DIGITAL SURVEY OF STAFF SCHOOL FEDERAL POLYTECHNIC DAMATURU YOBE STATE

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ABSTRACT

The research focused on the topographical survey of the Staff School of Federal Polytechnic Damaturu, Yobe State, which involved carrying out a perimeter and topographical survey of the study area for the production of Digital Map of the area. The characteristic feature of a topographical survey is the determination of location in both plane and elevation of selected points which are important for plotting contour lines and the planimetric location of features on a Digital map. This research is a third 3rd order survey job and was carried out using a Sokkia SET 630R Total Station equipment and processed using a computer system with Surfer 12 as software to generate the contours, while the boundary line and details were plotted using AutoCAD 2009 software at scale 1:1,500 and contour interval of 0.2m.

Key words: *Topographiacal Survey, Total station, AutoCAD, Sokkia*

Introduction

Surveying is the art and science of determining the relative positions of different objects on the surface of the earth by measuring the horizontal and vertical height between them and represented using suitable scale, (Basak, 1994). The Topographic survey is branch of surveying which deals with the representation of the relief (3-Dimensional) of the terrain and the natural and artificial features on a part of the earth surface. The availability of topographic maps of various scales provide a tool for exploration, exploitation and effective management of our country natural resources and particularly in rapid developing countries. Contour lines, are imaginary lines connecting points of the same elevation, they are used to portray elevations at any one of various intervals measured in meters, (Bannister & Raymond, 1983). Large scale topographic survey (as in this research) employs techniques of plane surveying and other special techniques to establish both horizontal and vertical control to produce the required map. Specifically, topographic survey may be carried out by methods such as,

differential leveling, tacheometry, stereo plotting from aerial photographs, and Differential Global Positioning System (DGPS) technique. The use of LiDAR and RADAR techniques for topographic mapping is now gaining grounds with the advancement of mapping technologies, (Bannister & Raymond 2004).
The Total Station is an instrument that combined an electronic distance measuring equipment (EDM) and a digital theodolite together with a micro-processor which enabled measurement to be reduced automatically to produce horizontal distance and difference in elevation to be displayed on the liquid crystal display (LCD)/screen, (Ndukwe, 2001). Maps may also include details of different engineering works such as roads, railways, highway, drainage or irrigation system, (Basak, 1994). In a topographical map, elevations of different points are shown by means of contours connecting places of equal height on the earth surface. The objective of Digital Map is to produce a topographical map showing elevations, natural and artificial features on the earth surface. Research focused on acquiring 3-D positional data of the study area for the purpose of planning and design of infrastructural development of the area and part of updating the master plan of the school.

Study area

The research site is located at the Staff School of the Federal Damaturu, Yobe state. The Federal Polytechnic is located along Maiduguri Kano road in Damaturu, the State capital of Yobe. The approximate coordinate of the Polytechnic is 11^0 44’51’’N, 11^0 59’ 03’’E.

Aim and Objectives of the Research

The aim of this research is to produce a Digital Survey Map of the study area through the following objectives:

i. Demarcate the boundary of school.
ii. Map out the existing features/details and depict the topography of the area using total Station.
iii. Produce the contour maps at the interval of 0.2m for subsequent architectural and engineering designs.
iv. To produce the Digital map the school

METHODOLOGY

Data Acquisition Procedures

The data was acquired in four stages; namely;

- Setting out of boundary pillars using Total Station.
- Perimeter traversing
- Heighting.

- Acquisition of spot heights using Total Station.

Setting Out of New Boundary Pillars

The following procedures were followed sequentially in setting out the boundary points.

- The instrument was set-up on control FPD 212 and SWITCH ON. All temporary and permanent adjustments were carried out on the total station.
- On "MENU" displayed on the screen
- "S-O" station orientation was selected.
- Under "S-O", "by coordinate" was selected.
- "Easting", "Northing", "Height of station" of FPD 212 was fed into the instrument and also target height fed into the instrument.
- OK was pressed
- Station was selected
- Back sight was selected and coordinate method also selected
- "Easting","Northing", "Height of station" of FPD 211 was fed into the Instrument.
- "OK" was pressed.
- "TAKE BACK SIGHT" window was display
- "YES" was selected
- Automatically displayed the coordinate of target station FPD 211. Having satisfied with the coordinate displayed.
- To start the operation, observation using coordinate was selected.

