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Measuring Building Substructures: Solutions to 'First Year' Introductory Level Examination Questions

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MEASURING BUILDING SUBSTRUCTURES: - SOLUTIONS TO 'FIRST YEAR' INTRODUCTORY LEVEL EXAMINATION QUESTIONS

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Introduction

The measurement of substructure works to simple domestic type buildings is a logical starting point for students to commence the process of taking-off building quantities. Substructure work is typically the first class of work to be explained in textbooks dealing with both construction technology and building measurement. However, substructure work is often one of the most challenging elements to measure. This element is unique, in that it contains both vertical (rising walls) and horizontal elements (ground floor slabs), and comprises work from a number of separate work sections and trades (e.g. excavation and earthworks, concrete work, brickwork and blockwork, waterproofing and occasionally aspects of woodwork, The element also contains works which are measured in linear metres (dpcs for example), square metres (e.g. blinding and powerfloating), and cubic metres (e.g. concrete foundations). Examiners may be of the view that if the candidate can demonstrate the ability to measure substructures that they should be able to successfully apply the principles of measurement to other areas of work. The task of measuring substructures is, as a result, a regular topic in first year building measurement and quantity surveying examinations.

In this paper, the author demonstrates the process of measuring basic substructure designs. The approach taken involves providing solutions to a sample of four Irish Department of Education *Technological Certificate: Builders' Quantities Intermediate Stage* examinations. These three-hour-long State examinations, which ceased in 2007, required candidates to answer two *compulsory* measurement questions, one of which almost always involved a substructure. The measurement questions accounted for 80% of the marks, (40 marks each). Candidates were also required to answer two other short questions (10% each) relating to various theoretical aspects of quantity surveying practice. The marking scheme above, indicates that each of the measurement questions should take approximately 75 minutes to answer. Completing the questions within this time frame is both challenging and pressurised.

The Worked Examples

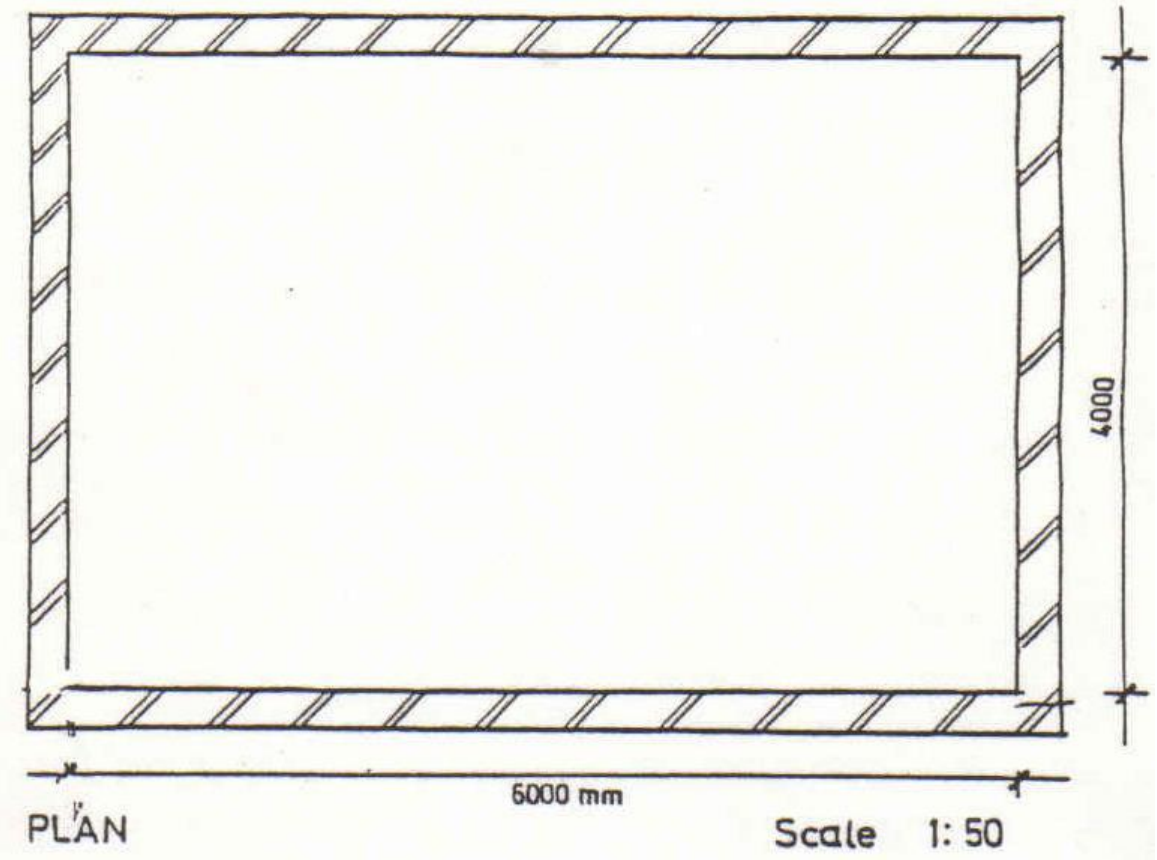
The worked examples are measured in accordance with the Irish Agreed Rules of Measurement (ARM4). Different rules may apply under other standard methods of measurement. Candidates taking these examinations were required to enter all dimensions on dimension sheets which were provided. Readers are therefore expected to be familiar with traditional 'paper based' taking-off procedures. These procedures are explained in the following papers *An Introduction to Taking Off Building Quantities: an Irish Approach* http://arrow.dit.ie/beschreoth/30, *Measuring Building Perimeters and Centrelines - Worked Examples* http://arrow.dit.ie/beschreoth/43, and *Composing Descriptions for Bills of Quantities in Accordance with ARM4 – Worked Examples* http://arrow.dit.ie/beschreoth/44.

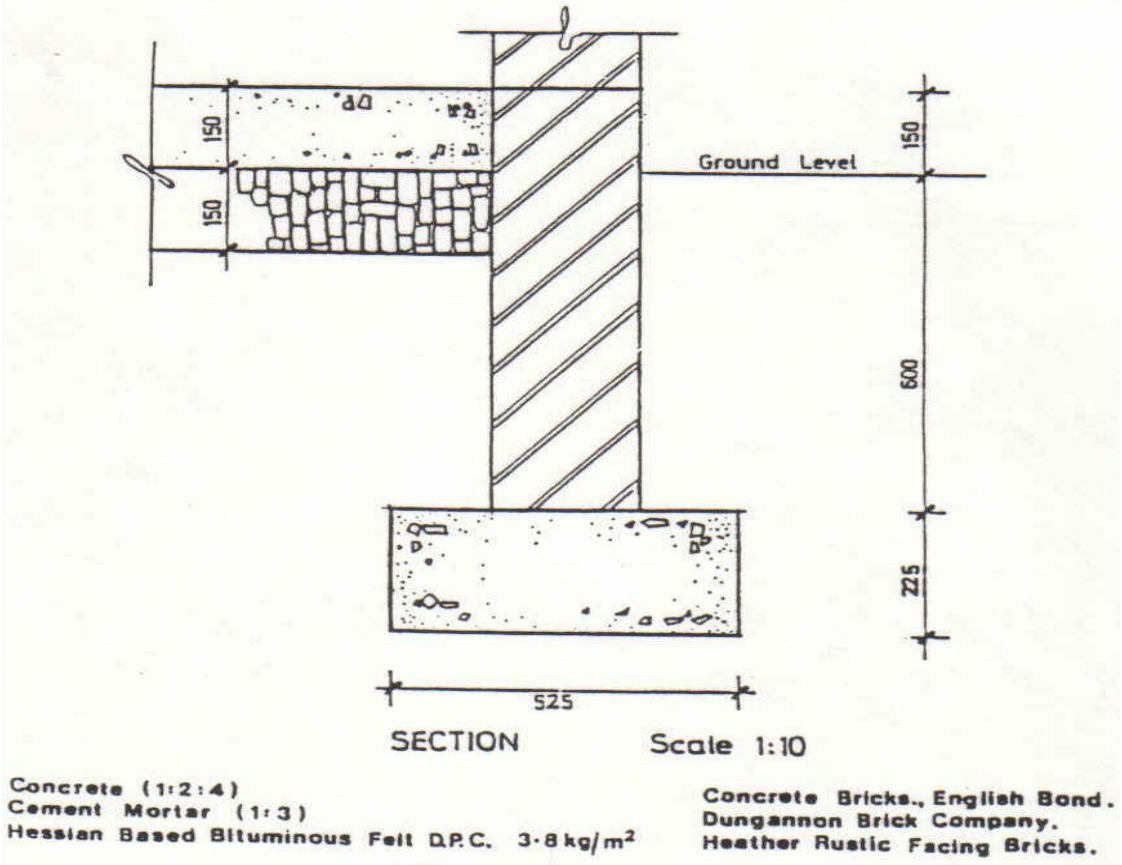
The worked examples are presented in order of increasing difficulty as the plans become more complex. Explanatory notes on ARM4 rules are presented to support the first worked example. In the interest of brevity these notes are not repeated for the subsequent questions, but apply nonetheless.

