Loughborough University

SITE SURVEYING AND MEASUREMENT (CEM)
(21CVA128)

Semester 2 2021-22 Online Short-window Exam paper

This is an online short-window examination, meaning you have a total of **2 hours plus additional 30 minutes** to complete and submit this paper. The additional 30 minutes are for downloading the paper and uploading your answers when you have finished. If you have extra time or rest breaks as part of a Reasonable Adjustment, you will have further additional time as indicated on your exam timetable.

It is your responsibility to submit your work by the deadline for this examination. You must make sure you leave yourself enough time to do so.

It is also your responsibility to check that you have submitted the correct file.

Exam Help
If you are experiencing difficulties in accessing or uploading files during the exam period, you should contact the Exam Helpline. For urgent queries please call **01509 222900**. For other queries email examhelp@lboro.ac.uk

You may handwrite and/or word process your answers, as you see fit.

You may use a calculator for this exam but candidates must write sufficient information to show the method used in deriving the answers.

Answer **QUESTION 1** in **Section A.**

Answer **TWO QUESTIONS** from **Section B**.

USE THE DIMENSION PAPER, DRAWINGS AND NRM2 SECTIONS PROVIDED.

Continues/…

SECTION A
(Answer **THIS** question)

Q1. With reference to Drawings L101-128 and L102-128 and the following NRM2 Work Sections:

5: Excavating and Filling
14: Masonry

measure all required items to fully describe and quantify all work at DPC level and below.

DO NOT measure:

Concrete floor slab or screed.
Brick or blockwork
DPCs, DPM
Insulation

DO measure the items associated with the following take-off list:

a) Topsoil removal [5 marks]
b) Excavation and related items [18 marks]
c) Concrete to foundations and cavity fill [10 marks]

Set-out your take-off following all standard conventions on appropriately formatted billing paper.

Enter dimensions in the deductions and additions columns of your billing paper only. Do not use the extensions/squaring column other than to indicate where a quantity would be calculated.

Use the provided query sheet as necessary to document any assumptions made during your take-off.

Follow all relevant NRM2 measurement rules, work and item classifications, and notes.

When finished, photograph or scan your billing paper, marked-up drawings, and any query sheet(s), **combine into a single pdf file** and upload your solution.

Continues/…

SECTION B
(Answer **TWO** questions)

Q2. The following sequence of staff readings in metres were observed using an automatic level, in good weather conditions.

BS: 0.843, ISs: 1.324, 2.376, 0.525, FS: 1.278
BS: 1.753, ISs: 0.274, 0.473, FS: 0.413
BS: 2.314, ISs: 2.347, (2.132), FS: 0.402
BS: 1.534, FS: 1.433

Where the readings in brackets denote a location where the levelling staff was inverted.

The first backsight was taken to a staff positioned on a Benchmark with a reduced level of 143.657m AOD. The final foresight was observed to a staff situated at a TBM at a reduced level of 146.580m AOD.

a) Draft a levelling table and set out, reduce and check the level readings using either the Rise and Fall or the Height of Collimation method. Ensure that you show all appropriate checks and establish the misclosure of the levelling.

[23 marks]

b) Determine the allowable misclosure and comment on whether the levelling should be accepted or rejected.

[2 marks]

c) Write short notes on the procedures to follow to reduce errors during levelling.

[8 marks]

Q3. a) Identify and describe the function of the various components and features of a Total Station.

[17 marks]

b) Write short notes on two developments in the design of a Total Station which increase efficiency in the way in which survey work is carried out.

[6 marks]

c) Write short notes on the methods for controlling vertically on site.

[10 marks]

Continues/…

Q4. a) Describe using diagrams as appropriate four main methods which can be used to define horizontal setting out points in relation to a site control system.

[20 marks]

b) Explain how the combination of sight rails and a traveller is used to control the excavation necessary to construct a drain. What modern technique could be used as an alternative?

[13 marks]

Q5. A circular curve is to connect two straight roads with an intersection angle of 062-56-32. The curve radius is 75m and the chainage of the intersection point is 430.440m.

a) Calculate the tangent length, length of the curve, chainage at T1 and T2, the first arc length and last arc length.

