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TOPOGRAPHIC SURVEY OF THE PROPOSED ADMINISTRATIVE QUARTERS OF SOCIETY OF SAINT PIUS DE X CATHOLIC CHURCH AT NEW HAVEN EXTENSION ENUGU NORTH LOCAL GOVERNMENT AREA, ENUGU STATE

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KEYWORDS: DATA SEARCH, DATA ACQUISITION, DATA PROCESSING

ABSTRACT

Topfelix Survey and Consultancy was commissioned by Society of Saint Pius De X Catholic Church through the contractor to carry out a topographic survey of a land acquired for the construction of the administrative quarters of the above-named church. The project involves producing boundary plan, spot height plan, contour plan and the topographic plan. The survey was carried out to aid the design of structure. The project covered an area of 3.533 Ha of land and is classified as third order survey project. The methods used to achieve this project were Traversing and Leveling (spot heighting) and Leica TS06 Total Station with its accessories were used for three (3) dimensional coordinates, distances and angular measurements, while standardized 100m steel tape for grid interval measurements. The grid and spot heighting were at 10m intervals. The Accuracy of the work was =1/28,000 and the elevation difference accuracy was 0.030m. This report is presented in sections. Section one focused on the introduction, aim and objectives of the project, scope of the work as well as my level of participation. Section two dealt with the project planning and instrument test carried out during the course of executing this project. Section three and four outlined the methodologies for data acquisition and processing of the data respectively while the fifth section refers to the presentation of the results. The survey was carried out in accordance with the Survey Rules and Regulations as well as company's specifications and instructions.

INTRODUCTION

A Topographic Survey is a 2-D representation of what is happening in the real world. The characteristics of a topographical survey can vary, but some of the most common elements include: contour, vegetation, physical attributes and utilities.The purpose of a topographic survey is to gather spatial information relating to a site of interest and the natural and man-made land features within.

The Society of Saint Pius De X Catholic Church acquired a piece of land at New Haven Extension in Enugu North Local Government Area of Enugu State, for the purpose of constructing administrative Quarters for her staff. Consequent upon this, Topfelix Survey and Consultancy situated at C3 & C4 Freedom Plaza opp. Intercity Super Market Aroma Awka, Anambra State was awarded the contract to carryout topographic survey of the acquired land through Akiota Works Limited that has been commissioned to carry out the structural development on the acquired land. I was assigned to handle the project with Topfelix Survey and Consultants' field crew under the supervision of Surv. (Dr.) Felix O. Ukebho.

LOCATION

The project was located at New Haven Extension in Enugu North Local Government Area of Enugu State. The site is geographically located between Northings: 713802.848m, Eastings: 338634.780m and Northings: 714194.237m, Eastings: 338850.450m. The terrain was relatively flat with few details within the project area.

TYPE AND ORDER OF SURVEY
The Project was a Topographical Survey of 3rd Order Accuracy.

AIM

The project aim was to determine the shape, size and the topography of the acquired land and to produce plans that would form part of the documentation for the application of Certificate of Occupancy (C of O) and aid engineering planning and design for construction purposes.

OBJECTIVES

The aim of the project was achieved with the following objectives:

i. To determine the perimeter and spot heights of the acquired land using Total station.

ii. To detail natural and artificial (man-made) features within the project area.

iii. To produce a Perimeter and Topographic plans.

iv. To produce a detailed Technical Report for the project.

INSTRUMENTATION & METHODOLOGY

Leica Total Station (TS06) with its' accessories was used for traversing and spot heighting, steel tape was used for setting out grids at 10m interval. Software such as AutoCAD land development 2009, Sufer10, Microsoft office, etc was used to process and produce topographical maps of the site.

SCOPE OF WORK

The project scope included the following:

i. Reconnaissance

ii. Clearing of the entire parcel of the acquired land as instructed by our client.

iii. Establishing of grid lines at 10m interval across the entire plot.

iv. Monumentation

v. Traversing

vi. Perimeter and spot heighting.

vii. Detailing of all natural and artificial (man-made) features within and around the acquisition.

viii. Data processing and presentation of results.

ix. Report writing.

MOBILIZATION

The Survey crew mobilized to the site on 9th November 2021 and demobilized 18th November 2021. Prior to the mobilization, instrument tests were carried out on all the survey equipment to be used for the execution of the project. Also all personnel to be involved in the project were certified medically fit.

PLANNING

In planning for the execution of the project, the following activities were carried out.

1. Data Search
2. Reconnaissance
3. Pre-Analysis
4. Selection of Instruments
5. Instrument Test

DATA SEARCH

Prior to data acquisition, the company, Akiota Works limited provided the coordinates of the three control points that exist in the site. These controls were previously established by the survey department of Akiota Works limited for the purpose of coordinating the site for both survey and other engineering services within the project area. The control beacons and their coordinates are shown in table 2.2.0 below.