1992 – A Plain Rectangular Building

The Question

Take off the quantities for the substructure to damp proof course level. (40 marks)

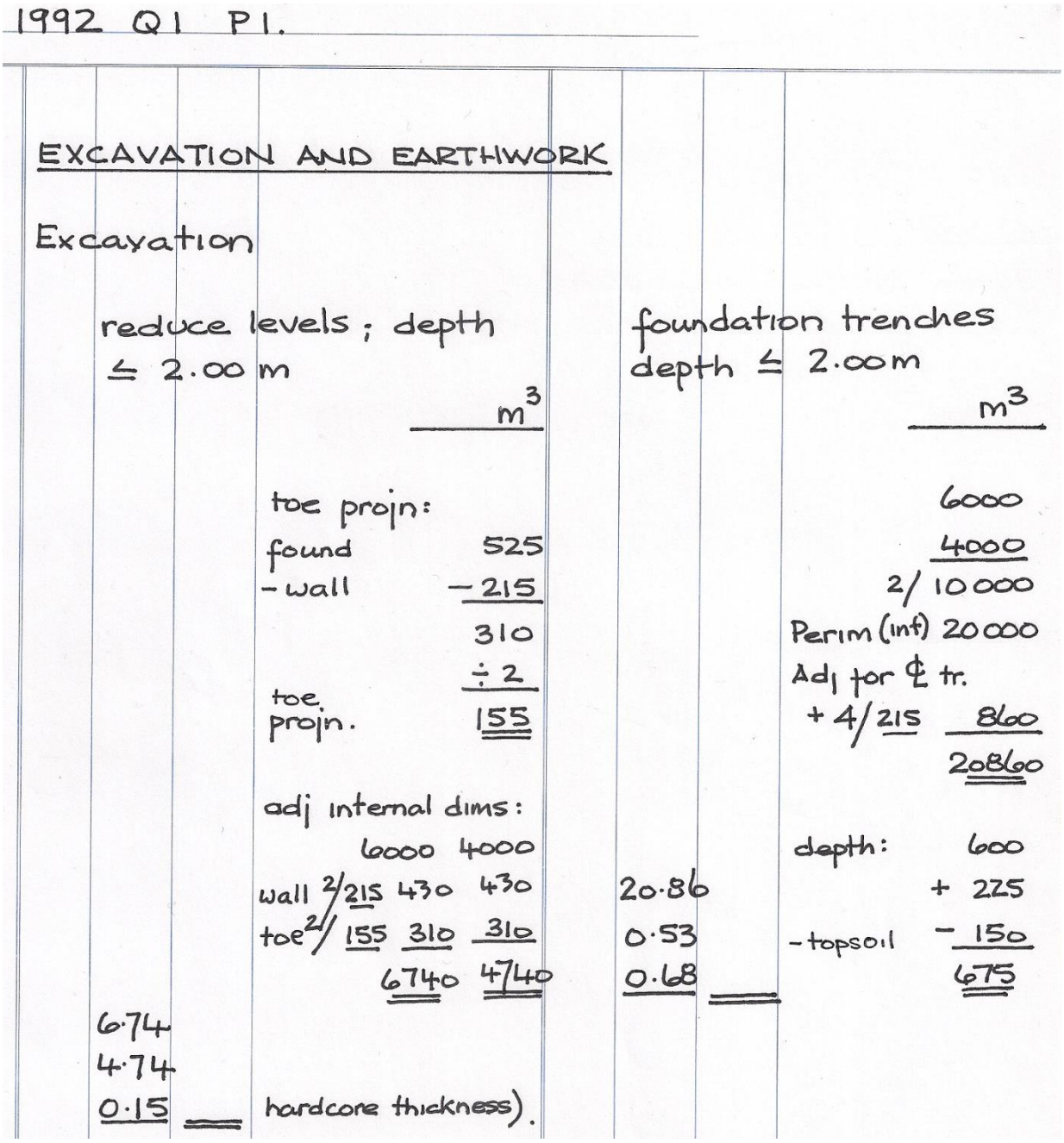

4000
6000 mm
PLAN
Scale 1:50


150
150
Ground Level
150
600
225
525
SECTION
Scale 1:10
Concrete (1:2:4)
Cement Mortar (1:3)
Hessian Based Bituminous Felt D.P.C. 3·8 kg/m²
Concrete Bricks., English Bond.
Dungannon Brick Company.
Heather Rustic Facing Bricks.

Although this is a straight-forward substructure layout which would be suitable for a garage or similar non-habitable outbuilding, the task required the candidates to take off the complete substructure. Candidates were not required to square the dimensions. As the candidates were not permitted to use the ARM, they were expected to remember what items needed to be measured and the various measurement and coverage rules governing these. The candidates would also have been expected to make certain assumptions regarding whether particular works were necessary. For example stripping of topsoil has **not** been measured in this example on the assumption that it is not required to be preserved, this assumption avoids the need to measure the items relating to stripping, preserving and spreading the topsoil, thereby speeding up the take-off process. All such assumptions should, however, be checked with the architect and documented on a query sheet.

In this instance it would be prudent to compile a 'to-take' list of the items to be measured. This will help to organise an effective take-off approach and reduce the risk of accidentally leaving out items to be measured. A to-take list showing ARM4 references and units of measurement to answer this question would include:

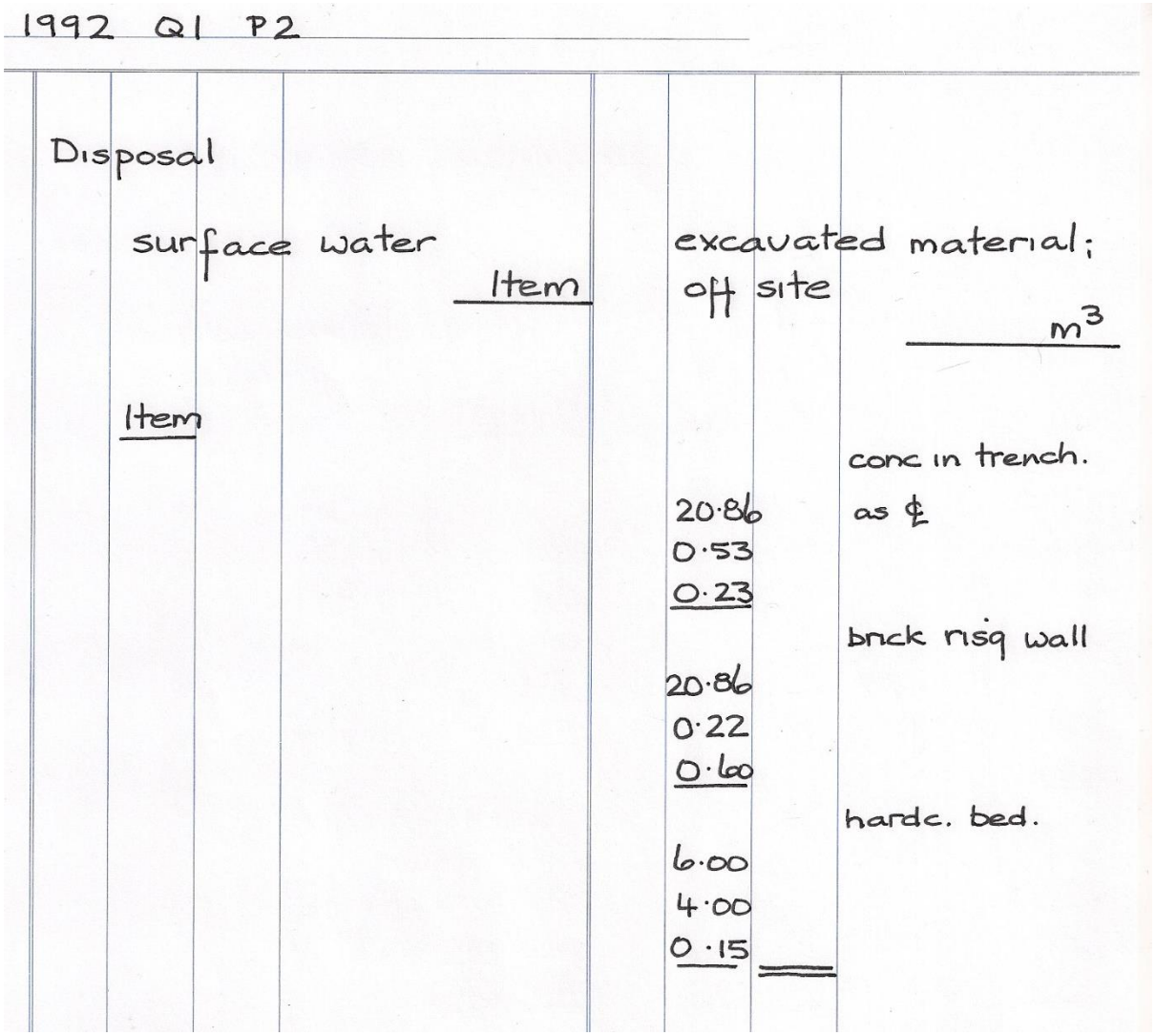
Reduce level excavation; - *assumed there is no requirement to preserve any topsoil.*	m^3	D22.3.7.4.
Trench excavation	m^3	D22.3.9.
Disposal of surface water	Item	D24.3.8.10.
Disposal of surplus excavated material	m^3	D24.3.10.
Backfilling trenches with excavated material	m^3	D24.4.11.16.
Backfilling to make up levels	m^3	D24.4.12.16.
Hardcore beds	m^3	D24.4.12.16.
Blinding hardcore beds	m^2	D24.5.13.
Concrete strip foundations	m^3	F36.4.0.0.2.
Concrete ground floor slabs	m^3	F36.9.1.
Powerfloating floor slab	m^2	F38.2.6.
Rising Walls	m^2	G48.2.1
Labours on brickwork	Item	G48.7.2
DPC	m	G52.3.5.2.3.
DPM horizontal	m^2	I66.2.1.1.
DPM perimeter kerb	m	I66.10.5.



