



An Analysis of Route Surveying and Mapping of Obada/Owode Ede Road

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Abstract: The project's objectives were to fix specifics along the route from Obada junction to Owode Ede junction, Ede North Local Government Area, Osun State, as well as to determine the route's direction and heights along its centre line. After careful evaluation, appropriate control beacons were selected, and profile intervals were determined by taking into account the task specifications and the route's topography. The route was roughly 5.634 kilometres long overall. Controls were set using differential Global Positioning System (GPS), and data was acquired using the South (NTS-352R) S57217 Total station with established GPS control points. Software from the South Total station was then used to retrieve and process the data. Both the longitudinal profile and the traverse profile were plotted using AutoCAD Land Development software 2009. For linear and levelling accuracy, the resulting accuracies are 1:13,000 and -0.0314m, respectively. Final coordinates were supplied with this report. The survey's final products (plans) were displayed at scales of 1: 5000 on the horizontal axis and 1:500 on the vertical axis for the longitudinal section, and 1:1000 on the horizontal axis and 1:100 on the vertical axis for the cross section, respectively.

Keywords: AutoCAD, Cross sections, GPS, longitudinal profile, Total Station,

1.0 Introduction

Even though certain professionals in the construction industry have traditionally undervalued their functions, engineering surveying is one of the most important services surveyors provide to humanity for developmental purposes. One of the most important factors in advancing our society and expanding a country's economy is the building of new roads. This project is necessary to accomplish this because, before beginning the building of the access road in such a society, a thorough longitudinal profile and cross sections of the road must be completed. This particular route is a crucial access road that connects Ede town to the capital of Osun state as well as to a few localities inside the state, where a significant portion of Ede town's produced goods, services, and food items arrive.

An essential component of engineering survey work, which deals with engineering construction, is route surveying. One definition of it is a large-scale engineering survey conducted to gather the data engineers need to plan, build, and lay out any kind of route, including roads, railroads, highways, oil pipelines, tunnels, canals, and transmission and communication lines. This is a crucial component of road construction, particularly for roadways longer than five kilometres. A route survey's objectives are to ascertain the road's alignment, elevation, and size as well as any physical characteristics or limitations that might have an impact on the road's construction or design. A route survey is carried out to collect data for the road's design, which involves figuring out the optimum path to take in order to minimise the impact on the environment, save construction costs, and guarantee road user safety. Reconnaissance, preliminary survey, comprehensive survey,

and construction staking are some of the processes involved in route surveying. The surveyor looks over the suggested route, gathers information on current physical characteristics and limitations, and assesses the terrain during the reconnaissance phase. A tentative road alignment design and the establishment of horizontal and vertical control points are part of the preliminary survey. The precise position, height, and dimensions of the road and its related characteristics are measured and documented as part of the comprehensive survey. In order to direct construction crews, the surveyor marks the road's location and related characteristics on the ground during construction staking.

Road route surveying necessitates a high level of precision and accuracy. Route surveying is now much more accurate and efficient because to modern surveying methods like GPS and LiDAR. While LiDAR technology allows surveyors to produce intricate 3D models of the landscape and physical elements along the route, GPS technology helps surveyors to precisely locate the road and its associated characteristics. Route surveying employs a variety of approaches, such as traditional surveying methods, LiDAR surveying, GPS surveying, Unmanned Aerial Vehicles (UAVs) surveying, and more. The desired level of accuracy, the cost, and the topography of the road alignment all influence the surveying method selection.

Traditional surveying methods measure the road's horizontal and vertical alignment using level equipment, theodolites, and total stations. Although this approach is precise, it takes a lot of time, particularly when aligning long-distance roads. A 120-kilometer road alignment in China was surveyed using traditional surveying methods in a study by Zhang et al. (2015). The precision of the survey was within 10 cm, and it took 160 days to finish.

Satellites are used in GPS surveying to pinpoint the position and altitude of survey locations. This approach can cover enormous areas more quickly than traditional surveying. A 100 kilometre road alignment in Iran was surveyed using GPS surveying in a study by Esmaeili et al. (2017). The precision of the survey was within 20 cm, and it took 25 days to complete.

