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Topographic Survey of Comprehensive Secondary School Nawfia, Anambra State.

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ABSTRACT

Topographic surveying is the detailed measurement and representation of the physical features of an area of land, including both natural and man-made elements. It involves measuring horizontal distances, elevation changes, and directions to create a highly accurate map that shows the layout and characteristics of the land. The need for a topographic survey can never be over emphasis as it aids in accurate planning and development for infrastructural projects, it also helps in informed decision making etc. This research is therefore aim at producing a topographic map of Comprehensive Secondary School Nawfia which can be used as a tool for effective planning and proper land management of the secondary school. The school covers an area of approximately 1707 Hectares, with grassland vegetation. The methodology used in this research work includes: Traversing, Leveling and Detailing this was carried out using Total Station (South NTS-352). Data obtained from the field was then analyzed and processed using AutoCAD 2012 and Sufer 10 and ArcGIS 10.7. These are the software which was used in this research work for Data analyzes. The result of this research was the development of the topographic map of the study area. In conclusion this research presented the significant need for a topographic map of Comprehensive Secondary School Nawfia.

Keywords: Anambra, Topographic, Survey.

1. Introduction

Topography refers to the characteristics of the land surface. These characteristics include relief, natural features, and artificial (or man-made) features. Relief is the conjuration of the earth surface and includes such features as hills, valleys, plains, summits, depressions, and other natural features, such as trees, streams, and lakes. Man-made features are highways, bridges, dams, wharfs, buildings and so forth. A graphic representation of the topography of an area is called a **Topographic map.** A topographic map is simply a drawing that shows the natural and artificial features of an area. A topographic survey is a survey conducted to obtain the data needed for the preparation of topographic map. This data consists of the horizontal and vertical locations of the features to be shown on a map.

A topographic survey is the means of producing a topographic map. The preparation of topographic map can be done by means of theodolite, aerial photography, Total Station, GNSS etc. High accuracy, efficiency and less time requirement give more predominance and acceptance to Total Station. Theodolite and other conventional surveying techniques are very slow and laborious and practically not feasible for a large area. Total station surveying is advancement to theodolite surveying. Many field operations such as angle and distance measuring and their field recording have been automated in Total Station surveying.

A topographic survey, often shortened to *topo survey*, is an invaluable tool for capturing the physical characteristics of a specific area of land. It goes beyond simply mapping boundaries (Cadastral Survey). It unveils the intricate details of the terrain, including natural and man-made features, elevations, and slopes. A topographical survey is sometimes known as a land survey or topographical land survey, and it is also described as a contour survey. A topographical land survey determines the accurate location and characteristics of natural and man-made elements within a given region of land. The survey is then turned into an accurate plan that incorporates human-made characteristics like boundaries, fencing, neighboring buildings, and walkways, among other things also natural elements such as ground, trees, ponds, walls, earthworks, etc. are also picked up by the topographical survey.

Generally surveying can be divided into various branches based on the type of operation in each branch. Uren and Prince (1994) divided the branches of surveying into the following:

- Cadastral Surveying
- Engineering Surveying

- Topographic Surveying
- Hydrographic Surveying
- Photogrammetry Surveying
- Geodetic Surveying

Topographic survey is the survey carried out to produce a topographic map showing the elevations of natural and man-made features of the earth surface. The objective of a topographic survey is to determine the position of any feature and point in terms of both the horizontal coordinates such as latitude and longitude and also determining the altitude |(height) of the features and recognizing typical land forms. A topographic survey may be made for a variety of reasons such as military planning and geological exploration. These have been primary motivation to start survey programmes both detailed information about terrain and surface features is essential for the planning and construction of any major civil engineering, public works or reclamation projects (USGS 2003). Topographic survey is created by determining the X, Y. Z coordinates of relevant features such as buildings, roads, electric poles, borehole, as well as points on the ground surface. These data can be obtained by the use of a Total Station.