Reduce level excavation is measured in m^3 classifying the depth as ≤ 2.00m or exceeding 2.00m in 2m increments. Reduce levels refers to the excavation required to reach the *formation level* i.e. the bottom of the hardcore bed - which is 150mm below ground level. The measurements are taken to the *footprint of the building* which extends to the outer edge of the foundations. This requires the width of the rising walls (215mm) plus the projection of the 'toe' of the foundation (155mm) to be added at both ends (2/) to the (internal) dimensions shown on the plan.

Trench excavation is also measured in m^3 classifying the depth as ≤ 2.00m or exceeding 2.00m in 2m increments. The trench is measured along its centreline, and its depth is calculated from formation

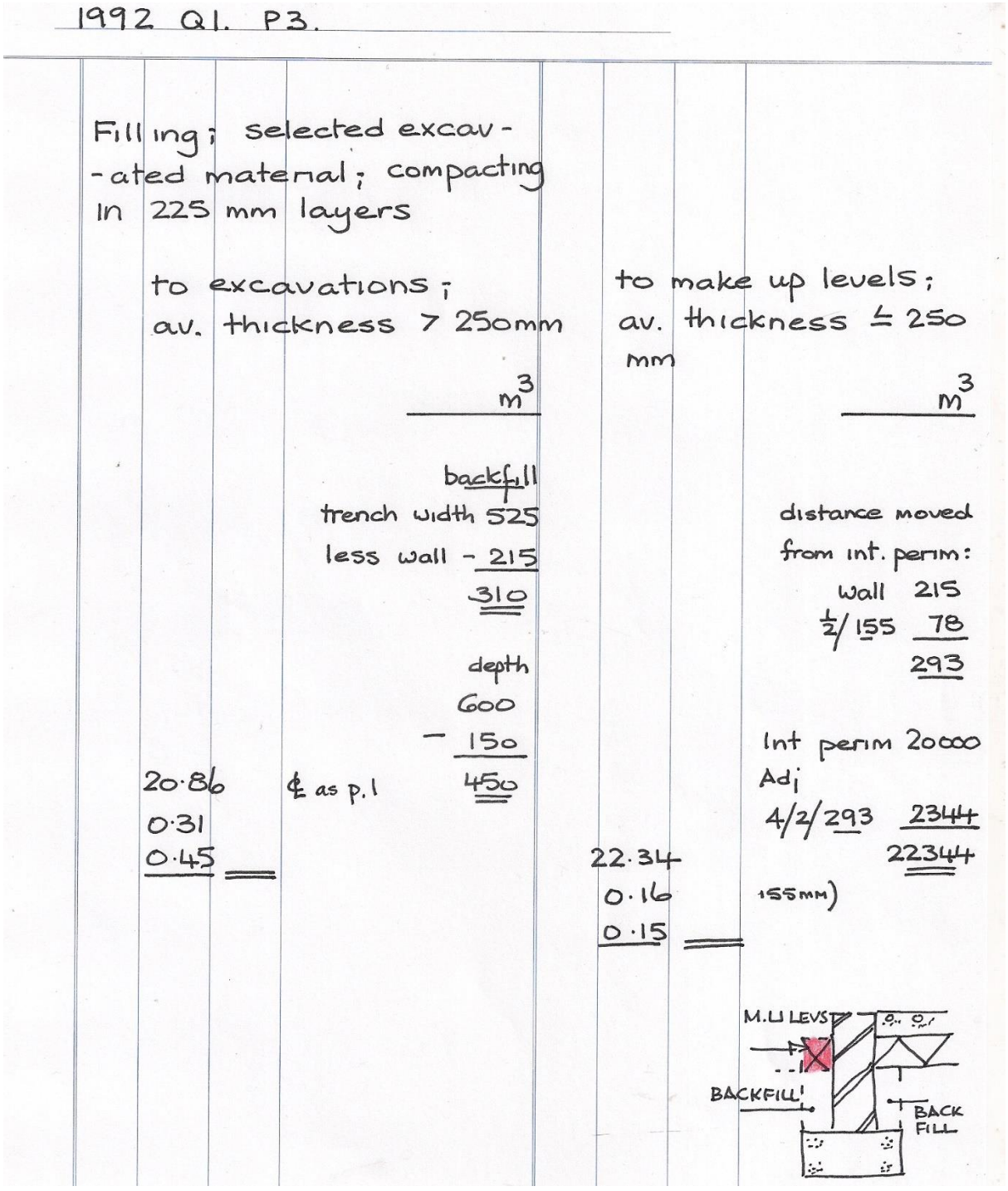
level (600-150mm) to base of the concrete foundation. Note that the standard formula for adjusting perimeters, **four times twice the distance moved,** can be simplified when moving to the centreline of a work item to four times the item's width/thickness, - the twice and half the thickness cancel each other out! Note also that where the dimensions relate to the inside of a building (as here) the centreline adjustments is **added** to the internal perimeter length.



Disposal of surface water: an item is taken to allow the contractor the opportunity of removing rainwater on the site and in the excavations.

Disposal of surplus excavated material: material removed from site is measured in m^3. The location of the tip is usually at the Contractor's discretion. There are a number of approaches that may be used to measure 'cartaway'. As the trenches are backfilled on both sides of the rising walls it seems that measuring the volume of earth displaced by the foundations, rising walls and hardcore bed is the most straightforward method of calculating this quantity. Note the re-use of the trench centreline

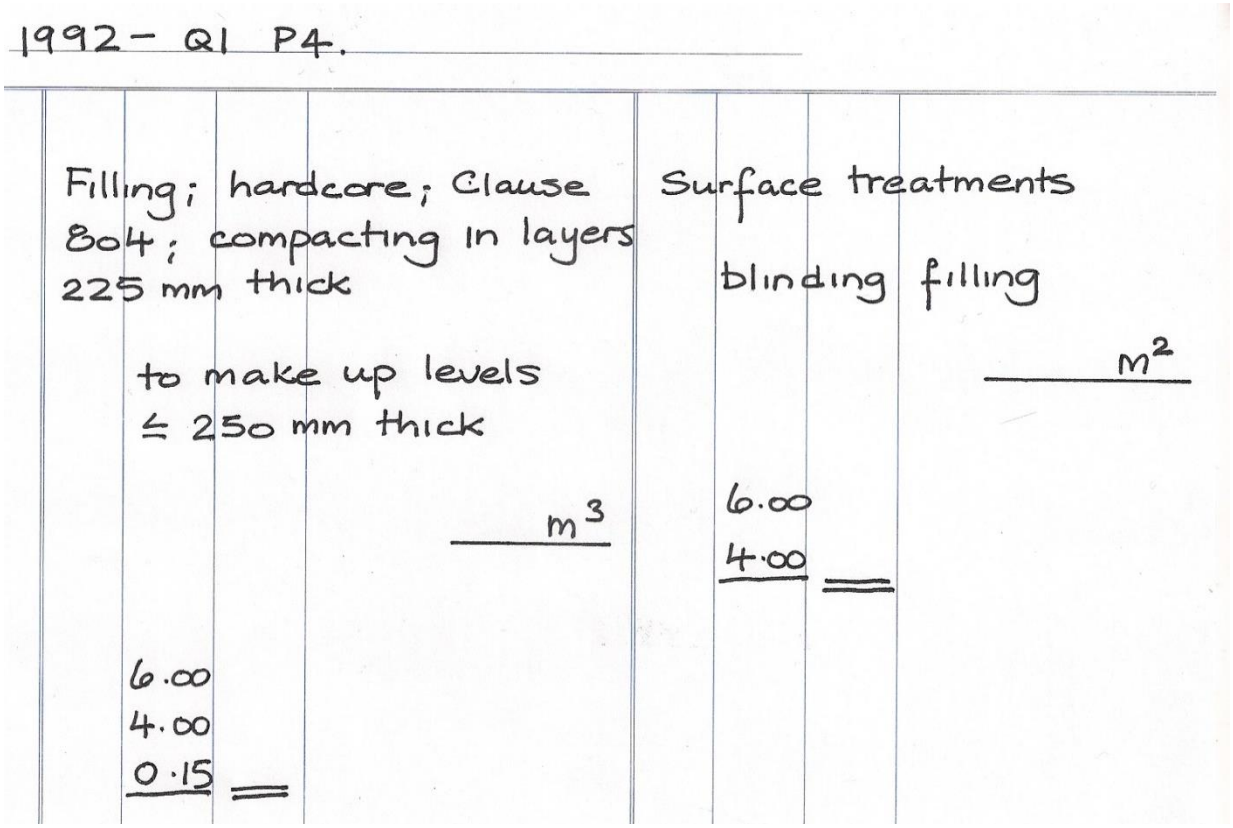
measurement in calculating the foundations and rising wall. An alternative approach is to add up all the excavation and deduct any backfilling. **Note**, no allowance is made for bulking of the excavated material when measuring this class of work.



Backfilling is measured in m^3 stating whether it exceeds or does not exceed 250mm thick. Details of treatment of the fill such as compacting in 225mm thick layers must be given in the description. Excavated material is commonly used to backfill voids left by excavation operations. In trenches this occurs between the rising wall and the trench side above the top of the foundation. In this case the

both sides of the trench are backfilled –therefore the width of the fill is obtained by subtracting the rising wall's thickness from the trench width.