In LiDAR surveying, the topography of the road alignment is measured using a laser scanner. This technique may cover a lot of ground and is quick and precise. A 30-kilometer road alignment in Pakistan was surveyed using LiDAR scanning in a study by Khan et al. (2020). The precision of the survey was within 5 cm, and it took 7 days to complete. Unmanned aerial vehicles, or drones, are used in UAV surveying to take detailed pictures of the road alignment. This approach is economical, precise, and quick. In a research by Akintola et al. (2020), a 5-kilometer road alignment in Nigeria was surveyed using UAVs. The precision of the survey was within 5 cm, and it took two days to complete. For this reason, route surveying is essential to maintaining the operation and safety of roads. In order to reduce the chance of accidents and guarantee efficient traffic flow, proper alignment and elevation are crucial. Furthermore, the correct design and construction of road elements like culverts, retaining walls, and bridges depend on precise survey data. Route surveying has been the subject of numerous studies. According to a study by Gao et al. (2020), both GPS and LiDAR produced extremely precise data when used for route surveying. The use of unmanned aerial vehicles (UAVs) in route surveying was the subject of another study by Liu et al. (2021), which concluded that UAVs offered a productive and economical substitute for conventional surveying techniques.

To sum up, route surveying is a crucial step in the building of highways, particularly those that are several km long. Construction staking, preliminary survey, comprehensive survey, and reconnaissance are some of the procedures involved. Route surveying is now much more accurate

and efficient thanks to modern surveying methods like GPS, LiDAR, and UAVs. For roads to be safe and functional as well as for road elements to be designed and built correctly, accurate survey data is essential.

However, the purpose of this project was to use a total station and its accessories to give baseline survey data for future engineering designs, re-alignment, and building of this specific rural road. Along the route, cross-sectional and longitudinal measurements were collected every 25 meters.

2.0 Materials and Methods

The South Total Station NTS-352R was used to conduct the profile survey. Centring, levelling, and focussing were among the temporary changes made after the observation began at pillar OCSD 223S. Data was selected once the instrument was turned on and a menu button was clicked. When the file name was displayed and the work was named Route, the instrument screen showed the occupy point, back sight, and foresight. Then, the Enter button was hit. Northing, Easting, and Height of occupied point were entered into the instrument to set the occupied point; the instrument's height was measured using a 5-meter steel tape and entered as well. Then the enter button was hit. The South Total Station NTS-352R was used to conduct the profile survey. Centring, levelling, and focussing were among the temporary changes made after the observation began at pillar OCSD 223S. Data was selected once the instrument was turned on and a menu button was clicked. When the file name was displayed and the work was named Route, the instrument screen showed the occupy point, back sight, and foresight. Then, the Enter button was hit. Back sight was then chosen. The reflector height, northing, easting, and station number were entered. In order to verify that the orientation was accurate, a field check was conducted by orienting to pillar AGT 01 and then observing OCSD 224S to get the position's coordinates. The reflector was held at zero point, and observations were taken to the reflector as the profile section began with a chainage of 0 + 000. As indicated during the planning stage, the reflector was continuously kept at 25-meter intervals along the centre line, left, and right of the path. This procedure was carried out repeatedly until the instrument's position changed. Until the section was covered, the identical field process was carried out again.

3.0 Data Downloading and Processing

3.1 Data Downloading

Using South software and a downloading cable, the data collected from the field observations using the South Total Station was transferred to a computer. These data were downloaded in the following formats: height (X, Y, and Z), easting, northing, and point id. On the PC, Microsoft Notepad and Excel were used to alter the downloaded data.

3.2 Data Processing

These downloaded data were processed to produce outcomes that adhere to SURCON guidelines. These were accomplished by utilising Microsoft Excel 2010 to update and prepare the script file for the final plans' preparation (Figure 1).

3.2.1 Analysis of Results

The traverse was closed on pillar OCSD 240S, and the misclosure was determined by comparing the observed coordinate with the available value, as shown in Table 1.0.

Table 1.0: Misclosure

Existing Coordinates				Observed Coordinates			Diff. Coordinate s	Diff. Height	
Station	Northing s (m)	Eastings (m)	Height	Northing s (m)	Eastings (m)	Height (m)	Misclosure (m)		
Station	Northing s (m)	Eastings (m)	Height	Northing s (m)	Eastings (m)	Height (m)	ΔN	ΔE	ΔH
OCS	852769.6	664283.65	322.07	852769.3	664283.8	322.1	0.33	-	-
D 240S	75	52	36	45	63	05	0	0.28	0.031
								1	4

Author field work (2023)

The linear accuracy was computed using the differences of +0.330mN, -0.281mE, and -0.0314m in Nothing, Easting, and Height as follows:

3.2.2 Accuracy Obtained

Linear Accuracy

On pillar OCSD 240S, the traversing operation was closed; table 3.1 details the closure. The linear accuracy was computed using the differences of +0.130mN and -0.081mE in Nothing and Easting.