Total Station surveying is defined as the use of electronic survey equipment used to perform horizontal and vertical measurements in reference to a grid system. Total Station is a form of an electronic theodolite combined with an electronic distance measuring device (EDM). Its primary function is to measure slope distance, vertical angle, and horizontal angle from a setup point called instrument station to a foresight point. Most Total Stations use a modulated near infrared light emitting diode which sends a beam from the instrument to a prism. The prism reflects this beam back to the instrument .The portion of wavelength that leaves the instrument and returns is assessed and calculated. Distance measurements can be related to this measurement using the principle of travel of light energy through air. Angle accuracy can range from 2'' to 5". Distance accuracy can range from +/- (0.8+1ppm* D) mm to +/- (3+3ppm* D) mm, where D is the distance measured.

Some of the advantages of Total Station surveying are:

- Reduce error: Manual errors involved in reading and recording can be eliminated.
- Time saving: Field work is carried out very fast.
- Accuracy of measurement is high.
- Precision data.
- Calculation of coordinates is very fast and accurate. Even corrections for temperature and pressure are automatically made.
- Computers can be employed for map making and plotting contour and cross section. Contour intervals and scales can be changed at any time.

2. Literature Review

In recent past, many different works has been done in the area of topographic surveying. A critical view of these researches done on topographic survey using Total Station will be discussed below.

Jeyapalan and Bhagawati (2000) conducted a study on Total Station, Differential Global Positioning System (DGPS), Video logging, soft photogrammetric and virtual reality methods of collecting data on road side features of urban, city and rural roads for creating a Geographic Information System (GIS). The first 15 highest priority road side features were: intersections, signs, pavement markings, signals, and curbs, guard rail, number of lanes, rail road crossings, shoulders, side walk, road names, pavement distress, roadway geometric, bridges and Right of way. The video logging system gives the digital image and the X, Y, Z coordinates of the camera locations, using this information and soft photogrammetry it is possible to determine the location of any feature. Virtual reality is the mode in which a user can view in 3D, fly through the virtual model, modify in real time and view or measure its effect. The conclusion of the study was, Total Station can be used to collect data for creating 2D GIS showing roadside features at a scale of 1!=25" or larger and or smaller. DGPS can be used for mapping at scale 1! = 50" or smaller. Both systems are time consuming in the field. Soft Photogrammetry with digital video logging imagery can be used to map roadside features at 1! = 25" or smaller. It saves field data collection time; however, it requires calibration and stereo data collection time in the office.

Vachher and Srivastava [2006] defined topographical map as a two dimensional representations of three dimensional land surfaces through a combination of contour lines, symbols and texts, topographical maps portray the shape and location of mountains, forest, rivers, lakes, cities, villages, roads, rails, bridges and most of other man-made and natural features existing on the surface of the earth. They also contains reference systems like graticule lines, grids, benchmarks, magnetic declination etc. Topographical maps are used by defence forces for planning operations as well as by administrators, civil engineers, natural resources managers, town planners, emergency service agencies, outdoor enthusiasts, historians, geographers etc.

Ragab Khalil (2013) studied the accuracy of GIS tools for transforming assumed total station surveys to real world coordinates. In this paper the effect of using Georeferencing tool, Spatial Adjustment tool (Affine and similarity) and CHaMP tool on the precision and relative accuracy of total station survey were studied. The effects of using geodetic GPS, hand-held GPS, Google Earth (GE) and Bing Base maps as sources for control points on the precision and relative accuracy of total station survey was also studied. These effects have been tested by using 111 points from a covered area of 60,000 m^2 and the results have shown that the CHaMP tool was the best tool for preserving the relative accuracy of the transformed points. The Georeferencing

and spatial adjustment tools gave the same results and their accuracy were between 1/1000 and 1/300 depending on the source of control points. The results have also shown that the cornerstone to preserve the precision and relative accuracy of the transformed coordinates is the relative position of the control points.

Adebayo, F. A., & Olagunju, R. E. (2017). Adebayo and Olagunju present a comprehensive review of remote sensing applications in topographic surveys, focusing on advancements and challenges specific to Nigeria. By analyzing the strengths and limitations of remote sensing technologies such as satellite imagery and LiDAR, they offer valuable insights into optimizing the use of remote sensing data for accurate topographic mapping and monitoring.

Lawal, D. U., & Alaga, A. T. (2018). Lawal and Alaga conduct a comparative analysis of traditional and modern surveying methods for topographic mapping in rural Nigeria. By evaluating the effectiveness, cost-efficiency, and accuracy of both approaches, they provide valuable insights into the selection of appropriate surveying techniques based on project requirements and resource constraints.

