CE 203: Geospatial Engineering

A
report on

Auto-Level
Digital-Level
Total Station
Surveying

by

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1
Auto-Level: Elevation profile of the ramp

1.1 Introduction

Surveying is the practice of accurately measuring positions and distances to determine the spatial layout of an area. Auto-level instruments, commonly used in construction and surveying projects, simplify leveling by providing a stable horizontal line of sight.

This survey used an auto level to obtain an accurate elevation profile of the ramp located at AB9. Calculating the slope of ramps is crucial in ensuring compliance with accessibility to disabled people, and for evaluating the suitability of the design for various uses.

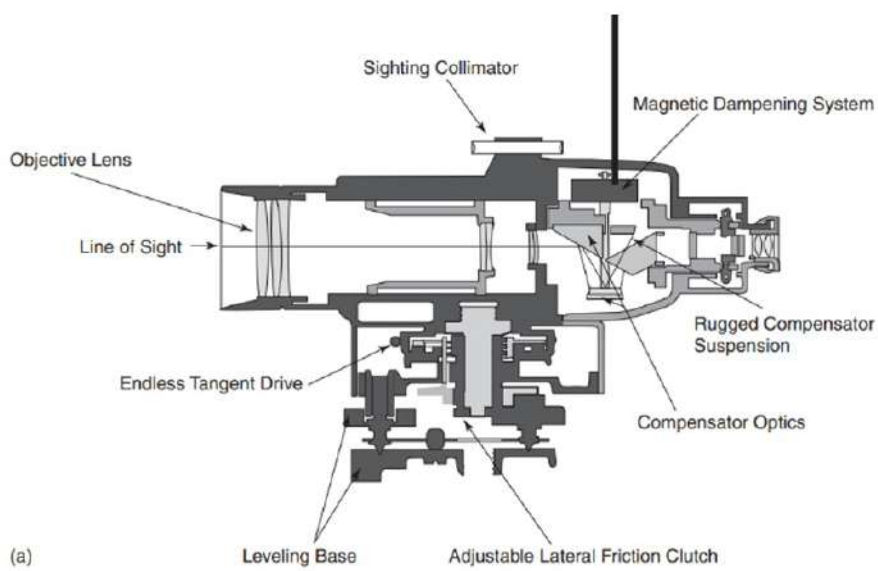


Figure 1.1: Model of Auto-Level

1.2 Equipment

The following equipments were used for this survey:

- **Auto Level:** Provides a stable horizontal reference, critical for measuring height differences between points.

- **Tripod:** Supports the auto-level instrument and maintains stability.

- **Leveling Staff:** A 4-meter foldable staff used to measure height differences.

- **Plumb Bob:** Used to precisely fix the backsight point.
- **Measuring Tape:** Used to measure distances along the ramp manually.
- **GPS Tracker:** This is used to measure the latitude and longitude of a specific location. In our case, we used our Android phone to keep track of the latitudes and longitudes.

1.3 Methodology

1.3.1 Setup of the Auto Level

Steps used during auto-level configuration:

1. Firstly, we chose a location from which both the benchmark point and the ramp were visible, so that we did not need to change the backsight point.

2. Fix the tripod in a stable position and level it (it is not compulsory but recommended).

Figure 1.2: Levelling the Tripod

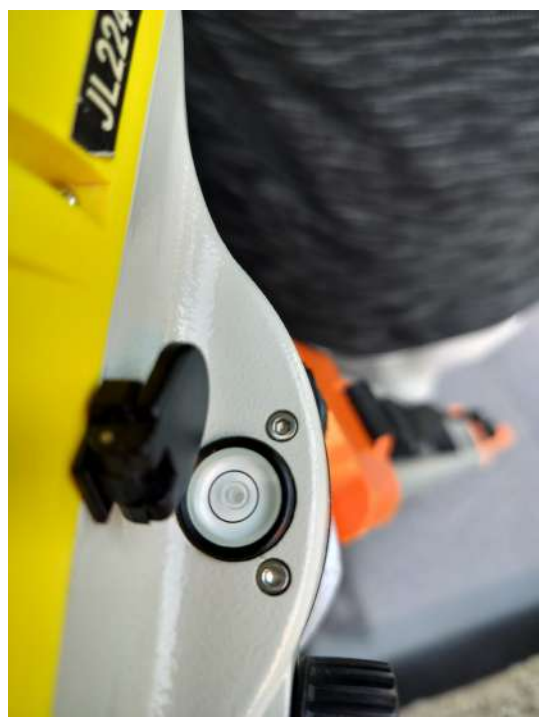


Figure 1.3: Levelling the built-in bubble level

3. Attach the auto-level to the tripod and ensure that it is level using the built-in bubble level.

4. Take an initial backsight (BS) reading from a known elevation reference (benchmark point).

5. Calculate the height of the instrument (HI) using the formula:

$$HI = \text{BM elevation (e.g., reference height)} + \text{BS reading (back sight measurement)} \quad .... (1.1)$$

Figure 1.4: Taking readings along the ramp

6. Take readings along the ramp and note the elevation and coordinates at each point.

1.3.2 Data Collection

After establishing the HI, readings were taken along the ramp at various points to obtain foresight (FS) values. The elevation at each point was calculated using:

$$\text{Elevation at Point} = HI - \text{FS reading} \quad .... (1.2)$$

This process was repeated at multiple points along the ramp to capture the elevation profile. We noted the elevation along with the latitude and longitude at each point.