The Linear accuracy was computed using the formula = $\frac{1}{\frac{\sqrt{(\Delta N^2 + \Delta E^2)}}{\sum D}}$

Where ΔN = misclosure in the Northing coordinate = +0.330mN

ΔE = misclosure in the Easting coordinate = -0.281mE

$\sum D$ = Total Distance = summation of distances within the network = 5.634km = 5634

$$\begin{aligned} \text{The Linear accuracy} &= \frac{1}{\frac{\sqrt{(+0.330^2 + -0.281^2)}}{5634}} = \frac{1}{\frac{\sqrt{(0.1089 + 0.078961)}}{5634}} \\ &= \frac{1}{0.00007693101674} = 12,998.65831 \approx 13,000 \end{aligned}$$

Linear accuracy = 1: 13,000

Leveling Accuracy

The leveling accuracy was computed using the formula $24\text{mm}\sqrt{K}$

Where K = Total distance covered in Kilometres = 5.634m

Leveling accuracy = $24\text{mm}\sqrt{K} = 24\text{mm}\sqrt{5.634} = 24 \times 2.373604853 = 56.96651648\text{mm} = 0.057\text{m}$

For the third order traverse, the permitted linear accuracy is 1/5,000, and 1/19,000 was attained for this project. Comparing this to the 1:5000 accuracy required by SURCON's specification, the acceptable limit was reached. Regarding vertical accuracy, the vertical difference after closing on pillar OCSD 240S was -0.0314m, while the minimal accuracy determined using the formula $24\text{mm}\sqrt{K}$ was 0.057m. As a result, the job's accuracy was within the acceptable range.

Table1. 2.0: Result Analysis

Aspect	Allowable Closure	Result Obtained	Remark
1. Traversing			
a. Angular misclosure ($30''\sqrt{N}$) Where N = total number of stations	00° 02' 10.77"	00° 01' 56.19"	Within allowable limit
b. Linear misclosure $\frac{1}{\sqrt{(\Delta N)^2 + (\Delta E)^2}}$ Total distance	1 : 5000	1 : 13,000	Within allowable limit
2. Levelling misclosure ($24mm\sqrt{k}$) Where k =total distance covered in kilometer.	±0.057m	-0.0314m	Within allowable limit

SOURCE: Author field work (2023)

4.0 Plan Production and Presentation

AutoCAD Land Development 2009 was used to plot the data. To do this, the points were first imported using the menu bar's points menu. Following the import of the points, the terrain model explorer was used to generate the surface from the terrain menu. After the label settings were changed, the polyline command was used to combine the centre line points, and alignment was generated from the polyline. By modifying the profile settings and sampling the currently formed surface, a profile was built from the profile menu. AutoCAD Land Development was used to plot the data at an appropriate scale. As seen in Figures 1.0, 2.0, 3.0, 4.0, and 5.0

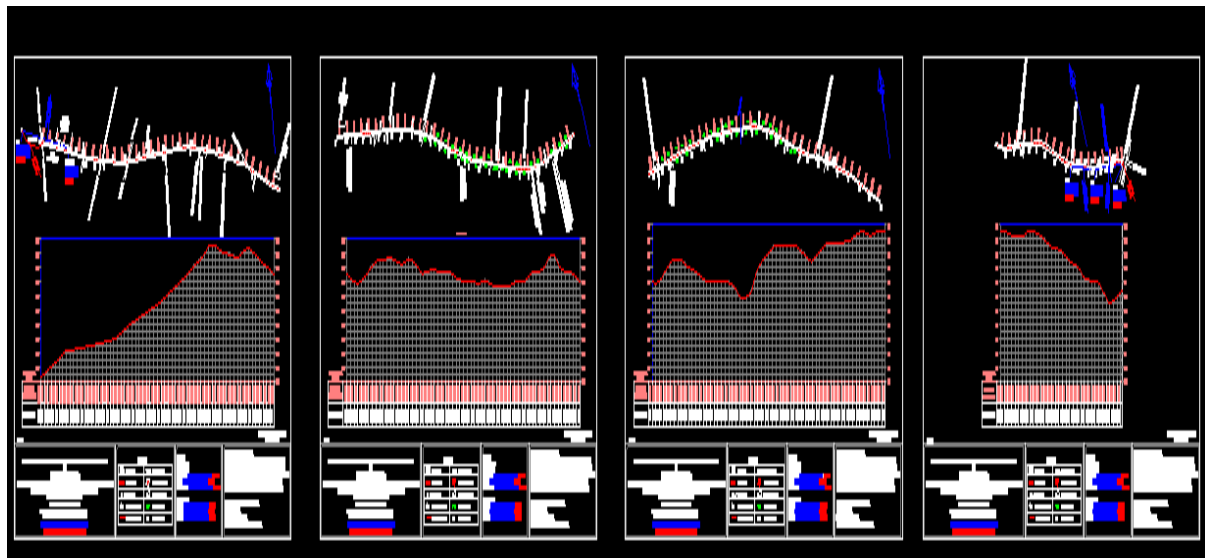


Figure 1.0 Corridor Plan of the Route and Longitudinal profile plan of the route (2023)