Adepoju, M. O., & Adebayo, A. O. (2019). Adepoju and Adebayo investigate the integration of GPS and GIS techniques for topographic mapping in southwestern Nigeria. Through a case study, they highlight the synergistic benefits of combining GPS-derived elevation data with GIS spatial analysis, enabling accurate and detailed topographic mapping essential for various land management applications.

Oyedepo, J. A., & Oke, S. A. (2020). This study explores the utilization of drone technology for topographic surveys in urban development projects in Nigeria. Oyedepo and Oke demonstrate the efficiency and accuracy of drones in capturing high-resolution topographic data, thus providing valuable insights into land planning and infrastructure development.

These recent studies contribute to the advancement of topographic survey methodologies in Nigeria, providing valuable insights into the application of innovative technologies and techniques for accurate and efficient terrain mapping.

2.1 Study Area

Nawfia is a town in southern part of Njikoka Local Government Area of Anambra State, Nigeria. Nawfia is surrounded by neighboring towns namely Enugwu Ukwu, Awka (Umuokpu), Nise, Amawbia and Enugwu Agidi. It is predominantly occupied by the Igbo ethnic group and is believed to be one of the towns that make up the ancestral home of Igbo people. Most of its inhabitants are Christians (with Anglicans and Catholics making up the vast majority). Igbo and English are the predominant languages spoken in Nawfia.

Comprehensive Secondary School Nawfia is located along old Onitsha Enugu express way at approximately latitude $6^{o}\,12^{`}\,59^{``}$ to $6^{o}\,13^{`}\,12^{``}$ N and longitude $7^{o}\,1^{`}\,19^{``}$ E to $7\,1^{`}\,21^{``}$ E. Comprehensive secondary school covers an approximate area of 17.7 hectares of land mass.

3. Materials and Methods

3.1. Instrumentation

Equipment used for this research work includes:

- One (1) SOUTH (NTS 352-R) Total Station and its accessories.
- One (1) plumb bob and string.
- Two (2) cutlasses.
- One (1) 50m Steel tape.
- Three (3) Ranging poles.
- One (1) Personal Computer (PC) and its peripherals.

Software used includes:

- AutoCAD Land Development 2012
- Golden Surfer 10 software
- Notepad
- Microsoft Office Excel 2012 and Microsoft Word 2012

3.2. Data Acquisition

This point is very important part of this research work. It is the foundation in which other operations were based. It consists capturing of both the geometric (spatial or locational) data and the attributes data. The geometric data acquisition involves the collection of the locational data (i.e. consisting the Northing,

Easting and Height) at the site, using the total station (SOUTH NTS-352R) and its accessories. The acquired data were stored in the internal memory of the instrument and later imputed into Microsoft Excel software.

Instrument test (Test for the accuracy of the Total Station) as well as Control checks were also performed before proper **Detailing and Traversing** began.

3.2.1. Control Check

The angle of the three control pillars was measured in order to ascertain if the control pillars were still in their true positions. The total station was set on control pillar **FGP045.** Temporary adjustments were carried out. The horizontal reading of the Total Station was set to 00° 00' 00" and control pillar W5388 was bisected with 00° 00' 00". Fore sight was then taken to **W5386** and the reading was recorded. The distances between **FGP045** and **W5388, FGP045** and **W5386** were also measured and recorded.

Observed check angle = 217º 23` 59``

Computed check angle = 217º 23` 57"

Discrepancy = 00º 00` 02"

Measured distance from FGP045 to W5388 = 72.429m

Computed distance from FGP045 to WS388 = 72.432m

Discrepancy = 0.003m

Measured distance from FGP045 to W5386 = 159.887m

Computed distance from FGP045 to W3386 = 159.891m

Discrepancy = 0.004m

Table 1 The Observed Coordinate of control point W5388 from FGP045 and Its Original value

Station	**Northings(m)**	**Eastings (m)**	**Status**
W5388	242437.822	508025.866	Observed
W5388	242437.829	508024.860	Original
Discrepancy	DN= -0.007	DE= +0.006	

Source: Field Survey

The above results had indicated that the controls were in their true position

Note the Data Sources used for this research is Primary source, the primary source data comprises of the spatial coordinates value (X, Y, Z) that is the Northing, Easting and Height of the various points acquired from field operations using the Total Station.

