Land Surveying for Civil Engineers (TC40077E)

GROUP REPORT

Land surveying assignment

Name	Student ID	Contribution
Bilal Hussain	21537488	Part 2 Earthwork volumes calculations and excavation cross section. Consider health and safety issues for carrying out this work (any hazard, risks, and control measures).
Ebrahim Ahmed	21537489	Part 2 Describe the setting out of depths of excavation for inserting the drainage pipeline network.
Mahdi Ahmed	21484585	Part 1: Describe method or procedure of differential levelling carried out in the field. Consider health and safety (any hazard, risks, and control measures).
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Prithvi Neupane	21501555	Part 1: Area of survey field by finding slope correction.
Shahzain Sajid	21580550	Part 3 and 4
Usman Irfhan	21484390	Part 1- HOC method, calculation checks, allowable misclosure Part 2-Sketch of drainage insertion, summary table of soil volume excavation
Muhammed Abubakar	21513651	Linear surveying
Zakeria Ali	21544415	Introduction, aims, objectives

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Introduction

Before setting out depths of excavation for pipeline networks we need to look at differential leveling. Differential leveling is a technique that allows us to see the difference between two points and how much of a difference the elevation is, the points will of course be separate, and this procedure can be completed with the use of measuring rods and more equipment. Linear surveying is like differential leveling in the sense of measuring the distance between two points, but instead we look for length and not necessarily elevation. Linear surveying equipment can consist of; tacheometer, tapes, electromagnetic distance measuring device (EDM) and track measurers. Earthwork volume is when we remove sections in specific area/field, the volume is calculated when we have an (average) cut/fill area, with the pair we then time it by the distance between the two sections.

Aims

- Levelling and linear surveying description and calculations
- Risk assessment
- complete earthwork calculation
- Reflect on the previous tasks
- Conclusion and recommendations

Objectives

- Calculate the earthworks volume
- Perform depth of excavation for a drainage pipeline and network

Drainage Plan and Section:

Figure 1 represents the proposed drainage network survey area for the University of West London faculty building.

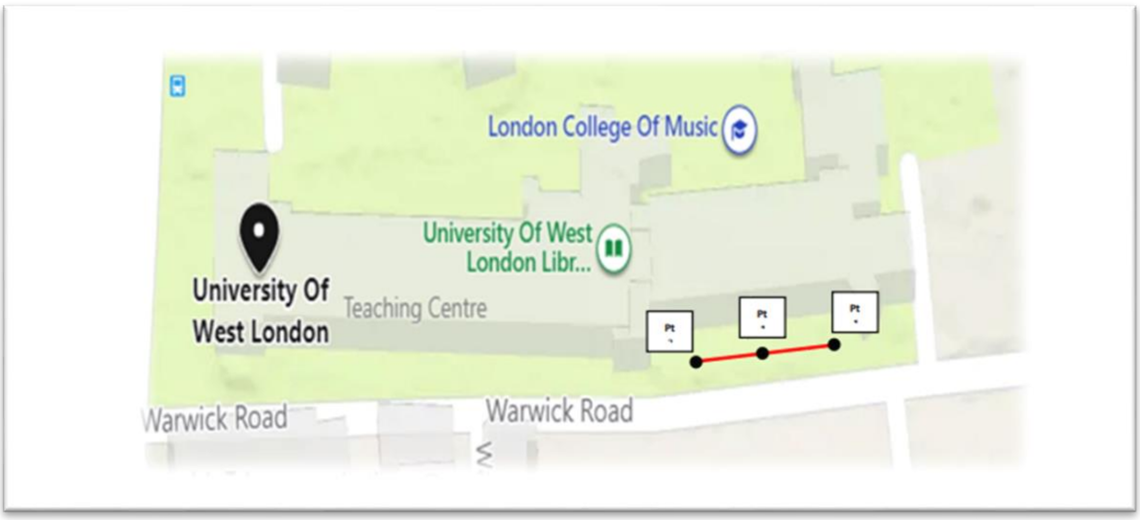


Figure 1

Differential levelling:

Differential levelling involves finding the difference in elevation between two or more points. Two readings are taken when the two points are within the sight limits of the instrument. (Progressive Gardening, 2022) The difference between the rod readings represents the elevation difference between the two points. In cases where one or more of the points exceed the instrument's range, turning points are used. (Progressive Gardening, 2022)

Differential levelling equipment should include the following:

- Level instrument
- Tripod
- Level rod
- Turning point
- Tape measure

As a summary, differential levelling involves the following steps:

1. Prepare the instrument for use. (Progressive Gardening, 2022)

2. The BS reading on BM1 should be taken.

3. Take the FS reading and determine the turning point.

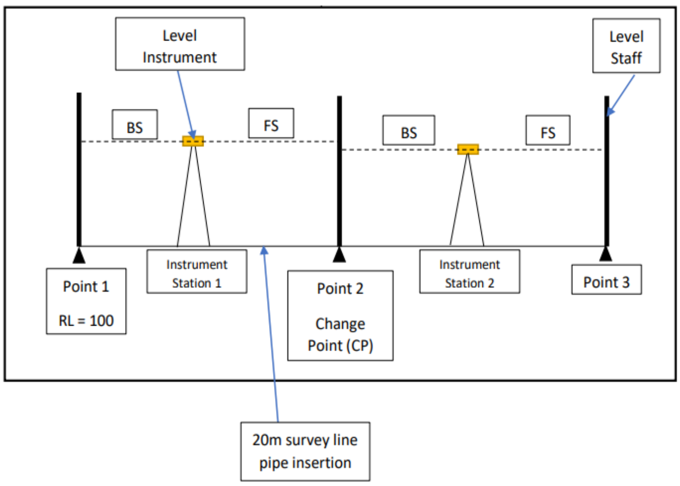
4. Set up again after moving the instrument. (Progressive Gardening, 2022)

5. Make a BS reading on the turning point.

6. Next, establish the next turning point, and take the FS reading.

7. Reposition the instrument and set it up again.

8. Continue to follow the steps 5 to 7 until a foresight is reached on the last station.
(Progressive Gardening, 2022)



Health and safety:

Vehicles- Injury/death	Locate surveyors away from traffic lanes wherever possible. For the duration of fieldwork, hi-vis clothing should be worn to prevent accidents and fatalities (Cutt, 2020).

Walking on uneven, soft, or densely vegetated surfaces can be hazardous	Where possible, regularly scheduled transects and survey routes should be kept clear of tripping hazards and overhanging branches; Surveyor should wear sturdy footwear (Cutt, 2020).
Inclement weather	weather-appropriate apparel, such as layers of warm, water-resistant clothing in the winter or light, airy clothing in the summer. If there is heavy rain or wind causing discomfort for the surveyor, stop the survey (Cutt, 2020).
Manual handling	Avoid twisting, straining, or excessive loads (Cutt, 2020).
Exposure to potentially harmful substances, such as contaminated soil	Create a strategy for handling hazardous items provide training on how to handle them safely (Cutt, 2020).

Hazards that were spotted at the sight was a small ditch, drainage covers and a small no fouling/CCTV sign that was camouflaged well in the grass. All students were advised to watch their step to avoid falling, slipping or tripping over them.

Please find the surveying booking sheet from the fieldwork conducted on the 27/11/2022
Fig. 2

Surveying Booking Sheet:

BS	IS	FS	HPC	RL	CORR	CORR RL	REMARKS
1.483			11.483	10.000			BM=10
	1.561			9.922			A
	1.548			9.935			B
1.382		1.448	11.417	10.035			2
	1.441			9.976			C

	1.441			9.976			D
1.410		1.398	11.429	10.019			3
		1.430		9.999			1
SUM	SUM	SUM					BM 1 =10
4.275	5.991	4.276					

Figure 2

Simple and full calculation checks:

Simple calculation check:

Equation: ∑FS - ∑BS = First RL - Last RL
4.276-4.275 = 0.001
10-9.999 = 0.001

The results show both sides of the equation to equal 0.001

Full Calculation Check:

Equation: ∑IS + ∑FS + ∑ (RLs except first) = ∑ (each HPC x number of applications)

∑IS	1.561 + 1.548 + 1.441 + 1.441 =	5.991
∑FS	1.448 + 1.398 + 1.430=	4.276
∑ (RLs except first)	9.922 + 9.935 + 10.035 + 9.976 + 9.976 + 10.019 + 9.999 =	69.862
∑ (each HPC x number of applications)	(11.483 x 3) + (11.417 x 3) + (11.429x1)	80.129

5.991 + 4.276 + 69.862 = 80.129

(11.483 x 3) + (11.417 x 3) + (11.429x1) = 80.129

The results for both side of the equations were equal (80.129= 80.129)

Calculating Allowable Misclosure:

The following formula is used to calculate the allowable misclosure:

Allowable misclosure = ± 5 √N mm

Where N is the Number of Instrument Positions which is the same as Number of BS readings

Therefore, our Allowable misclosure = ± 5 √3 mm = ± 8.66 mm

By comparing the Reduced Level taken at the end of the run to the RL at BM 1 (same benchmark is used as BM) the following misclosure is calculated:

9.999 - 10 = - 0.001 m

Which is within the limit of 8.6mm

The misclosure is acceptable after the calculation checks were completed. Applying a correction process to disperse the real misclosure is the last step (Ardakanian, 2022). Since the actual misclosure was -1mm, we must add 1mm to make up for it.

We consider that each time we set up the instrument, we made the same mistake. We set up the device three times because there are three backsights (Ardakanian, 2022).

We will add 1mm to each reduced level because we are unable to distribute our 1mm misclosure evenly among the three positions and we do not use fractions of a millimetre (Ardakanian, 2022).

Presenting the adjusted levels:

The table below Shows the updated data sheet capturing the misclosure distribution.

Note: The misclosure is cumulative, and the same correction is made to each RL taken under the same HPC.

BS	IS	FS	HPC	RL	CORR (mm)	CORR RL	REMARKS
1.483			**11.483**	10.000	x		BM=10
	1.561			**9.922**	**1**	9.923	A
	1.548			**9.935**	**1**	9.936	B
1.382		1.448	**11.417**	**10.035**	**1**	10.036	2
	1.441			**9.976**	**2**	9.978	C
	1.441			**9.976**	**2**	9.978	D

1.410		1.398	**11.429**	**10.019**	**2**	10.021	3
		1.430		**9.999**	**3**	10.002	1
SUM	SUM	SUM					BM 1 =10
4.275	5.991	4.276					

Figure 3

Linear surveying:

First step is to determine the points from which length will be taken. It is essential to give each point a name or number prevent any confusion that may cause. Measurment's are taken using a measuring tape, as it is required to calculate the area of the field.

Equipment used:

- 30.000m Long measuring tape.
- A staff and level.

Specifications of tape:

The tape weight approximately 30-50 kg/m and a cross-sectional area of 3.24 mm2. It was standardised at 20°C with an 89 N pull on the flat. The tape's material has a coefficient of linear expansion of 0.000011/°C and a Young's modulus of 20.7 x 104 MN/m2.

Additional data:

- The tape was not stretched while maturing.
- The temperature of the tape was constant during the measurement.

The mechanical linear surveying method was used for this exercise's fieldwork, along with a tape, a level, and staff.

Sketch of the field

The sketch down below shows an approximation of the field boundaries. Each points/corner has been labelled 1, 2, 3, and 4. detail measurements are written from each point as well as the staff reading on each point labelled.

Figure 4

Points	Staff Reading
1	1.483
2	1.382
3	1.410
4	1.430

Slope lengths are measurements made by linear surveying. Therefore, they must first be transformed into plan lengths to permit precise charting. Future computations, including those involving the field's area, won't be distorted because of calculation.

The following equation is used to compute slope corrections:

√ (Ds 2 - DH2)

Ds = Distance measured between two points

DH = Difference in staff reading (height) between two points

Area of survey field:

The trilateration method can be used to find the area of survey field. The data shown in figure are:

Sides	Distance(m)
AB	15.267
BC	19.675
CD	16.263
AC	29.265
AD	21.256

Note: Since, I was not in the surveying tour, the data mentioned above are all assumed to find the area of survey field. Point 1,2,3,4 is denoted as A, B, C, D

As mentioned above, Corrected distance must be calculated to get accurate plotting which are shown below:

Point	Sloping distance(m)	Difference in height	Correction	Corrected Distance(m)
AB	15.267	0.101	0.001	15.266
BC	19.675	(-) 0.028	0.001	19.674
CD	16.263	(-) 0.020	0.000	16.263
AC	29.265	(-) 0.053	0.000	29.265
AD	21.256	0.073	0.000	21.256

The calculation is shown in last page in picture format labelled as Appendix A.

