CIVE 2261: Lab Report Cover Sheet

Lab Day & Time: September 18 and 25, 2023

Lab Group No.: 4

Group Member Names & Contribution:

Member	Name	Contribution/Section(s)
1	Aidan Boni	Introduction/Survey 1 Data/ Survey 2 Points and Data
2	Raj Jagirdar	Survey 2 Introduction/ Procedure/Map
3	Mila Popovic	Survey 1 Points/Map
4	Anabella Vivas	Survey 1 Introduction/ Procedure

Instructions:

1. Fill out the lab day and time and lab group number at the top of the submission cover sheet.
2. Enter all group members' names in the contribution table.
3. Enter each group member's contribution in the contribution table (e.g., Results and Discussion, Abstract and Introduction).
4. Attach this cover sheet to your lab report for submission.

Grading:

Component of Report		Points	Score
Abstract		10	
Introduction & Theory/Procedure/Methods		15	
Results	Reasonable; analysis & discussion	20	
	Graphics and sample calculations	20	
Reflection/Questions		20	
Conclusion		10	
Appendices		5	
		100	

CIVE 2261 – Materials Laboratory

Fall 2023

Professor Craig M. Shillaber, Ph.D., P.E.

Surveying 1 & 2

October 23, 2023

Submitted By: Aidan Boni, Raj Jagirdar, Mila Popovic, Anabella Vivas

Survey 1 Completed: September 18, 2023

Survey 2 Completed: September 25, 2023

Introduction to Labs

These two surveying labs provided an introduction into the equipment and methodology of surveying. The first lab involved using the leveling technique to find the height of the Shillman Cat in comparison to the known height in front of the Snell Engineering Building. The resulting height of the cat was 21.55 ft. The second survey used the total station method to plot 50 points in a small area to create a topological map of the area between Snell Engineering and the Egan Research Center. The team learned how to use the leveling and topological method for finding elevation. The team also practiced making a field notebook and working through errors and issues with the tools.

Part 1: Leveling

Introduction

Leveling is the practice used for determining elevations of different points by taking vertical measurements using some fixed points and benchmarks. Prior to construction, it is necessary that Civil Engineers know the level of a terrain to ensure the safety, functionality and design of infrastructure like roads, bridges, or buildings. In this survey, the elevation of the Shillman Cat will be identified from a reference outside Snell, to understand and apply differential leveling using a level and rod. Additionally, skills like measuring distances through personal pace and stadia, generating field book notes, and correcting errors in closed traverse will be developed.

Procedure

The equipment used in this survey was a level a rod. First, the dome top tripod was set up on the ground and levelled using the phone level app. The automatic level was placed on top of the tripod and secured, and it was ensured that its bubble was aligned. One person extended the rod and held it in the decided point, so the rest of the group could take the measurements. The rest of the group took turns reading the telescope, ensuring that the reading was taken where the crosshair indicated in the rod. The measurement was recorded, and the person holding the rod moved to the next point so the next measurement could be taken. This was repeated three times according to the instructions, using the points described below and in Figure 2.

Points

The Benchmark point was the manhole cover outside of the Snell Engineering Building (see Figure 2), which had a known elevation of 20 ft. The level was placed in point A and a measurement was taken to the BM and to TP1, with a recorded elevation of 18.83 ft. Then, the level was placed at point B, and measurements of TP1 and TP2 were taken. Finally, the level was placed at point C and measurements of TP2 and the Shillman Cat were taken. Resulting in an elevation of 20.58 ft for TP2 and 21.55 ft for the Shillman Cat. The full results and the calculations made can be seen below in Table 1.1.

Data Collection and Calculations

Table 1.1 Elevation of Point P. Based on BM Elevation 20 ft

Points	BS. (+)	H.I.	FS. (-)	Elevation (ft)
BM				20
A	3.21	23.21		
TP1			4.38	18.83
B	7.24	26.07		
TP2			5.49	20.58
C	3.94	24.52		
P (Shillman Cat)			2.97	21.55

$$\sum BS - \sum FS = 14.39 - 12.84 = 1.55\,ft$$

$$Elev.\ P - Elev.\ BM\ = 21.55 - 20.0 = 1.55\,ft$$

The data in the table is found by starting with the known starting elevation and adding the reading from the rod. This gets the elevation of the level at its location. Once this is done, that reading on the rod at TP1 is subtracted from that elevation. This gives the elevation at TP1. This is repeated for all the turning points and finally to find the final elevation.