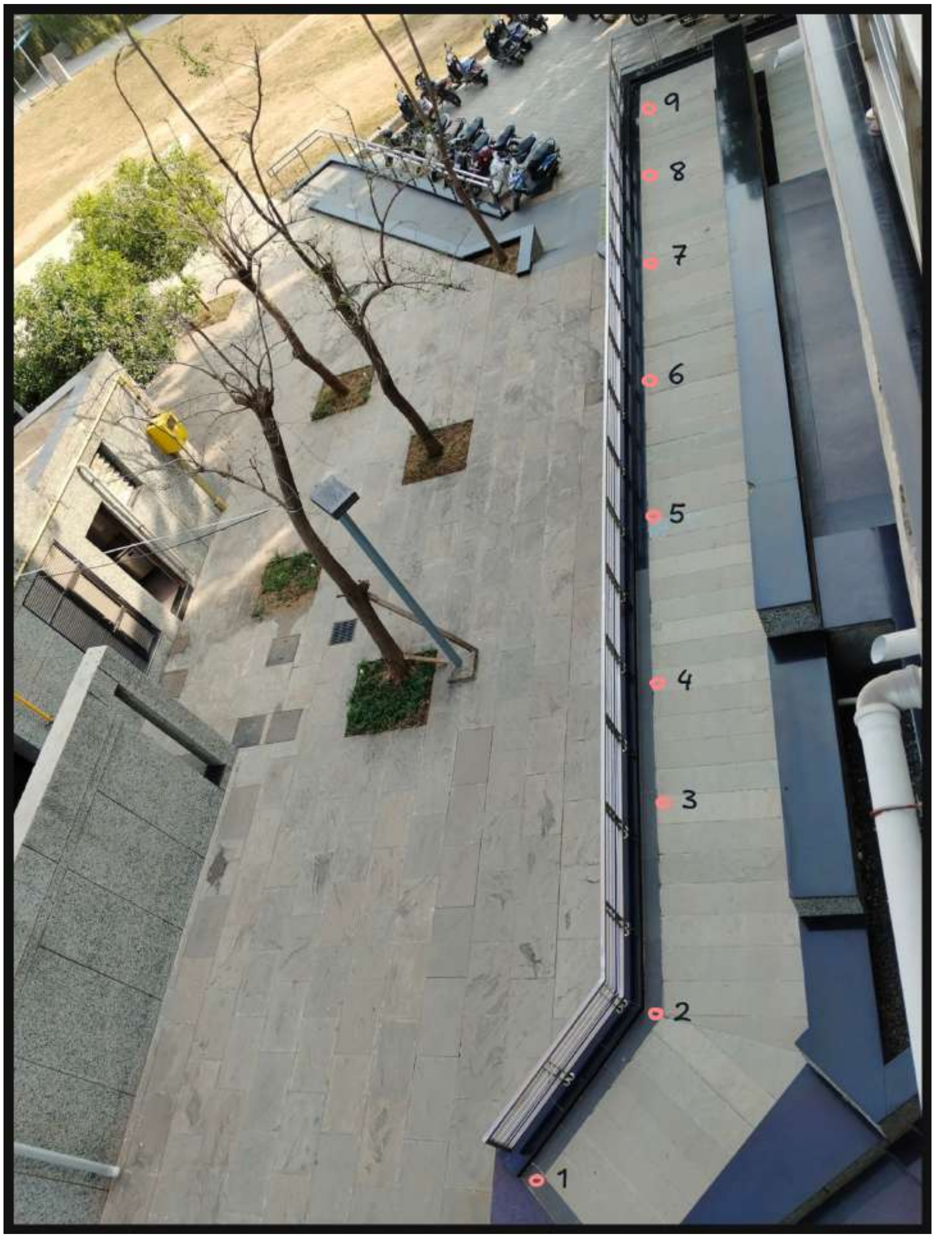


Figure 1.5: Points where readings were taken

1.4 Analysis and Results

The data collected was analyzed to generate the elevation profile of the ramp. The change in elevation across the points provides a detailed profile that can be used to evaluate the slope of the ramp.

Benchmark Height	75.583m
Backsight reading	2m
Instrument Height = BM elevation + BS reading	77.583m

Point	Latitude	Longitude	Height (in m)
1	23.21335171	72.68377264	75.653
2	23.21333283	72.6837594	75.833
3	23.213306	72.6837595	76.133
4	23.2133	72.6837596	76.218
5	23.2132859	72.6837597	76.413
6	23.2132507	72.6837598	76.838
7	23.2132323	72.6837599	77.033
8	23.2132121	72.68376	77.283
9	23.21319394	72.68376	77.468

Table 1.1: Elevation data for points along the ramp

The results indicate a consistent slope across the ramp. While creating the elevation profile we can directly use the latitudes on the x axis as it is relative to distance.

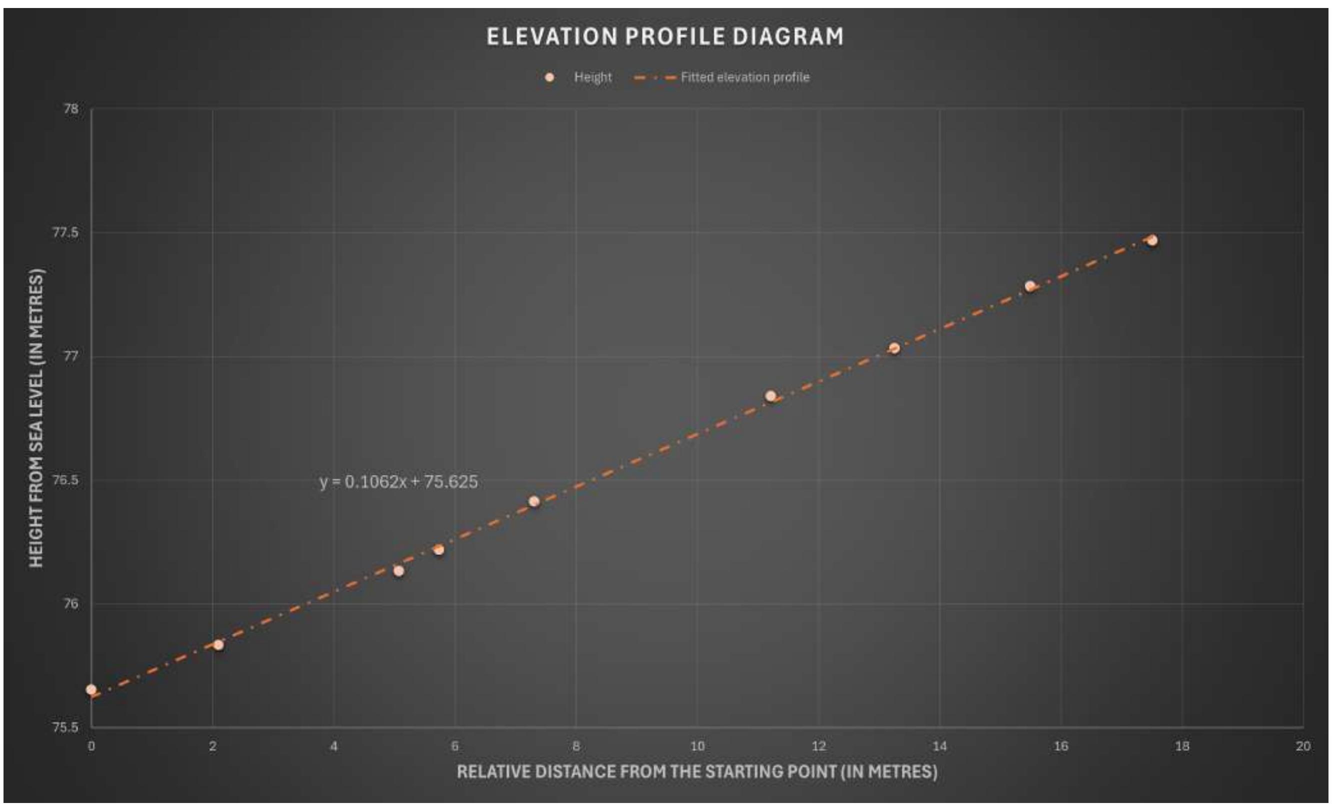


Figure 1.6: Elevation Profile Diagram

Using the coordinates, we can find the horizontal distance of the triangle formed by the ramp and vertical height of the triangle by the difference in the height of the top and the bottom point.