[12 marks]

b) Calculate and tabulate the data necessary to set out the required curve using a Theodolite and steel band, ensuring that the running chainage is maintained at intervals of 10m. Ensure you carry out the necessary checks for arc lengths and deflection angles.

[18 marks]

c) Describe how this setting out could be checked for errors.

[3 marks]

D S Thomson
R N Stanley

Formula Sheet on next page

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FORMULA SHEET

Coordinates

$$\Delta E_{AB} = D_{AB}.\sin\theta_{AB} \qquad \Delta N_{AB} = D_{AB}.\cos\theta_{AB}$$

$$\theta_{AB} = \tan^{-1}\left(\frac{\Delta E_{AB}}{\Delta N_{AB}}\right) \qquad D_{AB} = \sqrt{\Delta E_{AB}^2 + \Delta N_{AB}^2}$$

Tape Corrections

$$C_{\text{Standard}} = \frac{D(L - L_s)}{L_s} \qquad C_{\text{Temperature}} = D\alpha(t - t_s)$$

$$C_{\text{Tension}} = \frac{D(T - T_s)}{EA} \qquad C_{\text{Catenary}} = -\frac{w^2 D^3(\cos^2\theta)}{24T^2}$$

$$C_{\text{Slope}} = -D(1 - \cos\theta) \qquad C_{\text{Slope}} = \sqrt{(D^2 - \Delta H^2)} - D \qquad C_{\text{Slope}} \approx -\frac{\Delta H^2}{2D}$$

Areas

Coordinates: $2.Area = (N_1E_2 + N_2E_3 + .. + N_nE_1) - (E_1N_2 + E_2N_3 + .. + E_nN_1)$

Trapezoidal: $Area = \frac{L}{2}\left(O_1 + O_n + 2.\sum \text{remaining offsets}\right)$

Simpsons: $Area = \frac{L}{3}\left(O_1 + O_n + 4.\sum \text{even offsets} + 2.\sum \text{remaining odd offsets}\right)$

Volumes

Trapezoidal: $Volume = \frac{L}{2}\left(A_1 + A_n + 2.\sum \text{remaining Areas}\right)$

Simpsons: $Volume = \frac{L}{3}\left(A_1 + A_n + 4.\sum \text{even Areas} + 2.\sum \text{remaining odd Areas}\right)$

Triang. grid: $Volume = A.\frac{(h_1 + h_2 + h_3)}{3}$ Rect. Grid: $Volume = \frac{A}{4}.\sum(h_i.t_i)$