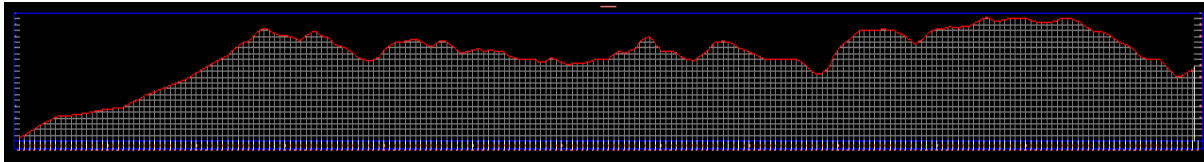


Figure 2.0 Longitudinal profile plan of the route (2023)

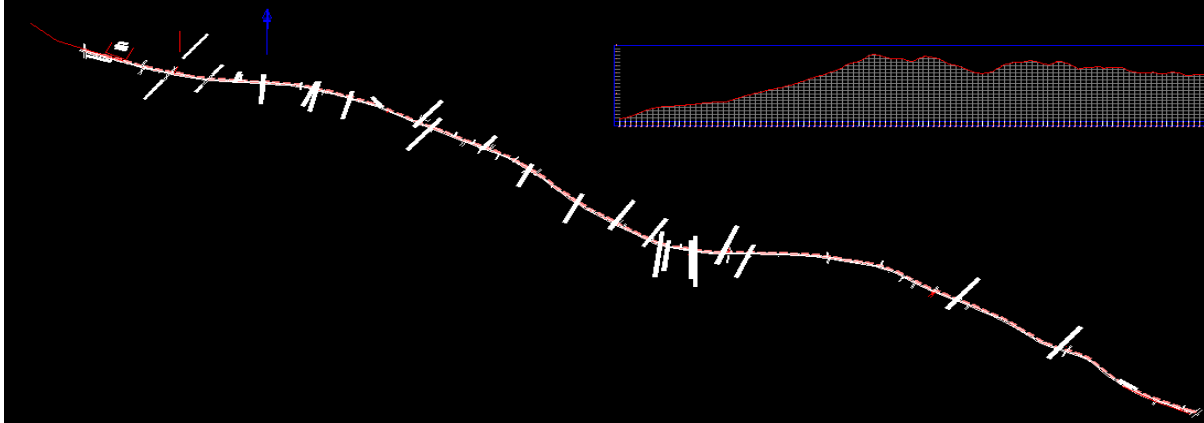


Figure 3.0 Route Alignment of Odeda/ Owode Ede (2023)

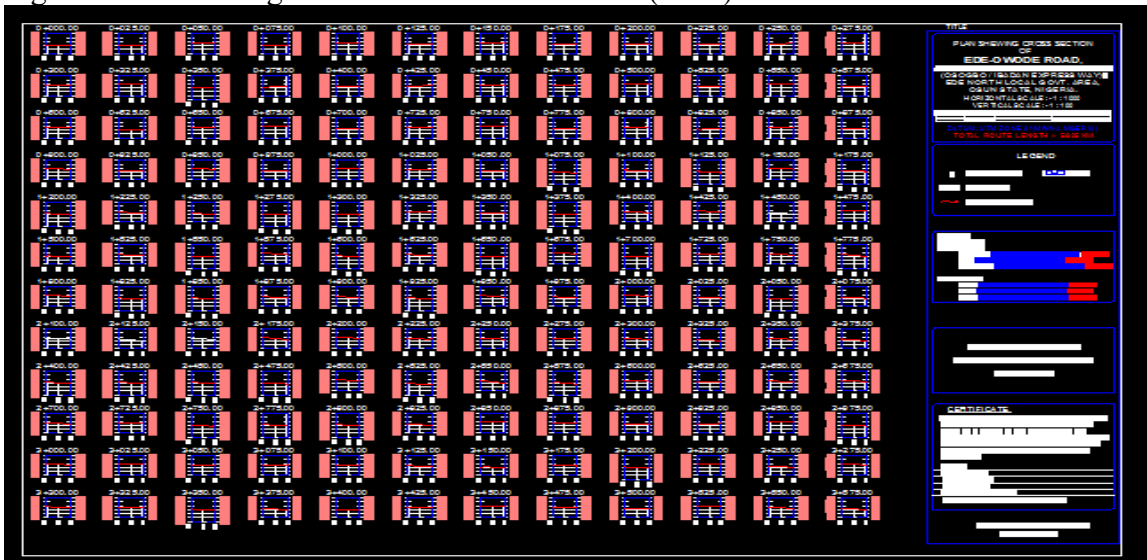


Figure 5.0 Cross section of the route (2023)