$$
\begin{aligned}
\text{Horizontal Distance} &= (\text{Difference in Latitude}) \times 111,000\,\text{m/degree latitude} \\
&\quad \text{(Since the ramp is nearly aligned to the North-South axis).} \\
&= (23.21335171 - 23.21319394) \text{ x } 111000 \text{ m} \\
&= 17.543\text{m} \\
\text{Vertical Height} &= \text{Height difference between the topmost and the bottommost point} \\
&= 77.468 - 75.653 \\
&= 1.815 \text{ m} \\
\text{Slope} &= \frac{\text{Vertical Height}}{\text{Horizontal Distance}} \\
&= \frac{1.815}{17.543} \\
&= 0.10346006954341 \\
\theta &= 5.9068096863602^\circ
\end{aligned}
$$

In order to verify the accuracy of the results obtained, we used the inch tape and measured the distances as shown in 1.7

Figure 1.7: Diagram showing distances measured

$$
\begin{aligned}
\text{Slope} &= \frac{\text{Height Difference}}{\text{Horizontal Distance}} \\
&= \frac{0.8001}{8.0518} \\
&= 0.099369085173502 \\
\theta &= 5.6748000579684^\circ
\end{aligned}
$$

1.5 Conclusion

This report demonstrated the use of an auto level to generate an elevation profile of a ramp. The survey methodology and data collection process were performed with precision, ensuring reliable results. Future work may include applying this technique to other infrastructure elements, such as walkways and staircases, to ensure compliance with accessibility standards.

2
Digital-Level: Elevation profile of the ground near Lal Minar

2.1 Introduction

Digital levels are modern surveying instruments that enhance the precision and efficiency of elevation measurement by automating data collection and reducing human error. Unlike traditional auto levels, digital levels capture readings digitally, allowing for easier data processing. In this survey, a digital level was employed to capture the elevation profile of a ground near Lal Minar. This location was chosen due to its uneven topography, making it an ideal test case for digital leveling techniques. Such surveys are essential for understanding topographic changes, particularly in areas requiring construction or landscaping adjustments.

2.2 Equipment

The equipment used in this survey included:

- **Digital Level:** Provides digital readings of elevation, reducing manual data handling and increasing accuracy.

- **Tripod:** Stabilizes the digital level, essential for maintaining accuracy.

- **Barcoded Leveling Staff:** Used in conjunction with the digital level for capturing height differences across points.

2.3 Methodology

2.3.1 Setup of the Digital Level

The digital level was set up as follows:

1. Fix the tripod securely on a stable surface, such that the benchmark is clearly visible. Also, consider levelling the tripod.

2. Mount the digital level on the tripod and ensure it is leveled using the instrument's built-in bubble level.

3. Power on the digital level and head over to the *Files* option and select *New Project* option to create a new project to store the survey data.

4. Navigate to the main menu to select the *Survey* mode and then choose *Intermediate sights* option.

5. Take an initial Back Sight (BS) reading at a known elevation benchmark.

6. Compute the Height of Instrument (HI) with:

$$HI = \text{BM elevation} + \text{BS reading} \qquad \text{.... (2.1)}$$

7. Either take reading after some fixed distance intervals or mark the coordinates of each point along with the reading of the device.

Figure 2.1: Location where readings were taken

Figure 2.2: Group 4 doing the Digital-Level task

2.3.2 Data Collection

Elevation data was collected at various points across the ground, including points at different levels and along the sloped section connecting them. Using the digital level, the elevation at each point was computed as follows:

$$\text{Elevation at Point} = HI - \text{FS reading} \qquad .... (2.2)$$

2.4 Analysis and Results

Code	Vertical Height (m)	Horizontal Distance (m)	Reduced Height (m)
BM1			75.583
BM1	0.24569	27.06	
A1	0.6414	5.98	75.18729
A2	0.84464	5.37	74.98405
A3	1.11849	4.9	74.71021
A4	1.47172	4.58	74.35697
A5	1.745	4.45	74.08369
CBM2			74.084
CBM2	0.28563	5.62	
A6	0.62828	5.11	73.74135
A7	0.97529	4.72	73.39434
A8	1.30574	4.39	73.06389
A9	1.41336	4.29	72.95627
A10	1.48176	4.34	72.88787
A11	1.56348	4.63	72.80615
A12	1.62613	5.08	72.74350
A13	1.71964	5.83	72.64999
A14	1.71415	6.56	72.65548
A15	1.82615	7.36	72.54348
A16	1.89038	8.2	72.47926
A17	1.92685	9.1	72.44277
A18	1.98987	10.01	72.37975
A19	2.03621	10.96	72.33342

Table 2.1: Raw data that is extract from the device

We took points at intervals of 1m, but here arises a problem we took intervals of 1m on the elevated surface so in order to create an elevation profile we need to take the projection of 1m onto the horizontal level. We have used Pythagorean theorem to calculate the projected distance. The attached figure 2.3 gives a better idea of this problem,

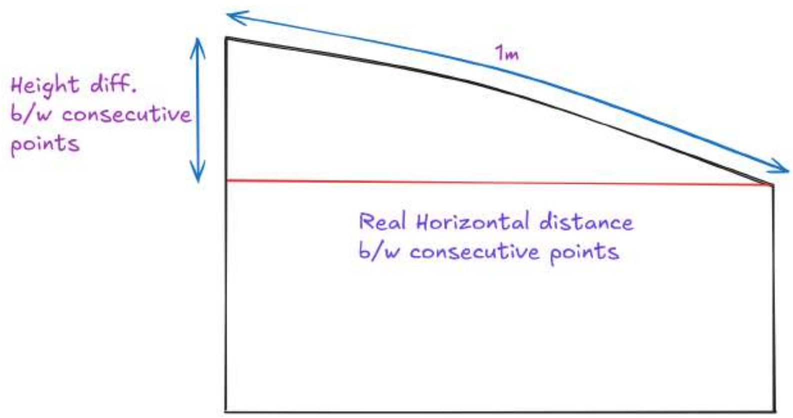


Figure 2.3: Diagram explaining need for projection

We have organized the data by extensively mentioning the Backsight and the Foresight point and we set distance parameter for the first point to be 0 and calculated the relative distance of all points.

