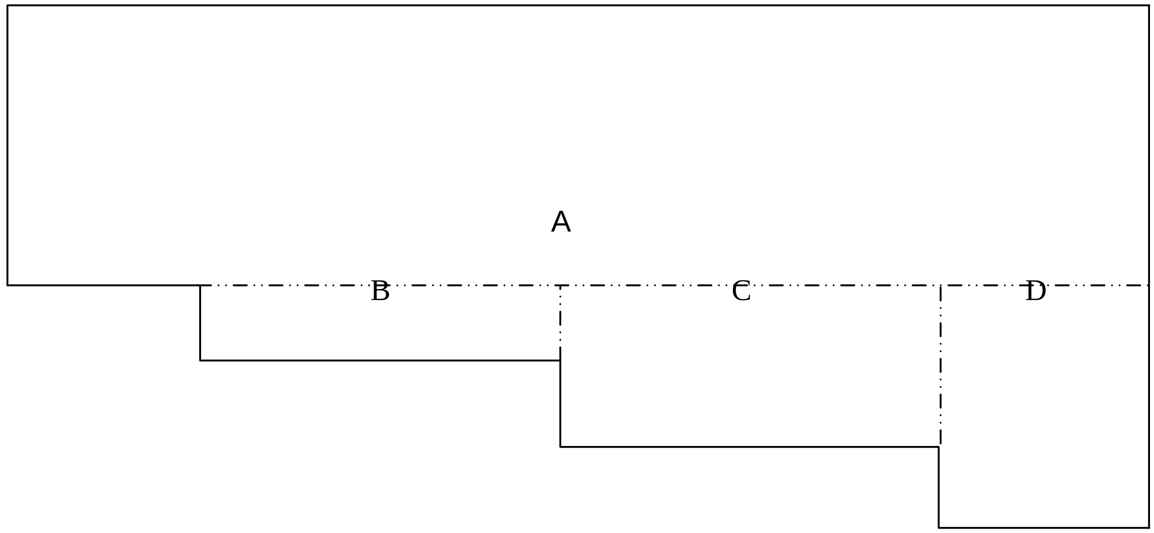
This additional volume is bracketed with the rest of the foundation concrete and side noted ‘steps’. Thickness of concrete in foundation has to be stated in stages and this may make it necessary to measure the whole step as a separate item from the rest of the strip foundation.



5. Formwork to steps

If less than 1.00m high is measured linear (E20: column 3, Number 1)

6. Blockwork/Brickwork



This diagram represents in elevation the foundation blockwork to a building with stepped foundations. Area of blockwork is taken in sections: A, B, C & D.

Flow chart for a foundation on a sloping site

Start	
NIL	Calculate depths of cut and fill and position of cut and fill line. Plot on drawing
Excavate topsoil	
D20.2.1.1.0 m^2	Plan area of building to external face of foundation projection
Disposal of topsoil excavation material	
D20.8.3.2.1	Cube up above plan area by thickness of topsoil
Surface Treatments	
D20.13.2.3.0 m^2	Same area as excavate topsoil
Excavate to reduce levels	
D20.2.2.2.0 m^3	Volume of reduced level excavation, = average length of reduced level excavation measured from the cut and fill line to the external face of foundation projection multiplied by the width measured between the external faces of foundation projection measured by the average depth of reduced level excavation
Disposal of reduced level excavation	
D20.8.3.1.0 m^3	Same volume as reduced level excavation

Information only	
NIL	Calculate position of line where trench excavation occurs 0.25m below existing ground level. See SMM 20.2.6.0.1 Plot on the drawing, called 0.25m line
Earthwork support to reduce levels	
D.20.7.1.3.0 m^2	Area of vertical face to sides of reduce level and topsoil excavations which in total exceeds 0.25m deep. See SMM D20.7.M9(a) = length of each side is calculated for the reduce level excavation, but measured from the 0.25m line where applicable multiplied by the average depth of the reduced level excavation and topsoil excavation on each side
Excavate trenches	
D20.2.6.2.0 m^3	Volume of trench excavation ignoring steps in foundation, = total measurements of equal centre line girth of trench x width of trench x depth of trench calculated from the highest level of foundation i.e. 99.3000. Note: For description purposes only, calculate maximum depth of trench including steps
Disposal of trench excavation	
D20.8.3.1.0 m_3	Same as volume of trench excavation
Excavate trenches exceeding 0.25m below existing ground level	
D20.2.6.2.1 m^3	Volume of trench excavation exceeding 0.25m below existing ground level = centre line girth of trench x from 0.25m line under reduce level x width of trench x depth of trench
Adjustment of excavate trenches	
D20.2.6.2.0 m^3	Deduct same volume as last item
Earthwork support to trenches	
D20.7.1.1.0 m^2	Area of vertical face of trench excavation plus face of topsoil and reduce level excavation (where not already measured) = total measurements to equal centre line girth of trench x depth of trench ignoring steps x two for both sides of trench. Plus external girth of topsoil excavation from cut and fill line around fill side of building x depth of topsoil excavation. Plus area of vertical face of reduce level and topsoil excavation between cut and fill line and 0.25m line.
Keep excavation free of surface water	

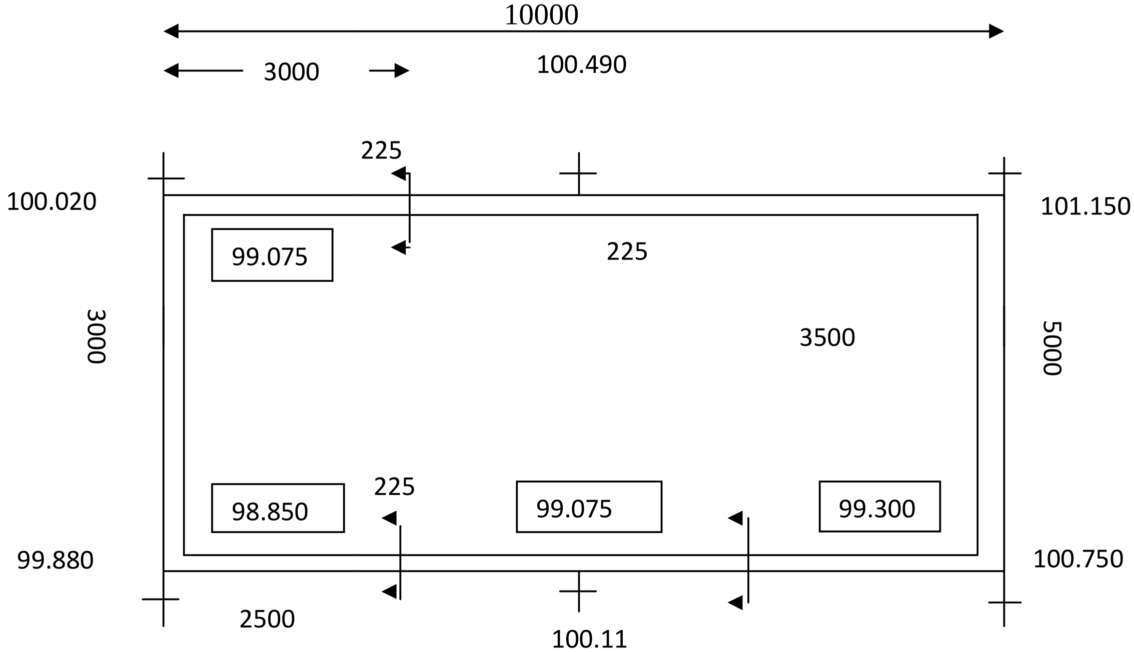
D20.8.1.0.0 m^2	No quantity
Concrete foundations	
E10.1.0.0.5 m^3	Volume of concrete in foundation viz centre line girth of trench x width of concrete foundation ignoring steps
Blockwork	
F10.1.1.1.0 m^2	Area of block wall ignoring steps, = centre line girth of wall x height of wall calculated from the top of highest level of concrete foundations
Hardcore filling to foundations	
D20.9.2.3.0 m^2	Volume of hardcore filling to internal projection of trenches ignoring steps, = total measurements to equal centre line girth of internal projection of concrete foundation x width of concrete projection x depth of trench calculated from the top of the highest level of concrete foundation to after strip or reduce level excavation
Earth filling to trenches	
D20.9.2.1.0 m^3	Volume of earth filling to external projection of trenches ignoring steps, = total of measurements to equal centre line girth of external projection of concrete foundation x width of concrete projection x depth of trench calculated from top of highest level of concrete foundation to after strip or reduce level
Adjustment of disposal of excavated material	
D20.8.3.1.0 m^3	Deduct same volume as last item
Damp proof course	
F.30.2.1.3.0 m^2	Plan area of wall, = centre line girth of wall x width of wall
Excavate trenches adjustment for steps	
D20.2.6.2.0 m^3	Volume of additional excavation in steps = where steps are same depth. Total girth of steps to excavation face. (Note drawing dimensions to concrete face) x width of trench x depth of step
Disposal of trench excavation (steps)	
D20.8.3.1.0 m^3	Same as volume of last item
Earthwork support to trenches (steps)	
D20.7.1..1.0 m^2	Area of additional vertical face of trench excavation, = total girth of steps as used in additional trench excavation x depth of step x two for both sides

Concrete in foundation (steps)	
E10.1.0.0.5 m^3	Volume of additional concrete in overlap at step = length of overlap x width of concrete foundation x depth of step x number of steps
Formwork to faces of steps	
E20.1.2.2.0 m	Length of vertical face of concrete to be supported = width of concrete foundation x number of steps
Blockwork (steps)	
F10.1.1.1.0 m^2	Area of additional blockwork in steps = total girth of steps to concrete face x depth of step
Hardcore filling to trenches (steps)	
D20.9.2.1.0 m^3	Volume of additional earth filling to external projections of trenches for steps = total girth of external projections of concrete foundation to concrete steps x width of concrete projection x depth of step
Earth filling to trenches (steps)	
D20.9.2.1.0 m^3	Volume of additional earth filling to external projection of trenches for steps = total girth of external projection of concrete foundation to concrete pf steps x width of concrete projection x depth of step
Adjustment of disposal of excavated material (steps)	
D20.8.3.1.0 m^3	Deduct same volume as last item
End of adjustment for steps	
Hardcore bed	
D20.10.1.3.0 m^3	Volume of standard hardcore bed ignoring additional fill = length of building to internal face of external walls x width of building to internal face of walls x thickness of hardcore bed
Additional hardcore filling	
D20.10.1.3.0 m^3	Volume of hardcore to standard bed and additional filing = average length of additional filling measured from cut and fill line to the internal face of external walls x width of building to internal face of walls x average thickness of additional hardcore fill plus the standard bed thickness
Hardcore filling adjustment	
D20.13.2.2.1 m^3	Deduct volume of standard bed hardcore included in additional filling measured above = the average length and width as calculated above x thickness of standard bed
Compact and blind hardcore bed	

D20.13.2.2.1 m^2	Total surface area of hardcore = length of building to internal face of external wall x width of building to internal face of external walls
Damp proof membrane	
J40.1.1.0.0 m^2	Internal surface area of building = same area as last item
Vertical damp proof membrane	
J40.1.1.0.0 m^2	Area of membrane at edge of concrete slab = same area as compact and blind hardcore bed x thickness of concrete bed
Concrete bed	
E10.4.1.0.0 m^3	Volume of concrete bed = same area as compact and blind hardcore bed x thickness of bed
Adjustment of soil to perimeter of building	
D20.10.1.2.3 m^3	Volume of soil filling around external walls(usually topsoil) = centre line girth of external projection of concrete foundation of external walls x width of concrete projection x thickness of filling
Block walls rendered externally	
M20.1.1.1.0 m^2	Area of block wall rendered externally, i.e. centre line girth of wall x height of wall externally (always take 250mm below finished ground level)
Painting externally	
M60.1.0.1.0 m^2	Same area as last item
Check drawings and take-off list for outstanding items	

WEEK 2: SLOPING SITE FOUNDATION TAKE-OFF ACTIVITY I

2.1 Example 1: Drawings



PLAN SCALE 1:100

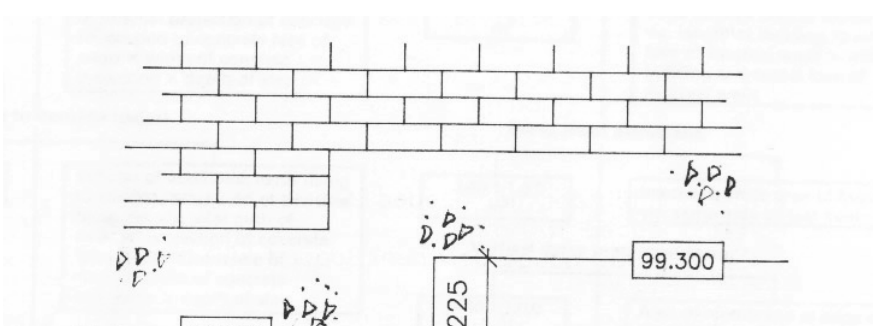
FOUNDATIONS TO SLOPING SITES

\+ 101.150 – Existing ground levels
5m x 5m grid

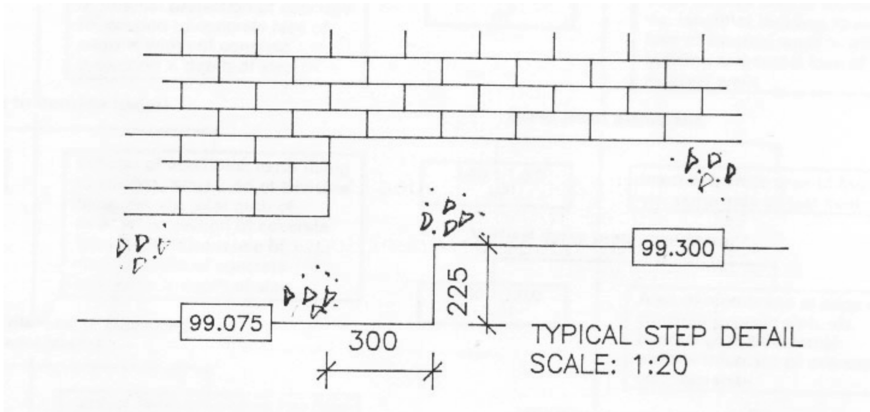
- Bottom of trench levels

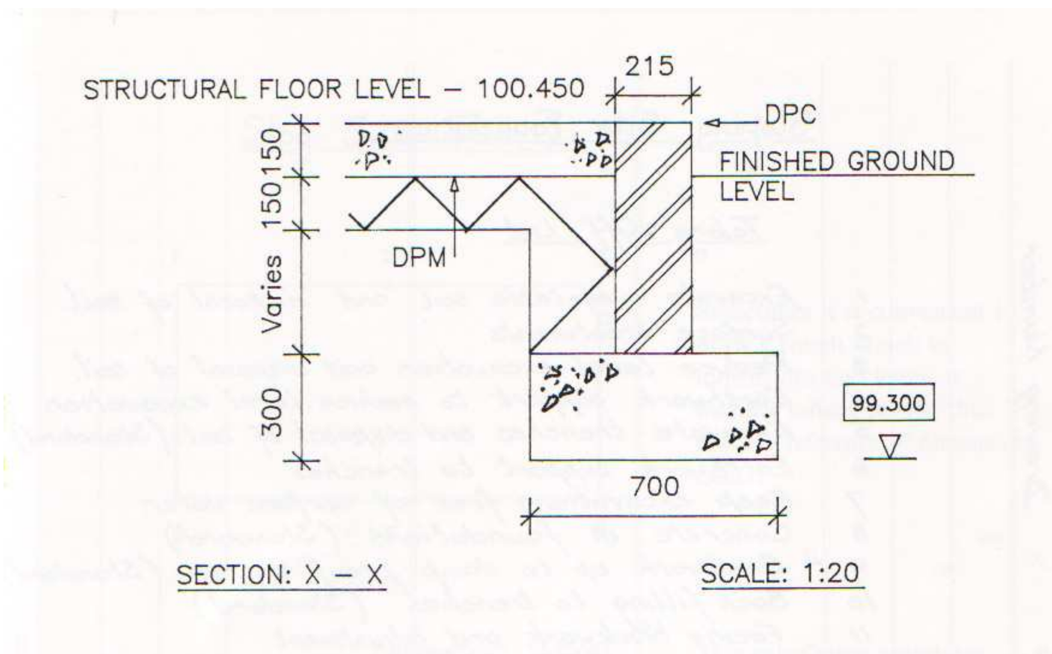
99.300

225 Step in bottom of trench showing position of concrete face, direction and depth of step - see detail below



TYPICAL STEP DETAIL
SCALE: 1:20





SPECIFICATION

1. Topsoil: 150mm deep, to be excavated and deposited in spoil heaps 30m from excavation
2. All surplus soil taken to tip provided by contractor
3. No ground water
4. Concrete: In situ concrete (1:2:4/20mm aggregate)
5. Blockwork: Hollow sandcrete blockwork in cement mortar (1:4) in stretcher bond
6. DPC: Pitch polymer bedded in cement mortar (1:3) lapped 150mm
7. DPM: one layer purloin NT4 water proof membrane lapped 150mm at all joints
8. Filling to make up levels: Hardcore

2.1 Title of Project:
Drawing No.:
Name:
Date:

Sloping Site Foundation 1

Take Off List

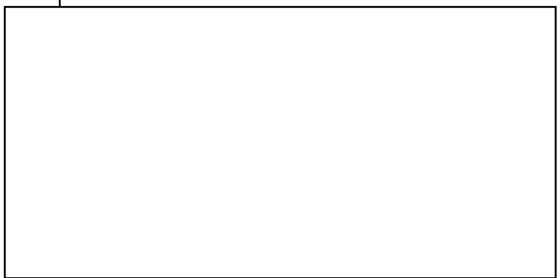
1	Excavate vegetable soil and disposal of soil
2	Surface treatments
3	Reduce level excavation and disposal of soil
4	Earthwork support to reduce level excavation
5	Excavate trenches and disposal of soil (standard)
6	Earthwork support to trenches
7	Keep excavations free of surface water
8	Concrete in foundation (standard)
9	Blockwork up to damp proof course (standard)
10	Backfilling to trenches (standard)
11	Damp proof course
12	Steps in foundation (adjust items 5-10 above)
13	Hardcore bed and adjustment for additional fill
14	Blind hardcore bed
15	Damp proof membrane
16	Concrete bed
17	Adjustment of top soil to perimeter

Page

Numbers

Sloping Site Foundation 2

1. 2. 3.