Additional filling is required **to make up levels** on the outside of the wall between the top of the trench and ground level (see the red box on the thumbnail sketch above). Note how the internal perimeter is adjusted to move to the centreline of this filling. The distance moved is 215 (Wall) plus 78mm (half the 'toe' projection) and is adjusted for each corner (4/2/293mm)

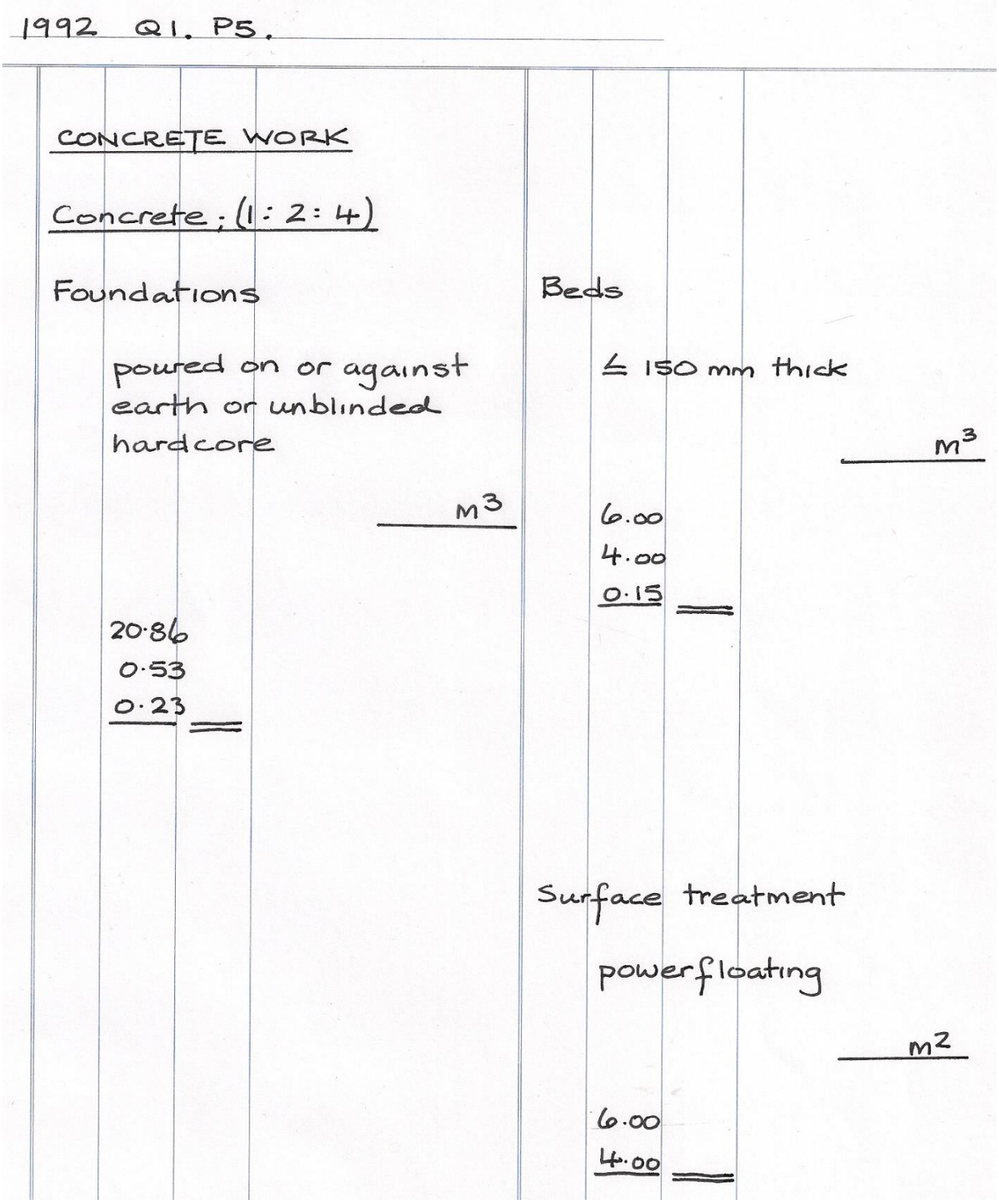


Hardcore a 150mm hardcore bed is required below the ground floor slab and is classified as making up levels and is measured in m^3 stating the average thickness as exceeding or not exceeding 250mm thick. Hardcore descriptions must specify the kind and quality of the materials and any treatments such as compacting. The measurements are taken within the walls producing a value which is often referred to as the 'gross internal floor area'

Surface treatments including blinding filling with sand is measured in m^2. Note that blinding sloping surfaces are measured separately.

Concrete Work is measured in accordance with section F of ARM. and is measured in cubic metres. Concrete particulars state the kind and quality of materials; any performance or mix details and any

testing requirements. In this question the concrete mix proportions are specified. Concrete is typically billed in order of increasing concrete strengths.



1992 Q1. P5.

CONCRETE WORK

Concrete: (1:2:4)

Foundations

poured on or against earth or unblinded hardcore

m3

20·86
0·53
0·23

Beds

≤ 150 mm thick

m3

6.00
4.00
0.15

Surface treatment

powerfloating

m2

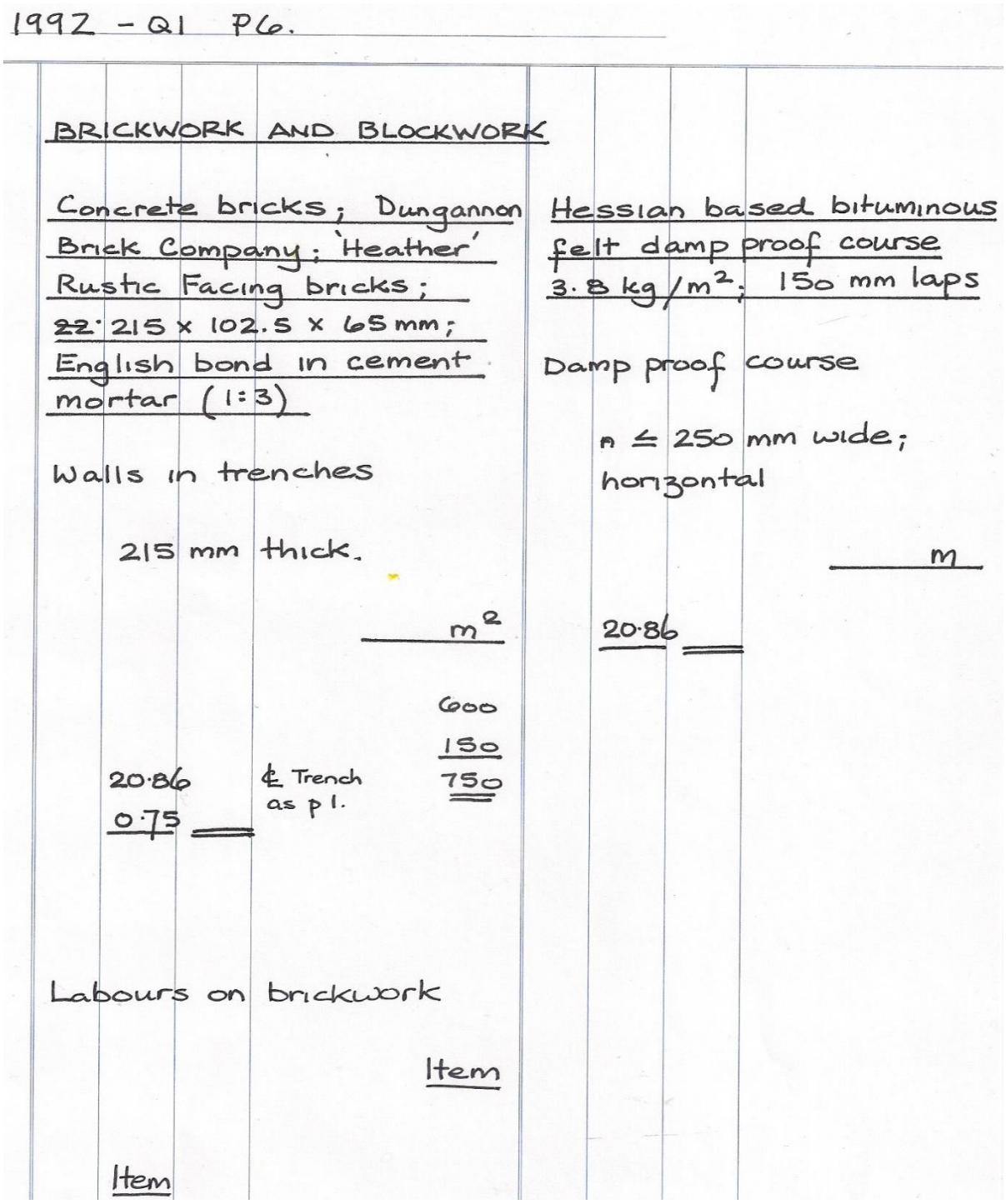
6.00
4.00

Concrete foundations must state if they are poured on or against earth or unblinded hardcore as in these instances a large proportion of the fill will seep into the surrounding ground strata. The estimator

will need to take this into consideration when pricing this class of work. Note the work is measured on the centreline of the trench.

Concrete ground floor slabs are described as beds and classified as either not exceeding, or exceeding, 150mm thick.

Surface Treatments such as power floating is measured in m^2.



1992 - Q1 P6.

BRICKWORK AND BLOCKWORK

Concrete bricks; Dungannon Brick Company: 'Heather' Rustic Facing bricks; 22·215 x 102.5 x 65 mm; English bond in cement mortar (1:3)

Walls in trenches

215 mm thick.

m²

20·86
0·75

℄ Trench as p 1.