Reading	BackSight (m)	ForeSight (m)	Reduced Height (m)	Distance (m)
1	0.24569		75.583	
2		0.6414	75.18729	0
3		0.84464	74.98405	0.9791
4		1.11849	74.71021	1.9409
5		1.47172	74.35697	2.8764
6		1.745	74.08369	3.8384
7	0.28563		74.084	
8		0.62828	73.74135	4.7779
9		0.97529	73.39434	5.7158
10		1.30574	73.06389	6.6596
11		1.41336	72.95627	7.6538
12		1.48176	72.88787	8.6515
13		1.56348	72.80615	9.6481
14		1.62613	72.7435	10.6462
15		1.71964	72.64999	11.6418
16		1.71415	72.65548	12.6418
17		1.82615	72.54348	13.6355
18		1.89038	72.47926	14.6334
19		1.92685	72.44277	15.6328
20		1.98987	72.37975	16.6308
21		2.03621	72.33342	17.6297

Table 2.2: Processed digital level data with calculated horizontal distances and reduced heights for elevation profile creation

Now we can use this data to create the Elevation profile diagram by putting the Reduced height column on the y axis and the distance column on the x axis.

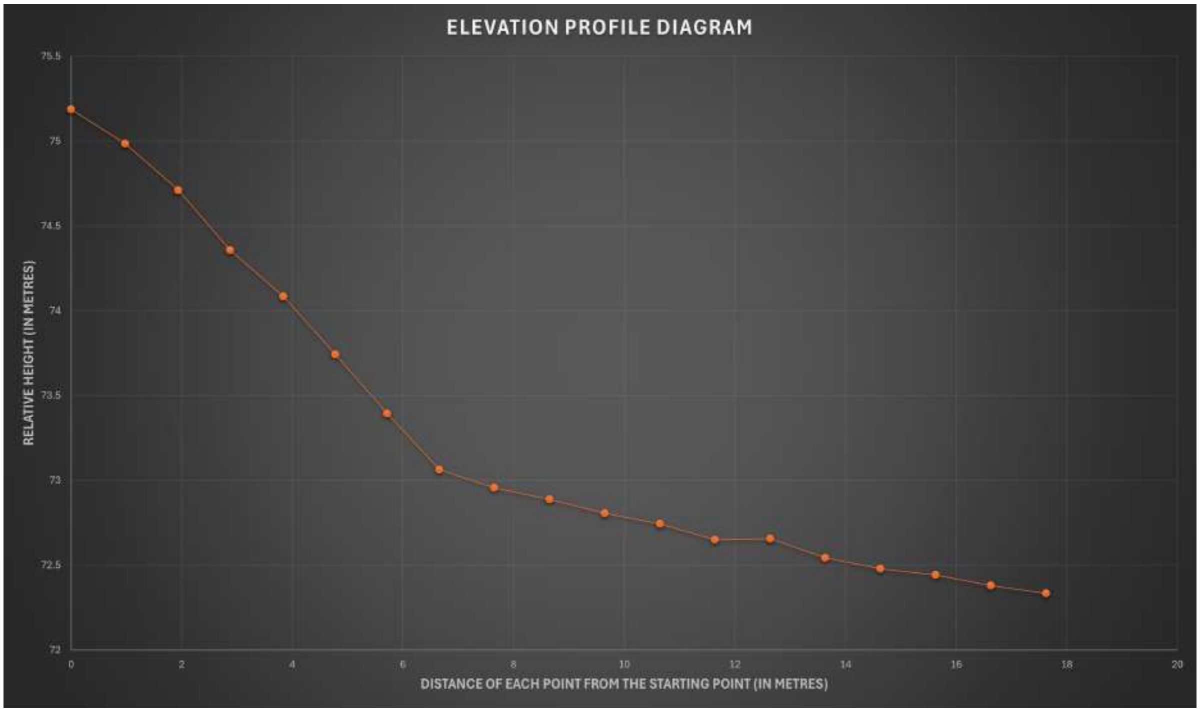


Figure 2.4: Elevation profile diagram

But this graph is very uneven and we can't visualize it as a surface so we fitted the graph in a 6 degree polynomial.