6. 5. 4.

PLAN

Sometimes it is convenient to draw a rough sketch in dimensions and letter or number salient points making reference in dimensions easier.

		Formation level
Structural floor level		100.450
Less		
Concrete bed	0.150	
Standard hd/c bed	0.150	0.300
Formation level		100.150

This calculation ascertains the formation level which is the level of the underside of the minimum hardcore bed required by the designer, and indicates the level at which the cut and fill line occurs

Calculation of cut and fill

Points	1	2	3
Existing GL	100.020	100.490	101.150
Less topsoil	0.150	0.150	0.150
Less FL	100.150	100.150	100.150
	- 0.280 Fill	+0.190 Cut	+0.850 Cut

Points	4	5	6
Existing GL	100.750	100.110	99.880
Less topsoil	0.150	0.150	0.150
ASL	100.600	99.960	99.730
Less FL	100.150	100.150	100.150
	+ 0.450 Cut	- 0.190 Fill	- 0.420 Fill

In these calculation, the formation level (FL) is compared with the after strip level (ASL).

Where the FL is lower than the ASL, cutting or digging is requires as at points 2,3 & 4, and where FL is higher than the ASL, filling is required as at points 1,5 & 6.

Sloping Site Foundation 3

Cut and fill Line

The position of the cut and fill line is calculated and drawn onto the foundation plan similar to a contour line. Any ground which is at a higher level than the formation level represented by the cut and fill line has to be excavated or reduced and any ground lower will have to be filled

Position of Cut & fill Line

C & F Line falls between 1 & 2

Point 1	0.280 fill	
Point 2	0.190 cut	
		0.470

By interpolation 0.190 = 0.470

X = 5.000

X = 2.021m

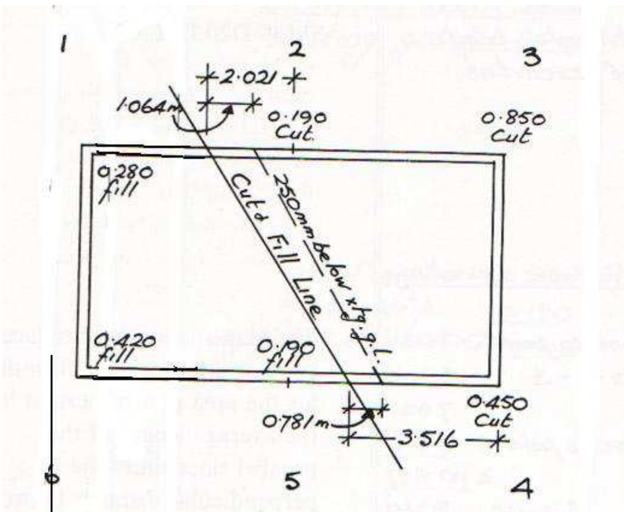
Cut & Fill line between 4 & 5

Point 4	0.450 cut	
Point 5	0.190 fill	
		0.640

By interpolation 0.450 = 0.640

Y 5.000

Y =



Sloping foundation 4

Excavate topsoil

		Ext. dims	10.000 x	5.000	
	Conc. Proj				
	Trn.	0.700			BESMM3 D20.2.1.1.0
	Less wall	0.215			
	2/½/	0.485	0.485	0.485	
			10.485	5.485	BESMM3 D20.8.3.2.1
10.49		Excavating topsoil for preservation average			
5.49		150mm deep			
					BESMM3 D20.1.13.2.3.0
					The plan shape of the reduced

&

Disp excavated material on site in spoil heaps av. 30m from excavation
cube x 0.15 = _______________ m^3

Surface treatments

10.49 | surface treatments compacting bottom of
5.49 | excavations

Reduce Levelling

C & F line to point 2   2.021
Points 2-3   5.000
7.021
C 7 f line to point 4 =   3.516
2)10.537
Average   5.269
Conc. Proj: ½/0.485   0.243
5.512
Trapezium dim x   5.485

Sloping Site Foundation 5

Average depth of RL

C & F Line   0.000
Point 2   0.190
Point 3   0.850
Point 4   0.450
C & F line   0.000
5)1.490
0.298

BESMM3 D20.2.2.2.0

BESMM3 D20.8.3.1.0
BESMM3 D20.2.0.0.1 requires any excavation which commences exceeding 0.25m below existing ground level to have the commencing level stated in the description. Therefore this depth = 250mm must be plotted on the foundation plan. See plan on sloping site foundation 3

5.51
5.49
0.30

Excavating to r.l max depth ≤ 1.00m

&

Disposal of excavated material off site

Position of 250mm total excavated excavation depth below existing g.l

Excavation of vegetable topsoil over site of 150mm has already been measured. Therefore it is necessary to calculate where the reduce level excavation is 100mm deep, giving a total excavation depth of 250mm

Total depth 0.250
Less topsoil 0.150
Depth of reduced level 0.100

Sloping Site Foundation 6

250 line occurs between C & F & pt 2

By interpolation 0.100 = 0.190

X 2.021

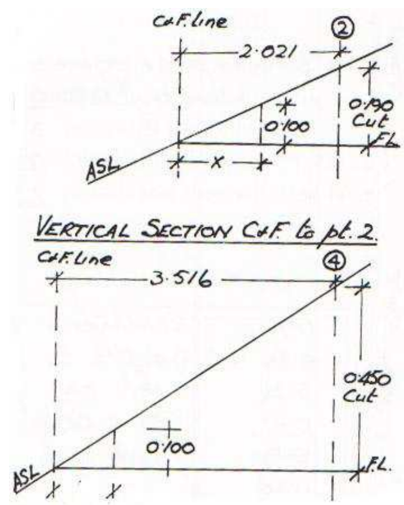
X = 1.064

250 line occurs between C & F & pt 4

By interpolation 0.100 = 0.450

Y 3.516

Y = 0.781m



Earthwork support to reduce levels etc.

	Length		depth	
a. between 250 line & pt 2	2.021		0.250	
Less		1.064		0.340
		0.957		2)0.590
				0.295
b. between pt. 2 & pt. 3	5.000		0.340	
Add conc. Proj. ½/0.485 =	0.243		1.000	
		5.243		2)1.340
				0.670
c. between pt. 3 & pt. $	5.485		1.000	
				0.600
				2)1.600
				0.800
d. between pt. 4 & 250 line	3.561		0.600	
Add conc proj ½/0.243	0.243		0.250	
		3.759		2)0.850
Less		0.781		0.425
		2.978		

BESMM3 D20.7.1.3.0

Sloping Site Foundation 7

Earthwork support max. depth ≤ 1.00m
dist between opposing faces □ 4.00m (a

0.96
0.30
5.24
0.67 (b
5.49
0.80 (c
2.98
0.43 (d

The maximum depth of trench excavation is required for maximum depth classification.

(See SMM D20.2.2 to 6.1 to 4)

Calculation of standard and maximum trench depth

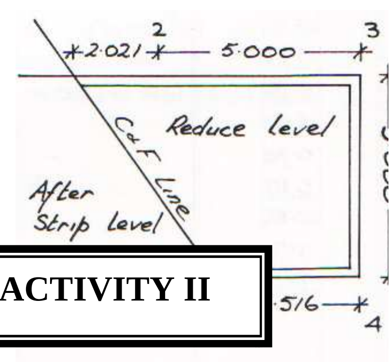
	1		2		3
ASL	99.870	FL	100.150	FL	99.300
Standard trench Level	99.300	99.300	99.300		
Standard trench Depth	0.570		0.850	0.850	
Add step	0.225				
	0.795				

Excavation of trenches at points 2, 3 & 4 commences at formation level (FL) and has a standard depth. That at points 1, 5 & 6 starts at after strip level (ASL) and has various trench depths.

The measurement of trench excavation commencing □ 0.25m below existing ground level must be measured separately (see previous note).

	4		5		6
FL	100.150	ASL	99.960	ASL	99.730
Standard trench Level	99.300	99.300		99.300	
Standard trench Depth	0.850	0.660		0.850	
Add step			0.225	2/0.225	0.450
			0.885	✧	0.880

Trench excavation etc. is measured to the highest foundation level. I.e. 99.300 all round and then adjusted later for steps.



WEEK 3: SLOPING SITE FOUNDATION TAKE-OFF ACTIVITY II

1.5 Sloping site foundation take-off activity II

Sloping Site Foundation 8

Standard trench excavated from R.L

0.850 deep trench	CL girth
C & f to pt 2	2.021
Pt. 2 – pt. 3	5.000
Pt. 3 – pt. 4	5.000

Pt 4 to c & f line 3.516

15.537

Less passings 2/2/½/0.215 0.430

CL girth 15.107

Standard trench excavated from ASL

CL girth

10.000

5.000

2/15.000

Excavate blkwk 30.000

Less passings 4/2/½/0.215 0.860

CL girth 29.140

Less CL girth trench in RL 15.107

CL girth 14.033

Depth

Pt 1 0.570

C & f line 0.850

C & f line 0.850

Pt. 5 0.660

Pt. 6 0.430

5) 3.360

Average depth 0.672

BESMM D20.2.6.2.0

Sloping Site foundation 9

15.11	Excavating trench □ 0.30m max depth		
0.70	≤ 1.00m	(trn blw RL	
0.85			
14.03			BESMM D20.8.3.1.0 The backfilling to trench is measured later, therefore the excavated soil is carted away and not backfilled in trench as in first example.
0.70	&	(trn below ASL	
0.67			
20.56			
0.70		(steps in fdn	
0.23	Disp excavated matl. off site		
			Calculation of average depth, commencing level below existing ground level

Adjustment for trenches commencing

≥ 0.25m below existing gl

CL girth

Girth of trn in rl 15.107
Less C &f line to 250 line
1.064
0.781 1.845
13.262

Av, depth below existing gl

0.250
Pt 2. Strip 0.150
Rl 0.190 0.340
Pt 3 0.150
0.850 1.000
Pt4 0.150
0.450 0.600
0.250
5)2.440
0.488
Say 0.500

BESMM3 D20.2.6.2.1

Sloping Site Foundation 10

13.26 0.70 0.85		Excavating trn □ 0.30m max depth ≤ 1.00m commencing av rl av. 0.50m below xtg gl	BESMM3 D20.2.6.2.0
		&	
		DDt Excavating trn □ 0.30m, max depth ≤ 1.00m a.b.d.	BESMM3 D20.7.1.1.0
		Earthwork support to trenches	
2/15.11 0.85		Earthwork support max. depth ≤ 1.00m dist between opposing faces ≤ 2.00m (trn blw rl	
2/14.03 0.67		(trn below ASL	
15.43 0.15		(site strip ASl	
1.85 0.20		(site strip & rl	
2/20.56 0.23		(steps	

Site strip ASL
CL trn below ASL 14.033
Add passings 2/2/½/0.700 1.400
Ext. girth 15.433

Site strip & rl
Betw C & f line & 250 line 1.064
0.781
1.845

Depth
Strip 0.150
Strip & rl 0.250
2)0.400
Av. 0.200

Sloping Site Foundation 11

Item — Disposal surface water

29.14
0.70
0.30
2/2/ 0.30
0.70
0.23

In situ conc (1:2:3/20mm agg) fdns poured on or against earth or unblinded hardcore (steps

Blockwork
Min height of blockwork
SFL 100.450
Bottom of trn. 99.300
Add conc. Fdn 0.300 99.600
0.850

29.14
0.85
19.36
0.23

Block walls, 225mm thick sandcrete blocks in stretcher bond in cement mortar(1:3)

Backfilling to trenches

Internal proj girth to trn in rl
CL girth ab 15.107
Less
passings bwk 2/2/½/0.215 0.430
projections 2/2/½/0.243 0.486 0.916
14.191

Depth
Trn depth 0.850
Less conc fdn 0.300
0.550

Int proj girth to trn from ASL
CL girth ab 14.033
Less passins as above 0.916
0.372

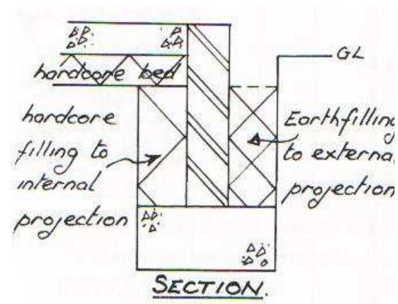
Sloping Site Foundation 12

Depth
Trn depth 0.672
Less conc. Fdn 0.300
0.372

SMM D20.8.1.0.0

The foundation concrete is measured ignoring any steps. There is no adjustment needed for filling to excavations as all soil is carted away off site. See previous note.
Height of brickwork ignoring steps

BESMM F10.1.1.1.0
There is no adjustment of filling needed. See note next concrete foundation above



The first passing adjustment adjusts the Centre Line (CL) girth of trench to the inside face of brickwork and the second passing

BESMM D20.9.2.3.0

14.19 Hd/c filling to excvn av thick (trn in rl
0.24 □ 0.25m obtained off site,
0.55 selected blocks and stones
13.12
0.24 (trn from ASL
0.37
17.98
0.24 (step
0.23

CL blockwork top step 14.070
Less passings as above 0.916
13.154

CL blockwk bottom step 5.285
Less passings
Blk wk 2/½/0.215 0.215
Proj. 2/½/0.243 0.234 0.458 4.827
CL int proj 2225mm high 17.981

Ext projection girth
Trn in rl
CL girth ab 15.107
Add passings ab 0.916
16.023

Trn from ASL
CL girth ab 14.033
Add passings ab 0.916
14.949

Same depths as for hd/c filling

Sloping site Foundations 13

16.02 Ddt
0.24 Dis. Excavated matl off site ab (trn in rl
0.55
14.95
0.24 & (trn from ASL
0.37
20.73
0.24 Add
0.23 Filling to excvns av. thickness
> 0.25m arising from excvns (steps

Steps
CL blkwk top step ab 14.070
Add passings ab 0.916
14.986

CL blkwk step ab 5.285
Add passings ab 0.458 5.743
CL ext. proj 225mm high 20.729

BESMM F30.2.1.3.0

All dimensions are measured from external corners of the building to the face of the concrete step

Dimensions
measured
to this face
225mm 300mm

DPC

29.14
0.22

Pitch polymer single layer
dpc width ≤ 225mm hoz bedded in
Cm(1:3) lapped 150mm at all passings
(measured nett)

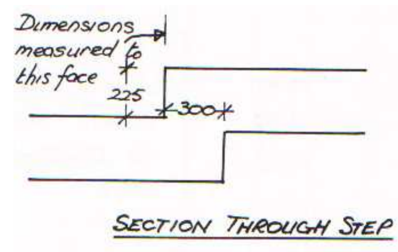
Adjustment for steps
225mm high steps

1st step bet pts 1 & 2 3.000
Bet pts 1 & 6 5.000
Bet. Pts 4 & 6 10.000
Less 3.500 6.500
14.500
Less passings 2/2/½/0.215 0.430
Blkwk CL 1st step 14.070

2nd step bet pts 1 & 6 3.000
Bet pts 5 & 6 2.500
5.500
Less passings 1/2/½/0.215 0.215
Blkwk CL 2nd step 5.285 5.285
Blockwork CL all steps 19.355

Sloping Site Foundation 14

CL trench excavation
Blockwork CL 19.355
Add conc overlap 2/2/0.300 1.200
20.555



Measurement of steps added back to sloping site foundation 8, et seq except:

Additional work caused by steps in foundation is measured in 225mm high strips

Formwork to face of steps

2/2/ 0.70

Formwork for in-situ conc. sides of fdns plain vert. hgt ≤ 250mm

Note: Earthwork support is not measurable to earth face of step as hgt of step does not exceed 250mm see BESMM3 D20.7 – Mp (a)

Hardcore bed
10.000 x 5.000
Less bwk 2/225 0.450 0.450
Internal dims 9.550 4.550

The standard hardcore bed is measured overall and then adjusted for the additional filling

9.55
4.55
0.15

Hardcore filling to make up levels av av. thickness ≤ 0.25m obtained off site

BESMM3 D20.10.1.3.0

Additional hd/c filling adjustment
Pt 1 to c & f line 5.000
Less 2.021
2.979
Less wall 0.225
2.754

Pt. 6 to C & f line 10.000
Less 3.516

			6.484	
			Less wall 0.215 6.269	
			2)9.033	
			Av = 4.517	
			Sloping site foundation 15	The total thickness of hardcore including the standard bed is averaged over the trapezium-shaped area shown above and then the standard bed is adjusted
			Thickness	
			Pt. 1. 0.280	
			C & f line 0.000	
			C & f line 0.000	
			Pt. 5 0.190	
			Pt. 6 0.420	
			5)0.890	BESMM3 20.10.1.3.0
			0.178	
			Add standard bed 0.150	
			Total av. thickness 0.328	
	4.52 4.57 0.33		Hardcore filling to make up levels av thickness > 0.25m obtained off site	BESMM3 d20.13.2.2.1
			Standard bed adjustment	BESMM3 D20.13.2.2.1
	4.52 4.57 0.15		Ddt ditto av thickness ≤ 0.25m ditto	BESMM3 J40.1.1.0.0 The dpm must be continuous with dpc
	9.57 4.57		Surface treatments compacting blinding with sand	
			&	
			Flexible sheet hoz NT4 dpm laid on blinded hardcore	BESMM3 E10.4.1.0.0
			Internal girth 9.570 4.570 2/14.140 28.280	
	28.28		Flexible sheet vertical NT4 dpm set against blockwork	
			Sloping site Foundation 16	BESMM3 E10.4.1.0.0
	9.57 4.57		In situ conc (1:2:4/20mmagg) beds thickness ≤ 150mm	
			Topsoil fill to perimeter	
			Excavate oversite dims 10.485 5.485 2/15.970	BESMM3 D20.10.1.2.3

	Ext. girth	=	31.940
	Less passings 4/2/½/0.243	=	0.972
	CL girth of prog	30.968	

30.97 Filling to make up levels av. thickness
≤ 0.25m obtained from on site spoil heaps

WEEK 4: BASEMENT MEASUREMENT PRINCIPLES

2.0 Basement measurement principles

2.1 Rules of Measurement

If a building comprises part basement and part strip foundation, measure the basement firs followed by the strip foundation, making any necessary adjustments. If a basement is of reinforced concrete construction then the engineer may require blinding layer on which to set out the reinforcement and these may not be shown on the drawing. The taker-off should check to see if they are required and if formwork is necessary to every face, before measurement commences.