3.2.2. Traversing

A traverse network forms the foundational framework for accurate measurements and mapping in topographic surveys. Control points serve as fixed reference markers across the survey area, enabling precise positioning and orientation of survey lines.

The traversing was carried out using (South NTS-352R) Total Station. The traverse started from control W5386 whose coordinate was earlier obtained from the ministry of land and survey Anambra State and closed hack on the same control W5386. This type of traversing is known as close traversing

3.2.3. Detailing

There are several methods of fixing details in surveying, some of which are Tachometry methods, Chain survey method (Offset and Tie-lines), Ray-method. In this study details were fixed using the **Ray method.** The details within and around the study site were fixed by placing the reflector on the edges of the buildings, electric poles, water tank, roads etc. using Total Station in its co-ordinate mode.

3.3. Data Processing and Analysis

The existing control coordinates obtained from the Ministry of Lands and Survey Anambra were first transformed from WGS 84 reference ellipsoid to Local Datum (Mina Datum). This transformation was done using the coordinate calculator software. The coordinate observed on site using the Total Station was transferred to Microsoft Excel 2012. The data thus obtained is saved in Notepad software as “SCR” format.

3.3.1. Area Computation

To compute the area, surveyors gather field data using instruments like total stations or GPS devices. They establish control points, define boundaries, and break down the land parcel into geometric shapes. For regular shapes, standard area formulas are used, while for irregular shapes, advanced methods like coordinate geometry or the trapezoidal rule are applied. The areas of individual segments are then summed up to obtain the total area of the land parcel. It's crucial to check for closure error and ensure the accuracy of measurements and calculations (Chandra, A. M. 2018).

To compute the area of school the following steps were followed:

- Data collection.
- Defining boundaries.
- Dividing the parcel into geometric shapes, computing area for each segment.
- Summation of areas.
- Checking for closure error.

3.3.2. Linear Accuracy

After running a close traverse from **W5386** and closing back on the same control the misclosure for the traverse was obtained, hence the linear accuracy was computed as shown below:

Table 2 The Observed Coordinate of control point W5388 from FGP045 and Its Original value

Station	**Northing**	**Eastings**
Original Coordinate of W5386	242490.354	508232.069
Closing Coordinate of W5386	242490.504	508231.986
Difference	-0.150	+0.083

Source: Field Survey.

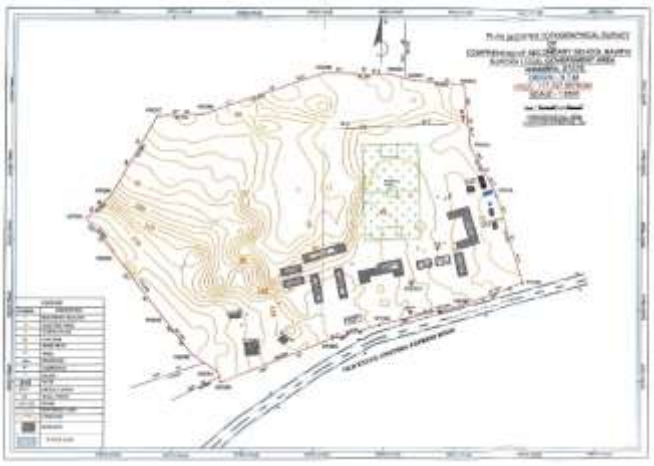
Total Distance = 1670.61

Misclosure in Northings (N) = -0.150

Misclosure in Eastings (E) = +0.083

Linear Accuracy = $\frac{1}{\frac{\sqrt{(N)^2+(E)^2}}{\text{Total Distance}}}$ (1)

∴ Linear Accuracy of the field survey = $\frac{1}{10{,}000}$ (2)



Source: Field Practical

Figure 1: Topographic map of Comprehensive Secondary School Nawfia

3.4. Results and Discussion

From the results these were some of the findings that were made:

- The total area of the study area was computed to be **17.7 Hectares** using coordinate method and AutoCAD software was used for verification.
- The terrain of the school was observed to be a relatively flat one.
- The total number of built up area covers about 2% of the total area of the school's total land area.
- In regards to the infrastructural development of the school as at the time of this research, it was observed that the school has a total number of twenty one (21) structures on site / on ground.