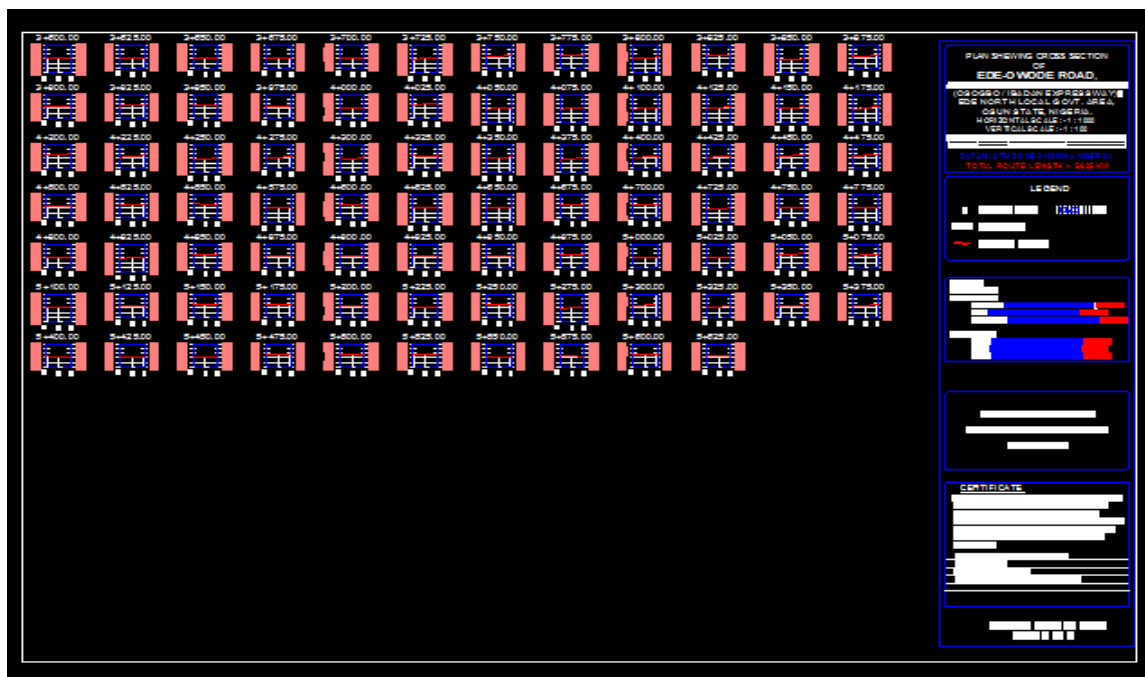


Figure 6.0 Cross section of the route (2023)

5.0 Summary, Problems Encountered, Recommendation and Conclusion

The project covered 5+634 kilometres of chainage in total. Data was collected along the route's centre line using the South (NTS-352R) S57217 total station. South downloading software was used to download and process the collected data. AutoCAD Land Development 2009 was used to produce the longitudinal profile at a horizontal scale of 1: 5,000 and a vertical scale of 1: 500 utilising the final coordinates that were obtained. Due to the quarry and construction site along the route, which delayed observations, the main issue encountered was motor traffic, particularly Tipper. This was effectively managed by using a white flag to regulate traffic and wearing reflective jackets. Inquisitive villagers' disruption also caused a delay in observation.

This experiment showed how route optimisation between Obada Junction and Owode Junction may increase safety, decrease traffic, and improve commuter efficiency. Given the road's economic and social benefits to the people of Ede, Oshogbo, and the surrounding area, I firmly believe that the Osun State Government should expedite the road's completion. Along the route, this would also increase free flow of vehicle, reduce accidents and robberies activities in the night. Through the precise determination of the height of centre points, direction, and distances between points along the existing route, procedures that were strictly followed made it possible for the project to achieve its goal and produce results that were satisfactory based on the level of accuracy obtained. As a result, the project's specifications were also met. The cost of completing the project was decreased by using the modern equipment, which also cut down on the number of days and staff needed.

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