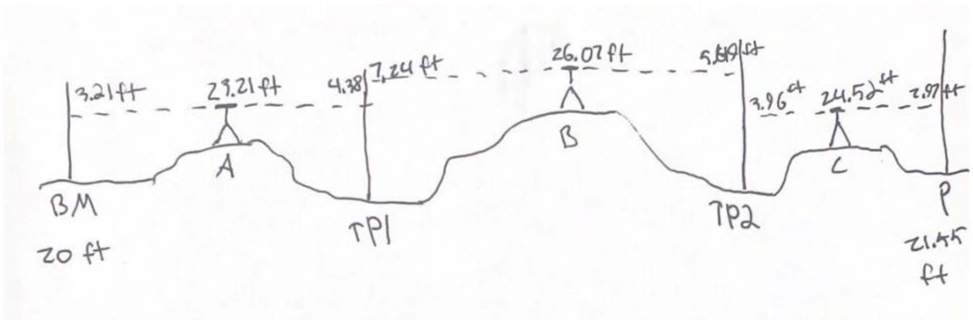

Figure 1.1 Drawing depicting elevation and points.

Since the two measurements are equal, no correction is needed. Furthermore, according to the measurements taken, the elevation of the Shillman cat is 21.55 ft. A possible source for error in this result is that the final measurement was taken by looking at the top of the cat's head, and not the crosshairs.

Map

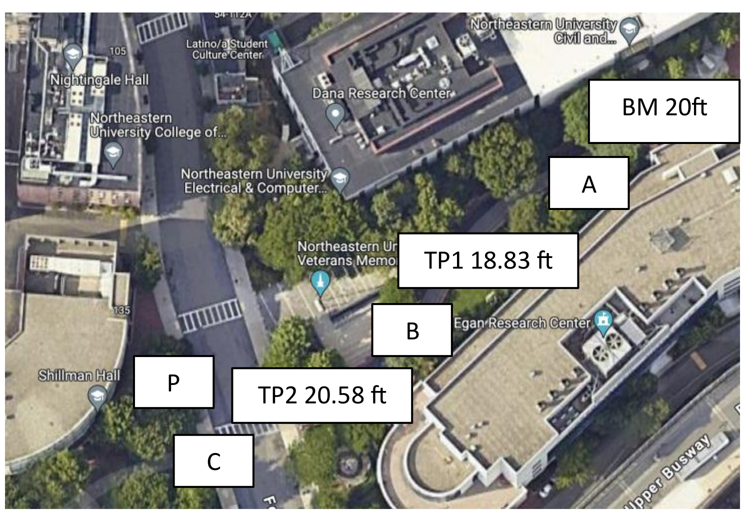

Figure 2.1 Approximate Map of Survey Points and their Elevations

Photos

Figure 3.1 Taking Readings of Elevation

Figure 4.1 Rod placement

Part 2: Total Station

Introduction

Topological surveying using a total station is a method that is widely used in Civil Engineering for a variety of different purposes. It is used to precisely map the characteristics of a certain area, giving engineers crucial data when designing around the existing features. Once a topological survey is complete, it can be used to analyze the landscape and plan construction based on features of the land. In the lab, team members used a total station to map the area between Snell Engineering and the Reagan Research center. The total station was placed in a location that could see the whole site, and 50 data points were collected.

Procedure

Creating a topological map using the method of Total Station method has an approach that is very methodical. The first part of this must include going out in the field and collecting measurements and data regarding the area we are trying to map. In the field, in the first step, a control point is to be chosen that will serve as the reference point for all of the other measurements that will be made. The next step is to set up the stable dome tripod at multiple locations in the survey area. Ensuring that the tripod is level, we take measurements to the established control point. Each measurement here has two parts: the first part is the distance from the control point to the point of capture, and the angle that the tripod is pointing at to get the measurement is the second part. We can use this data to calculate the elevation of each point in the area, using the control point as a reference. The data that we collected was captured by the tripod and then output in a spreadsheet format, with each point having a measure of distance and an angle.

The second part of this is to create the actual map. We can do this by utilizing the data we collected and the AutoDesk Civil 3D program which will generate a map. The data that we collected using the total station is stored in the form of a .csv file (comma-separated values). We extracted the data from the total station using a flash drive and were able to upload it to a computer to use with AutoDesk Civil 3D. Once the data was uploaded, we extracted the values that denoted the distances and coordinates in the East, North, and z-axis. Using these values, we can now import them into AutoDesk Civil 3D to create a topological map of the area. After inputting the values into surfaces, the program generates a map with minimal complexity and no labels. We are able to edit the contour of the map, as well as add labels.