600
150
750

Labours on brickwork

Item

Item

Hessian based bituminous felt damp proof course 3·8 kg/m²; 150 mm laps

Damp proof course

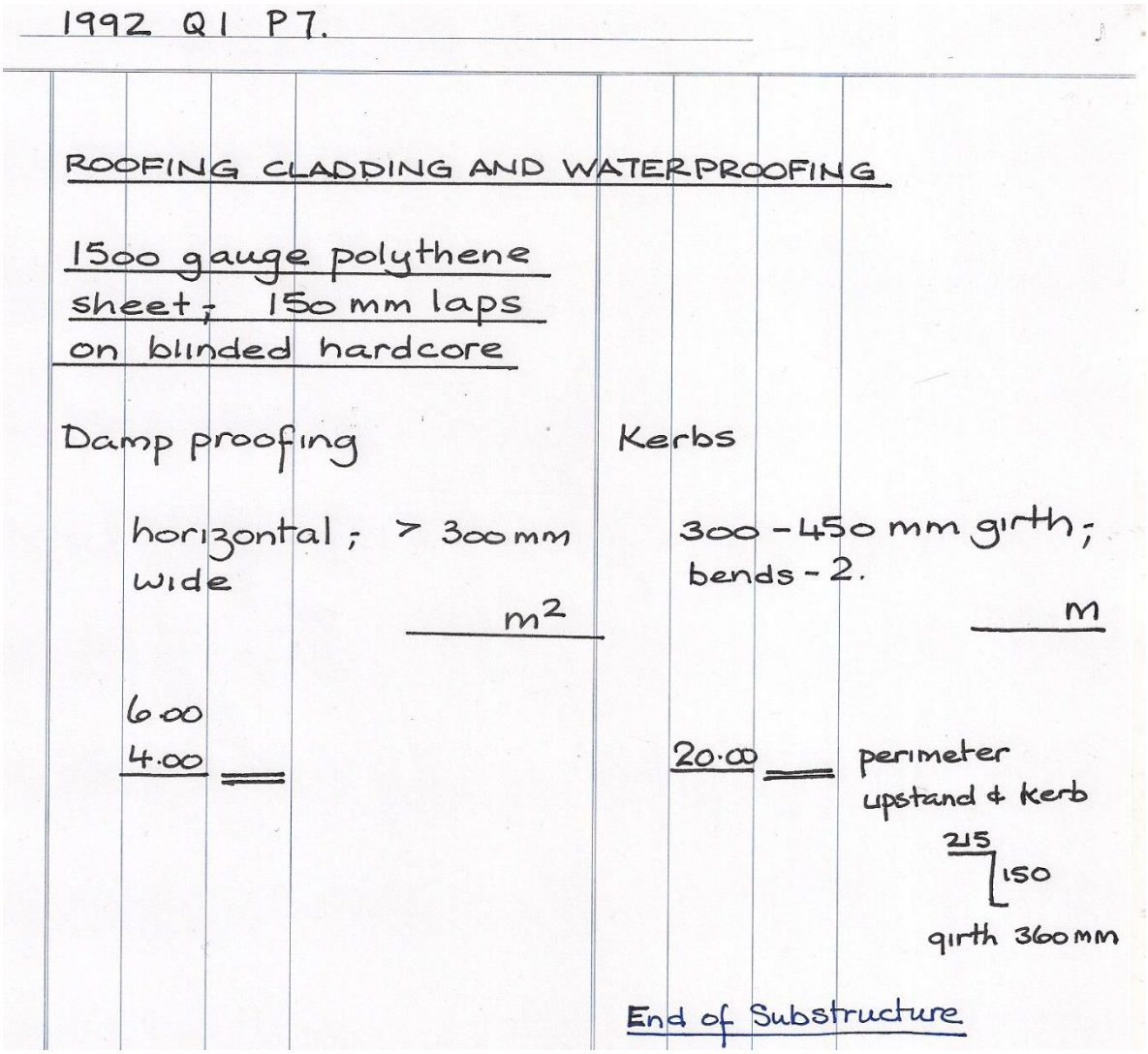
n ≤ 250 mm wide; horizontal

m

20·86

Brick rising walls are measured in accordance with Section G of ARM in $m^{2.}$ In answering this question candidates should have provided the following particulars in their brickwork descriptions: the kind, quality and size of the bricks; the type of bond; and the composition and mix of mortar. As the work is covered up there are no surface finish or pointing requirements. The work is classified as walls in trenches stating the thickness (215mm). The walls are measured on the centreline of the trench. An Item is taken for **labours on brickwork** which includes various tasks such as cutting, forming angles and ends, raking out joints and building in ends.

Damp proof courses not exceeding 225mm wide are measured in linear metres; where these exceed 225mm they are measured in m^2 with laps stated in the description.


1992 Q1 P7.

ROOFING CLADDING AND WATERPROOFING

1500 gauge polythene sheet; 150 mm laps on blinded hardcore

Damp proofing

horizontal; > 300 mm wide

m^2

6.00
4.00

Kerbs

300 - 450 mm girth; bends - 2.

m

20.00

perimeter upstand & kerb

215
150

girth 360 mm

End of Substructure

Damp proof membrane.is measured in m^2 in accordance with the Roofing Cladding and Waterproofing (Section I) of ARM, within the Waterproof and Gas Proof Non-metal Flexible Sheet Covering sub-section. The information to be provided in damp proofing coverings states: the kind, quality and thickness of the materials; the number of layers and extent of laps; the nature of the base

on which the material is applied, and any underlay and insulation. Damp proofing is categorised as (1) horizontal, (2) sloping 15-45 degrees, (3) sloping over 45 degrees – stating the slope, and (4) vertical. Membranes are further categorised as either exceeding or not exceeding 300mm wide, identifying whether the work is curved. A cautious approach has been taken in measuring the perimeter upstand and lap under the damp proof course as a separate kerb. Kerbs are described in detail stating the girth in stages of 150mm. Many surveyors, however, take the view that the upstand is not a separate activity from the general damp proofing and include it with the horizontal damp proofing activity.

2001 A 'T' Shaped Building

The Question

Measure **only** the following items below DPC level shown in Figure 1 and calculate the net quantities in the units indicated.

a.	Excavate topsoil average 150mm deep.	Sq.m.
b.	Excavate foundation trenches	Cu.m.
c.	Excavate to reduced level	Cu.m.
d.	Disposal of excavated material off site	Cu.m.
e.	Concrete in foundations	Cu.m.
f.	100mm thick concrete blockwork in skins of hollow wall	Sq.m.
g.	100mm wide DPC	M