The plan dimension for basement excavation is taken to the largest part of the basement construction, irrespective of the fact that working space may be required in addition to these dimensions. Any trenches at the bottom of the basement are described as excavating trenches with their commencing level stated.

Ground water

Ground water is water present in the subsoil which percolates through the sides of excavations. The ground water level, date when established and position of trial pit or bore hole must be included in the contract documentation. The level is defined as the ‘pre-contract water level’, (SMM D20.P1(A). Measurements in the bills of quantities are based on this level.

Changes in weather conditions during the contract period may cause the ground water level to rise or fall. It must therefore be re-established at the time each excavation is carried, when it is defined as the ‘post-contract water level’, see SMM D20.P(B).

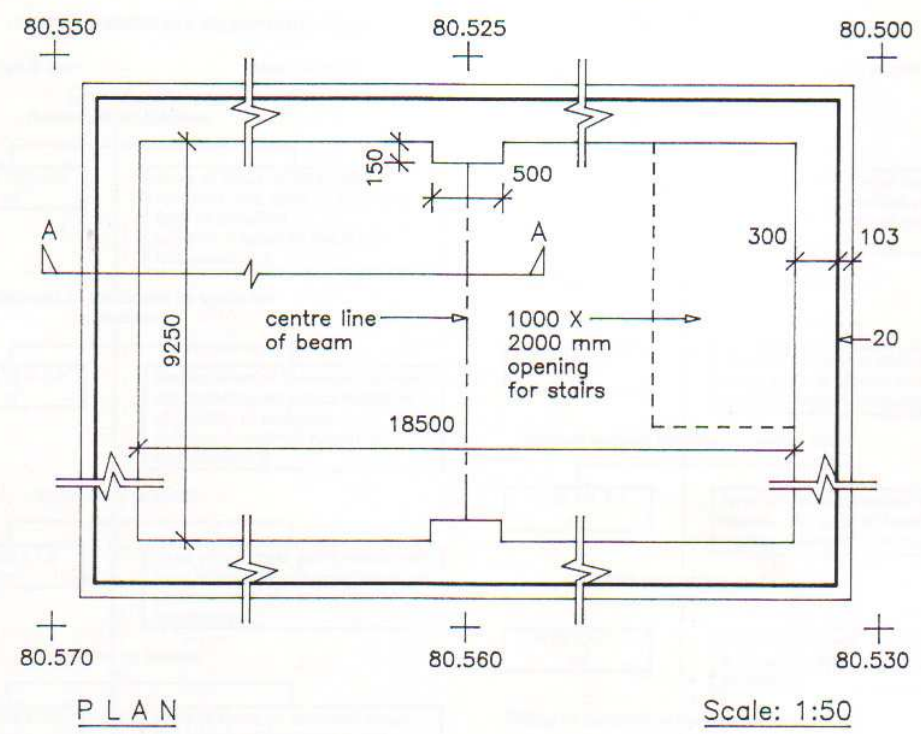
If the pre- and post-contract ground water levels differ then the quantity of excavation below ground water level will be re-measured. It is up to the contractor to decide how to dispose of the ground water and price accordingly.

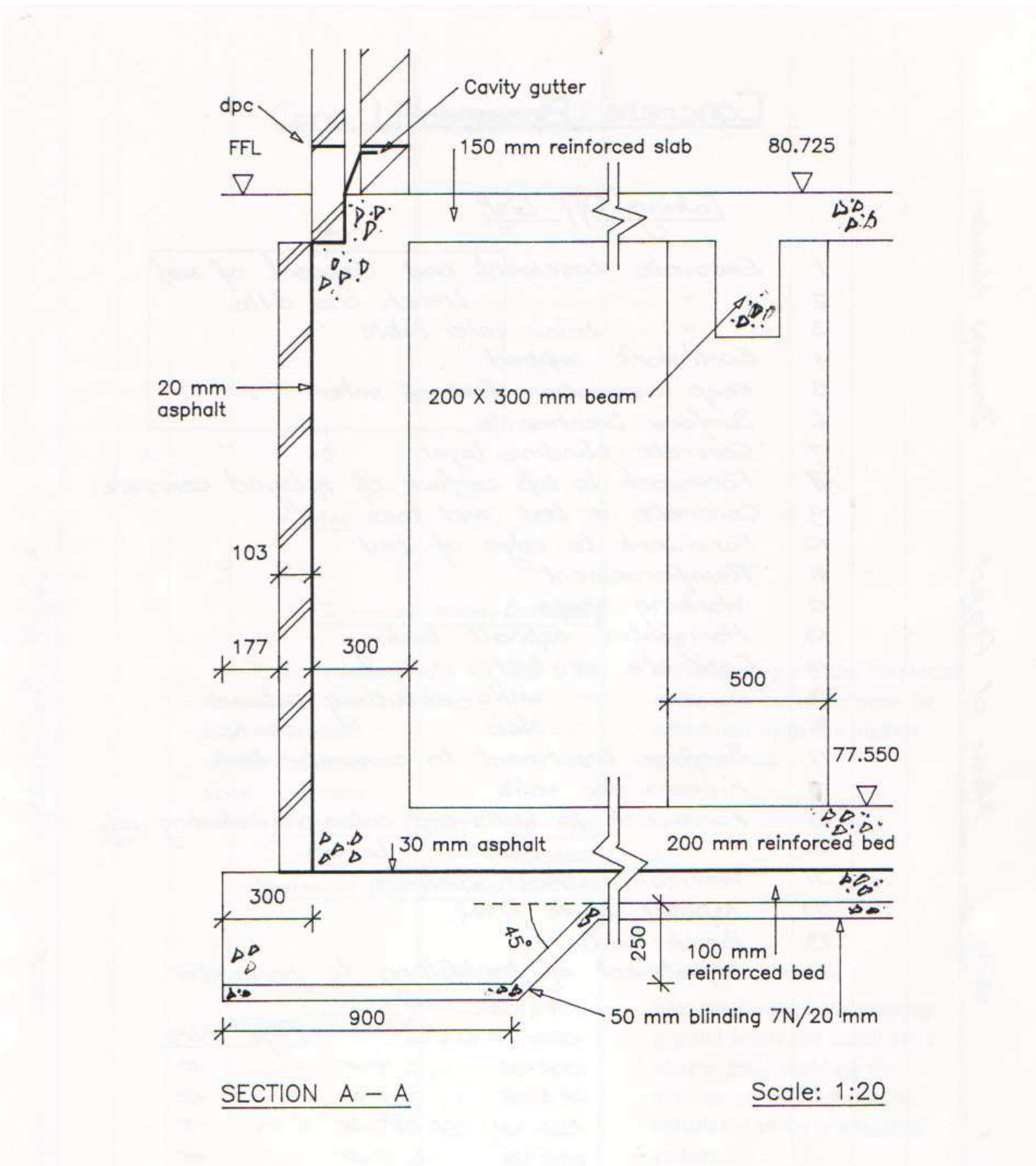
Excavating below ground water level

Only the volume of excavation occurring below the ground water level is measured and described as 'extra over any type of excavation for excavation below ground water level', see SMM D20.3.1. if the post-water level varies from that used to produce the bills of quantities then this must be re-measured, see SMM D20.3/M5.

Working space

Working space is measured where the face of the excavation is less than 600mm from the face of formwork, rendering, tanking or protective walls. It is measured in M^2 and calculated by multiplying the girth of formwork, etc. By the depth of excavation below the commencing level, see Figures 5.1 and 5.2. The item includes additional earthwork support, disposal, backfilling, etc., see SMM D20.6.M7, M8 and C2.





dpc
Cavity gutter
FFL
150 mm reinforced slab
80.725
20 mm
asphalt
200 X 300 mm beam
103
177
300
500
77.550
30 mm asphalt
200 mm reinforced bed
300
45°
250
100 mm
reinforced bed
900
50 mm blinding 7N/20 mm
SECTION A – A
Scale: 1:20

Fig 1

Earthwork support

Earthwork support is measured to the same dimensions as those used for the basement excavation, irrespective of the fact that working space may be required, see Figure above . An additional support caused by the working space is deemed to be included in the cost of the working space, see SMM D20.6.-C2.

If any part of the earthwork support extends below the ground water level then all the earthwork support must so be described. It is only measured when there is a corresponding item of extra over for excavating below the ground water level, see SMM D20-M10 and M11.

Earthwork support to basement trench excavation where the outside face coincides with the face of the basement excavation and does not exceed 0.25m high is, in practice, measured and included in the basement earthwork support. There is no need to measure earthwork support to the inside face of the basement trench if it does not exceed 0.25m high, see SMM D20.7-M9A. Earthwork support for basement trenches exceeding 0.25m high will be measured to both faces and classified according to the distance between opposing faces.

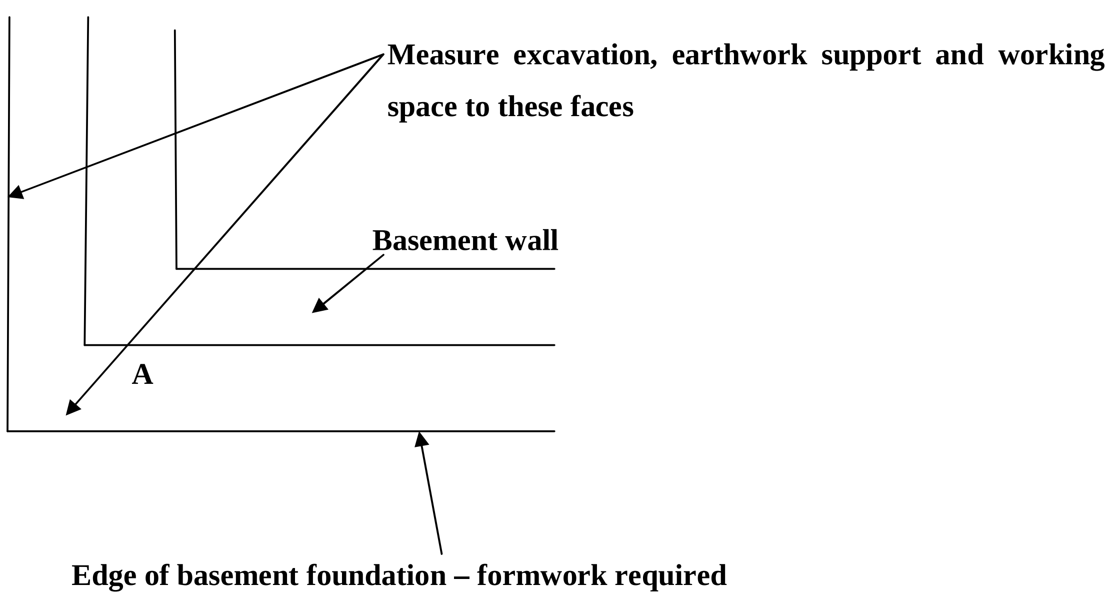


Figure 2: Plan at corner

In-situ concrete

In-situ concrete to beds, slabs, walls, etc., is measured in cubic metres and thickness range is included in the description. If a bed is thickened under a wall then the volume of this thickening is calculated and added to the volume of the bed. The thickness range of the slab is not altered even if it goes in to the next range, see SMM E10.4-D3.

Formwork for sloping in-situ concrete

In-situ concrete is initially a fluid-like material and if laid to a slope exceeding 15 degrees from the horizontal, it tends to flow downhill. Therefore, formwork to the top surface of the concrete must be measured, see SMM E20.11-M7.

Flow chart for concrete basement

SMM ref & unit — Measurement

Start

Excavate basement	
D20.2.3.4.0 M^3	Volume of basement excavation, viz. overall length of concrete bed including thickening at edges x overall width of concrete bed including thickening at edges x average depth to underside of concrete blinding layer under slab (excluding thickening)
Disposal of basement excavation	
D20.8.3.1.0 M^3	Same volume as basement excavation above.
Excavate basement trench	
D20.2.6.1.1 M^3	Volume of basement trench excavation for thickening under external walls at bottom of basement, viz centre line girth of trapezoidal shaped trench x average

	width of trench x depth of trench.
Disposal of basement trench excavation	
D20.8.3.1.0 M^3	Same volume as basement excavation above
Excavating below water table	
D20.3.1.0.0 M^3	Volume of all excavation occurring below the water table (ground water level), viz. same overall length and overall width as basement excavation x depth from water table level to underside of concrete blinding layer under slab, plus volume of basement trench excavation as above
Earthwork support	
D20.7.3.3.2 m^2	Area of vertical face of basement excavation and external face of basement trench below, viz. girth of basement excavation x average depth of basement plus depth of basement trench excavation.
Keep excavation free of surface water	
D20.8.1.0.0 Item	No quantity.
Keep excavation free of ground water	

D20.8.1.0.0 Item	No quantity
‘A’ surface treatment	
D20.13.2.3.0 m^2	Area of bottom of basement and basement trench excavation, viz. overall length x overall width as basement excavation (adj for sloping faces made later)
Concrete blinding	
E10.4.1.0.5 M^3	Volume of concrete in blinding layer, viz. same area as for surface treatments ‘A’ above x sloping width x thickness of blinding layer
Sloping concrete blinding	
E10.4.1.0.4 & 5 M^3	Volume of concrete in sloping blinding layer, viz. centre line girth of sloping blinding layer x sloping width x thickness of blinding layer
Formwork to top surface of sloping concrete blinding	
E20.11.0.3.0 M^2	Area of top surface of sloping concrete blind layer, viz. centre line girth of sloping blinding layer x sloping width
Surface treatments to earth for sloping concrete blinding	
D20.13.3.1.0	Same area as formwork to top surface of

m^2	sloping concrete blinding layer as above
Adjustment of horizontal concrete blinding for sloping blinding	
E10.4.1.0.5 m^2	Deduct volume of concrete in horizontal blinding layer, viz. centre line girth of sloping blinding layer x horizontal width x thickness of concrete blinding layer
Adjustment of surface treatments to earth for sloping concrete blinding	
D20.13.2.3.0 m^2	Deduct area of surface treatments compacting to bottoms of excavations, viz. centre line girth of sloping blinding layer x horizontal width of sloping blinding layer.
Concrete bed and thickening	
E10.4.1.0.1 M^3	Volume of concrete in bed and thickening, viz. same area as for surface treatments 'A' above x thickness of concrete bed, plus centre line of trapezoidal shaped thickening x average width of thickening x depth of thickening
Finish to concrete bed	
E41.3.0.0.0 m^2	Area of concrete bed, viz. same area as for surface treatments 'A' above.