COORDINATES OF CONTROL BEACONS

STATION	EASTINGS(M)	NORTHINGS(M)	Height(m)
CP 1	338766.501	714026.654	141.325
CP 2	338824.074	713890.745	136.662
CP 3	338745.566	713915.412	137.848

RECONNAISSANCE

The reconnaissance exercise was carried out to have first-hand knowledge about the project site. Three controls pillars were identified on ground and their suitability ascertained by conducting in-situ check. Prior to this, a general overview of the area was made in the office using Google Earth application installed in the computer system to examine patterns of spatial features within the project area. See Appendix1 (Reconnaissance Diagram).

The following were the outcome of the reconnaissance exercise:

i. The project site was fenced round and this makes it easier to identify the boundary lines.

ii. The number of beacons required was determined. The total number of beacons required for this project is 11.

iii. The methodology to achieve the task ahead was adopted.

iv. The necessary equipment needed to execute the project was determine

v. An estimate of the logistics requirement (that is, transport, feeding, Personal Protective Equipment (PPEs) etc.) for the project was also determined

vi. An estimate of the personnel requirement for the project was noted

vii. An estimate of the duration of the project was ascertained.

viii. An estimate of the cost of executing the project was evaluated.

ix. Three existing control points were noted and clearly described.

x. Existing features (fence lines, building, concrete basement etc.) that required detailing were noted.

PRE-ANALYSIS

Base on the client's instructions, the technical specifications for the project were determined. Also instruments necessary to achieve these specifications were also determined. A Leica TS06 Total Station with its accessories were used for traversing and spot heighting while steel tape of 100m length was used for gridding of the project area into 10m interval.

PROJECT SPECIFICATIONS

The project specifications were in accordance with the Survey Rules and Regulations by Surveyors Council of Nigeria (SURCON) for 3rd order surveys and company's Instructions.

The specifications included:

i. Beacons should be 18cm × 18cm × 75cm in dimension.
ii. All corners of the plot including points of changes in direction and on straight long lines at intervals of not more than 200.000m should be beaconed.
iii. Adjacent Property Boundary Beacons should be inter-visible.
iv. The Traverse should be tied to Controls within 5km from the project location.
v. The boundaries definition should be by Theodolite /Total Station traverses.
vi. The Theodolite /Total Station should be a minimum of 10'' graduation interval.
vii. Angular misclosure should not exceed $\pm 30''\sqrt{n}$. Where n is the number of instrument stations.
viii. Steel Tape or Digital Measuring Equipment should be used for linear measurement.
ix. The Accuracy of the traverse should not be less than 1:3,000.
x. The client maintained that height observation error should not exceed ±0.2m

INSTRUMENT CHOICE

Having done the reconnaissance and gone through the project specifications, the equipment listed below were chosen in order to achieve the desired accuracy.

a. Leica TS06 Total Station with its

b. One Tripod

c. Two Tracking Rod and six Ranging Poles.

d. Two Prism Reflectors

e. One 100m measuring steel tape

f. Two Cutlasses

g. Nails and Bottle corks

h. One Survey Umbrella

i. Safety Shoes

j. Coveralls

k. Safety Helmet

l. Booking Board, Pen and Field Sheets.

m. Calculator

n. HP Personal Computer

o. One Site Truck

p. Hammer

q. Wooden pegs

INSTRUMENT TEST

The following tests were carried on the instruments before they were used for data acquisition.

1. Horizontal Collimation and Vertical Index Error Tests.

HORIZONTAL COLLIMATION AND VERTICAL INDEX ERROR TESTS

Procedures:

i. The instrument was set over a station and temporary adjustments carried out.
ii. A target was set up at a distance 100m from the instrument station.
iii. After switching on the instrument, the menu button was pressed and held for about two seconds to display horizontal and vertical index error.
iv. Horizontal collimation was selected.
v. The target was sighted on face left, Enter Button was pressed. The instrument displayed the existing collimation error of the instrument and requested the target be sighted on face right.
vi. The same operation was repeated on face right. A new error was displayed. Either press yes to accept the new error or no to reject it. Yes was pressed to accept the new collimation error
vii. The same point on the target was sighted in order to achieve good results.
viii. The same operation (iii-vii) was repeated for test of vertical index error. But in this case vertical index error was selected.

This is shown in figure 2.6.1 below.