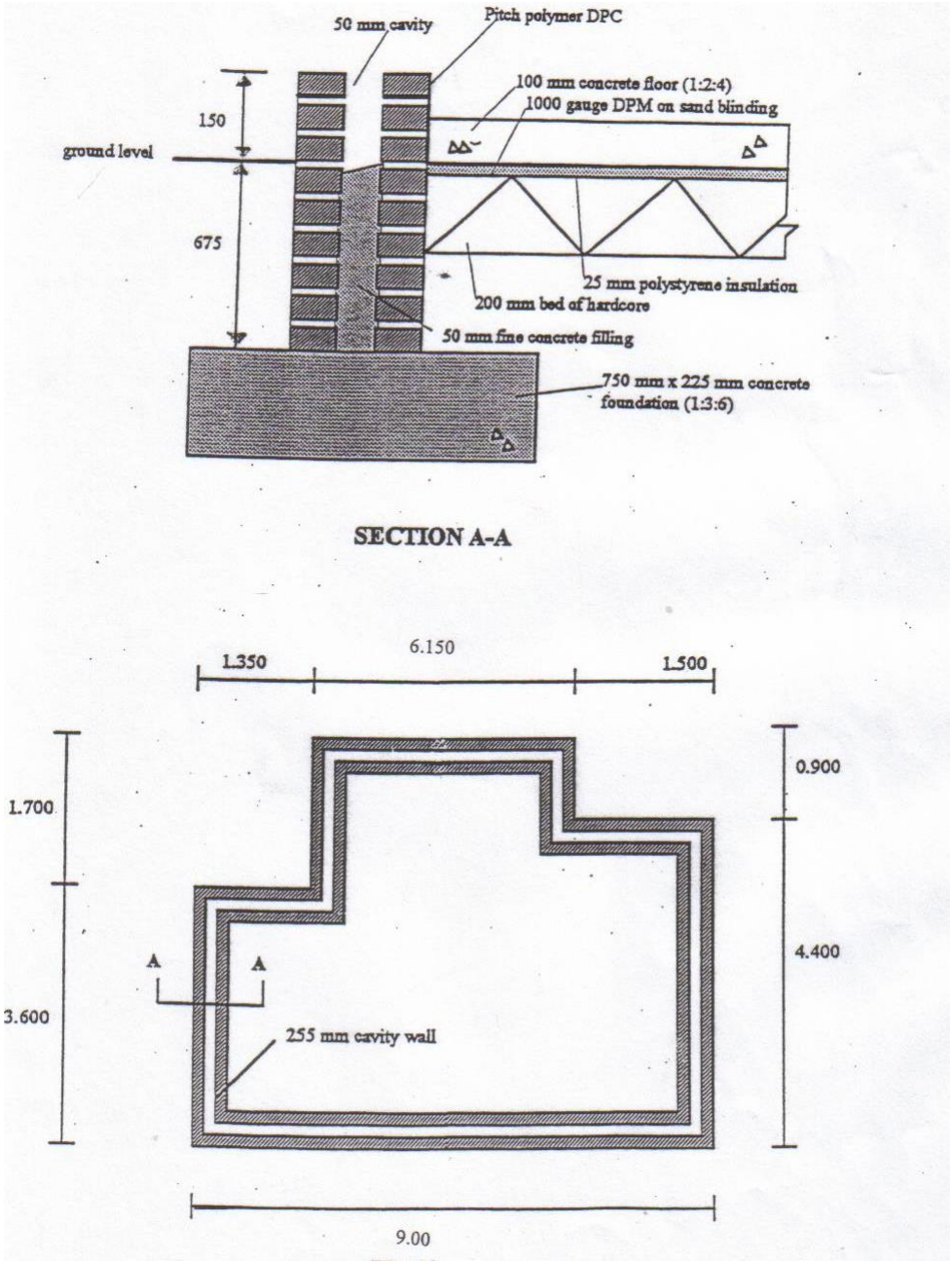
General Commentary

This question involves taking off and squaring seven items in the substructure, (the previous worked example contained 16 items). The question mainly focuses on the candidates' ability to calculate quantities derived from perimeter and centreline calculations. Candidates should use the overall building dimensions (9000 and 5300) to calculate the external perimeter. Submissions using the less efficient 'around the house' approach i.e. totalling the eight dimensions on the drawing would probably be marked down. The 'overall' approach also demonstrates the candidates' understanding that the clipped corners can be ignored when measuring perimeters. Note, however, that the figures used to calculate the overall width of the building (5300) must be shown as a side cast (1700 + 3600).

The question also examines the candidates' ability to calculate quantities relating to plan areas (parts a and c: topsoil strip and reduce level dig). These require candidates to measure the area of the topsoil stating its average thickness. This value can be labelled (TOT A) and repeated to calculate the volume of the reduce level dig, - note this technique (CUBE X). The topsoil is measured to the footprint of the building which extends to outer edge of the projecting 'toe' of the foundation. The approach taken

below is to measure overall and then adjust for the complications, (i.e. deduct for the two set-back ‘clipped’ corners at the top of the plan). The figured dimensions of the clipped corners are used, without adjustment, when deducting these the areas.

With regard to part (f) and (g), although the detail indicates brickwork, the question requests candidates to measure 100mm blockwork and this has been demonstrated here. A query sheet would confirm this discrepancy between the drawing and the bill of quantities. As the two skins of the cavity wall are positioned an equal distance on either side of the centreline of the foundation, the centreline can be twiced (this establishes the length of the dpcs) and multiplied by the height of the rising walls to produce the blockwork quantity. Note that the coverage rules of ARM4 state that the term ‘walls’ includes skins of hollow walls.


50 mm cavity
Pitch polymer DPC
100 mm concrete floor (1:2:4)
1000 gauge DPM on sand blinding
150
ground level
675
25 mm polystyrene insulation
200 mm bed of hardcore
50 mm fine concrete filling
750 mm x 225 mm concrete foundation (1:3:6)

SECTION A-A

6.150
1.350
1.500
1.700
3.600
0.900
4.400
A
A
255 mm cavity wall
9.00

2001 Q1 P1

EXCAVATION AND EARTHWORK

Excavation

topsoil for presevation
average depth 150 mm

51 m^2

			'toe' of found	750
				− 255
				2) 495
			spread =	248
				width 1700
			length	3600
			9000	5300
			spread 2/248	496
				9496
9.50				5796
5.80	55.10			
	Ddt.			
1.35				
1.70	2.30			
1.50				
0.90	1.35			
	3.65			
TOTA	51.45	TOTA.		

reduce levels; depth ≤ 2.00 m.

TOTA		
m^2		
51.45		
CUBEX 0.08	4.12	

4 m^3

Insul	25
hardcore	200
	225
− topsoil	150
	75

measured before trench excav.

2001 Q1 P2

foundation trenches; depth ≤ 2.00 m

14 m^3

length 9000
width 5300
2/ 14300
Ext Perim 28600
℄ Adj -4/255 -1020
℄ 27580

height 675
+ found + 225
- tot reduce lev - 225
depth 675

27.58
0.75
0.65 14.07

Disposal excavated material; off site

12 m^3

4.12
m^3 4.12

Reduce Level dig see p 1.

27.58
0.75
0.23 4.76

Conc Found. ℄ as across

27.58
0.26
0.45 3.23
12.11

Cavity Wall
675
Red 1 − 225
450

Ddt

Backfill above trench on outer face of wall.

Ext Perim 28600
+ 4/248 992
29592

29.59
0.25
0.08 0.59
11.52

2001 Q1 P3

CONCRETE WORK

Concrete; type A as specification

Foundations

poured on or against earth or unblinded hardcore

5 m^3

27.58 ℄ as.before
0.75
0.23 4.76

BRICKWORK AND BLOCKWORK

Blockwoek; as specified; solid; 440 x 215 x 100 mm; stretcher bond; in cement mortar (1:3)

Walls in trenches

100 mm thick

46 m^2

675
2/27.58 + 150
0 83 45.78 825
℄ as.before

2001 Q1 P4.

Damp proof course as specified; 150 mm laps

Damp proof course

≤ 250 mm wide; horizontal

55 m

2/27.58 55.16 ℄ as.before.

2000 A building with set-back corners and a recessed ‘bight’

The Question

Measure **only** the following items below DPC level shown in Figure 1 and calculate the net quantities in the units indicated.

i.	Excavate topsoil average 150mm deep.	Sq.m.
ii.	Excavate to reduced level	Cu.m.
iii.	Excavate foundation trenches starting at reduced level	Cu.m.
iv.	Disposal of excavated material off site	Cu.m.
v.	Concrete in foundations	Cu.m.
vi.	200mm thick concrete blockwork in rising walls	Sq.m.
vii.	50 thick sand blinding	Sq.m.

General Commentary

This question again involves measuring seven items, but there is a greater emphasis here in calculating quantities relating to areas on the plan.

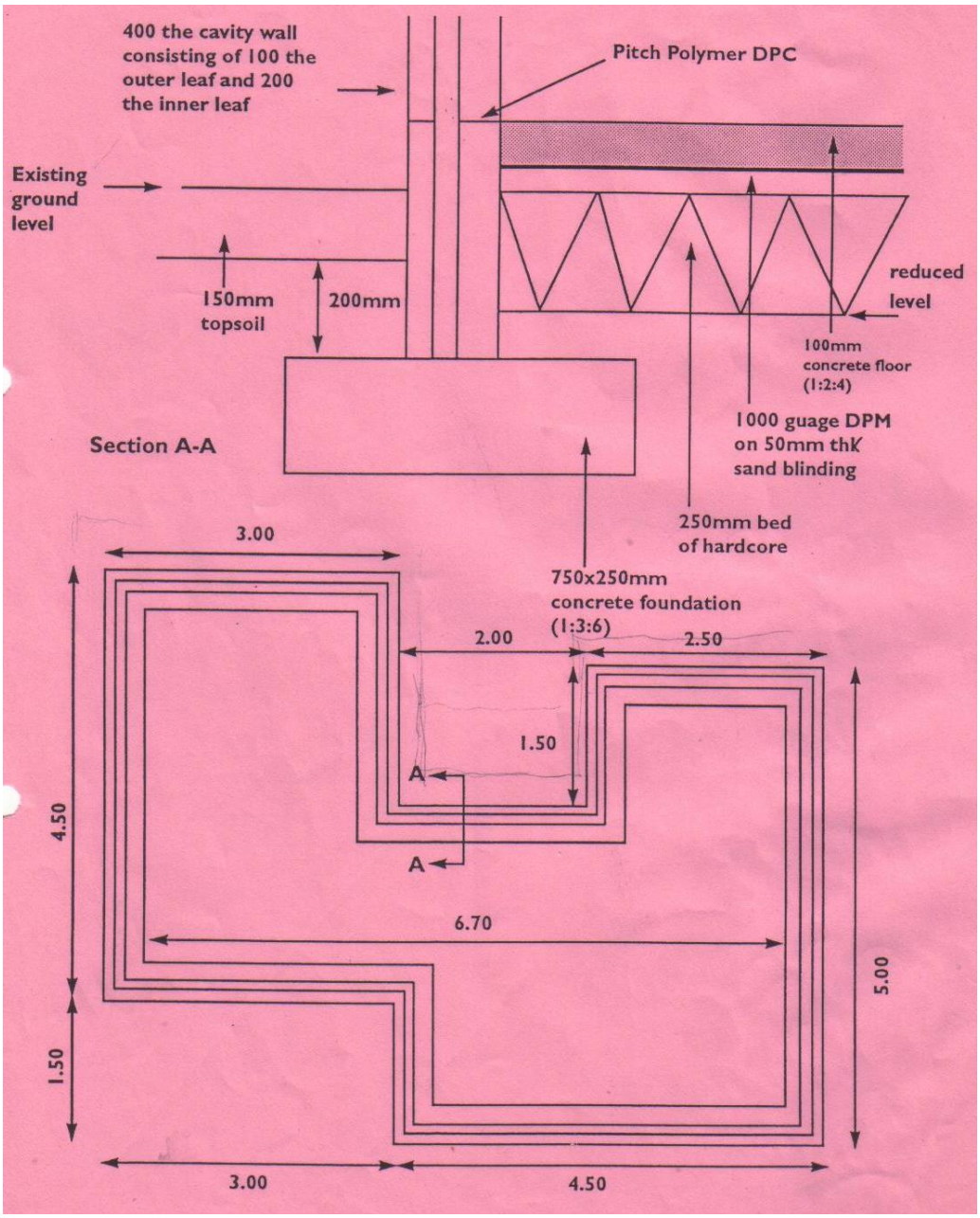
Candidates were required to measure areas based on the ‘footprint’ (parts i and ii) and the ‘gross internal floor area’ of the building (part vii). The presence of clipped corners and a recess or ‘bight’ results in a plan shape that is quite complicated. In dealing with this layout, it is advisable to measure overall in the first instance and then adjust for the various complications, - an approach that has been described as a ‘golden’ rule of measurement.