WEEK 5: BASEMENT TAKE OFF ACTIVITY I

2.2 Basement take-off activity I

Flow Chart to Measurement of Basement

Formwork to edge of concrete bed and thickening	
E20.2.1.3.0 m^2	Girth of external edge of concrete bed, viz. same girth of basement excavation as used for earthwork support
Working space	
D20.6.1.0.0 m^2	Area of vertical face of excavation, viz. same area as used for earthwork support
Reinforcement	
To take note from engineer's schedule	Not measured in this example
Horizontal asphalt tanking	
J20.1.4.1.1 m^2	Area of horizontal asphalt tanking, viz. length to external face of brick protection walls x width to external face of brick protection walls
Concrete floor	
E10.4.2.0.1 M^3	Volume of concrete in floor, viz. length to external face of concrete walls x width to external face of concrete walls x thickness of concret floor

Concrete walls	
E10.7.2.0.1 M^3	Volume of concrete in walls and attaché columns, viz. centre line girth of wall x thickness of wall x height of wall from top of floor to soffit of suspended slab, plus width of column x depth of column x height as for walls x 2
Concrete suspended floor	
E10.5.1.0.1 M^3	Volume of concrete in suspended floor and attached beam, viz. length to internal face of half brick superstructure walls x width to internal face of half brick superstructure walls x thickness of floor slab, plus length of beam in between piers x width of beam x depth of beam
Worked finishes to concrete floor	
E41.3..0.0.0 m^2	Internal area of basement floor less wants caused by attached columns
Wall kickers	
E20.22.0.0.0 m	Length of kicker, viz. centre line girth of wall as used for concrete wall
Formwork to walls	

E20.12.0.1.1 m^2	Area of both faces of concrete walls measure over columns, viz. external girth of concrete walls x height from bottom of basement floor to top of wall, plus internal girth of concrete walls x internal height of basement
Formwork to columns	
E20.15.2.1.0 m^2	Area of faces of attached columns, viz. girth of exposed face of attached column x internal height of basement x 2
Adjustment of formwork to walls for columns	
E20.12.0.1.1 m^2	Deduct area of formwork to walls displaced by attached columns, viz. width of attached column x internal height of basement x 2
Formwork to soffit	
E20.8.1.1.2 m^2	Area of concrete soffit measured over beam, viz. internal length of basement x internal width of basement
Formwork to beams	
E20.13.1.1.2 m^2	Deduct area of formwork to soffit displaced by attached beam and columns, viz. length of attached beam as used for formwork above x width of soffit of beam, plus with of attached column x depth of attached column x 2
Formwork to edge of suspended floor	
E20.3.1.2.0 m	External girth of edge of suspended floor slab.

Vertical asphalt tanking	
J20.1.4.1.1 m^2	Area of vertical asphalt tanking, viz. external girth of concrete walls x height from bottom of basement floor to top of wall
Internal asphalt angle fillet	
J20.12.1.0.0 m	Length of angle fillet between horizontal and vertical asphalt tanking, viz. external girth of concrete walls
Horizontal asphalt tanking to recess at top of wall	
J20.1.1.1.1 m^2	Area of horizontal asphalt tanking to recess, viz. centre the girth of recess x width of recess
Vertical asphalt tanking to recess, ditto	
J20.1.1.1.1 m^2	Area of vertical asphalt tanking to recess, viz. girth of back face of recess x height of recess
Brick protection wall	
F.10.1.1.1.1 m^2	Area of brick walls, viz. centre line girth of brick walls x height of brick walls

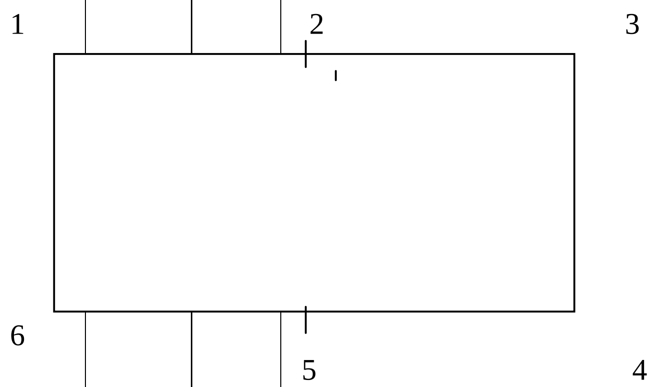
Filling to external projection of foundation	
D20.9.2.1.0 M^3	Volume of earth filling to external projection of foundation, viz. centre line girth of external projection x width of projection x depth from top of concrete sub-base to average ground level.
Adjustment of disposal of excavated material	
D20.20.8.3.1.0 M^3	Deduct same volume as last item
Adjustment for topsoil to perimeter of building	
To take note, measure with external works	Not measured in this example
Adjustment for staircase well	
To take note, measure with staircase	Not measured in this example

5.2 Concrete Basement Taking Off List

1. Excavate basement and disposal of soil
2. Excavate basement trench and ditto
3. Excavate below water table
4. Earthwork support
5. Keep excavation free of water
6. Surface treatments
7. Concrete blinding layer
8. Formwork to top surface of splayed concrete
9. Concrete in bed and toes
10. Formwork to edge of bed
11. Reinforcement
12. Working space
13. Horizontal asphalt tanking
14. Concrete in bed
15. Concrete in walls including columns
16. Concrete in slab including beams
17. Surface treatment to concrete bed
18. Kickers for walls
19. Formwork to walls and columns including adj.
20. Formwork to slab and beams including adj.
21. Vertical asphalt tanking
22. Asphalt angle fillet
23. Brick walls
24. Adjustment of backfilling to perimeter

Conc. Basement 2

ALWAYS REMEMBER TO SET UP YOUR QUERY LIST



Max. excavtn. depth

Pt.6. highest xtg G.L. 80.570
Basement level. 77.550
Slab 0.200
Asphalt 0.030
Slab 0.100
Blinding 0.050 - 0.380 77.170
3.400

Max excavn depth≤ 4.00m

On sloping site the maximum depth of excavation must be calculated from the highest ground level

Av. G.L.

Pt. 1 80.550
Pt. 2. 2/80.525 161.050
Pt. 3 80.500
Pt. 4 80.530
Pt. 5 2/80.560 161.120
Pt. 80.570
8) 644.320
Av.g.l. 80.540

The position of the existing are based on a sq grid, enabling the average ground level to be calculated using a weighted system

Conc. Basement 3

Excavtn. Depth

Av. g.l. 80.540
Formation l. 77.170

3.370

Overall basement dims.

18.500 x 9.250
Conc. Wall 0.300
Proj 0.300

The dims for excavtn etc, are taken to the extremes of the basement construction as shown on the drawing, even though additional space is required to waterproof and to build the half brick wall from the

				2/0.600 1.200 1.200 19.700 10.450 Excavtg. Basements and the like max. dp. ≤ 4.00m Dp. & Disposal excavtd mat. Off site	outside of the basement. See later measurement of working space SMM D20.2.3.4.0
		19.70 10.45 3.37		Toe fdn. Meas. As trapezium - width Bottom 0.900 Top. 0.900 45^0 splay 0.250 1.150 2) 2.050 Av. width 1.025	SMM D20.8.3.1.0

WEEK 6: BASEMENT TAKE-OFF ACTIVITY II

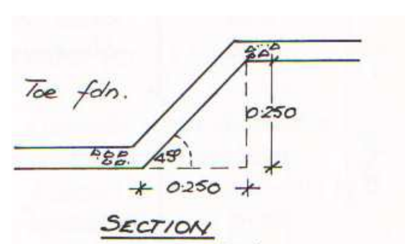
2.3 Basement take-off activity II

				Concrete Basement 4 **Toe fdn. (ctd)** **C girth** Excavtn. Dims. 19.700 10.450 2/ 30.150 60.300 - passings 4/2/0.5/1.025 4.100 56.200	
		56.20 1.03 0.25		Excavtg. Tr. Width > 0.30m max depth ≤ 0.25m comm.. av. 3.37m below xtg. g.l. &	SMM D20.2.6.1.1

				Disp. Excavtd. Excavtd. Mat. Off site.	
				Excavtg. Below water table Water level 78.500 - Excavtn. Depth 77.170 1.580	
				E.O. any type of excavtn. For excavtg. Below grd. Water level (basemt	SMM D20.8.3.1.0
		19.70 10.45 1.58		(toe	
		56.20 1.03 0.25			
					SMM D20.3.1.0.0 If the post-contract water level differs from the pre-contract water level stated in the contract documents then this measurement will be adjusted (D20-m5.)

				Concrete Basement 5	
				Earthwork suppt. Basement 3.370 Toe 0.250 3.620	
					SMM D20.7.3.3.2
		60.30 3.62		Earthwk. Suppt. Max depth ≤ 4.00m dist. b/w 0pp. Faces > 4.00m. below grd. water level	Earthwork suppt. To the ext. face of the basemt tr. Which is less than 0,25m high, but is in the same plane as the basemt excavtn, is included with the suppt to the basemt. Earthwk suppt to the sloping side of the trench is not measureable, i.e. trench < 0.25m deep and the face slopes ≤ 45^0. (see SMM D20.7-
		Item		Disposal of water	

				Disposal of surface water	M9.)
		Item		Disposal of ground water	
					SMM D20.8.1.0.0
					SMM D20.8.2.0.0 The item to dispose of grd water is reqd b/c an item of excavtg below g.w.l has been measured (D20.8.2-M12)

				Concrete Basement 6 Surf. treatments	
		19.70 10.45		Surf, treatments comp. bttms of excavtns	D20.13.13.2.3.0
				Trimming slopes adj Meas later	
				Conc blinding layer	
		19.70 10.45 0.05		Sulphate resistant in situ conc (7N/20mm) beds thi ≤ 150mm poured on or against earth	E10.4.1.0.5
				Slpg. Conc. blinding layer C girth ______ Ext gi. a. b. 60.300 - Passings 2/4/2/0.5/0.900 - 7.200 53.100 - slope passing 4/2/0.5/0.250 1.000 52.100 $\sqrt{(0.250^2 + 0.250^2)}$ = 0.354	 As the slope is 45°, the width on plan is the same dimension as the depth, i.e. 0.25 m.

				Concrete Basement 7	
				Sloping conc. blinging layer (ctd)	
		52.10 0.35 0.05		In situ conc (7N/20mm) beds thi ≤ 150mm sloping > 15^0 poured on or against earth	E10.4.1.0.4 & 5
		52.10 0.35		Fmwk to in situ conc top fmwk sloping > 15^0	E20.11.0.3.0
				&	Where conc is poured to slope > 15^0fmwk measured D20.13.3.10
				Surf treatements trimming sloping surf of exacvtn	Trimming to slopes is measured where the slop > 15 deg from horiz (D20.13-M
		52.10 0.25 0.05		Ddt insitu conc (7N/20mm) beds horiz a.b. ≤ 150mm thickness	E10.4.1.0.5
		52.10 0.25		Ddt surf treatements bttms of excavtns a.b.	D20.13.2.3.0

				Concrete Basement 8	
				Conc .bed	
		19.70 10.45 0.10		In situ concrete (20N/20mm) beds thickness ≤ 150mm reinfcd (toe fdn	E10.4.1.0.1 The conc thickness of

		56.20 1.03 0.25			the bed under the ext wall is added to the conc beds and described as beds. (E20-D3C) The range stated is that of the bed and not where the thickenssing occurs E20-M2
				Finish to conc.	
		19.70 10.45		Trowelling surf of conc	E41.3.0.0.0
				Fmwk to ext face of bed & fdn	
		60.30		Fmwk for in situ conc sides of grd beams and edges of beds, plain vert hgt. 250 – 500mm	E20.2.1.3.0
				Concrete Basement 9	
				Working space	
		60.30 3.62		**Working space allowance to excavtns red. Levels, basement and the like**	D20.6.1.0.0 As fmwk has been measured to the ext face of conc bed and toe fdn and excavtn has been measured the exact size of the basement, working space will be required. It is measured in m^2 viz. the girth of fmwk by the total depth of

				To take **All reinforcement from Engineers schedules**	excavtn. This item includes all backfilling etc. (D20.6-M7 & C2)
				Horriz Asphalt **18.500 x 9.250** **Conc wall 0.300** **Vert asp. 0.020** **Bk wall 0.103** **2/ 0.423 = 0.846 0.846** **19.346 10.096**	If information is not available then a 'To Take Note' is written into the dimensions to ensure that items are not forgotten

				Concrete Basement 10	
				Horriz Asp (ctd)	
		19.35 10.10		3ct mastic asp tanking & damp proofing to B.S. 1097 Col B, width > 300mm, horiz 30mm thick on conc .,fin. With a wood float, sub. covered	J20.1.4.1.1
				Conc Bed Int. dims 18.500 x 9.250	In the previous examples the taking-off has more or less followed the method of construction, i.e. formwork for walls followed by the concrete. Sometimes, as is done here, it is more convenient to measure one trade, i.e. measure all concrete work followed by all

				Walls 2/0.300 0.600 x 0.600 19.100 9.850 In situ concrete (20N/20mm) vibrated Conc beds thickness 150 – 450mm rfcd.	fmwk etc. This allows the taker-off to use headings, ditto etc., thus saving her time in repeating descriptions and the worker-up's time also
		19.10 9.85 0.20			

WEEK 7: BASEMENT TAKE-OFF ACTIVITY III

2.4 Basement take-off activity III

				Concrete Basement 11 In situ conc (20N/s0mm) (ctd) Wall Grd. f.l. 80.725 - Slab 0.150 80.575 - basement s.l. 77.550 Wall hgt. 3.025 C.L. girth 18.500 + 9.250 2/ 27.750 Int girth 55.500 - Passings 4/2/□2/0.300 1.200 C.L. 56.700 Conc walls thickness 150 – 450 rfcd	Demarcation lines of concrete measurement more or less follow the actual construction sequence on site, e.g. bed cast to ext face of walls, walls cast including attached columns etc.
		56.70 0.30 3.03			
	2	0.50 0.15 3.03		(attached cols.)	
				Suspd. Slab Bed 19.100 x 9.850 - walls 2/0.103 0.206 0.206 18.894 9.644 Attached Beam 9.250 - cols 2/0.150 0.300 8.950	E10.7.2.0.1 The concrete for the attached column is included with the concrete for the wall (E10-D6)

				Conc. Basement 12	
				In situ conc (20N/20mm) (ctd)	
		18.89 9.64 0.15		Conc slab thickness ≤ 150mm rfcd	E10.5.1.0.1
		8.95 0.20 0.30			Concrete for the attached beam is included with the concrete for the slab. (E10-D4(a).)
				End of in situ con (20N/20mm)	
				Surface treatment to slab	
	2	18.50 9.25 0.50 0.15		Trowelling surface of conc	Note to cancel the heading at beginning of concrete measurement
				Ddt ditto (attached cols	E41.3.0.0.0
				Formwork	E41.3.0.0.0
				NB: All concrete surfaces are covered by finishings. Therefore only a basic finish to formwork is reqd.	
					Note to show that no special or formed finish to fmwk reqd.
				Conc. Basement 13	
				Fmwk. (ctd) **Walls.**	
		56.70		Fmwk for suspd wall kickers	

				External wall face C.L. wall 56.700 4/2/□2/0.300 1.200 Ext. girth 57.900 Height Conc wall 3.025 + conc bed 0.200 Ext. height 3.225 Internal wall face C.L. wall 56.700 - passings 4/2/0.5/0.300 1.200 Int. girth 55.500	E20.22.0.0.0 Fmwk for wall kickers is measured along the centre line of the wall and includes both sides. (E10-M15) The fmwk to the edge of the 200mm thick bed is in the same plane as the ext. face of the wall and is measured as fmwk to walls
		57.90 3.23 55.50 3.03		Fmwk for in situ conc walls, Vert. hgt. > 3.00m above floor Level (ext. (face (int. face	
				Girth of col. Face 0.500 Retunrns 2/0.150 0.300 0.800	E20.12.0.1.1 Where the ht of the wall exceeds 3.00m above floor level, all of the area of formwork to the wall is described as such (E10-D….) There is no deduction of formwork for the wall thicker (E10-M10)

				Concrete Basement 14 **Fmwk. (ctd)** **Columns.**	
	2 2	0.80 3.03 0.50 3.03		Fmwk for in situ conc cols. attached to walls reg. shape rectangular, hgt. > 3.00m above flr. l. (In Nr. 2) Adj. of fmwk to walls	E20.15.2.1.0 Additional information can be given if deemed necessary. The height is given as for walls.