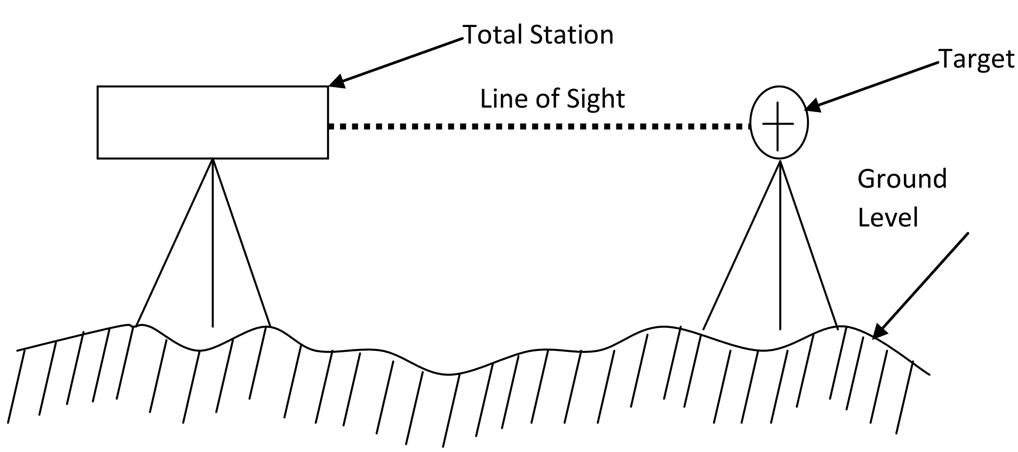


Fig 2.6.1.: Horizontal Collimation and Vertical Index Error Tests

Differences in values obtained for the face left and face right readings were accepted as the new horizontal collimation and vertical index errors respectively.

The results of the test carried out are as shown in Table 2.6.1 and 2.6.2 below. This horizontal collimation error check was done to ensure that the line of sight is perpendicular to the trunnion axis when the plate bubble is central.

Table 2.6.1: Horizontal Collimation Tests Results

Horizontal Circle Readings		**C=Collimation**	**Correction**	**Remarks**
Face Left	167^0 31’ 48”	00^0 00’ 01”	167^0 31’ 47”	Okay
Face Right	347^0 31’ 45”	00^0 00’ 02”	347^0 31’ 47”	Okay
FL - FR	180^0 00’ 03”	-	180^0 00’ 00”	Okay
2C	00^0 00’ 03”	-	-	-

Table1.2.6.2: Vertical Collimation Tests Results

Vertical Circle Readings		**i =Index Error**	**Corrected Value**	**Remarks**
Face Left	90^0 00’ 02”	00^0 00’ 01”	90^0 00’ 03”	Okay
Face Right	269^0 59’ 56”	00^0 00’ 01”	**269^0 59’ 57”**	Okay
FL + FR	359^0 59’ 58”	-	360^0 00’ 00”	Okay
2i	00^0 00’ 02”	-	-	-

Two Peg Test

Since we used Total station for acquiring height component in this project, two reflector poles were place at known stationsNIO_1 and NIO_3 and the Total Station instrument was set up on DPR345 which is another known station and orientation taken on NIO_1. Readings were taken to stations NIO_3 and re-observed on NIO_1 and recorded. When the readings of the two observations were compared with the provisional known values for the two stations NIO_1 and NIO_3, there was a difference of 0.006m and 0.008m for NIO_1 and NIO_3 respectively in their height component. This fell within ±0.2 which is the client's specified allowable error for this project.

IN- SITU CHECK FOR HORIZONTAL CONTROL

An in-situ check was carried out on the controls CP1 CP2 and CP3 to ascertain their stability. These three existing controls were previously established for the purpose of coordinating all engineering works needed in the site. This was carried out by setting up the Total station on pillar CP3, zeroing on CP1 and targeting CP2 to measure the internal angle <CP1CP3CP2. The summary of the results showed in table 2.7.1 below proved that the pillars were in-situ.

Table 2.7.1: Summary of the Results of In-Situ Check

S/N	Pillar No.	Parameters.	Observed	Computed	Difference	Remarks
1	CP1-CP3-CP2	Angle	96^{O}47' 59''	96^{O}48' 00''	00^{O} 00' 01''	OK
2	CP1-CP2	Distance	147.602m	147.600m	0.002m	OK
3	CP2-CP3	Distance	82.291m	82.292m	0.001m	OK

DATA ACQUISITION

SITE PREPARATION

Prior to the data acquisition site preparation was carried out. These included:

1. <u>Site clearing/Line Cutting:</u>The site was completely cleared of bushes by D7 Bulldozer employed by Akiota Works Limited before gridding into 10m interval was carried out.
2. <u>Monumentation:</u>Since the site was bounded by fence, survey pillar were buried at every change in direction of the fence line according to the instruction of the client.