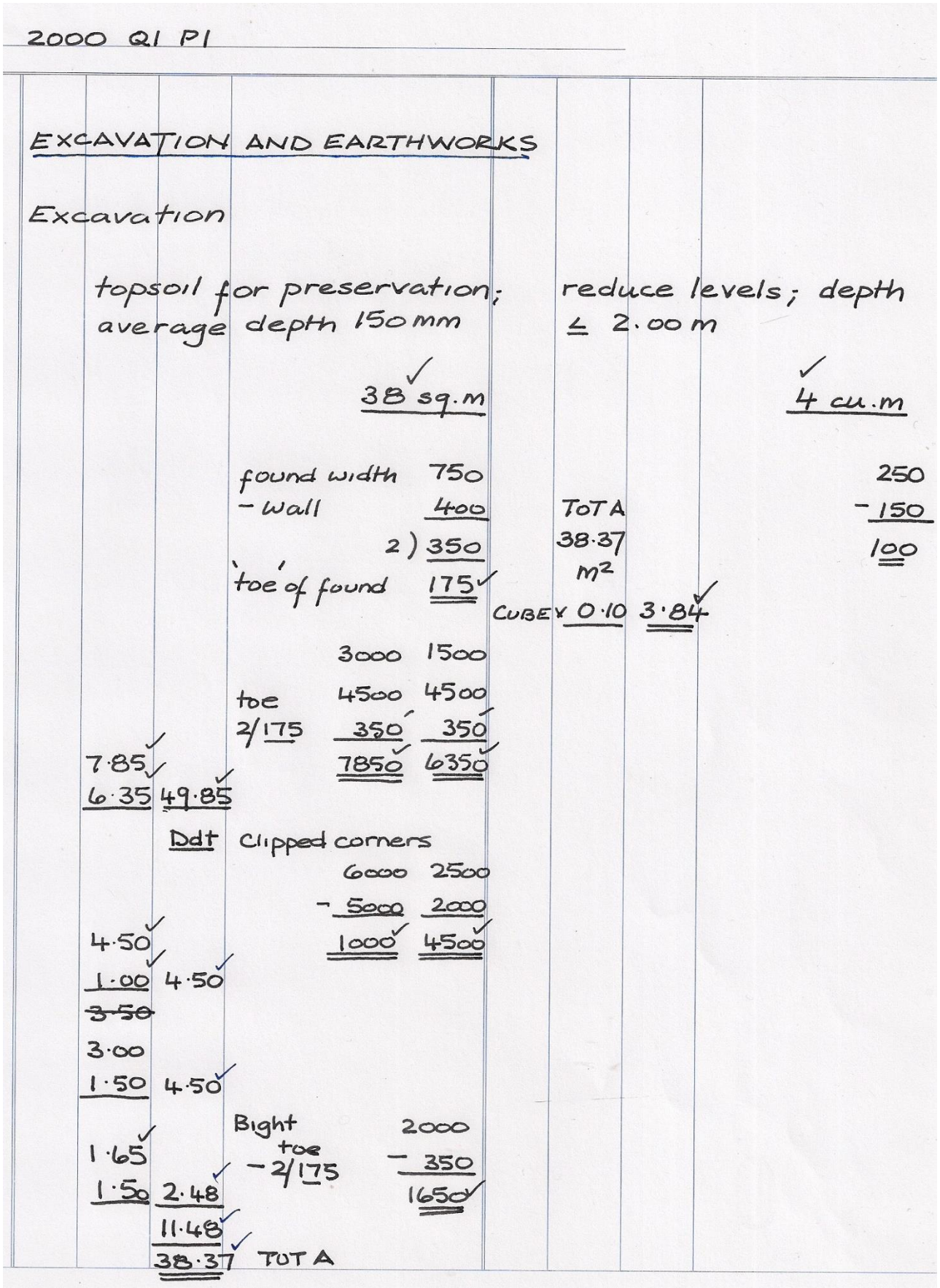
Dealing with ‘clipped’ corners is relatively straight forward. The plan dimensions for the adjustment of the set-back are **constant.** Therefore, in moving outwards they can be applied to the topsoil, and moving inwards they apply to the floor slab.

Adjustments for recesses or ‘bights’, on the other hand, are variable in their width but constant in their depth. So, when moving outwards to adjust for the topsoil the width of the bight tightens by the ‘toe’ of the foundation on either side (2/175). Similarly, when adjusting for floor slab, the width of the bight expands to include the width of the wall on both sides (2/400). Note the adjustment for the depth of the bight remains constant in both cases (1500mm).

In calculating the perimeter of the building and associated girthings, candidates must have taken account of the depth of the bight. The perimeter formula here is expressed as **twice times the sum of the overall length, width and projections**. Again, the figures used to calculate the overall length, width and the set-back to the top right side of the building must be shown as side casts.

Note how the external perimeter is adjusted when calculating the volume of the backfill on the inside and outside of the rising walls in the trench and the area of the 200mm blockwork (part vi), which is adjusted using the formula four times twice times the distance moved.





Note that process of checking the squaring by somebody else is demonstrated in this example.

2000 Q1 P2.

foundation trenhes;
depth ≤ 2.00m

7 cu.m.

7500
6000
bight 1500
2/15000
EXT PERIM 30000
- 4/400 -1600
28400

topsoil 150
on drg. 200
found 250
- red lev - 250
350

28.40
0.75
0.35 7.46

Disposal

excavated material;
off site.

10 cu.m

3.84
m³ Reduce level
7.46
m³ 11.30 trench dig.
Ddt

Assumed backfill
on both sides of
trench.

Ext Perim 30000
+ 4/175 700
30700

30.70
0.18
0.20 1.11 Fill on outside of wall

400
½/175 88
Perim adj 488

Ext Perim 30000
26.10 -4/2/488 3904
0.18 26096
0.10 0.47 Fill on inside of wall
1.58
9.72

2000 Q1 P3

Surface Treatment.

blinding with sand
50 mm thick

22 Sq.m ✓

6000
-walls 2/400 800
5200 ✓

6.70 ✓
5.20 ✓ 34.84 ✓

Ddt Clipped corners

4.50
1.00 4.50 ✓
3.00
1.50 4.50 ✓

'Bight' 2000
2.80 ✓ + walls 2/400 + 800
1.50 4.20 ✓ 2800 ✓
13.20 ✓
21.64 ✓

CONCRETE WORK

Concrete; Type A as described (1:3:6)

Foundations

poured on or against earth or unblinded hardcore

5 ✓ Cu m

28.40 ✓ & trench
0.75
0.25 5.33 ✓

2000 Q1 P4

BRICKWORK AND BLOCKWORK

Concrete blockwork; solid; type A as described; stretcher bond; in cement mortar (1:3)

Walls in trenches

200 mm thick

14 Sq.m

Ext Perim		30000
outer leaf	100	
cavity	100	
½ inner lf	100	
- 4/2/	300	2400
		27600

Height		
trench		100
hadcore		250
Sand		50
Slab	100	100
		500

27.60
0.50 13.80

2007 A Building with Internal Walls

The Question

Measure the following items below DPC level shown in Figure 1 and calculate the net quantities in the units indicated.

a)	Excavate topsoil average 150mm deep.	Sq.m.
b)	Excavate foundation trenches starting from stripped level	Cu.m.
c)	Concrete to foundation trenches	Cu.m.
d)	Concrete to floor slab	Cu.m.
e)	100mm thick brickwork internal walls	Sq.m.
f)	100mm thick brickwork external leaf of cavity wall	Sq.m.
g)	150 mm thick blockwork internal leaf of cavity wall	Sq.m.