Circular Curves

$$\text{TL} = R\tan\theta/2 \qquad L = R\theta$$

Deflection Angles

$$\delta\text{rad} = \text{arc}/2R \qquad \text{chord} = 2R\sin\delta$$

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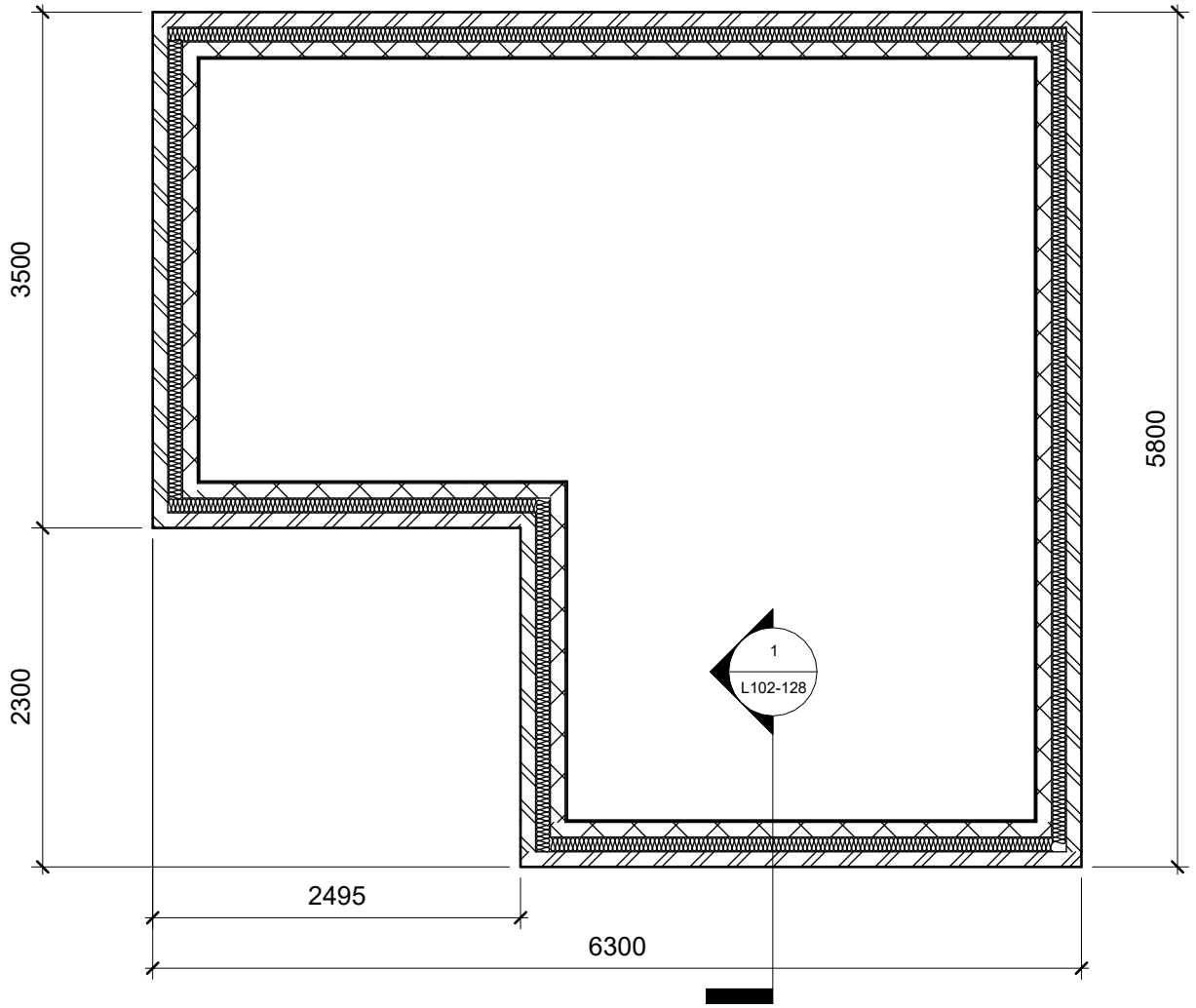
The following documents are also attached to this paper:

Drawing L101-128

Drawing L102-128

Blank Query Sheet



SPECIFICATION NOTES

Topsoil average depth 150mm to be retained on site in a temporary spoil heap at 33m average distance from excavation.

Excavation for foundations measured from underside of topsoil,

Surplus topsoil and surplus general excavated material to be disposed off-site.

Trench fill concrete to be in-situ concrete grade C25, max. 20mm aggregate, poured against unblinded earth.

Brickwork outer skin below DPC to be Class B engineering bricks, in stretcher bond, gauged mortar (1:3:4).

Cavity to be formed using stainless steel twisted wall ties, five per m2.