The above procedures were repeated until all the pillars has been set out.

Perimeter Survey Verification

The initial perimeter survey carried out by this party was checked to ascertain the correctness of the survey beacons using the following procedures;

a. Confirmation of beacon positions – physically the locations of these pillars were visited and their status were assessed to be in-situ
b. Distance check – Distances between some pillars were very short and steel band tape was used to confirm that these distances. They were found to be the same as at the time of the perimeter survey.

Line Clearing For Topographic Survey

In order to do correct gridding the Sokkia SET 630 R total station was deployed to accomplish this task. The total station was set up on FPY015 and back sighted to FPD212. With the horizontal circle reading the computed bearing between

the two control pillars. The included angle between survey lines FPY015 – FPY016 and FPY016- FPY017 was set out. Aligning ranging poles and cutting of the survey lines followed.
The exercise was repeated for other survey lines that defined the perimeter of the site. Ranging was carried out and lines were cut for visibility from one pillar to another.

Grid Layout and Pegging

Gridding for this work was first carried out on the computer using AutoCAD software specifying the required intervals of 20m. The total number of grid points, representing the proposed peg locations, was determined. This also gave us a provisional coordinates of the proposed grid points.
On the field, Sokkia SET 630 R Total Station was used for orientation and the instrument line of site was directed from FPY 015- FPY 016. According to specification in the Instruction to Survey (I to S) for the research height of points was to be determined. Distances were measured from FPY015 to FPY016 and at every 20m points, pegs were buried accordingly. Throughout the entire research area, pegs were buried at every 20m point.

Spot Heighting

This was a major component of the work. The essence of the research is to show the true nature of the terrain. This was done with Sokkia Total Station was set up at PBY 015, temporary adjustment of the instrument was carried out, line of sight established from FPY015 to FPY016 and the ground heights at the peg locations were read and manually recorded in to the field sheets. The following steps were taken. New boundary points were set out. As a precautionary measure, I ensured that the distance between the instrument station and the set out point does not exceed 150m to minimize error due to bisection.

- The target was bisected, reflector height was entered and "ALL" was pressed to record and store the data. The instrument allowed us to edit any input and also confirm it.
- All recorded data was stored in the same observation and manually recorded on the field sheet.

DATA PROCESSING AND PRESENTATION OF RESULT

Data Transfer/ Downloading

All observed data were copied into the field sheets right on site.

Survey Computations

From the field book that served as a guide and the copied data, different computations were carried out. These include; computing the minor control traverse, perimeter traverse and spot heights.

Perimeter Traverse

The control points coordinates and logged point coordinates were extracted out to define the perimeter of the research site. The total area of coverage of the research site was computed as shown in figure 1 below.

For the spot heighting the total station results obtained met a third order for leveling.

$$A = \pm 24mm\ (\sqrt{k})$$

Where K = total distance in kilometers = 1531.58m = 1.531km

24mm = the misclosure.

A = 0.04041

Plan Production and Presentation

Data acquires from various field observations were adjusted and used for the preparation of all plans. The boundary plotting was done using AutoCAD 2007 while the spot heights, contours and DTM were plotted in surfer (win 32) version 6.04 software and exported to AutoCAD 2007 through data exchange format (DXF) as indicated in figure 1.