				<u>Ddt</u> fmwk for walls a.b. E20.12.0.1.1	It is a requirement of SMM that the number of columns is stated.
		18.50 9.25			
				<u>Soffit</u>	
		8.95 0.80		Fmwk. for in situ conc. soffits of slabs thickness ≤ 200mm, horriz. hgt. to soff. ≤ 4.50m	E20.8..1.1.2
				<u>Girth of Beam</u> Soff 0.200 Sides 2/0.300 <u>0.600</u> <u>0.800</u>	
				Ditto beams attached to slabs reg. shape rect. Hgt. to soff. ≥ 4.50m (<u>In Nr. 1)</u>	E20.13.1.1.2

				<u>Concrete Basement 15</u> **<u>Fmwk. (ctd)</u>** <u>Beams (ctd)</u>	
	2	8.95 0.20 0.50 0.15		<u>Ddt</u> fmwk. to soff. of slabs a.b. (beam (cols	E20.8.1.1.2 No deductions of formwork is made where the beam meets the face of the pier (E20.16-M11) The deduction for the columns is a want, i.e. occurring at the boundary and therefore must be deducted. (SMM General Rules 3.4)
				<u>Girth of slab edge</u> 18.894 <u>9.644</u> 2/ <u>28.538</u> <u>57.076</u>	
		57.08		Fmwk for in situ conc edges of suspd. slabs. plain ver. hgt. ≤ 250mm	E20.3.1.2.0

				<u>To Take</u> 1. Adj for staircase well 2. Soil to finished grd level to measure with external works 3. Brickwork, dpc. etc above recess & top of slab	The previous to take note for reinforcement will cover all of the reinforcement required. These to take notes are out of order, but have been noted here due to lack of room on C.B. 17

				<u>Concrete Basement 16</u>	
				<u>Asphalt</u>	
		57.90 3.23		2ct. mastic asp. Ttanking a.b. width > 300mm ver. 20mm thick on conc. Fin. with a wood float, sub. covered	J20.1.4.1.1 Asphalt is measure the area in contact with the base (J20.1-M3)
				<u>Angle fillet</u>	
		57.90		Mastic asp. a.b. int. < fillet triangular 50 x 50mm	
				<u>Recess at top of wall</u>	
				Ext. gi. 57.900 - Passings 4/2/0.5/0.103 <u>0.412</u> <u>57.488</u>	J20.12.1.0.0
		57.49 0.10		2ct. mastic asp. tanking a.b. width ≤ 150mm horiz. 20mm thick on conc sub covered	
				C.L. gi. 57.488 - passings 4/2/0.5/0.103 <u>0.412</u> <u>57.076</u>	J20.1.1.1.1

		57.08 0.15		Ditto width ≤ 150mm vert. 20mm thick ditto	J20.1.1.1.1

				<u>Concrete Basement 17</u>	
				<u>C.L. girth of brick wall</u> Ext. girth of conc. wall 57.900 + passing asp 2/4/2/0.5/0.020 0.160 + bwk 4/2/0.5/0.103 <u>0.412</u> <u>58.472</u>	
		58.47 3.23		Bk. Walls □2 B thick in Class B Engineering bks. In stretcher bond in sulphate resistant c.m. (1:3). Vert. bdg. against other work	F10.1.1.1.1 No working space is needed for the brickwork as working space has been measured for the full depth of excavation for formwork to the toe foundation
				<u>Back filling to perimeter</u> Girth of earthwk suppt. 60.300 - Passing 4/2/0.5/0.177 <u>0.708</u> C.L. girth <u>59.592</u> <u>Depth</u> Av. exc. depth 3.370 - Blinding layer 0.050 - Conc bed <u>0.100</u> <u>0.150</u> <u>3.220</u>	
		59.59 0.18 3.22		Filling to excavtns. av. thick > 0.25 arising from excavtn. & Ddt disp. of excavtd. mat. off site NB: To take rates for topsoil and bwk added back to P15	D20.9.2.1.0

					D20.8.3.1.0

WEEK 8: REINFORCED CONCRETE FLAT ROOF

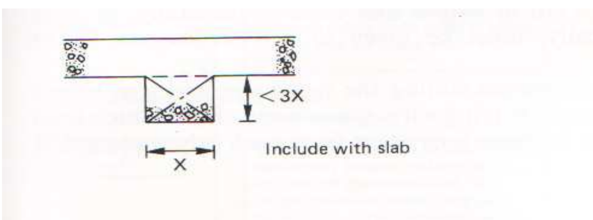
3.0 Reinforced concrete flat roof

3.1 Rules of Measurement

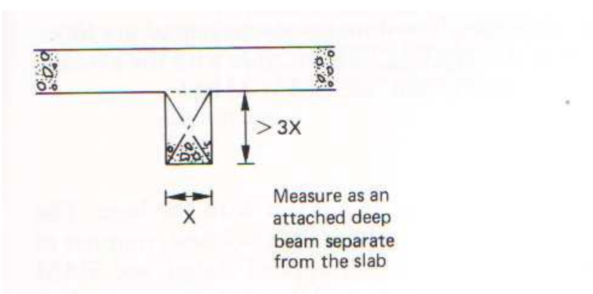
The notes made in previous weeks where applicable also apply to this example, with the following additional comments.

In-situ concrete

Concrete in slabs is measured in cubic meters with the thickness range stated in the description. If the concrete is reinforced, this must be state, see SMM E10.5.1-3.0.1. Any beam or beam casings attached to the soffit which would normally be poured at the same time as the slab are measured in cubic meters and are included with the slap, see SMM E10.5-D4, although the thickness range of the slap over the beam should not be adjusted. Attached beams or beams casings are only measured separately if they are defined as deep beams, see SMM E10.9-D9 and Figures 12.1 and 12.2.



Section



Section

Formwork

Formwork is measured to the concrete surfaces of finished structure which require temporary support during casting, see SMM E220-M1. Formwork to the soffit slaps is measured in square metres and the slab thickness and height to soffit are given in the description, see SMM E20.8 .1.1.1, etc .Formwork to regular shaped (i.e. a rectangular or square in cross-section) beams is measured in square metres and the number of beams and height to soffit are given in the description, see SMM E20.13.1.1.1. Form to edges of suspended slabs can include formwork to the side of upstands if they are in the same plane and is measured in linear metres if less than 1 m high. Formwork also provides the finish to the concrete surface and, therefore, if any finish other than the basic finish is required, it is measured 'extra over the basic finish', see SMM E20.20, etc.

Reinforcement

The design engineer usually produces a schedule for all reinforcement which will give the bar type, diameter, number of bars, shape of bars, dimension of bars and length of bar needed to form the required shape, i.e. to make allowance for hooks, bends, etc. This schedule can be used to weight up the bars for direct entry in the dimensions or abstracted for billing in tonnes in the bills of quantities. However, in the absence of such a schedule bar reinforcement is measured in linear metres, with its diameter and shape stated and weighted up.

In the following example, the number and lengths of bar reinforcement have been calculated from the drawing by first deducting the amount of concrete cover (for weather or fire protection) from both sides and then adding an allowance of nine times the diameter of the bar for each hook. Often, to increase the bond between steel concrete ,twisted or formed bars exceeding 12m in length and fixed horizontally, or bars exceeding 6m long which are fixed vertically , must be given in3 m stages, see SMM E30.1.1.1-4.

Fabric reinforcement is measured in square metres stating the mesh size and weight per square metre. All reinforcement is deemed to include tying wire, spaces and chairs which hold the reinforcement the required distance above formwork or apart from each other, see SMM E30.1 or 4 and C1 or C2 respectively.

Screed

In the following worked example the insulations and falls to the roof are provided by the screed which directs the rainwater to outlets. Consequently, the falls in the surface of the screed are in in two directions and are described as to falls and cross falls. The dimensions measured are those in contact with the base and given in square metres if exceeding 300mm wide with the average thickness and number of coats being given in the description, see SMM M10.5.

Asphalt roofing

Asphalt roofing is measured in square metres, being the area in contact with the base. The description will include the width in stages, see SMM J20.3.1-4 with the thickness, number of coats, any surface treatment and the nature of the base to which applied stated, see SMM J20-S1-S4.Coverings to kerbs, etc., are measured in linear metres and the girth is measured on face, see SMM J20.11-M4, and is deemed to include edges, arises (angles), internal angle fillets, etc., see SMM J20.11-C5.

Flow chart for reinforced concrete flat roof

SMM ref & unit   Measurement

Start

Concrete roof slab	
E.10.5.1.0.1 m^2	Volume of concrete in roof slap, viz. Length of slap x width of slab x thickness of slab
Formwork to soffit	
E.20.8.1.1.2 m^2	Area of formwork to soffit of slab, viz. Area measured to inside face of brickwalls (measured over beams – adjusted later)
Formwork to edge of slab	
E.20.83.1.3.0 m	Length of formwork to edge of slab, viz. External girth of concrete slab
Forming fair finish on external surfaces of concrete	
E.20.20.5.0.0 M^2	Area of edge of slab and upstand, viz. External girth of concrete slab x height of slab and upstand

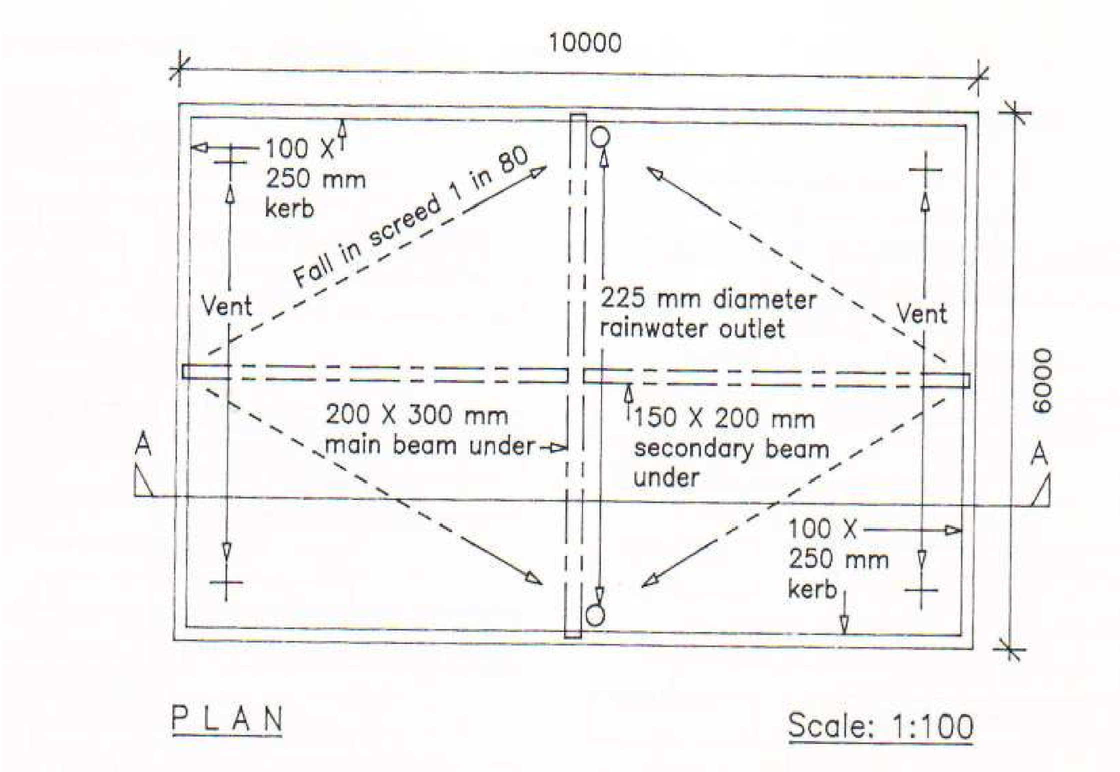
Fabric reinforcement to slab	
E30.4.1.0.0 M^2	Area of fabric reinforcement in the slab, viz. External girth of concrete slab x width of slab less concrete cover both ends
Attached concrete beams	
E10.5.1.0.1 M^3	Volume of concrete in main and secondary beam (added to volume of concrete slab), viz. Length of main beam (largest beam) measured between centre line of brickwalls x width of beam x depth of beam below slab, plus length of secondary beam (smallest beam) measured between centre line of brickwall to face of the main beam x width of beam x depth of beam below slab x 2 for both beams
Formwork to beams	
E20.13.1.1.2 m^2	Area of faces of attached beams, viz. Length of main beams measured between inside face of brickwalls x girth of exposed face of main beam, plus length of secondary beams measured between inside the face of brickwall and face of main beam x girth of exposed face of secondary beams x 2nr for both beams
Adjustment of formwork to soffit for beams	
E20.8.1.1.2 m^2	Deduct area of formwork to soffit displaced by attached beams, viz.

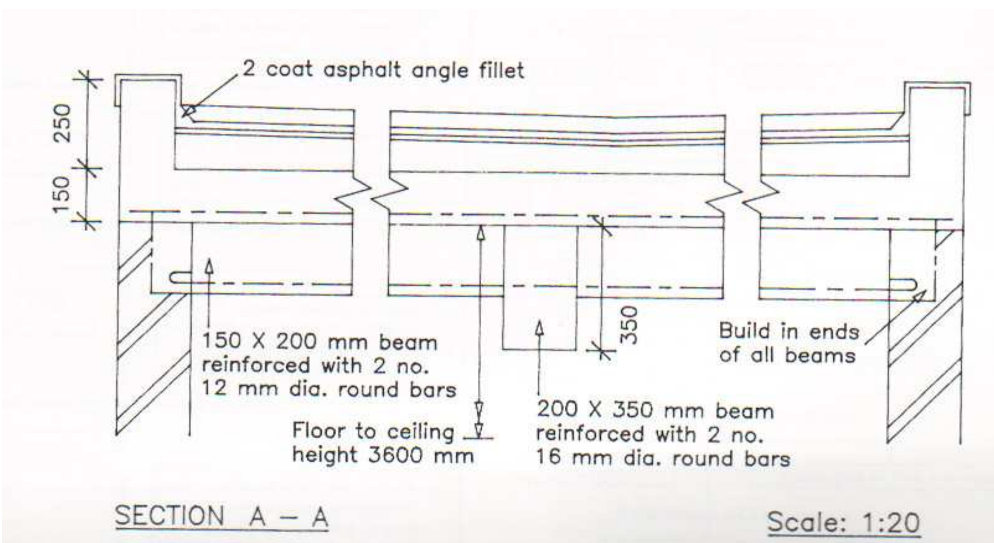
	Length of main beams as used for formwork above x width of soffit of main beam, plus length of secondary beams as used for formwork above x width of soffit of secondary beams x 2 for both beams
Reinforcement in main beams	
E30.1.1.1.0 t	Weight of reinforcing rods in main beam, viz. Length of rod (calculated from length of concrete of main beam less concrete cover at both ends, plus allowance for hooks at both ends) x number of rods in main beam x weight of rods in Kg/m
Ditto in secondary beams	
E30.1.1.1.0 t	Procedure as above
Concrete upstand	
E10.14.0.0.0 M^3	Volume of concrete in upstand, viz. Centre line girth of upstand x width of upstand x height of upstand
Formwork to upstand	
E20.4.1.2.0 M	Length of formwork to upstand, viz. Calculate girth of inside face of upstand
Asphalt roofing	
J21.3.4.1.0 M^2	Area of asphalt roofing measured in contact with base, viz. Area measured between internal face of concrete upstand

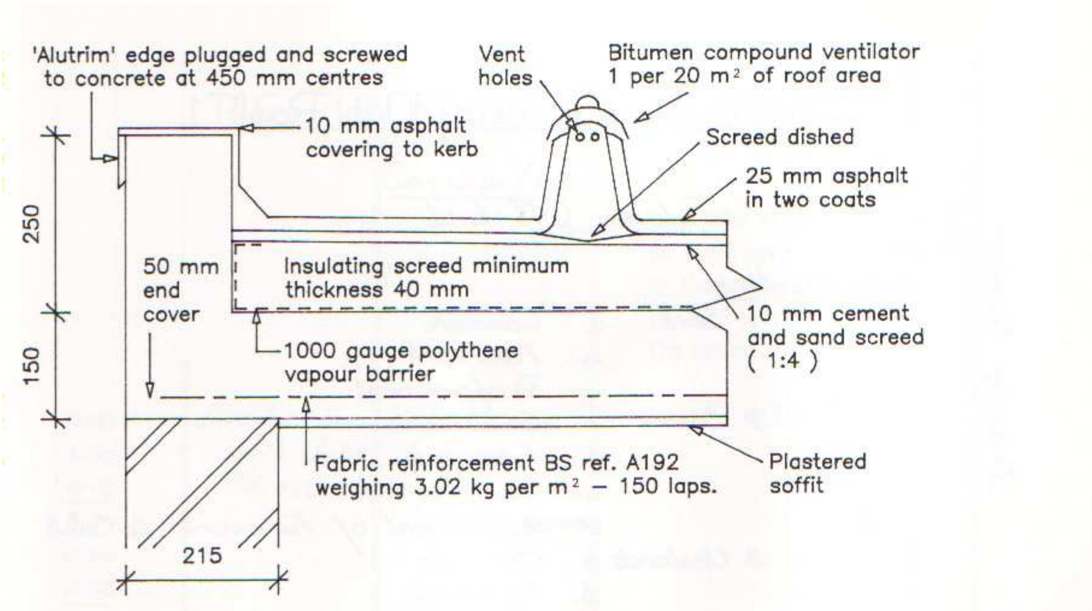
Polythene vapour barrier	
P10.1.1.1.0 m^2	Area of vapour barrier, viz. Same area as above
Insulating screed	
M10.6..1.1.0 m^2	Area of insulating screed measured in contact with base, viz. Same as for asphalt roofing above
Cement and sand topping to screed	
M10.6.1.1.0 M^2	Area of topping measured in contact with base, viz. Same as area for asphalt roofing above
Vertical polythene vapour barrier to upstand	
P10.1.1.2.0 m^2	Area of vapour barrier to face of concrete upstand, viz. Girth of inside face of upstand x height of screed and

WEEK 9:	REINFORCED CONCRETE FLAT ROOF MEASUREMENT ACTIVITY I

3.2 Reinforced concrete flat roof measurement activity I







SPECIFICATION

1. Concrete to be 25N/20mm
2. External exposed concrete to have a fair face
3. Mastic Asphalt to BS 986 limestone aggregate in two coats, laid on sheathing felt to BS 747 4A (i), finished with white spar chippings in bitumen compound.
4. Polythene vapour barrier to have solvent welded joints.
5. The ‘Alutrim’ edging to have sleeved joints.