TOOLS BOX AND SAFETY MEETINGS

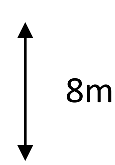
Tool Box Meetings (Morning Preparation Talk) were conducted every morning before the start of work. The essence was to increase the safety awareness of workers and discuss the task ahead. Every worker was encouraged to look out for each other, work safely and have an injury and incident free mindset. Personnel were told of the dangers involved in their various duties and how to mitigate (guard) against them.

LINE CUTTING/ SITE CLEARING

Leica TS06 Total Station was used to coordinate the beacon points along the boundary lines. The survey pillars were buried along the fence line at every change in direction of the fence line as instructed by the client ensuring intervisibility between stations. No cutting of line of sight was required since the site has been cleared of any form of obstruction.

MONUMENTATION

Monumentation was done with concrete pillar with the dimensions 18cm square by 75cm long. 60cm of the survey pillar was buried and 15cm projecting above the ground surface. The survey pillars were constructed in-situ with concrete mixed in the ratio 3:2:1 of sharp sand, crushed stone and cement respectively used to mould the pillars around the above mentioned marker with 6inches nail fixed at the centre. Eleven pillars were numbered with the mixture of sand and cement. The survey pillars were numbered appropriately using the beacon numbers that were assigned by the client. They were named AK01/PB to AK10/PB and they were strictly meant for private use for subsequent engineering works on the site. See figure 1.3.3 below;



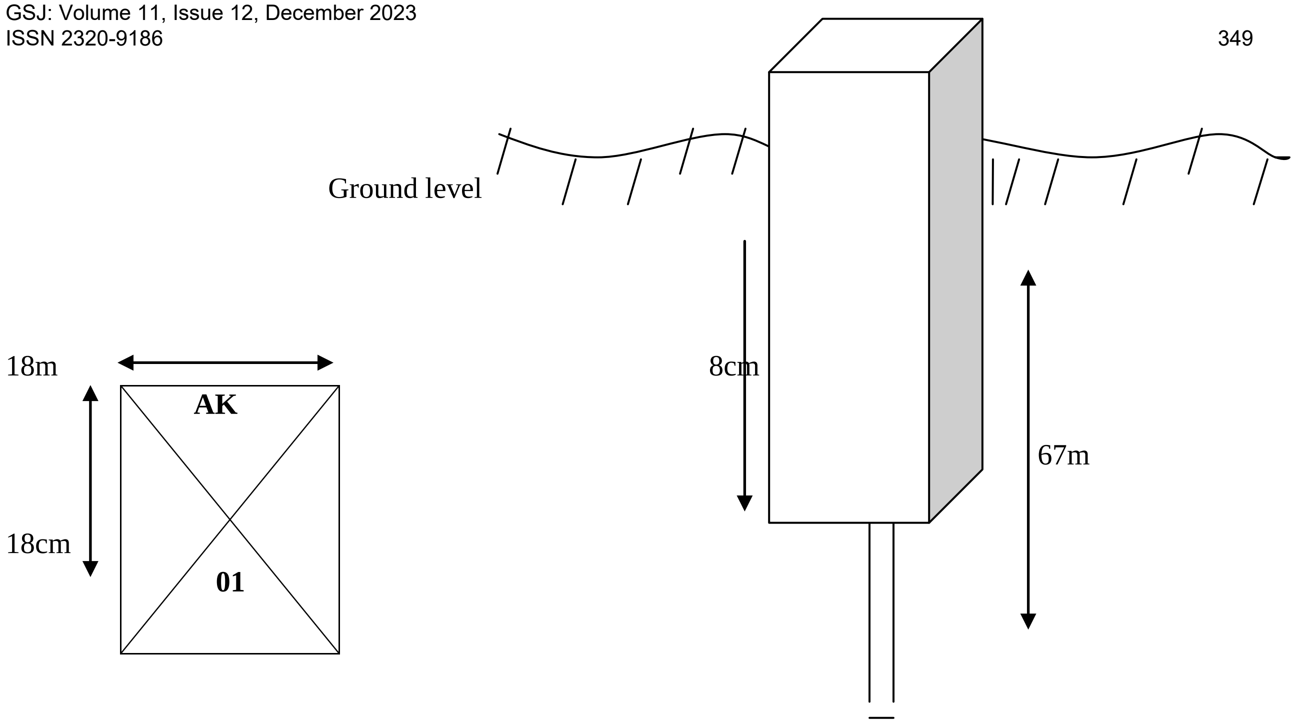


Fig. 3.4.0: Plan and section of property beacon (Not drawn to scale)

Wooden Pegs were fixed firm at 10m interval along the perimeter line and inside the project area.

DATA ACQUISITION

Data acquisition in surveying entails the use of survey instruments to collect data in the field. The Total Station which applies the Indirect (Trigonometrical) levelling method was deployed for obtaining the data required for the topographic modelling of the terrain.

