Loughborough University

Measurement and Site Surveying
22CVA124

Semester 2 2023 In-Person Exam Paper

This examination is to take place in-person at a central University venue under exam conditions. The standard length of time for this paper is **2 hours**.

You will not be able to leave the exam hall for the first 30 or final 15 minutes of your exam. Your invigilator will collect your exam paper when you have finished.

Help during the exam

Invigilators are not able to answer queries about the content of your exam paper. Instead, please make a note of your query in your answer script to be considered during the marking process.

If you feel unwell, please raise your hand so that an invigilator can assist you.

You may use a calculator for this exam. It must comply with the University's Calculator Policy for In-Person exams, in particular that it must not be able to transmit or receive information (e.g. mobile devices and smart watches are **not** allowed).

Candidates must write sufficient information to show the method used in deriving the answers.

Answer **THREE** questions only.
Answer **BOTH** questions from Section A.
Answer **ONE** question from Section B.

You must use a separate answer book for each section. Print **SECTION A** or **SECTION B** on the front of the applicable answer books.

All questions carry equal marks.

Drawing L101 is provided.

A Formula Sheet is provided for Section B.

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SECTION A
(Answer **BOTH** questions)

1. a) Identify the location (or locations) of the following types of information in the contract documentation:

   i) locations and dimensions

   [3 marks]

   ii) descriptions and specifications

   [3 marks]

   iii) quantifications

   [2 marks]

   b) Describe the structure and content of the Bills of Quantities as used in the tender package and, later, the contract documents.

   [10 marks]

   c) Describe the purpose of billing paper, what it is used for, how it is organised, and the types of information contained in it.

   [15 marks]

2. Using drawing L101 (appended), determine the total quantity of fill and the total quantity of cut using the trapezoidal method.

   [33 marks]

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SECTION B
(Answer **ONE** question)

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

   BS: 1.624, ISs: 2.125 at Peg A, 2.010 at Peg B, 1.905 at Peg C, FS: 1.852
   BS: 0.624, ISs: 1.412 at Peg D, 0.325 at Peg E, FS: 0.595
   BS: 1.610, ISs: 1.458 at Ground Level Below Bridge, (3.351) at Bridge Soffit Level, FS: 0.487
   BS: 1.336, FS: 1.006

   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 104.320m AOD. The final foresight was observed to a staff situated at a TBM at a reduced level of 105.570m 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.

   [21 marks]

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

   [2 marks]

   c) List the sources of error in levelling and explain how these errors can be reduced when carrying out levelling.

   [10 marks]

4. a) Describe the workflow for surveying three-dimensional detail using a total station.

   [21 marks]

   b) State which information should be normally included on the completed survey plan in addition to the actual surveyed area.

   [12 marks]

R N Stanley
D S Thomson

Drawing L101 and Formula Sheet on next pages

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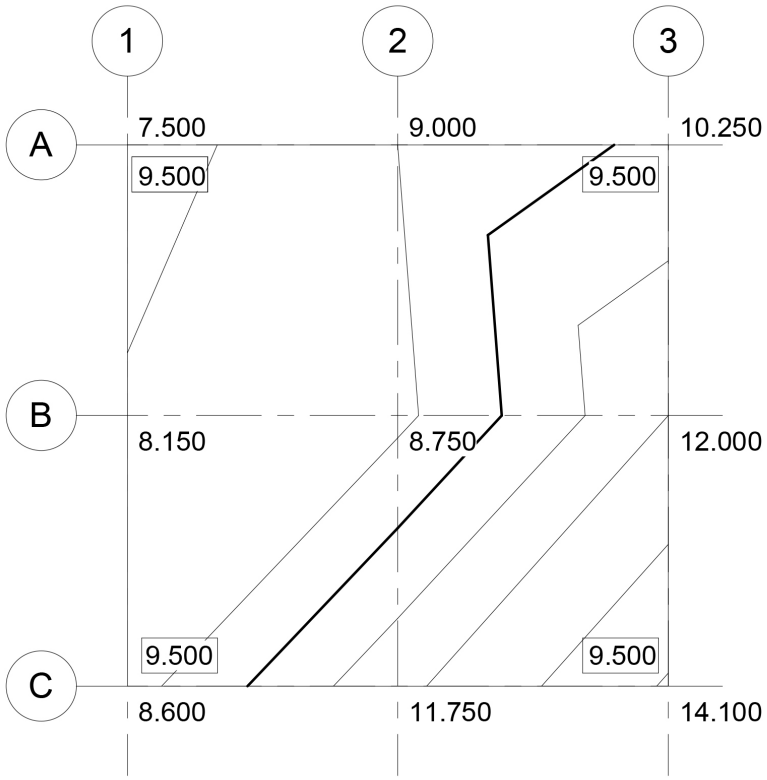
DRAWING L101



Notes:
Existing site levels are plotted on 10 x 10m grid.
300mm of topsoil to be stripped over whole site.
Whole site to be brought to level 9500 AOD.

Loughborough University		PROJECT: Examination Question	CLIENT: CVA124		
Code	Status		Date: Issue Date	Project Number: 5678	Scale (@ A4): 1 : 200 / REV
SUITABILITY DESCRIPTION	PURPOSE OF ISSUE	SHEET: Existing and proposed levels	Drawn by: Author	DRAWING NUMBER: L101	
			Checked by: Checker		

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FORMULA SHEET

Levelling

Rise and Fall check formula:

$$\sum BS - \sum FS = \sum Rises - \sum Falls = LastRL - FirstRL$$

Height of Collimation check formula:

$$\sum BS - \sum FS = LastRL - FirstRL$$

$$\sum(\text{all } RL \text{ except 1st}) + \sum \text{IS} + \sum \text{FS} = \sum(\text{each } Hoc \times \text{no. IS and FS taken})$$

Allowable Misclosure formula:

$$\boldsymbol{allowable\ misclosure = m\sqrt{n}}$$ where m = 5mm, n = no. of instrument setups