CONCRETE FLAT ROOF

Taking-off List

Construction

Slab

- Concrete
- Formwork
- Reinforcement

Beams

- Concrete
- Formwork
- Reinforcement
- Adjustment of Formwork to slab

Upstand

- Concrete
- Formwork

Coverings

Asphalt to roof

Screeds

Asphalt covering to kerbs

Edging

Vents

Rainwater Goods

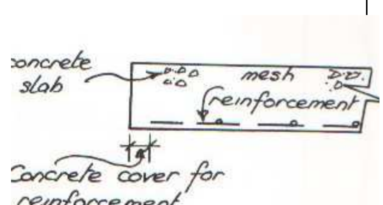
Pipe including fittings

Builder's work

				R.C. Flat Roof 1	
				Construction **Slab**	N.B. The external walls will be built up to the underside of the concrete slab with pockets left for ends of the beams.
		10.00 6.00 0.15		In situ conc. (25N/20mm agg.) slabs Thickness ≤ 150mm rfcd	E10.5.1.0.1
		5.79 0.20 0.35		(main bm	
		9.59 0.15 0.20		(sec. beam	
				Formwork 10.000 x 6.000 - walls 2/0.215 0.430 0.430 9.570 5.570	
				Fmwk for in situ conc soff of slabs, Slab thickness≤ 200mm horiz hgt to soff Exc 3.00m & n.e. 4.50m	
		9.57 5.57			The formwork is measured to the inside face of the brick external walls, over the beams, which are adjusted later E20.8.1.1.2

				R.C. Flat Roof 2	
				Construction (ctd) **Slab (ctd)** **Fmwk (ctd)**	As the edge of concrete slab and the outside face of upstand are in the same plane, it is sensible to measure the formwork as one item
				Edge Girth 10.000 6.000 2/16.000 32.000	
				Height slab 0.150 Upstand 0.250	

				0.400	
		32.00		Fmwk for in situ conc edges of suspd Slabs plain vert hgt 250 – 500	E20.3.1.3.0
				&	
				E.O. basic fin for a lining to fmwk to Produce a fair finish to edges of suspd Slabs & upstand X 0.40 = M^2	E20.20.5.0.0
					400mm is the combined height of the edge of concrete slab
				To Take Fmwk to int face of Uostand. Meas on R/8	

				R.C. Flat Roof 3	
				Construction (ctd) Slab (ctd) Rfmt.	
				Over all dims. 10.000 x 6.000 - Conc cover 2/0.050 0.100 0.100 9.900 5.900	
		9.90 5.90		Fabric refmt for in situ conc to BS 4483 ref. A192 wgh. 3.02Kg/m^2 with 150mm laps at all passings.	Reinforcement must not be exposed to the elements etc. other wise it will rust and spoil the concrete. Therefore an adjustment is made for the concrete cover when measuring reinforcement E30.4.1.0.0
				Beams lengths	
				Main beam 6.000 - b.i. ends 2/0.5/0.215 0.215	

5.785

Sec. beam 10.000
1. b.i. ends a.b. 0.215
2. main beam 0.200 0.415
9.585

As the concrete to beams is poured at the same time as the concrete to slab, the volumes of concrete are added together and described as concrete in slabs (E10.5.-D4). The thickness range is based on the slab thickness only. (F10.5 M2).

R.C. Flat Roof 4

Construction (ctd)
Slab (ctd)
Fmwk

Main beams girth

soffit 0.200
+ sides 2/0.350 0.700
0.900

Sec beams total length
Fmwk dim 9.570
3. main beam 0.200
9.370

girth

soffit 0.150
+ sides 2/0.200 0.400
0.550

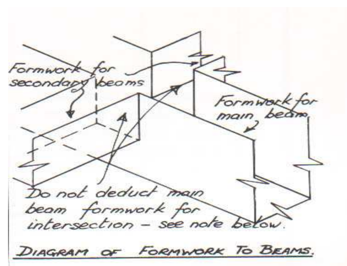


DIAGRAM OF FORMWORK TO BEAMS.

		5.57 0.90		Fmwk for in situ conc beams (main bm attached to slabs reg. shape, rect. hgt to soff exceeding 3.00m n.e. 4.50m (In Nr 4)
		9.37 0.55		(sec bm

R.C. Flat Roof 5

Construction (ctd)

				Beam (ctd) Fmwk adj to slab	E20.13.1.1.2 Where the secondary beam meet the main beam no deduction of formwork is made, but this junction constitutes the start of a new member. (E20.13.1.1.2 – M11)
		5.57 0.20		**Ddt** fmwk to soff of slab a.b. (Main beam	
		9.37 0.15			
				Reinforcement Length of bar rfcmt in beams Main beam 5.785 Less conc cover 2/0.050 0.100 5.685 Add hooks 2/9/0.016 0.288 5.973 Sec beams 10.000 Less bwk 2/0.5/0.215 0.215 conc cover a.b. 0.100 0.315 9.685 Add hooks 2/9/0.012 0.216 9.901	
					E20.8.1.1.2
				R.C. Flat Roof 6 Construction (ctd) Beams (ctd) Rfmt	
	2	5.97		Reinforcement for in situ conc, mild steel bars (main bar to BS 4449, 16mm dia straight. Wgt up x 1.579 = ________ Kg	Usually the weight of reinforcement is obtained from bending schedules produced by the structural engineer and reinforcement is not often measured. Allowances must be made for hooks, bends, hobs, etc. when measuring reinforcement. The allowance for a
	2	9.90		Sec beam Ditto 12mm dia str wgt up X 0.888 kg/m	

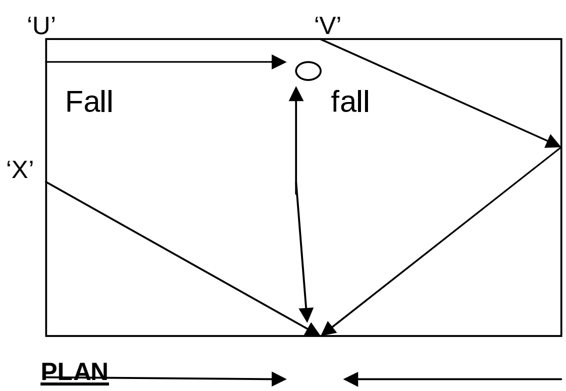
				= ______________ Kg	semicircular hook on round bars is nine times the diameter of the bar (BS 4466)
				Upstands Girth 10.000 6.000 2/16.000 32.000 Less passings Ext girth 4/2/0.5/0.150 0.600 31.400	E30.1.1.1.0
		31.40 0.15 0.25		In situ conc (25N/20mm agg) upstand	All bar reinforcement is given by weight in the bills of quantities and therefore the measurement must be weighted up on dimensions or abstract.
					E30.1.1.1.0

					E10.14.0.0.0

				R.C. Flat Roof 7 Construction (ctd) Upstand (ctd) Fmwk C.L. girth 31.400 - passings 4/2/0.5/0.150 0.600 Int. girth 30.800	
		30.80		Fmwk for in situ conc. Sides of Upstands plain vert hgt ≤ 250mm	
				NB: Fmwk to ext face included with fmwk to edge of slab Coverings 10.000 6.000 - upstand 2/0.150 0.300 0.300 9.700 5.700	F20.4.1.2.0
		9.70 5.70		Mastic asp rfg 25mm thick to BS 988 limestone agg in 2 cts laid bkg jt with isol membrane of sheathing felt to BS 7474 A(i) lapped 50mm at all passings laid loose on c&s screed, finished with white spar chippings bedded in bit compound, width > 300mm to falls & cross falls	Asphalt is measure the area in contact with the base (J21.3.4.1.0)

WEEK 10: REINFORCED CONCRETE FLAT ROOF MEASUREMENT ACTIVITY II

3.3 Reinforced concrete flat roof measurement activity II

				R.C. Flat Roof 8	
				Coverings (ctd)	
		9.70 5.70		1000 g Polythene sheet vapour barrier with welded jts plain areas horiz	P10.1.1.1.0
				Screeds Av. thickness Min. next outlet 'v' = 0.040 Max at pt 'x' 0.040 + fall = max dim (diag) / 80 = 0.073 Less Max thickness 0.113 Pts u.w & x 3/0.113 0.339 4) 0.339 Average thickness 0.095	The expanded lightweight aggregate screed provides the fall of the roof, and it is necessary to work out the average thickness of the screed based on providing a fall of 1 in 80.
					As the roof is symmetrical the average thickness of the screed can be worked out over one quarter of roof, and applied to the whole screed
				R. C. FLAT ROOF 9 Coverings (ctd) Screed (Ctd)	
		9.70		Cmt & lightweight agg. (1:5) as spec insulating	

		5.70		screed to roofs, to falls & crossfalls & to slopes ≤ 15^0 from horiz ave. 95mm thick in one ct. laid on poly covered conc. External	M10.6.1.1.0
				&	All work is deemed to be internal unless otherwise described (M10-D1)
				C & s. (1:4) screed, rfs. to falls & crossfalls & to slopes ≤ 15^0 from horz. 10mm thick in one ct laid on insulating screed External	M10.6.1.1.0
				Vapour barrier to edge	
				Girth 9.700	
				5.700	
				2/15.400	
				Int girth of upstand 30.800	
				Height	
				Screed max 0.113	
				C&s topping 0.010	
				Top 0.075	
				0.198	

				R. C. FLAT ROOF 10 Coverings (ctd) Vapour barrier(ctd)	
		30.80 0.20		Poly. Vapour barrier a.b., plain areas . vert.	SMM P10.1.1.2.0
				Kerbs Short sides	
				Girths	
				Conc. Upsatnds 0.250	The covering to kerbs along the short side of roof will have a regular girth for its whole length, but the covering to the two long sides will have an average girth because they follow the fall of the roof. The girth of coverings is the girth on face.(See
				Less	
				screed max 0.113	
				tapping 0.010	
				asp. rfg. 0.025 0.148	
				0.102	
				Add L fillet 2 x 0.050 0.100	
				Fillet face = $\sqrt{0.050^2 \text{ x } 2.}$ 0.071	
				0.273	
				Passings 2/2/ ½/0.010 = 0.020	
				Girt on face = 0.293	
				Long sides	

				Min. girth as above =0.293 Max girth : min. 0.293 +fall 0.073 0.366 2)0.659 Av girth on face = 0.330	SMM J21-M4

Timesing	Dimensions	Squaring	Description	Reference
			R. C. FLAT ROOF 11	
			Coverings (ctd)	
			Kerbs (ctd)	
			Short sides	
			Length 6.000	
			- to centre of kerb 2/0.5/0.150 0.150	
			5.850	
2/	5.85		Mastic asp a.b. cvgs to kerbs girth 225 – 300mm, 10mm thick in 2 cts on conc trowelled smooth inc < fillet at base, arris & wkg into alum trim	J21.11.3.0.0
			Long sides	
			Length 10.000	
			- to centre of kerb a.b. 0.150	
			9.850	
2/	9.85		Ditto girth > 300mm ave. 330mm girth ditto External	J21.11.4.0.0
			Edge trim	
			Ext. girth of kerb a.b. 32.000	
			+ passings 2/4/2/0.5/0.010 = 0.080	
			32.080	
			R. C. FLAT ROOF 12	
			Coverings (ctd)	
			Edge trim (ctd)	
	32.08		Aluminium preformed trim Alutrim type Z to suit asphalt p & s with alum screws to conc at 450mm centres sleeved jts.	
			Roof vents	
			Bitumen compound rf vents fxd in asp rfg inc dishing	

		4		screed & Asph collar around pipes,standards & like members 75mm dia rf vent 125mm high NB: one rf vent is taken in each quarter of rf. This exceeds requirement of one for each 20m^2	J21.22.0.0.0 J21.23.0.0.0
				R. C. FLAT ROOF 14 Rainwater Goods	
		2		Rainwater pipework ancillaries outlet 225mm dia with luting outlet flange for asp. & screwed grtg to BS 416 c.i. with outlet for 75mm dia pipe bedding in pre-formed hole in conc rf in c.m (1:3) & caulked lead jt to pipe & Fmwk for in situ conc holes girth 500mm – 1.00m Depth ≤ 250mm conical circular shape 250mm dia at top & 100mm dia at base	J21.18.1.0.0.0 R10.6.2.1.1

					E20.27.2.1.3
					Fabric reinforcement is deemed to include all cutting (E30-C2)
					Screeds are deemed to include working into outlets, etc. (M10 – C1(b)
					Asphalt is deemed to include working into outlet pipes etc (J21 – C1(c)

				R. C. FLAT ROOF 11	
				Rainwater goods (ctd)	
				Pipes	
				Flr clg hgt 3.600	
				Offset 0.150	
				Into dr collar 0.050	
				3.800	
	2	3.80			
				C.i. r.w.p. to B.S. 416 str 75mm dia. with socketted caulked lead jts fxd with holder bats p & s to bwk at 2m centres	R10.1.1.1.1
	2	1			
				E.O. ditto fittings pipe > 65mm dia. offset 150mm projection	

				To Take • Decoration to pipe • Joint to drain	R10.2.4.5.0

WEEK 11: THE BILL OF QUANTITIES

4.0 THE BILL OF QUANTITIES

4.1 Introduction

The Bill of Quantities is a document containing every single cost element in a construction project. Not only must the quantities for every item of labour and material be included, but so also must the items of plant and equipment, as well as any temporary work necessary, or expenses incurred by way of insurances, fees, provision of power and water supplies and such-like intangible expenses. The BOQ (bill of quantities) must contain every conceivable cost component implied by the project.

4.2 Basic components of the bill of quantities

- Preliminaries
- Preambles
- Prime Cost sums and Provisional sums
- Measured items

- Provisional Quantities

Preliminaries

The SMM is divided into sections. The first section covers general rules. Next to that is Section 1A of Part 1 which deals with preliminaries in connection with building works and building services. The rest of Part 1is divided into 16 work groups each made up of roughly 170 work sections.

Preliminaries are general items of cost not related to any particular work section. E.g. Water will be required for concretework (Section E), Masonry (Section F), Surface finishes (Section M), etc. in the same vein, scaffolding for instance will be required for concretework (Section E), Masonry (Section F), structural carcassing metal/timber (Section G), Cladding/covering (Section H), (Surface finishes (Section M), etc.

As a general rule, preliminary items since they are generalities and cannot be measured do not require quantities. The preliminary items are listed in a separate bill (Bill No. 1) and lump sums are inserted against the items. The preliminaries bill is the first part of the BOQ.

Preambles

These are described as non-measurable items each of which applies to a particular work section. They do not in themselves cost money but may affect the cost of the work sections to which they apply. They fall mainly into two classes:

1. Items specifying quality of materials and workmanship
2. Pricing instructions to tenderers

Preambles for each work section are grouped together and inserted either at the beginning of that particular work section or combined with preambles for other work sections and inserted after the preliminaries bill, but before the “bill proper”.

<u>Example:</u>

Preambles for concretework will include items such as:

- All cement used in the works shall be ordinary Portland cement complying with BS 12
- Aggregate shall be obtained from an approved source and shall comply with BS 882
- The contractor shall make allowances in his rates for sampling of aggregates.

Prime Cost and Provisional Sums

Prime cost (PC) sums are those sums provided in respect of work to be carried out by a nominated sub-contractor or statutory body or materials to be supplied by a nominated supplier.

The general contractor is allowed an item for attendance for the use of his facilities by the nominated contractor. The main contractor is also allowed some profit on PC Sums generally.

PC sums are covered by 1A51 and 1A52 of the BESMM3

PC Sum items are usually dealt with in two ways in the BOQ:

1. Lump sum items giving a total sum of money to be spent as directed
2. Measured items the descriptions for which contain a unit price which the estimator must allow for in his price build-up.

A provisional sum is defined as a sum provided for work or costs that cannot be entirely foreseen, defined or detailed or detailed at the time the tender documents are issued. General rule 10.2 of the BESMM3 states that where work cannot be described and given in terms of the normal rules of measurement it shall be given as a Provisional Sum either defined or undefined. Provisional Sums for defined work is provided for work which is not completely designed but for which some amount of information is available, such as:

- Nature of the work and method of construction
- Location in the building
- Scope of work in terms of quantity
- Any specific limitations

A Provisional Sum for undefined work covers work where none of the above information is provided.

The aim of including such items is to provide the estimator with a firm price for the work concerned, the amount being subsequently deducted from the contract sum and the actual expenditure added back. In this way, each initial bid by the contractors who are tendering is prepared based on the same data.