Trilateration is possible due to the field having four shapes. This shape can be divided into two triangles as shown in figure below which are:

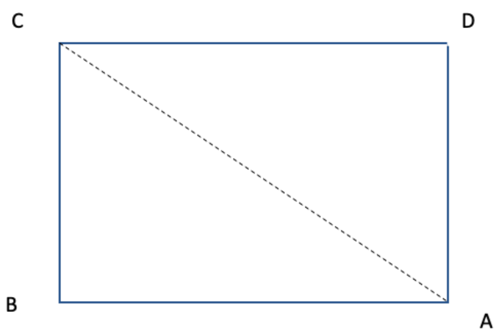
Triangle ABC

Triangle ADC

The Area of tringle is calculated using this equation. That is:

Area of Triangle= (s(s-a) (s-b) (s-c)) ^½ where,

S= ½(a+b+c) and a, b, c are the lengths of each side.



For Triangle ABC,

AB(a)= 15.266, BC(b)= 19.674, AC(c)= 29.265

S= 0.5(15.266+19.674+29.265) = 32.102

Area= (32.102(32.102-15.266) (32.102-19.674) (32.102-29.265)) ^½

= 138.0434 m2

= 138.043 m2

For Triangle ACD,

AC(c)= 29.265, CD(d)= 16.263, AD(d)= 21.256

S= 0.5(29.265+16.263+21.256) = 33.392

Area= (33.392(33.392-29.265) (33.392-16.263) (33.392-21.256)) ^½

= 169.25528 m2

= 169. 255 m2

Therefore, Total area of survey field= Area of triangle ABC+ Area of triangle ACD

= 138.043+169.255 m2

= 307.298 m2.

Part 2 - Earthwork Volume Calculation:

Setting out of depths of excavation for inserting the drainage pipeline network.

When setting out to lay a pipeline for drainage there is several factors to take into consideration. When setting out for depths for a pipeline we will need to factor that this network will need to lay on material which will support, insulate and protect it from any leaks therefore we may need to excavate some extra to lay the pipe on top of fine aggregates.

This pipe work will also need to be laid at a gradient of – 0.5% this will help the pipeline to effectively drain. we will need to firstly identify any the depths that previous pipework is installed (if any) this can be done by using tools such as pipeline locators, this will allow a point-to-point recording off depth cover. In the case that there is no pre-existing pipeline we would need to excavate to a depth of at least 600 mm below ground level (may vary dependent on regulations).

However, it is stated in the brief that the depths for this pipeline needed to be laid is 1m deep therefore we will need to use a pipeline locator or look at previous plans so that we do not excavate or damage any possible utilities and services connected to the university. We will also need to implement barriers around the place where any work is carried out and ensure the surrounding are safe to work in Before carrying out excavations, we will need make boundaries. We will also need to set out points such as benchmarks and mark points of excavation so that is clear and visible when carrying out these earthworks

Earthwork volumes calculations and excavation cross section.

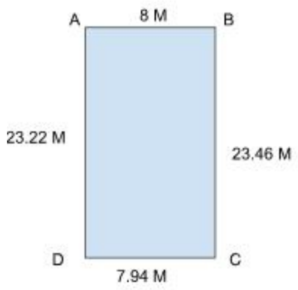


Diagram 1 Sketch of area where leveling and surveying was taken place

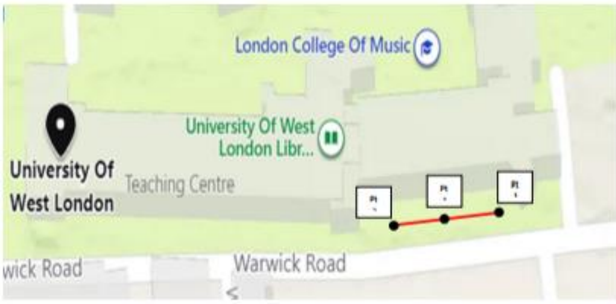


Diagram 2

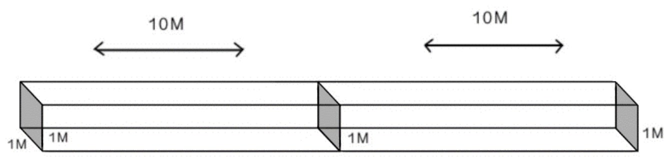
Figure 5

Looking at the brief it indicates that the distance between drainage sections is 10M therefore we can suggest from viewing the second diagram of the university that between the 3 points there is a total of 20m in length. This is an estimate taking into consideration the dimensions noted in diagram 1 these were recorded whilst carrying out the surveying in person.