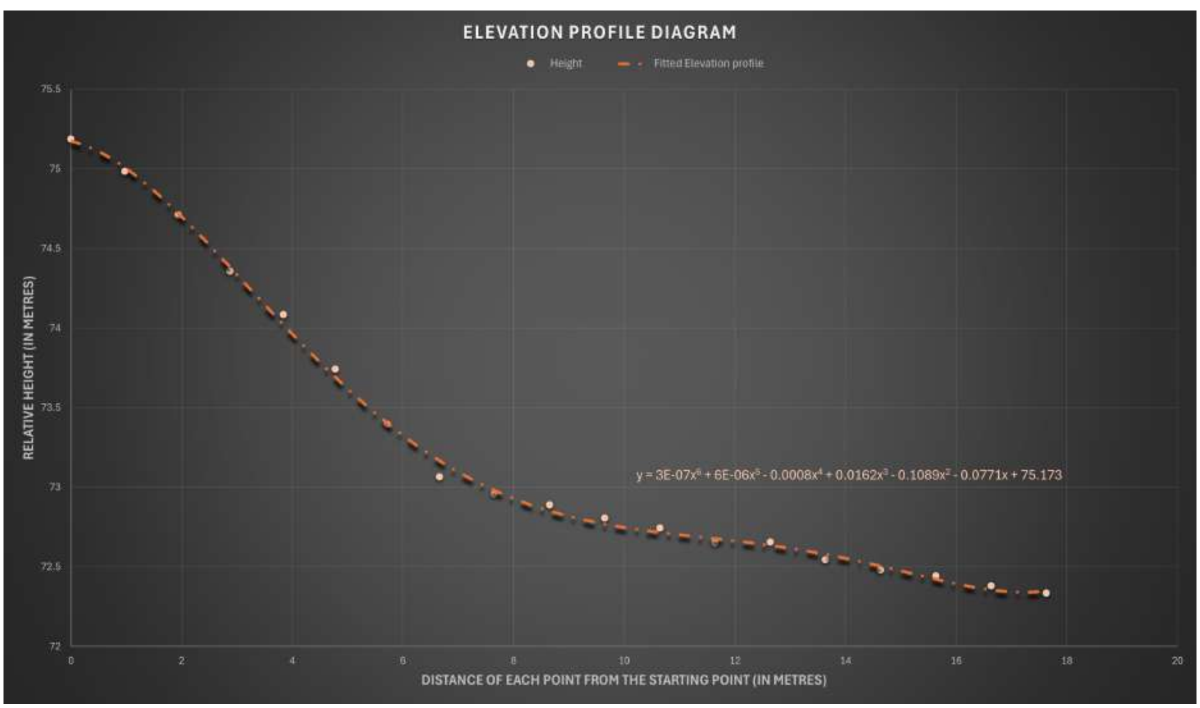


Figure 2.5: Fitted elevation profile diagram

2.5 Conclusion

This survey successfully demonstrated the use of a digital level to generate an elevation profile for a uneven terrain. The methodology involved systematic data collection using intermediate sights, precise computation of reduced heights. This ensured an accurate representation of the terrain's elevation characteristics.

The survey's results highlight the importance of careful data processing and visualization for topographic analysis. By addressing the challenges of uneven terrain and slope projection, this assignment demonstrated a practical approach to digital leveling for ground profiling. The findings can be used for construction planning, landscaping, and other infrastructure-related activities, ensuring precise knowledge of elevation variations.

3
Total Station: DEM generation, Cutting-Filling Analysis

3.1 Introduction

Total station surveys provide accurate three-dimensional spatial data by combining angle and distance measurements, which are vital for generating detailed Digital Elevation Models (DEM) and performing terrain analyses. It is one of the starting task that is to be done while planning any construction project. This survey aimed to generate a DEM of a ground area near Lal Minar with varying elevation levels and conduct a cut-and-fill analysis.

3.2 Equipment

The following equipment was utilized:

- **Total Station:** An electronic surveying instrument that measures angles and distances with high precision.

- **Tripod:** Provides a stable setup for the total station, crucial for accuracy.
- **Prism Reflector:** Used with the total station to reflect the instrument's signal for distance measurement.

3.3 Methodology

3.3.1 Setup of the Total Station

The total station was set up according to standard procedures:

1. Fix the tripod over a benchmark (BM) and level it using the circular bubble.
2. Mount and secure the total station on the tripod, ensuring it is leveled by centering the bubble in the plate level.
3. Set units, coordinate system, and create a new job in the total station for the survey.
4. Enter the station's coordinates (e.g., Northing, Easting, Elevation) and instrument height.
5. Set the Azimuth angle and measure it for a known location or angle.
6. Take the prism staff to various locations across the survey area, focusing on points with significant height variations. Ensure measurements are taken at boundary points and within the area to capture terrain details.

3.3.2 Data Collection

Boundary points were selected to define the extent of the surveyed area, while internal points were chosen based on significant elevation changes to capture terrain variability accurately. The collected data are attached in Appendix **5.1** and the attached figure 3.1 shows the physical location of each point on the ground.

This setup allowed for the precise capture of the features of the terrain, which were used to create the DEM and analyze areas of potential cut and fill.

3.4 Analysis and Results

Since we need to create a DEM of the area, we will first interpolate the data using *TIN interpolation*.The colors in the interpolated layer represent elevation ranges, with warmer colors indicating higher elevations and cooler colors representing lower elevations. Contours further enhance the visualization by marking lines of equal elevation, providing a clear depiction of terrain variation.