3.5. Implications or Significance of this research results

The significance of this result is discussed below:

Site Analysis and Planning:

A topographic map of the school helps provides detailed information about the terrain of the school, including elevation, slopes, and natural features such as hills, and vegetation. Furthermore it will enable planners and architects to use this data to conduct site analysis and make informed decisions regarding building placement, road alignment, and infrastructure development.

Infrastructure Design and Engineering:

Engineers will rely on topographic maps to design infrastructure systems such as drainage networks, roads, and utilities, within the school environment. Understanding the terrain's contours and gradients helps engineers optimize infrastructure layouts and minimize construction costs.

4. Challenges of Topographic Survey in Nigeria

Topographic surveying in Nigeria, like in many other countries of the world, presents several challenges. Some of these challenges include:

- Rough or rugged Terrain.
- Vegetation and Land cover.
- Accessibility
- Lack of updated data.

Recommendations

Adequate, sophisticated and modern surveying equipment such as drones should be encouraged for use when carrying out topographic surveying operations, this will help improved the accuracy of results and also take care of the issue of the rough and rugged terrain of some surveying sites.

There is urgent need for accurate and reliable topographic survey mapping of the country and the provision of database where these maps can be stored not only as paper (analogue) but also in digital format. This will enable the update of such maps to be done easier and faster.

5. Conclusion

This research work has successfully led to the creation of a topographic map of Comprehensive Secondary School Nawfia. The topographic map of the school will be of great important not just to the school but to the community at large as it can aid in the provision of effective land information which can be used for better planning and proper land management. Furthermore the result obtained (i.e. Topographic map of Community Secondary School Nawfia) can be used to perform various analysis which can be used for the production of various thematic maps.

From this study, it can be concluded that Total station is good surveying equipment that can be used for topographic surveying in a short span of time in a more accurate manner.

Reference

Adebayo, F. A., & Olagunju, R. E. (2017). Remote sensing applications in topographic surveys: A review of advancements and challenges in Nigeria. Journal of Remote Sensing & GIS, 8(3), 23-36.

Adepoju, M. O., & Adebayo, A. O. (2019). Integrating GPS and GIS techniques for topographic mapping: A case study of southwestern Nigeria. Geomatics, Natural Hazards and Risk, 10(1), 185-198.

Chandra, A. M. (2018). Surveying and Levelling. New Delhi: McGraw-Hill Education.

Jeyapalan, K. and Bhagawati, D. 2000. As built surveys of road side features for GIS,visualization, and virtual reality. International Archives of Photogrammetry and Remote Sensing.1113:406-413.

Lawal, D. U., & Alaga, A. T. (2018). Comparative analysis of traditional and modern surveying methods for topographic mapping in rural Nigeria. International Journal of Applied Engineering Research, 13(24), 18014-18022.

Lee, J.M., Park, J.Y., and Choi, J.Y. 2013. Evaluation of Sub-aerial Topographic Surveying

TechniquesUsing Total Station and RTK-GPS for Applications in Macro tidal Sand Beach Environment. Journal of Coastal Research. (65):535-540.

Oyedepo, J. A., & Oke, S. A. (2020). Application of drone technology in topographic surveys: A case study of urban development in Nigeria. Journal of Geographic Information Systems, 12(2), 132-145.

Pankaj Singh Diwakar., Amit Kumar, S. and Katiyar, K. 2014. Horizontal Accuracy Assessment of Differential-GPS Survey. International Journal of Emerging Technology and Advanced Engineering. 4(12):357-360.

Ragab Khalil. 2013. The Accuracy of GIS Tools for Transforming Assumed Total Station Surveys to Real World Coordinates.Journal of Geographic Information System. 5:486-491.

Valbuena, R., Mauro, F., Rodriguez-Solano, R., and Manzanera, J. A. 2010. Accuracy and precision of GPS receivers under forest canopies in a mountainous environment.Spanish Journal of Agricultural Research.8(4):1047-1057.