Measured Items

The measured items make up what is known as the "Bill Proper". These are items taken-off from drawings which have been squared and sorted. In the bill, each measured item will comprise:

(a) A reference symbol

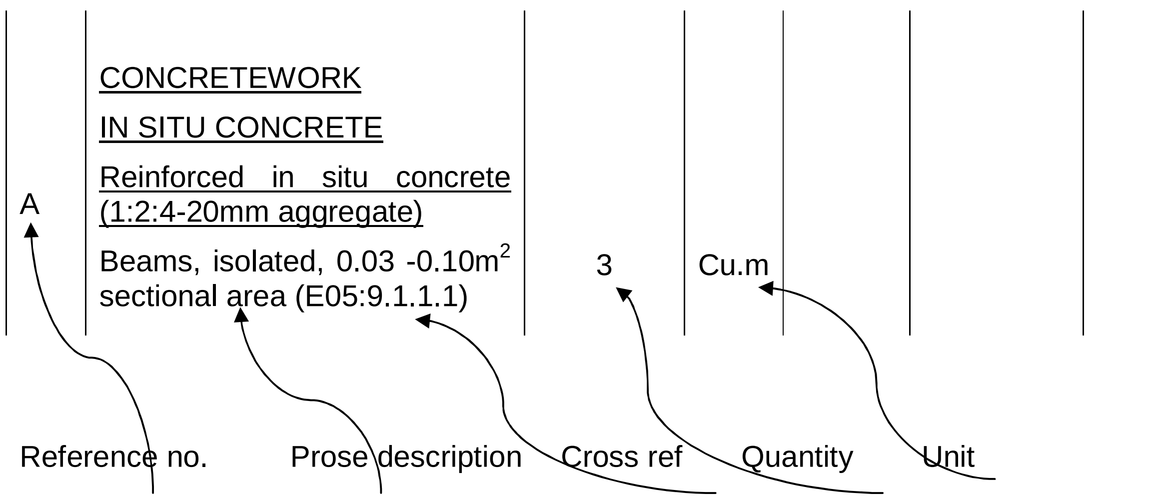
(b) A prose description

(c) An associated quantity

(d) The unit to which the quantity has been reduced:

Lin.m	-	Linear metre
Sq.m	-	Square metre
Cu.m	-	Cubic metre
Kg	-	Kilogram
No.	-	Number

(e) A cross-reference or code to facilitate computer billing



Note from the example above that headings are an essential feature of BOQs and they also appear in the appropriate places on the dimension sheet while taking-off.

Provisional Quantities

General rule 10.1 of BESMM3 provides for the inclusion in the BOQ of work which for some reason or other cannot be measured accurately at pre contract stage. Unlike provisional sums (for work which cannot be measured) provisional quantities are for work which can be defined as to description, but not as to extent. That is, the quantity cannot be accurately determined.

The items are estimated as to quantity and marked as approximate or “provisional” to allow for it to be adjusted when work is actually executed. For example, work underground is usually measured and marked as provisional and is subject to re-measurement when work is actually carried out.

Bill Preparation Process

The traditional procedure for bill preparation involves:

1. Taking-off

2. Working up which consists of:

    - Squaring
    - Abstracting
    - Billing

Taking-Off

This implies reading off dimensions from drawings and setting them down in a specific order on special paper know as “dimension sheets” and inserting an appropriate description.

This aspect has been properly covered in previous semesters.

Working Up

1. Squaring

Squaring involves calculating and recording the areas, volumes and lengths represented by dimensions. Results are written on the taking-off sheets in the squaring column. It is traditional for the squaring to be checked independently by another quantity surveyor in the office to eliminate errors.

2. Abstracting

Procedure

- The descriptions are transferred to abstract paper where they are assembled in bill order. Associated squaring results are inserted under their descriptions, repeat items forming columns for subsequent casting. Addition and deduction columns enable final results to represent net quantities.
- The abstract sheet is usually a double sheet (A3 paper) ruled in columns about an inch wide. Both sides of the sheet are used in each case working from the left to the right. Every sheet should be headed with the project title and the section and subsection of the work involved.
- The full descriptions for each item is written across two columns and underlined with the unit of measurement indicated beside the description. The order of abstracting is strictly the order in which the items will appear in the BOQ.
- Positive or “Add” quantities from the take-off sheets are inserted in the right column while “Ddt” items are inserted into the left column. A reference to the page number on the take-off sheet from where the quantity has been abstracted is written beside the quantity on the abstract sheet.
- As each quantity is abstracted it is run through on the take-off sheet with a line using ink of a different colour to clearly show that that figure has been transferred to the abstract sheet and should not be treated again
- It is essential to leave enough space between items to allow for omissions to be inserted and also to avoid confusion
- When all the items have been properly abstracted from the taking-off sheets, the columns of figures are totalled and the “Deduct” items subtracted from the totals of the “Add” items to arrive at net quantities. The figure obtained is then rounded to the nearest whole number and it is this figure that is transferred to the billing sheet.

SAMPLE ABSTRACT SHEET

3. Billing

Each description on the abstract is now transferred to standard bill paper, the format of which is suitable for pricing by the tendering contractors.

- The total reduced quantity for each item is transferred to the quantity column of the bill and the appropriate unit inserted.
- Each transferred item is cancelled from the abstract sheet to avoid an item being transferred more than once.
- Then, suitable trade and section headings are inserted.
- Finally, preliminaries, preambles and other appendices are inserted and the bill is ready for final proofing, printing and binding

WEEK 12: NON TRADITIONAL METHODS OF BILL

5.0 NON TRADITIONAL METHODS OF BILL PREPARATION

5.1 Billing procedures

Cut and Shuffle Method of Bill Preparation

This is a variation of the traditional method of bill preparation which reduces the time spent in working-up by eliminating the time spent in working-up by eliminating the operation of abstracting. The method also reduces the number of technical staff required.

Taking-off

This is similar in principle to the normal method except that special paper is used and certain procedures are observed.

A sheet of foolscap or A4 size paper is divided into four sections which can be separated by perforations or cutting with a guillotine.

Figure 3 shows a sample of a typical cut and shuffle sheet.

The following procedures are observed:

- One description only with its associated dimensions is written on each section. Only one side of the sheets are used
- Each section is coded with a trade reference to facilitate sorting
- Repeat items are cross-referenced to their original sections to facilitate subsequent collation
- To avoid draft billing, descriptions are written in full by the taker-off, except in the case of repeat items. Use of the word “ditto” should be avoided since subsequent sorting will render them invalid

Squaring and checking

This is carried out in the traditional way

Copying

Before each squared dimension sheet is cut, the sheets are photocopied. Alternatively duplicate copies are made from the start by using carbonised paper

Cutting

The original dimension sheets are retained for record purposes and the copied sheets are ‘cut’ to produce ‘slips’, each containing one item.

Trade Sortation:

Slips are sorted into trades using a rack of pigeon holes, one for each trade.

Item Sortation**:**

When each trade is complete, its slips are removed from the pigeon hole and sorted to bill item order. Each slip containing a repeat item (a slave slip) is clipped to the back of the slip containing the original item (the master slip) thus merging like items together.

Reducing

The squaring totals on the slips are now reduced to the unit of measurement required in the bill, a printed box being provided for this on each slip. In the case of slave slips the totals are transferred to the attached master slip for addition or deduction as necessary.

Insertion of Headings

To avoid draft billing, the trade and section headings required to appear in the bill must be written on slips, which are inserted in the relevant positions.

Re-numbering of Slips

The slips are now re-numbered serially, slave slips having been discarded and heading slips inserted. At this stage a careful check on the total number of slips is made to ensure that none is missing.

Drafting Preliminaries and Preambles

These are drafted in the normal way and sent for typing with the slips

Editing, Typing & Binding

Editing is done in the usual way and typing can be done directly from the slips. The bill is then neatly bound as usual.

SAMPLE CUT AND SHUFFLE SHEET

Block A															
Substructure															
			3a				3b				3c				3d

Direct Billing

This method also eliminates the abstract sheet and all collections are done on the taking-off sheet. This is possible where the project is small, the number of items are few and repeat items are also few.

Standard dimension sheets are may be used or special sheets that resemble an abbreviated BOQ may also be used. This sheet has dimension columns on the left and the usual bill pricing columns on the right. Collection of dimensions is done below the description of the item in the same way as on an abstract sheet and the net quantity is transferred to the quantity column while the associated unit of measurement goes in the appropriate column.

The draft bill is produced from these sheets. Other normal processes of billing follow.

Computer Billing

Computer aided bill production systems provide the facility to check accuracy, but care is needed in the coding of dimensions and entry of data. Modern computerised billing systems can however, print out errors in the form of tables. The coding can be double checked, although a random check may be considered adequate.

WEEK 13: SPECIFICATION

6.0 SPECIFICATION

6.1 Introduction

Specifications are detailed descriptions prepared by a consulting engineer or architect to tell the contractor everything about the quality of material and workmanship required which cannot be shown on the drawing

6.2 The Purpose and Use of Specifications

Specifications may serve three purposes, in each case in conjunction with the drawings.

1. To be read by the builder's estimator as the only information he has on which to prepare a competitive tender.
2. To be read by the Quantity Surveyor to enable him prepare a bill of quantities as a basis for such competitive tenders.
3. To be read by the clerk of works and the builder's foreman during the progress of the contract as the architect's instructions for carrying out the work.

The use to which the specification will be put determines the extent and level of detail expected of each of the clauses when used as a basis for tender, the specifications need to be specific, crystal-clear and complete in detail. In this case, the specification will be one of the contract documents and therefore will have to be detailed and unambiguous.

Specifications used by the QS in preparing bills do not form part of the contract documents but give the QS more details than the drawings can on the quality of materials and levels of workmanship expected for the works. For this purpose, specifications still need to be complete and detailed but the form of presentation need not be as formal since it is not a contract document.

Specifications as instructions to the foreman and clerk of works on site must give all the level of detail which may not be clearly stated in the descriptions of measured items in the bills. Usually these are included in a section in the bill known as preambles to the trades and this section usually precedes the measured items.

Specifications are usually subdivided into work sections and each work section subdivided under specific headings. Under each section material clauses are kept separate from workmanship clauses. Order of presentation is usually:

1. General clauses
2. Material clauses
3. Workmanship clauses

It is usually helpful to follow the headings under each work section of the standard method of measurement as omissions are less likely to occur.

The following are typical specification clauses for some work sections. The clauses given are by no means exhaustive and many more may be required for a particular job. The clauses given are not standard and are only given as a guide. Each project must be treated as it merits.

6.3 Drafting of Specification Clauses

Material Descriptions

(a) A full description of the material or component is given with details of desirable and undesirable characteristics and appropriate test requirements.

(b) Relevant British standard reference, together with details of class or type where required is given. The contractor can then refer to the BS for fuller information.

(c) Name of manufacturer proprietary brand or source of supply is stated and the contractor can obtain further particulars from the manufacturers or supplier.

(d) A brief description of the material is given together with the prime cost for the supply as delivery of a certain quantity of the material to the site e.g. a trip of gravel.

Illustration

Particulars required	Actual description
Material	Cement
Type	Portland
Name of manufacturer	Ashaka
Or source of supply	
Desirable characteristics	Delivered to site approved sealed begs or containers which are clearly marked with the name of the manufacturer
	Stored in a water – proof shed having a timber floor raised above the ground
British standard	BS 12

Note:

Reference to the appropriate British standard usually reduces the height of a specification clause as the contractor is expected to check the British standard for test requirements and desirable and undesirable characteristics.

Cement:

Cement for use in the works shall be obtained from an approved manufacturer and shall conform in all respects to BS12 for Portland cement. For the purpose of BS12, the site shall be decried to have a tropical climate.

Particulars required	Actual description
Material	Bricks
Type	Red engineering bricks
Name of manufacturer Or source of supply.	Nigerian Mining Corporation
Prime Cost	₦ 25,000 per thousand delivered to site
Desirable characteristics	Well burnt, of uniform shape, size and colour and sound and hard
Undesirable characteristics	Free from cracks, stones, lime and other delectation substances.
Test	Minimum compressive strength of 48.3 MN/m^2 maximum water absorption of 7 percent by weight.

Workmanship Clauses

These are generally drafted in the imperative e.g. ‘lay manhole bases in concrete’ or alternatively ‘The contractor shall lay etc’.

Workmanship example

Block work

"Blocks shall be laid in stretcher bond with 10mm joints properly bedded in cement mortar and with joints flushed up as the work proceeds".

6.4 Sources of information

(1) Previous Specification

Specifications for past jobs are used as a basis in the preparation of a new specification for a job of similar type. Care must be taken however to update the clauses by incorporating recent development and techniques', and to allow for differences of design, construction or site conditions of the curvent job. Also to omit details which are not applicable?

(2) Contract Drawings

These show the character and extent to the works. And the specification writer will work systematically through the drawings to extract information when compiling the specification.

(3) Employer's Requirements

The employer may lay down certain conditions for the job which will need to be included in the specifications. E.g. programming of the works so that certain sections are completed at specified dates and the taking of various precautions to reduce interference with the employers production processes within the premises.

(4) Site Investigations:

Information such as soil conditions, water table level and extent of site clearance work will be obtained from site investigations.

(5) British Standard: Reference to the relevant British Standard ensures a good standard for materials and reduces length of specification clauses

(6) Codes of Practice:

Reference to codes of practice ensures a good standard of construction and workmanship without the need for lengthy specification clauses

(7) Trade Catalogues:

Where proprietary articles are to be used on a job, reference should be made to the manufacturer's catalogues for the extraction of the necessary particulars to include in the specs. This procedure reduces the length of specification clauses and will ensure the use of the specific material which the designer is sure of its performance.

Sample specifications for a simple building in the following areas will be studied for the remainder of this course:

- Excavation and Earthworks
- Concretework
- Brickwork & Blockwork
- Roofing

6.5 Excavation and earthworks

Excavation and Earthworks:

Site Clearance: Before commencing work on site the contractor is to inform the Architect/supervising officer and ascertain the extent of site clearance required.

Surface Soil: Surface soil shall be stripped and deposited in temporary storage heaps, preparatory to being used for the preparation of beds to receive trees and shrubs.

Excavation: The excavation shall be carried out to the dimensions, levels, lines and profiles indicated on the contract Drawings or to such dimensions as may be directed in writing by the supervising officer.

The excavations are to be performed in whatever material may be found, but extra payment will be made for excavation in rock. Rock is defined as material which in the opinion of the Architect/supervising officer can be removed only by the use of compressed – air plant, wedges or explosives and is found in continuous beds exceeding 75mm in thickness or in isolated stones exceeding $0.06m^3$ in volume.

The contractor shall include for getting out the excavated material by hand or machine and for leveling and compacting surfaces prior to commencing constructional work.

The faces and beds of all excavations after being excavated to the required dimensions shall be carefully trimmed to required profiles and cleaned of all loose mud, dirt or other debris.

Trench excavation shall be assumed to be not exceeding 1.50m deep.

Any excavation carried out in excess of the dimensions or levels shown on the drawing are to be filled in with weak concrete to the Architects/supervising officers instructions at the expense of the contractor.

Disposal of Surplus Excavated Material:

All surplus excavated material is to be deposited, spread and leveled where directed or removed from site as required, the contractor being responsible for finding a deposit and paying all fees and charges which may be demanded.

Backfilling of Trenches:

Filling around foundations in trenches is to be of selected earth obtained from the excavating free from roots and all vegetable matter and it is to be filled in layers not exceeding 225mm in thickness each layer well rammed and consolidated by rolling or ramming and well watered.

Filling:

Approved filling to make up levels shall be in soft laterite or other such materials approved by the Architect/supervising officer and shall be deposited in layers not exceeding 300mm thick and well watered and consolidated. If material obtained from excavation is approved for use in filling, a reduction in the price quoted shall be agreed with the contractor.

Hardcore filling shall be selected broken stone, old cement, concrete or other clean, hard, dry material to pass through a 75mm mesh and approved by the Architect/supervising officer and shall be free from dust and dirt and deposited in layers not exceeding 300mm thick, each layer being well consolidated by rolling or ramming.

Anti-termite Treatment:

The contractor shall destroy all ant nests and resmin encountered during excavation.

‘Dieldrex’ anti-termite treatment shall consist of ‘Dieldrex’ 20 Emulsion (manufactured by National Oil and Chemical Company Nigeria Limited), diluted with water and applied with a spray gun at the rate of 5 litres of the diluted emulsion per square metre, all as recommended by NOLCHEM’s current agricultural circular on the subject.

‘Dieldrex’ is to be sprayed over surfaces of excavation and the ground prior to the laying of concrete floor slab.

WEEK 14: SPECIFICATION

6.6 Sample specifications for a Simple Building

Concretework

Generally:

All materials used in the concrete work, and the mixing, placing and curing of the concrete and the workmanship generally are to comply with the latest British Standard and code of practice applicable.

Concrete

Materials

Cement:

Cement for use in the works shall be obtained from an approved manufacturer and shall conform in all respects to B.S. 12 for Portland cement. For the purpose of B.S.12, the site shall be deemed to have a tropical climate.

The cement shall be delivered to the site in approved sealed bags or containers which are to be clearly marked with the name of the manufacturer.

Cement is to be stored in a water – proof shed having a timber floor raised above the ground. Each consignment of cement shall be stacked separately and marked so as to be easily identifiable, and shall be used in order of delivery. Any cement rejected by the Architect or Engineer shall be immediately removed from the site and if requested, all other cement from the same consignment shall also be removed.

Aggregate:

Fine aggregate shall be well washed and shall be sharp and free from clay, chalk, organic matter and other impurities. It shall comply with the requirements of B.S. 882 and shall be graded in accordance with Table 2, zone 2.

Coarse aggregate shall be gravel or other suitable material and shall be well washed and free from sand, clay, quarry refuse and other impurities. It shall comply with the requirements of B.S. 882 and shall be graded in accordance with Table 1.

Aggregates generally shall be stored in proper stockpiles and in such a manner that they do not mix with the underlying soil or come into contact with impurities, or mix with each other.