<u>Dimensional cross section of the excavation.</u>

Sketch of drainage insertion

S1-S2:



The dimensions listed in the brief are as follows;

Depth	1m
Width	1m

To find the cross-sectional area, we will need calculate:

Length x Width	20m x 1m = 20 m2

Surface area/cross sectional of excavation area = 20m2

Surface area x depth = volume	20m x 1m x 1 m = 20 m3

Volume of excavated material = 20m3

Summary table of soil volume excavation.

The soil volumes can be determined using the following formula, since the pipe is installed at a continuous gradient of –0.5%:

Formula= (Cross sectional Area of X + Cross sectional Area of Y)/2) * length of run

Example:

S1-S2:

((1X1) + (1x1)/2) * 10

The table below provides a summary of the excavation's soil volumes. To calculate the overall volume given sand as the component, a bulking (swelling) factor of 1.05 must be applied.

Section of excavation:	Volume of earth (m3)
S1-S2	10
S2-S3	10
TOTAL	20
Bulking factor (1.05)	21

Health and safety issues:

When carrying out any excavation and earthworks we will need to take into consideration several factors and take the necessary investigations to fully understand the site and soils we are working with.

As we will be carrying out earthworks very close to the university, we will need to take into consideration the people around the area as we know this can be a busy road, the university building and parked vehicles around the area will also be needed to be considered. This is because we will require machinery to excavate which will be operated around the site, therefore we will need to have clear boundaries and barriers so that no one is to fall into excavated areas.

Workers on site will need to be fully qualified, trained to use any machinery to reduce the risk of damage or injury. From assessing our site, we know that this area consists of a small muddy area therefore we should use a small, tracked excavator to make the process much quicker. As the site is very close to the university this will also possibly cause noise and vibration which can disrupt lessons.

We will also need to carry out a soil investigation so that groundwater levels are dealt with correctly as dewatering may be necessary. As previously mentioned, this site is located adjacent to the university therefore the operator must be skilful not to damage the buildings services as well not affect the stability or the structure/foundation. From recalling the sites surroundings there are several planted trees throughout the site we will be excavating therefore we will need ensure these trees are protected by boundaries, barrier and their roots or other parts are not injured through the construction phase.

Critical Reflection

The following excavation stages took place where there were certain errors or correct calculations based on the network as we have established with the booking sheet. As it was important to discuss the matters regarding health and safety which was used with a checklist, as it was reinstated by the group leader to be present punctually with the right safety equipment such as raincoats (due to the harsh weather conditions) as well as a green/yellow high vest, and lastly safety boots.

The calculations were double checked in case of errors with the help of all members having a last review. The equipment stated helped to take readings for the first step of excavations as this was split into two different members as this was assigned, the end result was a reading of 4.52 ft. Additional material was needed during these times to adapt or maintain these things i.e., pipelines for drainage as they were recorded whilst carrying out the surveys in person. The recorded hazards were obviously observed, stated and avoided with precaution.

After the calculation the result did end up equal to which was already assumed (included things such as the allowable misclosure). As planned the calculation allowed us to identify the volume of the earthwork with the help of a day just to analyse and investigate the land with the help of surveys

Conclusion and Recommendation

The achievements with this excavation have allowed the skills such as group activities, group socializing and practical importance to establish how it can improve rather than just committing to it through theory. Things such as double checking, safety and problem solving allows us as engineers to develop and sometimes perfect our skills and understanding of the presented problem.

Reference

Ardakanian, A. (2022). 'Principle of Levelling' [PowerPoint presentation] TC40077E: Land surveying. Available at: https://online.uwl.ac.uk/bbcswebdav/pid-6520359-dt-content-rid-15771620_2/xid-15771620_2 (Accessed: 26 January 2023).

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[Accessed 20th December 2022]

Appendix A:

DATE:

The correction point between A and B:
for AB,

$\sqrt{(15.267^2-(1.483-1.382)^2)}$

$\sqrt{(15.267^2-0.101^2}$

15.2666

15.266 (in 3 D.p)

15.267 - 15.266 = 0.001m correction.

for BC,

= $\sqrt{(19.675^2-(1.382-1.410)^2)}$

= 19.674

corrections = 0.001m.

for CD,

= $\sqrt{(16.263^2-(1.410-1.430)^2)}$

= 16.263

Correction = 0.000 m.

for AD,

= $\sqrt{(21.256^2-(1.430-1.483)^2}$

= 21.256

no correction.

for AC = $\sqrt{(20.265^2-(1.483-1.410)^2)}$

= 20.265

no correction.