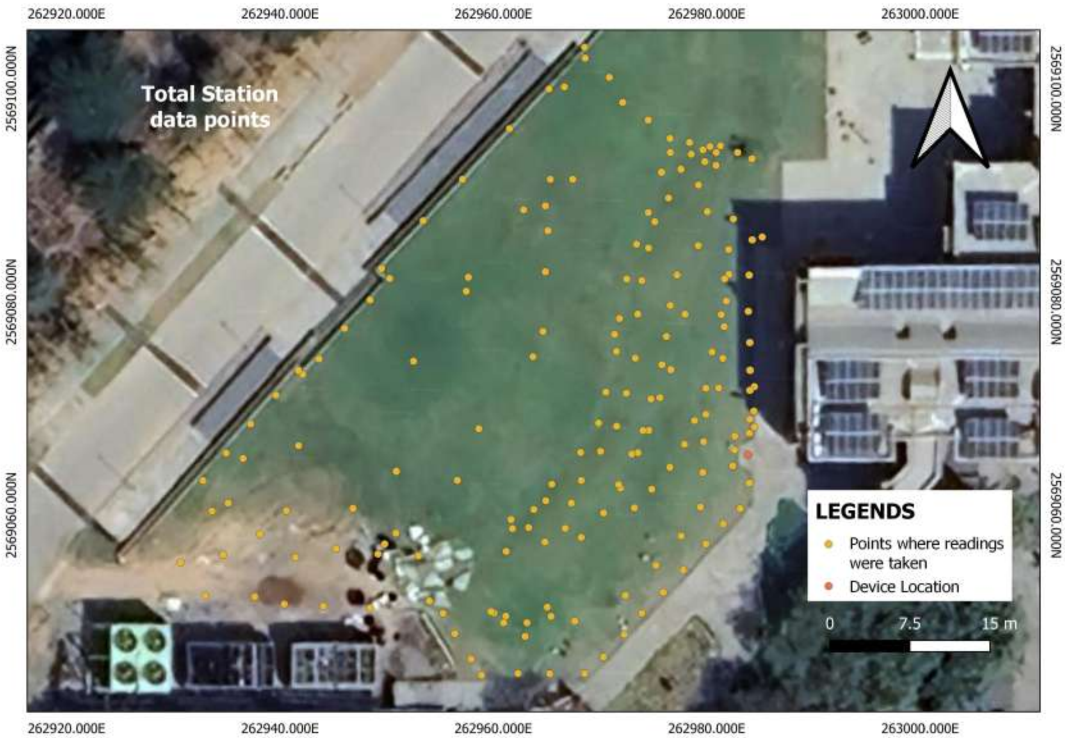


Figure 3.1: Points where readings were taken

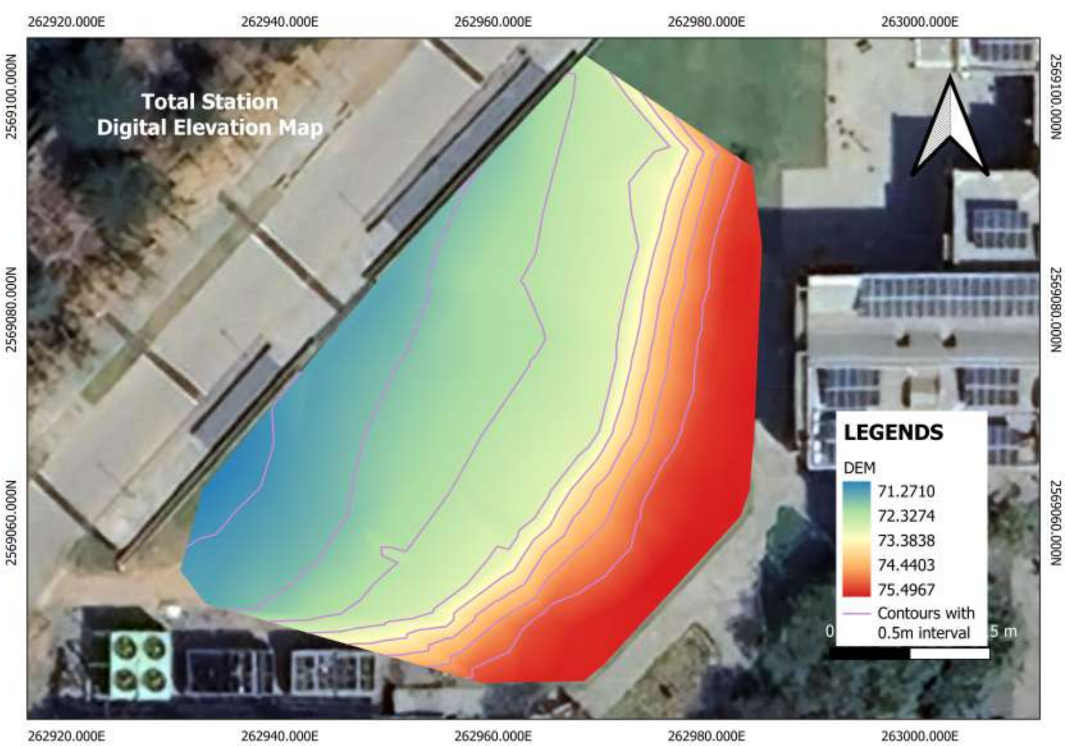
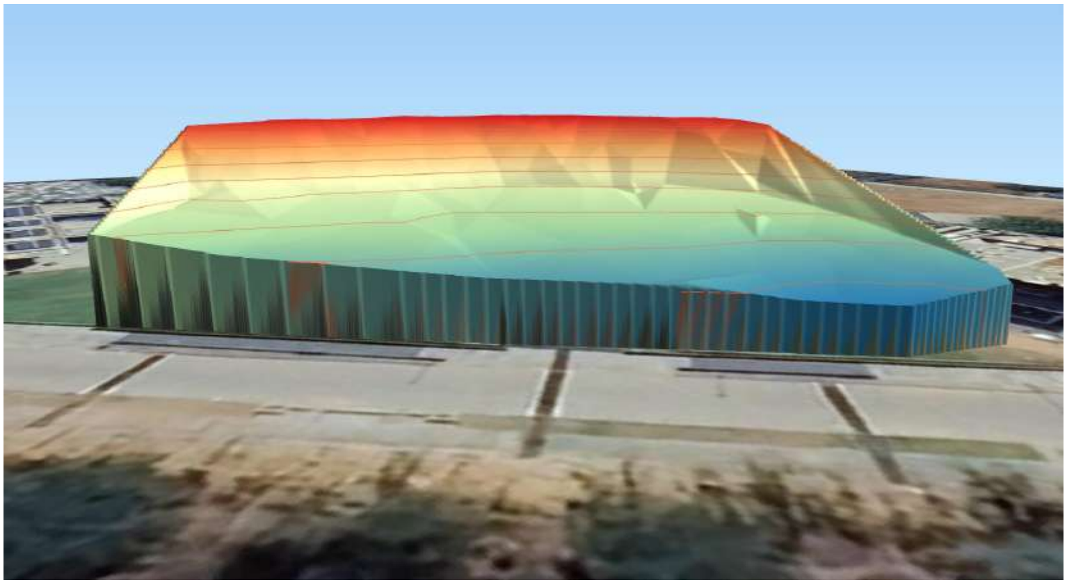
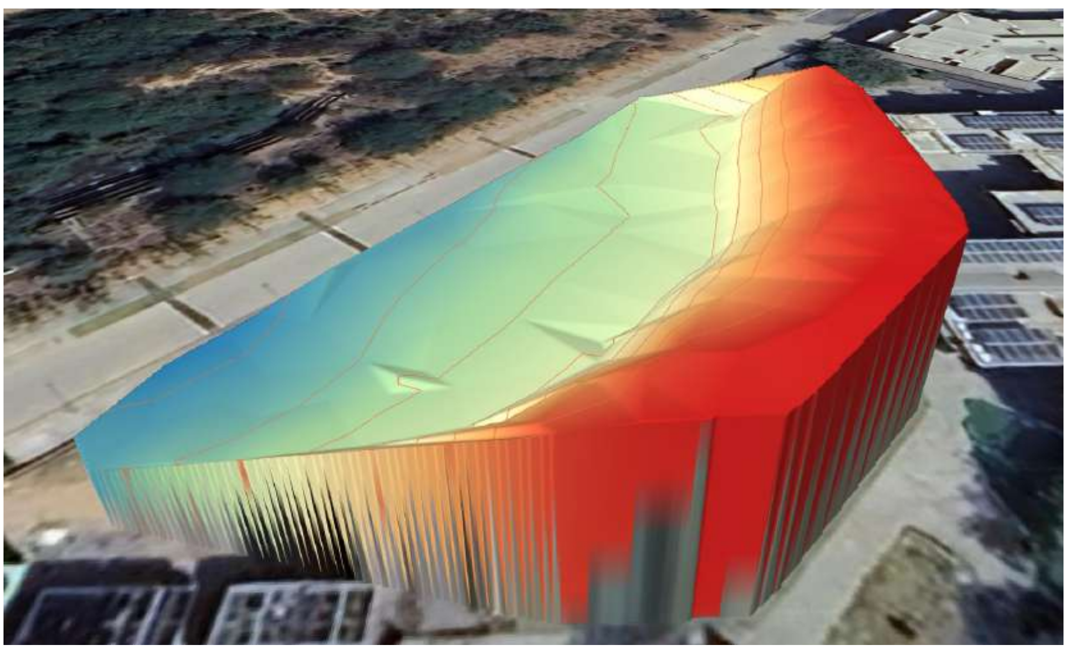


Figure 3.2: DEM of the surveyed area

Also, we can use tools like *QGIS2threeJS* to visualize the 3D model of the area.