All aggregates shall be clean and free from chemical organic and mineralogical Constituents which react unfavourably with cement, reduce the strength and durability of the concrete or attack the steel reinforcement.

Water:

Water shall be clean, pure and free from impurities in suspension or solution.

Workmanship

Proportions of Concrete:

Concrete in foundation trenches shall be 1:3:6 mix concrete in bed, beams and lintels shall be 1:2:4 mix. These indicate the volumetric proportions of cement, fine aggregate and coarse aggregate respectively.

Unless otherwise stated the coarse aggregate for concrete shall be 38mm for 1:3:6 mix and 19mm for 1:2:4 mix.

Concrete for reinforced work generally shall comply with the requirement of British Code of Practice CP114; Structural Use of Reinforced Concrete in Buildings.

<u>Mixing of Concrete:</u>

Concrete for reinforced concrete must be mechanically mixed. Mixing shall be done in an approved mechanical batch mixer. The volume of materials inserted per batch shall not exceed the manufacturer's rated capacity and the volume of each batch shall be such that only whole bags of cement will be used.

The mixer drum shall be emptied completely before being refilled. All materials shall be mixed until the concrete is uniform in colour and consistency and in no case shall it take less than two minutes.

Where hand mixing is approved for other qualities of concrete, the ingredients shall be mixed dry on a watertight platform until a uniform colour is obtained. Clean water shall then be added gradually through a rose head and the whole mass turned over at least three times in a wet state until it attains a slightly wet consistency.

The amount of water used shall be the minimum necessary to bring the mass to a plastic condition and should not exceed 29.5 litres to each 50kg bag of cement. In no case is the slump to exceed the maximum specified.

Water must not be added later to facilitate handling or other purposes.

<u>Testing Concrete:</u>

Price of concrete shall include for carrying out all tests in accordance with the requirement of B.S. code of practice 114 as and when required by the Architect or supervising officer including supplying all test cubes, slump cones etc and paying all fees and charges incurred.

The minimum crushing strengths on 150mm test cubes of ordinary Portland cement shall be:

Mixes of Concrete	**Minimum Crushing Strength in N/mm^2**	
	After 7 Days	**After 28 Days**
1:3:6	9.31 N/mm^2	12.41 N/mm^2
1:2:4	15.51 N/mm^2	21 N/mm^2

Placing Concrete:

Concrete shall be used as soon as it has been mixed and shall be conveyed in and deposited directly in the work from proper metal concreting barrows. Care must be taken to prevent workmen placing concrete from introducing clay or other harmful matter on their boots. Before any concrete is placed in position, the formwork and other adjoining surfaces shall be clean and free from all foreign matter.

In placing concrete, it shall not be dropped into its final position from a height of more than 900mm nor shall it be deposited in water.

Only sufficient concrete shall be prepared as is required for immediate use and concrete shall be placed within 30 minutes of being mixed and once placed and consolidated shall not be disturbed. The use of "revived" concrete is prohibited.

The concrete shall be thoroughly worked in to all parts of the formwork and between and around steel reinforcement, and compacted by approved methods to give a dense and compact concrete free from honeycombs or voids of any kind.

Great care should be taken to prevent the displacement or deformation of the steel reinforcement during concreting.

Reinforced concrete shall be vibrated by use of an approved mechanical poker vibrator.

Protection

Curing of concrete shall be in accordance with the recommendations set out in the B.S. Code of practice and all surfaces shall be kept continually wet after concreting and protected from the sun and drying winds by covering with wet sacking for not less than one week.

Concrete floors shall be protected from damage by traffic by covering with sand or timber strips or other approved means.

Concrete is not to have weight put on it for one week after laying. During periods of heavy rainfall, surfaces of concrete just deposited are to be satisfactorily protected by sacking, felt, etc.

Bar reinforcement in beams and lintels shall be mild steel bars complying with B.S. 4449.

Mesh reinforcement in ground floor slab shall comply with B.S. 1221. All mesh shall be delivered in flat sheets.

All reinforcement shall immediately prior to placing, be free from loose mile scale, loose rust, oil, grease, dirt or other foreign matter.

Placing Reinforcement:

All reinforcement shall be set out exactly as shown on the working drawings and is to be securely wired with and including soft pliable mild steel wire of approved gauge at all intersections and adequately supported in such a manner that no movement takes place before concrete has set.

Cover to Reinforcement:

The minimum concrete cover to reinforcement shall be as follows:

Bar reinforcement: The diameter of the bar or 20mm in beams and lintels whichever is the greater.

Mesh reinforcement in ground floor slab – 40mm

All bars are to be bent cold on the site in a suitable and approved bar bending machine and accurately shaped to the shapes and profiles indicated in the drawings.

Prices for bar reinforcement should include for the following:

- Cutting of any description, notchings, bending tying wires and distance blocks.
- The extra malarial at laps
- Protection

Formwork:

All formwork shall be true to line and of suitable thickness and sufficiently strutted and braced to be free from deflection under the load of concrete to be placed on it.

The joint shall be so tight as to prevent leakages of liquid cement.

Formwork shall be so erected that in striking, the sides of beams may be exposed first and independently and the undersides of beams last.

After removal of formwork the faces of the exposed concrete shall be rubbed down immediately to remove fins or other irregularities.

WEEK 15: SPECIFICATION

6.7 Further Sample Specification for a Simple Building

Blockwork

Materials

1. Blocks
2. Curing of blocks
3. Mortar.

Workmanship

4. Block work generally

Brickwork

Materials:

1. Bricks
2. Mortars
3. Damp proof courses

Workmanship:

4. Bricklaying generally
5. Faced brickwork and pointing
6. Special features or clauses of work.

BLOCK WORK

Materials:

<u>Blocks</u>

The cement and sand (aggregate) for the “sand Crete” blocks shall be as described in “Concrete work”.

The blocks shall be made generally in accordance with B.S. 2028 in an approved vibrating type block making machine.

The sand Crete blocks generally are to be solid or hollow cored blocks made in an approved machine and shall be composed of one part of cement to six of sand mixed with just sufficient water to bind the mix under slight pressure. The mixture shall be well rammed and consolidated in the mould and shall be made into blocks within 30 minutes of the water being added to the mix.

<u>Curing of Blocks</u>

On removal from the machine on pallets the blocks are to be matured in the shade in separate rows one block high with a space between for at least 24 hours and sprayed with water. They may be removed from the pallets but not stacked or removed from the shade for a further 4 days and shall be sprayed with water at intervals. Following this the blocks may be stacked not more than five blocks high in the shade for a further 14 days and allowed to dry out.

No blocks are to be built into any part of the building until they have matured in the manner described for at least 21 days.

All blocks to be used in the works shall have attained a minimum compressive strength of $3.5N/mm^2$ fourteen days after manufacture and the contractor is to allow for provision of samples and carrying out tests to determine the compressive strength as directed. If any samples fail to reach the prescribed strength, the Architect/Supervising officer may reject the batch which contained the samples. And if so rejected, the contractor shall break up or remove from the site, the whole batch as directed.

The blocks generally shall be 450mm long, 225mm deep and of the thickness indicated in the drawings. Blocks of special sizes and shapes shall be solid unless otherwise stated. All blocks shall be cast true to shape, even in size, smooth faced and free from flaws or blow holes and with clean and sharp arises.

Mortar:

The mortar used shall be composed of cement and sand (1:6) and an approved plasticizer to give a strength equal to the strength of the blocks.

The mortar shall be used within one hour of mixing. Mortar shall not be used or mixed with any other mortar after it has begun to set nor shall any mortar of any kind of a previous day's mixing be used.

Workmanship

Block work generally

Blocks shall be laid in stretcher bond with 10mm joints properly bedded in cement mortar and with joints flushed up as the work proceeds.

The block work shall be carried up in a uniform manner. No portion shall be raised more than 1 metre above another at any time. The work shall be carried up course by course and the height of four courses rising to a height of 1.00 metre. Courses are to be level, prepends kept and quoins, jambs and other angles plumbed as work proceeds. Walls and partitions of different thicknesses are to be properly bonded to one another at junctions and intersections.

Intersecting beaming walls shall be terminated at the face of a pier, and tied with steel ties 3mm thick, 25mm wide and 750mm long. Walls shall not be bonded to piers by another method. Ties shall occur at 1125mm maximum centres.

Wall abutting concrete columns etc shall be tied with steel ties 3mm thick, 25mm wide and 450mm long with one end fishtailed and built into concrete. Ties shall occur at maximum 1125mm centres.

Builder the whole of block work walls, partitions etc as cement mortar to the several thicknesses and the heights and extends shown on the drawings and all as hereinbefore described. Form all openings as shown with true reveals prepared to receive frames. Wedge and pin up block work to soffit of concrete slab, etc and build in ties to concrete columns etc.

Where indicated on the Drawings fill the wide of hollow block walls, etc, such as below damp proof course level with concrete as specified fill in, well tamped and consolidated as work proceeds.

The top course of all walls shall be filled with concrete including inserting a strip of wide expanded metal lathing in the bed joint immediately under the course to be filled as permanent formwork.

The contractor shall allow for using solid blocks at tops and ends of hollow block walling.

BRICK WORK

Materials:

Bricks:

All bricks shall conform to the requirements of BS 3921 and in addition they shall be hard, sound, square, well burnt uniform in texture, regular in shape with true square arises, and even in size. Care is to be taken in loading, unloading, stacking and handling and no clipped or damaged bricks shall be used.

All bricks shall be equal to samples submitted to and approved by the Architect/Supervising officer before any brick work is commenced. Adequate stocks of bricks shall be maintained on the site to ensure continuity of working.

Common bricks shall be 65mm commons supplied by Nigerian Mining Limited or other equal and approved.

Engineering bricks shall conform to the requirements for class B engineering bricks in BS 3921.

Facing bricks are to be Antique dark brown facing bricks obtained from Nigerian Mining Co. Ltd or other equal and approved.

Mortar

(As with block work except may be a difference in cement and sand mix, say (1:4) for common bricks and (1:3) for engineering bricks).

Damp – Proof Courses

(a) Engineering bricks: The contractor shall lay over the full thickness of all walls in the positions indicated on the drawings, a damp – proof course of two courses of class B engineering bricks to BS 3921 bedded and pointed in cement (1:3).

(b) Bitumen Felt: The contractor shall lay over the full thickness of all walls in the positions indicated on the drawings a damp – proof course of a single layer of bitumen felt, incorporating a lesion base and a layer of lead in accordance with BS 743, type 5D. Joints in the bitumen felt shall be kept to a minimum and the damp – proof course shall be lapped 225mm at joints. The bitumen felt shall be bedded and pointed in cement mortar (1:4).

Workmanship

Brick laying generally

All brick work shall be built to the dimensions thicknesses and heights and in the positions shown on the drawings or as directed by the Engineer and in conformity with CP 121 part I. Clean off and prepare all concrete and other surfaces on which bricks are to be laid.

All brick work shall be built uniform, true and level, with all perpends vertical and in line and shall rise 300mm in every four courses. No brick work shall rise more than 1.25m above adjoining work during brick laying and the work in rising shall be properly toothed and racked back.

All bricks shall be welted sufficiently prior to laying to avoid excessive suction. All bed and vertical joints shall be filled solid with mortar as the bricks are laid. Bricks shall be laid with frogs supper most and shall be welted during hot weather.

Prices for brickwork shall include the cost of all necessary scaffolding.

Walls exceeding 102.5mm in thickness shall be built in English bond unless otherwise directed by Architect/supervising officer. Half brick walls shall be constructed in stretcher bond. Hollow walls shall be constructed of two half brick skins separated by a 50mm cavity and tied with three 150mm galvanized strip – type fish – tailed ties to BS 1243 per square metre in staggered formation. All ties shall be kept clear of mortar droppings. The use of snap headers shall not be permitted and bats shall be allowed only as closures.

The contractor shall build in or cut and pin the ends of joist lintels, steps, corbels, etc and shall build in all frames and bed and point in cement mortar. The contractor shall perform all necessary rough and fair cutting and shall form all necessary chases and reveals.

The contractor shall slake out joints of brick work for insertion of metal flashings, wedge the flashings and afterwards point the joints in cement mortar.

Faced Brick work and Pointing:

Facing bricks of the type specified shall be laid in the positions indicated on the Drawings and all facing brick work shall be well bonded to the backing bricks. No facing brick work shall at any time be more than 600mm above the backing brick work.

All facing brick work shall be pointed with a rubbed joint as the work proceeds and internal faces of brick work shall be pointed with a neat flush joint to give a fair face.

Faced work shall be kept clean at all times and scaffold boards adjoining brick faces shall be turned back at night or during heavy rain. All faced brick work shall be cleaned down as necessary on completion to give an even coloured surface free of mortar droppings or staining of any kind. The contractor shall carefully fill all putlog holes with bricks similar to the surrounding brick work, point up as required and generally make good.

Reinforced Brick work:

Reinforced brick work shall be provided with strips of No.20 gauge expanded metal in each bed joint as shown on the Drawings. The expanded metal reinforcement shall be lapped a minimum of 450mm at joints.

ROOFING

<u>Roofing Generally</u>

The whole of the roofing is to be left secure and in a water light condition.

The contractor is to ensure that the roof is adequately protected against the movement of following trades and is to reduce such movement to a minimum.

Purlius must strictly follow the profile of the roof and maintain an even slope over all cross falls. A straight gauge will be provided by the contractor and the purlius will be checked in the presence of the Architect and the roofing sub-contractor, if such sub-contractor is required in the contract, before covering commences.

Any defective purlius will be removed or otherwise corrected as directed by the Architect or supervising officer before sheeting commences.

Corrugated Sheet Roofing

Materials

Corrugated aluminium roofing shall be ‘Alumaco’ or other equal and approved. Unless otherwise required the roofing sheets shall be of 225SG with stucco mill finish.

Corrugated zinc roofing shall be ‘Star’ or other equal and approved.

Workmanship

All corrugated asbestos, aluminium, galvanized iron, and zinc roofing is to be fixed in accordance with the recommendations of the manufacturer. Unless otherwise required, the sheets are to be fixed with the recommended side and end laps, at least 225mm at ends and one and a half corrugations at sides.

Exposed edges of laps are to face away from prevailing winds. Where plastic seals are particularly required to the laps in the roof covering, the laps shall be sealed with an approved bituminous mastic as recommended by the manufacturers unless otherwise specified.

All courses are to be laid with corrugations in straight lines from eaves to ridge, the mitred corners of sheets to be properly weathered by the overlapping corrugations of the sheets above. Sheet sides are to be such that all horizontal laps occur immediately over a purlin. All fixing holes are o be drilled and not punched and made in the crown of the corrugations and all cutting to be neatly done by hand sans.

Ridges generally, are to be fitted with approved pattern close fitting type ridge capping. Ends of ridge capping are to be closed by means of approved finials.

Hips are to be covered with two- piece adjustable hip coverings, edges turned down, or 20SWG aluminium 450mm wide dressed to shape under sheet roofing.

Ridges, hips, valleys, flashing etc are to be lapped minimum 150mm at ends.

The sheet roofing with its fittings, etc to be properly fixed where and as required by means of hook bolts, seam bolts and drive screws with slotted treads. The bolts and screws to be galvanized of approved pattern or aluminium and of dimensions and shapes required to suit the purlins, etc to which the sheets are to be fixed. Bolts and screws will not be less than 6mm diameter for small corrugation roofing sheets. All bolts and screws to have galvanized steel diamond washers or load cup shaped washers bedded on felt asbestos composition washers or plastic washers and no fixings are to be nearer than 38mm to the edge of a sheet.

All sheet roofing and accessories to be fixed in accordance with the manufacturer's recommendations, and in a manner to permit slight movement in the roof structure without damage to the roof covering.

The prices for all sheet roofing are to include for cutting of any description, bedding and pointing at eaves, verges and the like and lapping in accordance with the manufacturer's instructions.

Bitumen – Felt Roofing

Materials

The felt roofing is to be Andersons Built – up Thermoglass Glass Fibre base roofing felt or other equal and approved roofing felt to B.S. 747 class 5 and CP 144101 laid in three layers. The first and second layers should weigh not less than 27kg per $20m^2$ and the top layer is to be finished with white mineral surface and to weigh not less than 32kg per $10m^2$. Rolls shall be stored on end under cover, on boards.

Workmanship

Laying

The screed shall be clean and dry and primed with cut back bitumen primer. Each layer shall be fully lapped 50mm at sides and 75mm at ends. The first layer shall be fully bonded to the screed with PF4 bituminous primer hot bonding compound and each subsequent layer fully bonded to the previous layer using same. Apply bitumen dressing compound to the top layer and dress with granite chippings at the rate of 16kg/square metre and remove loose chippings.

The prices for felt roofing are to include for the following:

1. Raking and curved cutting fair edges, turning into grooves wedging and the like.
2. Working into outlet pipes, gullies and the like.

Sheet Metal Flashings and Gutters

Materials:

Aluminium flashings and cappings to be super purity to BS 1470, coated in bitumen on underside before fixing.

Flashings are to be lapped minimum 150mm at ends.

Prices for flashings are to include for all laps at passings and angles and bedding edges in grooves.

Prices for cappings are to include mitre angles and returned ends.

<u>Protection</u>