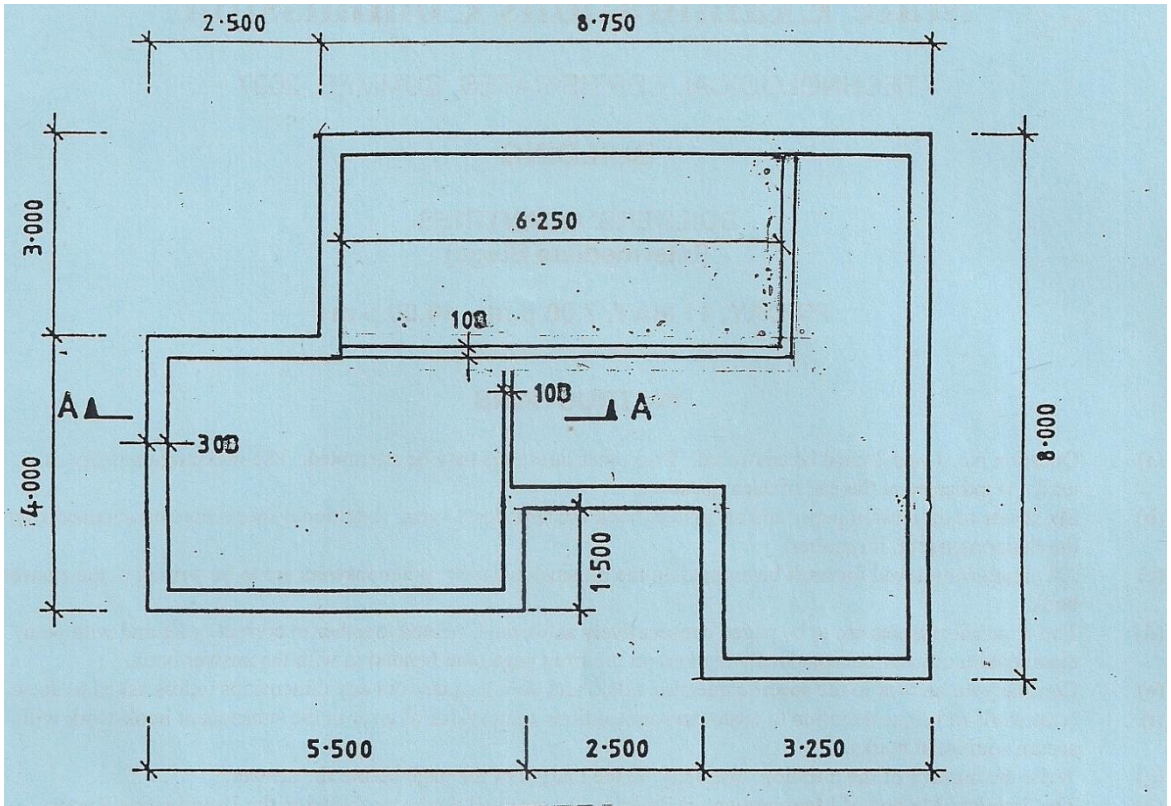
General Commentary

This question involves measuring the seven items above. The layout contains a clipped corner, a bight, and foundations to both external *and* internal walls.

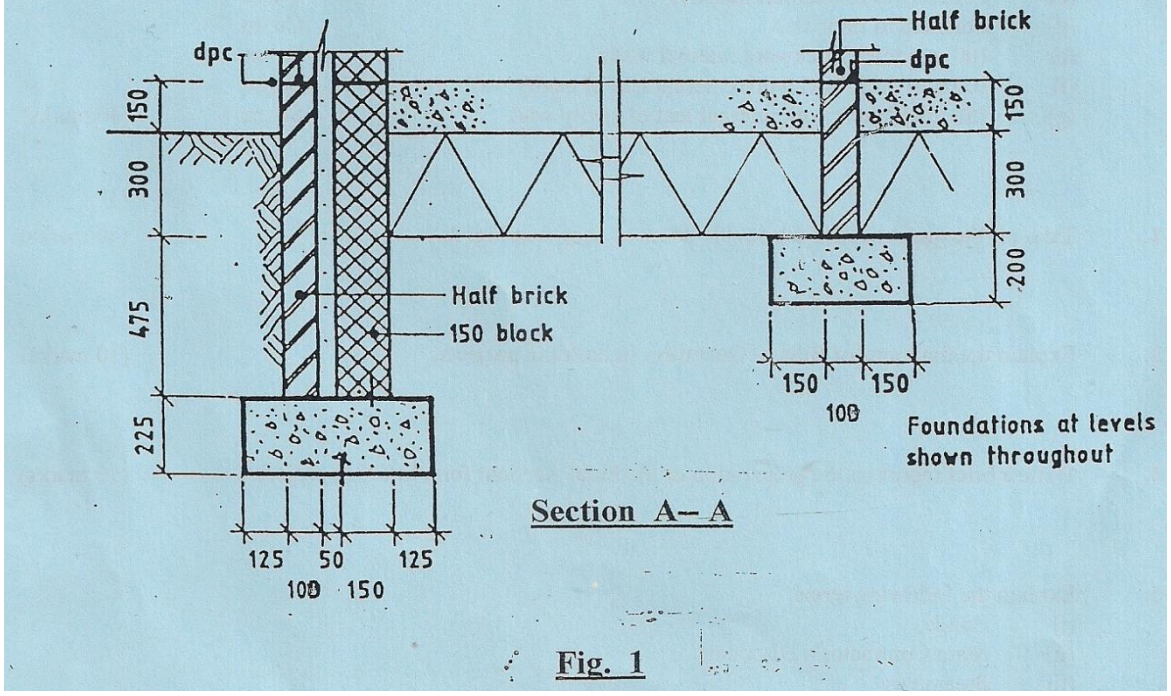
The additional issues involved in this layout requires candidates to measure foundations to partition walls and to deal with the effects of angles and intersections on the internal foundations and also with junctions between the internal and external foundations. In addition, works relating to the ground floor slab must take account of the rising walls which penetrate the various constituents of the floor structure.

It may be noted that when measuring the partitions that the lengths of the foundation trenches do not equal the lengths of the walls. This is due to the trenches overlapping each other at the various junctions. On external foundations, the extent of the projecting ‘toe’ is subtracted from the adjoining internal foundation trench. Where internal partitions intersect, the width of the intersecting foundation is deducted. Note also, that in measuring the partitions, it is possible to envision a simplified layout by realigning the partitions running top to bottom on the plan to form a continuous ‘crosswall’ (see item b).

With regard to the two 100mm brickwork items (items e and f), these would normally be aggregated and measured together. The question, however, requires the two to be measured separately and this instruction has been followed here.



Plan



Section A– A

Fig. 1

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EXCAVATION AND EARTHWORKS

Excavation

topsoil for preservation average 150 mm deep.

76 Sq.m

		5500	
		2500	
		3250	
		11250	
		Add toe 2/125 as Sec A-A	250
			11500
			8000
11.50		toe above	250
8.25	94.88		8250
	Ddt.		
2.50		Clipped Corners.	
3.00	7.50		
		5500	8000
8.00		2500	-3000
1.00	8.00	8000	-4000
			1000
		Bight	2500
2.25		- toe -2/125	-250
1.50	3.38		2250
	18.88		
	76.00		

foundation trenches : starting from stripped level; depth not exceeding 2.00 m

20 Cu.m

		length	11250
			8000
		bight	1500
		2/	20750
		EXT PERIM	41500
		Ext leaf	100
		Cavity	50
		Int leaf	150
		4 / 300	-1200
		℄ of trench	40300

		Width	Depth
		125	300
		100	475
		50	225
40.30		150	- tops 150
0.55		125	850
0.85	18.84	550	

Continued over.

18.84 Carried forward

Int Walls 6250
- overlap on ext Wall -125
+150
Ⓐ 6275

Cross Wall
7000
- bight -1500
- ext walls -2/300 -600
- ext overlap -2/125 -250
- part foundtion -400
Ⓑ 4250

Ⓐ 6275
Ⓑ 4250
10525

		Width	Depth
		150	300
10.53		100	200
0.40		150	-150
0.35	1.47	400	350
	20.31		

CONCRETE WORK

Concrete: Type A as specification

Foundations

poured on or against earth or unblinded hardcore

6 Cu m

40.30		Ext Trenches &
0.55		as bef.
0.23	5.10	
10.53		Int Trenches
0.40		
0.20	0.84	
	5.94	

Concrete; Type B as specification

Beds

≤ 150 mm thick

9 Cu.m

			11250
		-Walls 2/300	- 600
			10650
10·65			8000
7·40		Walls	- 600
0·15	11·82		7400
	Ddt		
2·50		Clipped Corners	
3·00			
0·15	1·13		
8·00			
1·00			
0·15	1·20		
3·10		Bight	2500
1·50		Walls	600
0·15	0·70		3100
		Internal Walls	
11·15		partition	6250
0·10		+	7000
0·15	0·17	bight -	1500
	3·20	Walls 2/300	- 600
	8·62		11150

BRICKWORK AND BLOCKWORK

Brickwork; Type A as specification; 215×103×65mm; stretcher bond in cement mortar (1:3)

Walls

100 mm thick

5 Sq.m

11·15		Int. walls only	
0·45	5.02	as last)	
			300
			150
			450

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100 mm thick

38 Sq.m

External Walls only

EXT PERIM 41500
- 4/100 - 400
℄ of brick 41100

475
300
150
925

41.10
0.93 38.22

Blockwork; Type B as specification; 440 x 215 x 150 mm; stretcher bond; in cement mortar

Walls

150 mm thick

37 Sq.m

EXT PERIM 41500

brick 100
Cavity 50
½ block 75
-4/2/225 -1800
℄ block 39700

39.70
0.93 36.92 ht as brick.

In Summary

Measuring substructures is a frequent examination topic on first year quantity surveying programmes. These examinations remain, to a great extent, paper based and require the candidates to demonstrate sound measurement procedure in describing and quantifying work. In this paper the Author presents solutions to a sample of four State examinations. The intention is to demonstrate how descriptions, dimensions and the supporting 'waste calculations' and annotations may be set out. It is acknowledged that there are many ways to arrive at a quantity, but examiners must be able to follow the candidates thought process without undue difficulty. Demonstrating a clear and effective approach is the key to obtaining high marks. Sound practice holds that all steps in performing calculations should be clearly recorded, and that mental arithmetic should be avoided. Candidates should also avoid presenting cramped / sloppy work.

The substructure examination questions selected here show the importance of the ability to measure and adjust surface areas and perimeters accurately and effectively. This skill is acquired through practice. It is hoped that the worked examples presented here will help students to develop these skills and develop their ability to apply the principles to other situations.

Further Reading

Readers are recommended to consult Chapter Four of *Seeley and Winfield's Building Quantities Explained Irish Edition.* (Hore, A.V. O'Kelly, M. and Scully, R. eds. (2009) Palgrave McMillan, Basingstoke.) This Chapter sets out a full substructure measure with accompanying explanations and commentary.