Procedures for Plotting

Script files were prepared using notepad for the boundary coordinates and for the edited spot height data copied from the total station. Script files were prepared for line, points and texts. The following procedures were followed for the preparation of the script files for line object;

X,Y…… coordinate of insertion point

Text height……..Height of text

Rotation angle……....Angle of plotting the next

Text……the text

After writing the script files, they were saved with, .scr extension e.g boundary.scr. Furthermore, the following procedures were followed in running the scripts in AutoCAD 2009:

- AutoCAD 2007 was launched from the desktop
- Units was selected under format menu to set the drawing units such as decimal places (3), angle (degree, minute seconds) angle direction (North and Clockwise) precision (0d 00’ 00”) and meters were set and ok wasclicked.
- Layers for each features and their colours were also created e.g. boundary – red colour.
- From the menu bar, “Run Script” was clicked under tool menu, the required script file (boundary) was selected through the relevant path.
- Zoom extent was clicked on from view menu to view the plotted features.

- These procedures were repeated for plotting the remaining scripts without altering the units of the drawing.
- The features were plotted into different layers and the drawing was saved.

Plotting Contour

The contour and the digital terrain model (DTM) were done using surfer (win 32) software version 6.04 from surface mapping system inc. Generally, contour line join places of equal heights together while digital terrain model shows a three-dimensional representation of a terrain surface consisting of X,Y,Z coordinates stored in digital format. **Bannister and Raymond,** (1983) DTM can be used to model, analyze and display phenomena related to topography or similar surfaces and it's more appreciated than contour. Bannister & Raymond, (2004); Task such as surface characterization, site visibility analysis, slope and aspect depend upon quality digital terrain models (DTM).

The following procedures were followed in plotting the contour.

- Surfer (win32) was launched from desktop.
- Grid file was then generated from the edited spot edited spot height data saved on the computer by clicking on data under grid menu.
- From the dialogue box displayed, the data was selected by opening the path, column for easting (X), Northing (Y) and Height (Z) were specified.
- Kringing was selected as the gridding method and the output grid file was specified
- OK was clicked, the grid file was generated and the report displayed.
- Contour was then generated from map on the menu bar.
- The following contour properties were among the settings carried out from the contour layer; contour interval (0.5m), contour line thickness, contour labeling, plotting scale etc. ok was clicked on to edit the contour map.

Procedures for Plotting the Spot Height Map

- New post map was selected from post map under map menu.
- The path for the original data file was specified.
- The file has previously been saved as 'dat'
- The post map was edited accordingly.

Exporting to AutoCAD

- The entire surfer drawings were exported to AutoCAD in data exchange format (DXF) by clicking export from file menu, the required boxed for scaling lines color, line style and others were checked. Figure 1 showed the final Digital Map of the study area.