TRAVERSING

The traverse was carried out in accordance with the principle of "whole to part". All angular and linear observations were carried out using Leica (TS06) Total Station in coordinate mode. The coordinates were obtained for each boundary stations. The coordinates of the perimeter was plotted in AutoCAD, with the aid of the CAD tools, the entire extents was divided into 10m grids after which the coordinates of the grid intersections were extracted from the AutoCAD application. This was to ensure that the data was dense enough and also properly distributed which when utilized for the topographic modeling of the entire place through interpolations will reflect the reality of the terrain.

These coordinates were then uploaded into the Total Station. Since the perimeter survey of the property has been previously determined, we used ray method to determine the coordinates of the corner beacons established along the fence line of the property. This is to verify the size of the property as provided by the client. The total distance traversed was996.006m and 8stations were occupied as instrument change points. The traverse was tied to the existing control beacons shown in table 3.6.0 below. The coordinates of the grid points were determined at 10m interval with respect to the established coordinates of points using coordinates method of observation in the Total Station.

Table 3.6.0: Coordinates of Control Beacons

Station	**Eastings (m)**	**Northings (m)**	**Height (m)**
CP1	338766.501	714026.654	141.325
CP2	338824.074	713890.745	136.662
CP3	338745.566	713915.412	137.848

Having obtained the XYZ coordinates of the control points; the survey proceeded by obtaining the XYZ of grid intersection points.

To achieve this, the entire area was divided into 10m square grids using the perimeter coordinates extracted from the Detail survey of the property previously executed. The coordinates of the perimeter was plotted in AutoCAD, with the aid of the CAD tools, the entire extents was divided into 10m grids after which the coordinates of the grid intersections were extracted from the AutoCAD application. This was to ensure that the data was dense enough and also properly distributed which when utilized for the topographic modelling of the entire place through interpolations will reflect the reality of the terrain. These coordinates were then uploaded into the Total Station.

The Total Station was set up over a control point, centred and levelled. The instrument height was measured and noted. The Total Station, through the Coordinate menu, was oriented by keying in the occupied station coordinates as well as the coordinate of the Back station utilized for the orientation.

During the orientation, the instrument height measured earlier as well as the Reflector height was keyed in when required. To complete the orientation process, the Total Station was used to bisect a reflector (mounted on a tracking rod) placed at the back station and the direction was set as the azimuth. After this has been done, the reflector was then taken to the third control point and the observation was taken. I compared the XYZ coordinates obtained with the current observation and the already known coordinates of the control point which agrees to sub millimetre level (agreed to be due to targeting).

Using the Setting Out option of the Total Station, the coordinates already uploaded into the Total Station were used to guide the reflector to the grid intersection points. By so doing, the reflector was then taken to the several grid intersection points as well as any commanding point along the terrain where a considerable difference in height was noticed within the grid intersection points. After picking all the points possible from a particular instrument station, the reflector was taken back to the control point where the first observation was taken and then re-observed to serve as a check before the instrument is moved to another station. By occupying any of the three controls and using the others as Back and or Check stations, the entire grid intersection points as well as other necessary points were all occupied with the reflector and their XYZ coordinates obtained.

However, there were few areas where the grid intersection points which cover them could not be captured due to the structures within the property as well as the height differences of the terrain. For such case, the Total Station ray method was used to establish sub-control points close to those areas. These points were gotten through the average of observations made from two instrument stations. The sub-control points are then occupied to capture the XYZ coordinates of grid intersection points as well as commanding points within the area. The process explained above was repeated until enough data; which consisted of the grid intersections as well as data for other commanding points was captured to enable the Digital terrain modelling of all sections of the project area.

OBSERVATIONAL PROCEDURES FOR PERIMETER SURVEY OF THE STUDY AREA.

i. The instrument mounted on tripod was set over CP3 and Temporary adjustments (centering and leveling) were carried out. The total station (TS06) uses laser plummet, therefore, centering was by the laser ray from the instrument which was activated by pressing the 'FNC' key on the instrument.

ii. After temporary adjustment, the instrument was powered on using the power switch button and the 'main menu' of the instrument was immediately displayed showing Q-survey, Program, Manage, Transfer, Setting and Tools icons.

iii. The 'Prog' was selected using function keys 'F1' and surveying was chosen from the program list so that 'set job' , 'set station', 'set orientation' and 'start' dialog box pops up

iv. On set job setting, the name of the job and name of operator were set as AKIOTA and FUNA

v. On the station setting, the Easting, Northings and Height of the instrument station CP3 were manually entered into the instrument and 'ok' button accepted.

vi. The coordinate method was used for orientation setting since the coordinate of the back station CP1 was also given. The Northings, Easting and Height of the back station CP1 were manually entered into the instrument and 'ok' button selected to accept the command.