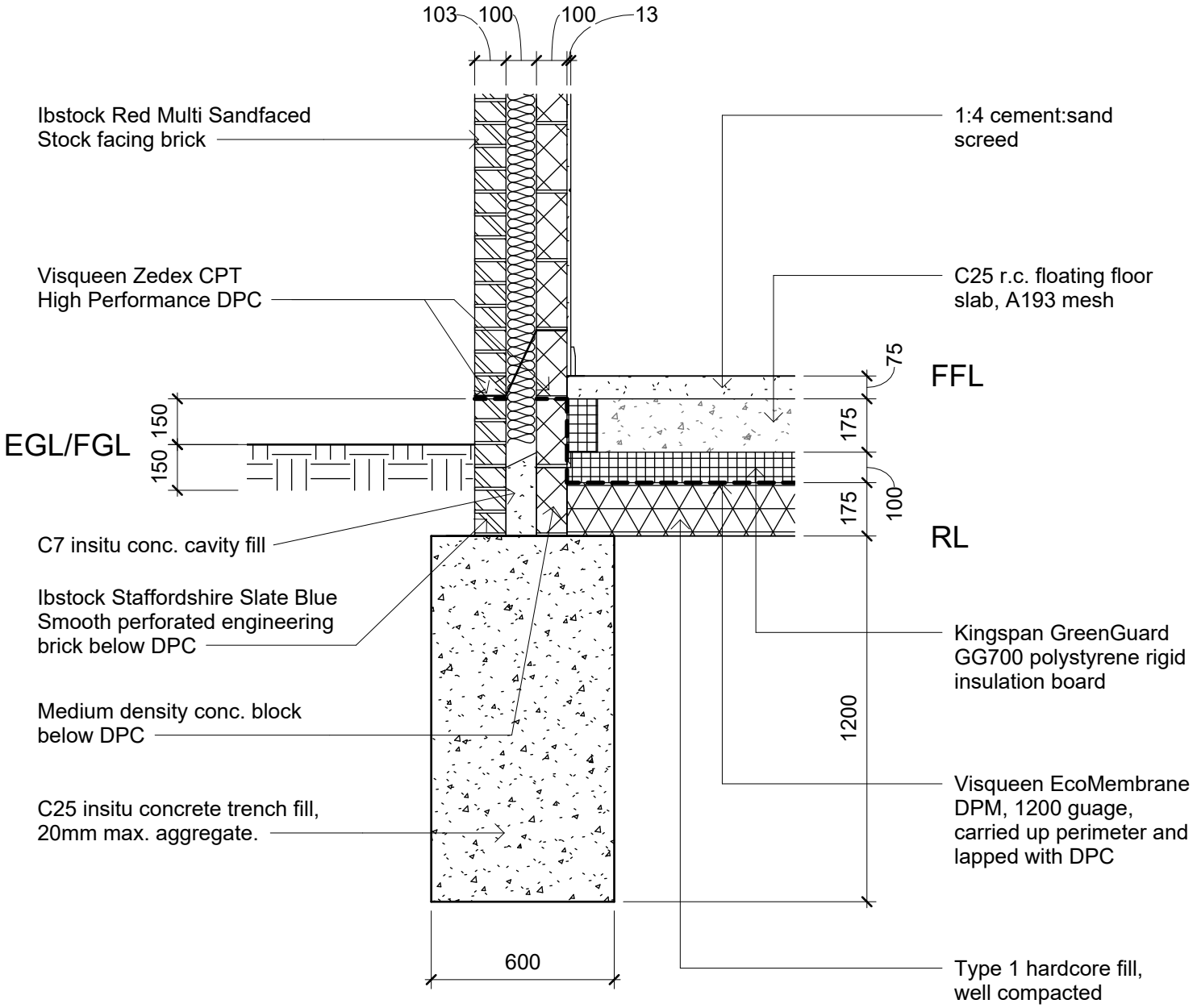
Blockwork to be 100mm solid dense concrete to BS EN 711-3.

Filling to be DOT Type 1 imported hardcore with no organic material.

Weep holes to outer leaf to be provided every fourth brick.

DPC to be Visqueen Polythene Damp Proof Course to BS 6515.

Loughborough University		PROJECT 21CVA128	CLIENT Examination			
Code	Status		Date Issue Date	Project Number Project Number	Scale (@ A4) 1 : 50	REV
SUITABILITY DESCRIPTION	PURPOSE OF ISSUE	SHEET General Arrangement	Drawn by Author	DRAWING NUMBER L101-128		
			Checked by Checker			



Loughborough University		PROJECT 21CVA128	CLIENT Examination		
Code	Status		Date Issue Date	Project Number Project Number	Scale (@ A4) 1 : 20	REV
SUITABILITY DESCRIPTION	PURPOSE OF ISSUE	SHEET Foundation Section	Drawn by Author	DRAWING NUMBER L102-128	
			Checked by Checker		

Chartered Quantity Surveyors LLP

Query List

Project: _____ Date: _____

Issued to: _____ Submitted by: _____

Sheet nr: _____

Query Nr	Query	Response