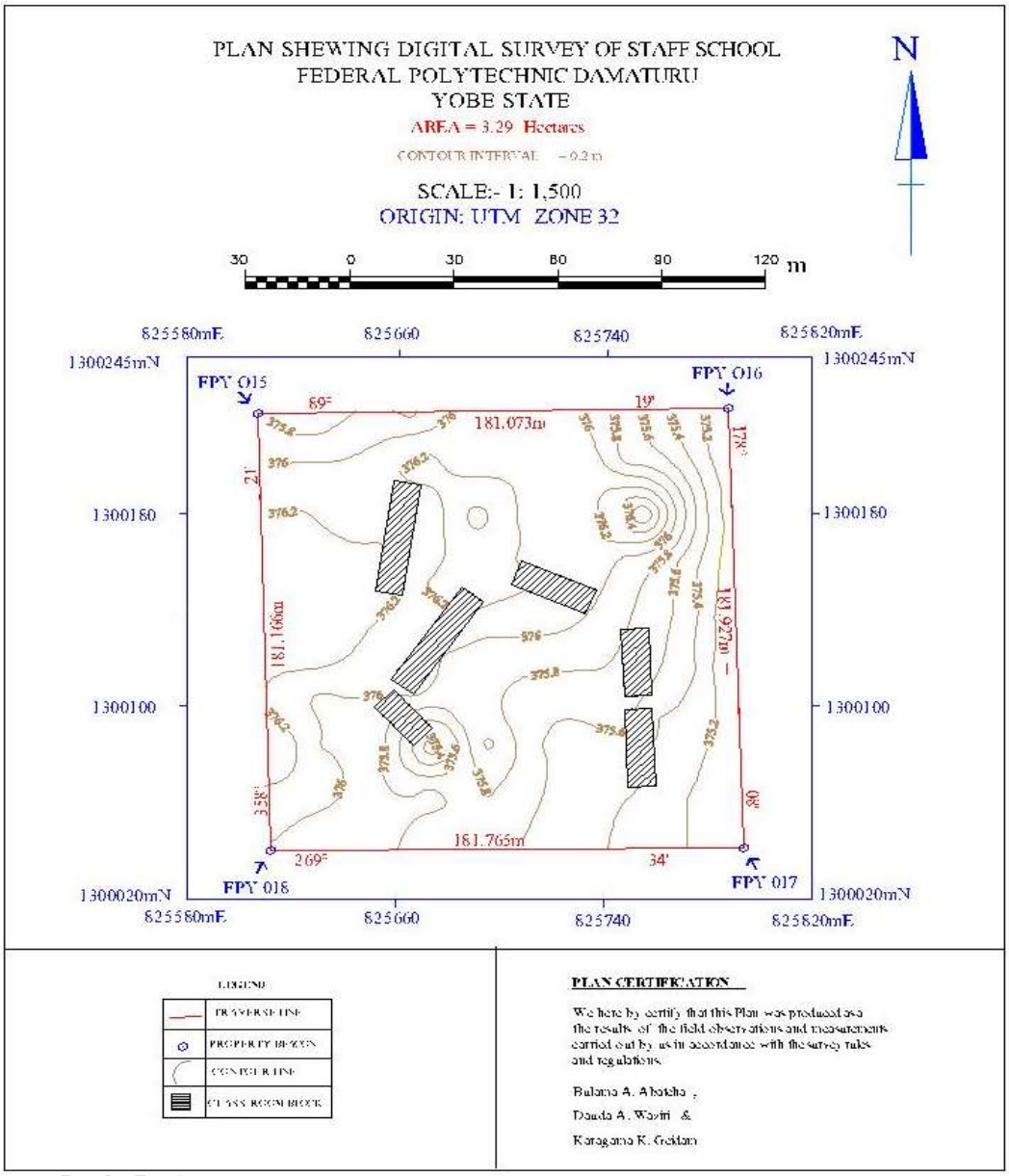

Figure 1: Digital Map of Staff School of the Federal Polytechnic Damaturu.

CONCLUSION AND RECOMMENDATION

Conclusion

The research was successfully completed and the purpose of the research was achieved within the time frame and the client is satisfied with the result. The total station 3D data collection method was very okay for the job as it provided the required 3D positional data within the acceptable tolerance. The results from the research are also within the third order specifications. The area of the land was known, the topography for engineering works is very clear with the aids of

the contours, the school is properly demarcated and the record are stored for re-establishment and other purposes.

Recommendation

The 3D data collection method fast and within the accuracy for topographic survey or third order jobs, it is important and I recommended that surveyors engaged in engineering jobs need to use the method. Also, both Government and private sector should be encourage in carry out research in Digital mapping to enable Engineers, Planners, Architect to make used of facilities within research site.

REFERENCES

Bannister A. & Raymond S. (1998): Surveying. Addison Wesley Longman Limited.

Basak, N, N. (1994). *Surveying & Levelling. McGraw-Hill Education*

Ndukwe, N. k. (2001). *Dital Technology in Surveying and Mapping: Principles, Applications and Legistlative issues.* Rhyce Krex.

Allan A. L. et al (1968): Practical Field Surveying and Computation.Great Britain

Oliver J. G. Cledinning J. (1978): Principle of Surveying, Workingham, Bershire, England.

Opaleye J. O. (2005): Topographical Information System of Federal School of Surveying, Oyo, Oyo State. A project submitted to the Department of Surveying and Geoinformatics, Federal School of Surveying, Oyo, Oyo State (2005).

Ramsay J. P. (1978): Land Surveying Eastover Plymouth.

Russel C. Brinker and Paul Wolf (1978): Elementan Surveying, New York.

Specification for Large Scale Engineering Surveys Council of Nigeria, Lagos, Nigeria (2003).