3.4.1 Cut-and-Fill Analysis

We have divided the Cut-and-Fill Analysis in three parts:

1. If we cut the earth to the lowest point in our survey (i.e. 71.271m) we would have the volume of the earth to cut. For this we can use option *Raster Surface Volume* to calculate the volume of the earth above the base level (i.e. 71.271m).

$$\textbf{Cut Volume} = \textbf{3904.176148180586 m}^2$$

```
{ 'BAND' : 1, 'INPUT' : 'C:/Users/stuxn/Downloads/CE203 Resources/try/G4Pv2.sdat', 'LEVEL' : 71.271,
'METHOD' : 0, 'OUTPUT_HTML_FILE' : 'TEMPORARY_OUTPUT' }

Execution completed in 11.03 seconds
Results:
{'AREA': 2033.8381440719734,
'OUTPUT_HTML_FILE': 'C:/Users/stuxn/AppData/Local/Temp/processing_wxVbxE/
4371d324c05646408ae47ffa7761b48f/OUTPUT_HTML_FILE.html',
'PIXEL_COUNT': 24629783,
'VOLUME': 3904.17614818058 6}
```

Figure 3.3: Volume to cut

2. If we want to fill the area to the maximum height (i.e. 75.4967m) we will have to calculate the total volume (from minimum height to the maximum height) and then subtract the cut volume to get the fill volume. From figure 1 we know that,

$$
\begin{aligned}
\text{Area} &= 2033.838144071973 \; m^2 \\
\text{Height} &= \text{Max. Height - Min. Height} \\
&= 75.4967 \text{ - } 71.271 \; m \\
&= 4.2257 \, m \\
\text{Total Volume} &= \text{Area} \times \text{Height Difference} \\
&= 2033.838 \, m^2 \times (4.2257 \, m) \\
&= 8594.390 \, m^3 \\
\text{Fill Volume} &= \text{Total Volume - Cut Volume} \\
\textbf{Fill Volume} &= \textbf{4690.21369722435} \; m^3
\end{aligned}
$$

3. We also analyzed a scenario where the cut and fill volumes balance each other, minimizing the need to move earth off-site. In this case, we determined the height at which the volume of earth removed equals the volume added. This height was calculated by equating the cut volume to the product of the area and the new height.

$$
\begin{aligned}
\textbf{Cut Volume} &= \textbf{Area * New Height} \\
\textbf{New Height} &= \frac{\textbf{Cut Volume}}{\textbf{Area}} \\
\textbf{New Height} &= \textbf{1.919610053317215 m}
\end{aligned}
$$

Since the New Height is from the base level (i.e. 71.271) so the **Final New Height** is **73.191 m**.

3.5 Conclusion

This survey demonstrated the use of a total station for generating a detailed DEM and performing cut-and-fill analysis. The results highlight the precision of total station measurements in capturing terrain features and estimating earth-moving requirements. Such techniques are invaluable for efficient construction planning, reducing costs, and ensuring sustainable land modification. Future applications could include larger-scale terrain analysis or integration with advanced QGIS tools for enhanced visualization and decision-making.

4
References

- QGIS Documentation, ”QGIS User Guide,” QGIS.org,
  Available at:https://docs.qgis.org/latest/en/docs/user_manual/, Accessed: [22-11-2024].
- Lab Manual on QGIS & Field Surveying, ”Auto Level Survey,” IIT Gandhinagar, pp. 69-70.
- Lab Manual on QGIS & Field Surveying, ”Digital Level Survey,” IIT Gandhinagar, pp. 71-72.
- Lab Manual on QGIS & Field Surveying, ”Total Station Survey,” IIT Gandhinagar, pp. 73-75.

5
Appendix

5.1 Total Station Readings

Code	Latitude	Longitude	Height(m)
0	2569086.087	262985.196	75.3689
1	2569068.271	262984.4552	75.4091
2	2569069.775	262984.4183	75.4566
3	2569072.069	262984.4584	75.4553
4	2569085.825	262984.2719	75.4245
5	2569093.427	262984.2584	75.2451
6	2569094.016	262982.9144	74.9496
7	2569094.004	262980.8981	74.5696
8	2569094.262	262979.6485	74.0314
9	2569094.959	262978.3925	73.5374
10	2569094.01	262976.5851	73.097
11	2569097.073	262974.5325	72.8208
12	2569098.726	262972.1357	72.7975
13	2569101.087	262970.8694	72.7028
14	2569102.869	262968.5995	72.5499
15	2569100.19	262966.6729	72.4464
16	2569099.986	262965.2252	72.3595
17	2569103.889	262968.5474	72.6071
18	2569096.254	262961.5183	72.0726
19	2569091.521	262957.1294	71.9761
20	2569087.62	262953.422	71.8505
21	2569083.139	262949.5306	71.7328
22	2569082.219	262950.2929	71.7025
23	2569080.188	262948.4493	71.6719
24	2569077.528	262946.0553	71.6578
25	2569074.643	262943.6475	71.6333
26	2569073.227	262942.1447	71.7172
27	2569073.581	262941.7285	71.6792
28	2569071.274	262939.6191	71.5252
29	2569068.562	262937.2399	71.3558

Code	Latitude	Longitude	Height(m)
30	2569065.809	262934.9704	71.2956
31	2569063.27	262932.7922	71.2666
32	2569060.392	262933.6444	71.4437
33	2569055.56	262930.677	71.5918
34	2569052.457	262933.0277	71.6895
35	2569052.364	262937.6314	71.9775
36	2569051.665	262940.4048	72.1335
37	2569051.476	262944.054	72.4132
38	2569051.32	262948.4629	72.6542
39	2569051.961	262954.0089	72.9006
40	2569050.804	262955.2849	73.2498
41	2569048.886	262956.4001	74.1591
42	2569046.502	262957.9193	74.9686
43	2569045	262958.9079	75.2155
44	2569045.171	262962.3059	75.3882
45	2569045.141	262965.3011	75.4358
46	2569045.168	262968.5413	75.4243
47	2569046.692	262970.3376	75.412
48	2569048.809	262972.2795	75.4365
49	2569050.808	262973.938	75.4474
50	2569052.775	262975.9309	75.4652
51	2569054.855	262977.8082	75.4976
52	2569057.297	262979.9321	75.4844
53	2569059.18	262981.565	75.4483
54	2569060.624	262983.1489	75.4899
55	2569063.03	262984.0004	75.4434
56	2569064.618	262982.4523	75.4558
57	2569066.1	262982.6327	75.4341
58	2569067.408	262982.6524	75.4269
59	2569067.688	262984.0078	75.441