Points

The area that we mapped was the area between the south entrance of Snell Engineering Center down until the start of the Veterans Memorial. We mapped the area from wall to wall of the building surrounding the area. The area includes a great deal of variety in terms of the features that it includes. The benchmark that we used to measure the rest of the points in this area was the north corner of the catch basin frame outside of the south entrance of Snell Engineering. The elevation at that point was 21.87 ft, and all of the points that we measured were measured to this point. The point that was used to set up the total station was halfway down the path on the side closest to Eagen. There were 50 points taken across the area of interest, approximately 10 rows with 5 points in each row. These points were spaces approximal equidistance apart.

The main feature of the area is the path that runs directly through the area and is arguably the most used path by students on campus. The other prominent feature of the lab is the hill that extends up towards Eagan Research center. These features can both be seen clearly on the map.

Data Collection and Calculations

Data was collected by the total station and exported to excel where the calculations were done. The points exported from the total station were ready to be exported into AutoDesk to create the contour map. This was done easily to create the map seen below.

The data in the excel sheet was in a X, Y, Z format from the total station and the elevation calculations were already done. The benchmark elevation was known and the rest of the points reflect the elevation comparison to said benchmark. To achieve the correct elevation of all the points the benchmark and points needed to be adjusted, this was done by adding the elevation to all the points in AutoDesk while creating the map. The final map can be seen below.

Table 2.1 Survey 2 Measurements

X Coordinate	Y Coordinate	Z Coordinate
-7.775	-86.375	3.045
-17.15	-78.765	1.66
-38.49	-55.945	2.38
-50.675	-43.575	2.07
-56.895	-32.72	1.85
-46.11	4.79	0.93
-25.2	-13.035	0.635
-9.065	-16.58	-0.17
-0.265	-30.315	1.425
11.34	-36.73	2.615
16.57	-27.42	3.065
4.44	-19.89	1.28
-6.405	-13.955	-0.2
-19.75	9.165	0.03
-31.845	19.45	0.235
-32.425	31.305	0.485
-18.905	24.46	-0.025
-8.105	12.355	-0.78
7	-6.425	0.995
13.925	-13.535	2.405
24.71	-24.295	3.335
34.86	-5.605	3.445
23.205	-1.61	3.11

6.23	12.19	-0.91
-8.98	28.885	-0.605
-18.405	39.53	0.5
-11.115	45.215	0.29
0.1	45.06	-0.43
14.19	30.63	-0.865
27.53	22.46	2.7
45.26	28.835	3.69
36.975	37.67	1.895
30.665	45.445	-0.025
12.01	56.115	-0.1
-1.34	67.285	0.645
18.4	67.355	0.21
33.475	53.035	-0.32
38.795	47.84	1.08
46.39	44.175	3.385
49.53	36.925	3.68
48.185	47.795	3.16
42.465	52.825	1.06
27.945	65.37	-0.03
20.605	76.99	-0.15
12.35	87.225	-0.24
88.125	104.46	1.35
82.755	110.02	0.835
75.42	116.95	0.59
68.135	121.675	0.11
61.23	130.68	0.06

Map

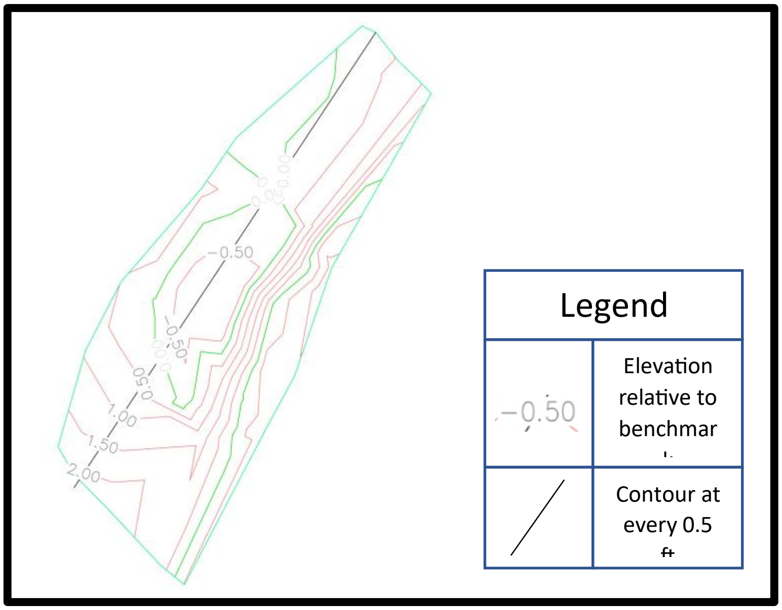

Figure 5.1 Topographical Map of Selected Area

Photos

Figure 6.1 Survey 2 Measuring