vii. After the previous operation, reflector mounted on its tracking rod was placed on the back station CP1 and targeted by the instrument on CP3 to determine the difference between the inputted back station coordinate and the observed coordinate of the back station. The result shows discrepancy of 0.001m, 0.005m and 0.006m for ΔE, ΔN and ΔH respectively.

viii. The telescope of the instrument was pointed to AK01/PB which has been occupied by a reflector and the coordinate recorded in the instrument. This was done for all the stations visible to the instrument station and their respective coordinates were recorded in the instrument. There was just one change of instrument station to enable us determine the coordinates of few stations that were not visible from the point of first instrument set up. At each change of instrument station, steps 5 and 6 were repeated before determining the coordinates of other stations till the last station.

ix. Finally, the telescope of the total station was pointed to the known stations CP3to determine the coordinates and the differences between the observed coordinates and the given coordinates of this station all readings were booked and recorded in the instrument.

OBSERVATIONAL PRECAUTIONS

a. The instrument (Leica TS06 Total Station) was set on firm ground to ensure stability of the instrument during observation.

b. The instrument was properly centered over the station mark and temporary adjustments (centering and leveling) were carried out before observations were made.

c. The instrument was usually covered with Survey Umbrella during excessive sunny weather to protect it from the excessive heat from the sun.

d. The differences between the manually entered back station coordinate and observed back station coordinate were in millimeters.

e. Distances were tracked in opposite directions.

The perimeter survey done by Total Station ray observation method was also checked at the instant of observation by re-observing on the control point before the instrument is moved to another change point. This is to ensure that the coordinates generated for a point at the start of observations was within the tolerable range at the end of the observation from that instrument station. Also as the observation progresses, the XYZ of the controls are always observed when the grid points come around them and this will be checked with the known coordinates of these controls which was always kept handy.

DETAILING

All natural and artificial (man-made) features were detailed along the traverse line and within the project area using Total Station in coordinate mode. All detailing data were booked and recorded appropriately in the Total station instrument. In this project, few details were found in the site and these include, existing illegal fence, embankment, security building, and concrete basement within the project area.

GRIDDING/SPOT-HEIGHTING

The gridding of the project area was designed in AutoCAD land development 2009into 10m intervals in the office using the data obtained in the field for the perimeter boundary. The coordinates (Northings and Eastings) of the gridded points were extracted from the CAD software and imported into the Total Station for setting out of the points and trigonometric leveling on the gridded points using Total Station instrument**.** The leveling operation was based on the provisional coordinates of CP1, CP2 and CP3 whose heights were also given as provided by the client, see table 3.9.0.The leveling operation was done in 3 loops with Total Station. Each of the loop starts from point of known coordinates and ends at same station. The leveling started and closed at the same Stations (CP1, CP2 and CP3) whose elevations are known. Back station coordinates, instrument station coordinates were used at every change in the instrument set up to orient the instrument for 3-dimensional observation of the gridded points. At every change of instrument station, the 3-dimensional position (Northing, Eastings and Height) of two points previously determined were used for instrument station and back station. At every instrument set up, the necessary temporary adjustments were carried out before observations were taken. All observations were stored in the instrument and vital descriptive notes recorded in the field book.

A quick field check was done by finding the deference between the observed coordinates of CP1, CP2 and CP3 and their known values. Their differences were in millimeters.

Theallowable misclosure was also tabulated using:

$$misclosure = 24mm\sqrt{k}$$

Where ‘K’ is the total distance covered in a kilometer. Hence the readings were adopted. See Table 3.9.0 below.

Table 3.9.0Observed Coordinates Differentials from Known Stations

Stn	**E (m)**	**N (m)**	**H (m)**	**E (m)**	**N (m)**	**H (m)**	**ΔE**	**ΔN**	**ΔH**
	Known coordinate values			**Observed coordinate values**			**Differentials (m)**		
CP1	338766.501	714026.654	141.325	33766.511	714026.649	141.319	0.01	0.005	0.006
CP2	338824.074	713890.745	136.662	338824.066	713890.754	136.673	0.008	0.009	0.007
CP3	338745.566	713915.412	137.848	338745.548	713915.424	137.857	0.018	0.012	0.009

DATA PROCESSING AND ANALYSIS

At the end of the data acquisition process, data processing was the next phase. Data processing simply means converting the raw data to a format such that information can be extracted from it. The data acquired from the field were processed using the following:

i. Scientific Calculator

ii. HP Personal Computer.

iii. AutoCAD Land development 2009

vi. Surfer 8

PROCESSING OF THE TOTAL STATION RAW DATA

The Total Station automates data logging into its internal memory. These coordinate points are saved serially by default (though that can be changed to user specified choice) after the first point has been assigned a numeric value. Since the coordinates were carefully obtained directly of the grid intersection points, with proper observational checks and are to be utilized for digital terrain modelling, the logged data were downloaded from the instrument.