Code	Latitude	Longitude	Height(m)
60	2569069.003	262984.0565	75.4619
61	2569071.727	262984.0554	75.4882
62	2569073.597	262984.069	75.4601
63	2569076.188	262984.048	75.4304
64	2569079.127	262983.9101	75.4068
65	2569082.526	262983.9854	75.4414
66	2569082.593	262982.0943	75.383
67	2569080.098	262981.8593	75.3696
68	2569077.688	262981.6469	75.3318
69	2569074.705	262981.5262	75.3242
70	2569071.944	262981.1299	75.3485
71	2569069.466	262979.9306	75.3029
72	2569066.898	262979.7144	75.3154
73	2569064.02	262979.6358	75.4035
74	2569060.781	262979.4194	75.4533
75	2569058.048	262977.5948	75.4664
76	2569055.279	262975.2663	75.4943
77	2569052.49	262972.384	75.4442
78	2569050.061	262967.6307	75.3749
79	2569050.515	262965.4182	75.2192
80	2569049.913	262963.1515	75.0739
81	2569050.541	262961.165	74.6923
82	2569050.541	262961.165	74.6923
83	2569050.831	262960.0428	74.4248
84	2569050.961	262959.7965	74.384
85	2569049.909	262960.9558	74.7186
86	2569048.629	262962.9783	75.1684
87	2569051.377	262965.0637	75.0983
88	2569051.377	262965.0637	75.0983
89	2569057.487	262964.847	73.9627
90	2569058.841	262963.311	73.2855
91	2569059.6	262961.6494	72.7763
92	2569056.6	262961.1951	73.1055
93	2569061.366	262964.9306	73.1389
94	2569087.79	262982.5186	75.2597
95	2569084.909	262982.0714	75.3236
96	2569082.18	262981.6846	75.3253
97	2569078.821	262981.377	75.3188
98	2569075.305	262980.5049	75.2878
99	2569071.924	262979.9389	75.2119
100	2569068.875	262978.8621	75.2013

Code	Latitude	Longitude	Height(m)
101	2569066.652	262977.9173	75.1972
102	2569064.499	262976.544	75.2252
103	2569062.449	262974.8624	75.0996
104	2569060.692	262973.2299	74.9322
105	2569062.548	262971.9316	74.5554
106	2569065.863	262973.5706	74.5057
107	2569067.949	262974.5856	74.4907
108	2569071.038	262975.6248	74.5603
109	2569073.661	262976.6282	74.5984
110	2569078.863	262977.9744	74.7354
111	2569085.281	262979.2163	74.7596
112	2569088.478	262980.0694	74.7861
113	2569092.796	262980.8857	74.641
114	2569094.637	262981.2878	74.5373
115	2569094.569	262980.3175	74.2246
116	2569093.156	262979.8302	74.2673
117	2569090.984	262979.2356	74.2895
118	2569090.984	262979.2356	74.2895
119	2569090.984	262979.2356	74.2895
120	2569082.55	262977.2055	74.3193
121	2569079.689	262976.5781	74.3815
122	2569076.767	262976.2247	74.4288
123	2569074.103	262975.8077	74.4024
124	2569070.906	262974.7844	74.3655
125	2569067.939	262974.0354	74.3189
126	2569065.726	262972.9896	74.4391
127	2569062.879	262971.7488	74.4976
128	2569060.215	262970.3359	74.457
129	2569057.918	262968.233	74.48
130	2569058.764	262966.751	74.0358
131	2569061.141	262967.3296	73.8706
132	2569063.271	262968.2295	73.7467
133	2569065.976	262970.0481	73.592
134	2569068.354	262971.5656	73.6587
135	2569071.448	262972.4772	73.6181
136	2569074.725	262973.3161	73.6259
137	2569078.864	262973.5503	73.4125
138	2569082.018	262973.9323	73.3932
139	2569085.052	262974.559	73.3735
140	2569087.532	262975.1539	73.3242
141	2569089.761	262976.4117	73.5578

Code	Latitude	Longitude	Height(m)
142	2569092.451	262977.5824	73.61
143	2569093.854	262978.5483	73.7701
144	2569095.33	262976.5518	72.9989
145	2569092.17	262975.7713	73.2136
146	2569088.396	262974.5421	73.1055
147	2569085.414	262973.4318	72.9779
148	2569082.165	262972.5091	72.9756
149	2569078.452	262971.8315	73.005
150	2569075.352	262971.536	72.9956
151	2569071.56	262970.5468	72.9602
152	2569068.642	262969.8655	72.9723
153	2569065.878	262968.1746	73.0234
154	2569062.922	262965.4923	73.0076
155	2569060.542	262963.7966	72.9614
156	2569058.741	262961.7953	72.8567
157	2569066.52	262941.7607	71.6512
158	2569074.435	262952.5037	72.0884
159	2569077.235	262964.6563	72.4832
160	2569076.962	262971.3684	72.9388
161	2569074.853	262963.7193	72.5114
162	2569068.108	262958.6515	72.4906
163	2569061.147	262935.1543	71.4718
164	2569065.317	262936.5349	71.3653
165	2569064.118	262950.926	72.2454
166	2569060.646	262946.8439	72.0302
167	2569056.023	262941.4574	71.8969
168	2569058.221	262938.1328	71.6742
169	2569056.272	262934.6887	71.6021
170	2569063.282	262956.6336	72.5202
171	2569060.435	262940.6126	71.6996
172	2569057.3	262949.8293	72.5638
173	2569058.309	262950.8861	72.4108
174	2569056.349	262949.2019	72.3999
175	2569056.186	262952.978	72.6055
176	2569056.863	262945.2546	72.0801
177	2569091.526	262967.4599	72.6326
178	2569091.518	262965.343	72.5028
179	2569086.682	262965.1309	72.5551
180	2569082.837	262964.8844	72.5839
181	2569082.331	262957.6691	72.323
182	2569089.023	262964.8952	72.5155
183	2569088.651	262962.8377	72.3876
184	2569081.021	262957.4669	72.2702