The observed data was transferred to the computer for post processing using a USB memory stick inserted into the USB host port. The USB device was connected to the USB device port housed in the communication side cover of the instrument. The instrument was switched on and the transfer option selected from the main menu. The export option was selected next the job was searched for and selected for downloading.

After downloading the data, the data was opened in Notepad, formatted properly with adequate space delimiting and then reopened with Microsoft Excel. On the Excel workbook, the data was arranged in such a way that it will easily be imported into the DTM application (i.e. Surfer-8) to be used for terrain modelling. These arrangements include making the first column a data column, and also making the first row a data row. The data was also checked for any inconsistency and was found to be in order.

The coordinate title code was included for completeness and easy understanding.

At the end of the processing, a sub-folder was opened inside the JOBS folder located on the Desktop and all data files relating to the project at hand were saved therein. This is to enable easy navigation and improves access to those data during the plan production.

Since the perimeter traverse was done using ray method and closed back on a known station CP3, the 2 dimensional position differences between the known coordinate of CP3 and the observed coordinate for the same station (CP3) was identified in the northing and Easting as 0.026m and 0.01m respectively. This was distributed in all the stations as seen in table 4.1.0 below.

Computation of Accuracy: The accuracy of a traverse is computed with the formula below.

$$\frac{1/\sqrt{eEi^2 + eNi^2}}{\text{Total Distance}}$$

Where eE = 0.01m, eN = 0.026m,

Total distance covered for the perimeter = 996.460m

$$\text{LINEAR ACCURACY} = \frac{1}{\sqrt{(0.01)^2 + (0.026)^2}}$$

996.460= 1:35,770.829

Obtained Linear Accuracy = **1:36,000.**

Allowable Linear Accuracy = **1: 5,000**

Table **4.1.0. Distribution of the coordinate misclosure**

					Obs. Eastn	Obs. North.	

From Station	ΔE	A.R .+E/-W.	ΔN	A.R .+N/-S.	Corr. Final Eastn	Corr. Final North.	To Station
	m	m	m	M	m	m	
					338766.422	714026.569	CP1
					338824.074	713890.745	CP2
					338745.566	713915.412	CP3
					338850.448	713815.158	
					0.002	0.003	
CP3	104.884	105	-100.251	100	338850.450	713815.161	AK01/PB
					338806.643	713802.845	
					0.003	0.003	
AK01/PB	-43.804	149	-12.313	113	338806.646	713802.848	AK02/PB
					338764.315	713874.891	
					0.004	0.006	
AK02/PB	-42.327	191	72.049	185	338764.319	713874.897	AK03/PB
					338634.306	714073.504	
					0.006	0.012	
AK03/PB	-130.007	321	198.619	384	338634.312	714073.516	AK04/PB
					338678.530	714149.944	
					0.007	0.014	
AK04/PB	44.225	365	76.442	460	338678.537	714149.958	AK05/PB
					338682.463	714194.222	
					0.007	0.015	
AK05/PB	3.933	369	44.279	504	338682.470	714194.237	AK06/PB
					338698.499	714106.116	
					0.007	0.018	
AK06/PB	16.036	385	-88.103	592	338698.506	714106.134	AK07/PB
					338790.983	714123.104	
					0.009	0.019	
AK07/PB	92.486	477	16.989	609	338790.992	714123.123	AK08/PB
					338811.898	714014.768	

					0.010	0.022	
AK08/PB	20.916	498	-108.333	717	338811.908	714014.790	AK09/PB
					338838.226	713878.399	
					0.010	0.026	
AKO9/PB	26.328	524	-136.365	853	338838.236	713878.425	AK10/PB

PROCESSING OF THE TOTAL STATION LEVELLING DATA

The levelling operation was carried out in loops. A total of three loops were used to cover the gridded points within the project area. The Total station was set up on the known station (with Northing, Easting and Height known) and orientation taken on another known station (N, E, H known). The coordinates of the gridded points in loop one was staked out and the height information for each gridded point determined. The levelling operation continues to all gridded point and closed on the starting point. For loop one, a total distance of 1655.268m was covered and levelling misclosure of 0.007m was observed on CP2. In loop two, 2179.436m distance was covered and the levelling operation closed on CP3 station with an observed levelling misclosure of 0.012m while in loop three, the total distance covered is 1518.251m with observed misclosure of 0.008m on CP1.

The allowable misclosure is calculated using a

General formula$misclosure = 24mm\sqrt{k}$.

See table below for details:

Table 4.2.0: Levelling Misclosure

Loops	Distance Leveled K(m)	Cumulative Distance (m)	Allowable Misclosure ±24mm√k	Obtained Leveling Misclosure (m)	Remark
Loop 1	1655.268	1655.268	0.031m	0.007	Good
Loop2	2179.436	3834.704	0.035m	0.012	Good

Loop3	1518.251	5352.955	0.030m	0.008	Good

RESULT AND ANALYSIS

LOOP ONE: Levelling misclosure

Third order leveling accuracy= ± 24mm $K\sqrt{(km)}$ $\sqrt{\ }$ = 0.024 x 1.655268 = 0.031

Obtained Value =± 0.007m

Allowable Value (3rd Order) leveling Accuracy = ± 0.031m

LOOP TWO: Levelling misclosure

Third order leveling accuracy= ± 24mm $K\sqrt{(km)}$ = $\sqrt{0.024 \times 2}$.179436 = 0.035

Obtained Value =± 0.012m

Allowable Value (3rd Order) leveling Accuracy = ± 0.035m

LOOP THREE: Levelling misclosure

Third order leveling accuracy

= ± 24mm $K\sqrt{(km)}$ = $\sqrt{0.024 \times}$ 1.518251= 0.030

Obtained Value =± 0.008m

Allowable Value (3rd Order) leveling Accuracy = ± 0.030m

From the result of the levelling operation, we discovered that the highest elevation within the project area is 148.746 while 132.002m is the lowest elevation. We also discovered that the direction of water flow is in the North-East direction given the contour of the project area. The coordinate of the perimeter beacons was plotted in AUTOCAD land development and the area determined to be 3.533 hectares.

PRESENTATION OF RESULTS

PLOTTING

The Processed data of the traverse was plotted at scale 1:2,000.The plotting was done with AutoCAD land development 2009 and Surfer 8software. The perimeter and spot heights were plotted with AutoCAD land development 2009 software while the contour was generated using Surfer 8 software which was then exported in data exchange format (.dxf) to AutoCAD environment for editing and final printing.

Four plans were produced. These included;

a. Perimeter plan at scale 1:2,000.

b. Connection Plan at scales 1:2,000

c. Topographical Plan (Spot Heights) at scale 1:2,000.

d. Topographical Plan (Spot Heights) at scale 1:1,000.

e. Topographical Plan (Contour) at scale 1:2,000 with contour interval of 0.20m.

See Appendices (1C (i)-C(v)).

ABSRACT OF RESULTS

The following are the abstracts of the results submitted with this report.

a. Reconnaissance Diagram

b. Downloaded filtered data

c. Computation Sheets

d. The perimeter plan

e. The Connection Plan

f. Topographical plans (Spot heights and Contour).

PROJECT CHALLENGES

The challenge experienced during the execution of the project included:

(i) This job was done by academic team of Topfelix Survey and Consultancy therefore the execution of the job was strictly on weekends, this resulted to some kind of delay.

(ii) There were difficulties in maintaining the gridding pattern and spacing in some parts of the project area during spot Heights data acquisition due to obstruction, this was resolved by altering the pacing pattern and using irregular pattern in such instances.

CONCLUSION

The scope of this survey project covered the perimeter and topographical surveys of the acquired parcel of land for planning and engineering design purposes. The survey was carried out from reconnaissance stage to the final plan production. The timely duration of project was attributed to the use of modern equipment. All field data were captured and processed following stipulated guidelines. The processed data were checked against the job specifications to further validate the quality of the data. The plans were produced with scales of 1:2000 and 1:1000 as approved by SURCON.

CONTRIBUTION TO KNOWLEDGE

The project exposes the advantages of working with modern instrument and established the fact that modern surveying instrument has similar principle with classical instrument. In the course of the survey, the following were noted;

- That the site was stony and can hold any structure type in terms of the soil type.
- That on the grid interval of 10m x 10m, the total of 365 spot heights was observed.
- That the highest reduced level was 148.375m and the lowest reduced level was 131.976.
- That the difference in elevation between the highest level and the lowest level was 20.268m, the distance between the two points was 279.453m and the slope was approximately 0.073m that was 7.3%.
- That the location of the site is at St. Pius De X Catholic Church, New Haven Extension Enugu North L.G. A. Enugu State.
- Finally, Autodesk Land Desktop 2004 and Surfer8 software were used to plot the contour. This showed that the contour lines were scanty using Autodesk Land Desktop 2004 and full using Surfer8 software.

Recommendation

i. I recommend that all contractors should have a consultant surveyor that should head and oversee all matters that relates to surveying activities within their respective companies.

ii. I also recommend that relationship between Total station derived height and classical levelling with levelling instrument be researched and established.

iii. Government should also request the description of terrain as a benchmark for building approval. This will assist better design and effective planning.

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