PERIMETER SURVEY OF A PROPOSED HOUSING ESTATE IN ENOHIA, AFIKPO NORTH L.G.A. EBONYI STATE.

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Abstract

This project, focus on Perimeter Survey of a proposed mass housing estate located at Enohia, Afikpo North L.G.A. Ebonyi State. The project was essentially for the demarcation and Perimeter Survey of the plot. The survey involved demarcation of boundary pillars, perimeter traverse of the plot, and production of a survey plan of the plot. CHC model X91 GNSS receivers were used for data acquisition. Data were picked using Real Time Kinematic mode, ensuring coordinates were fixed while maintaining lock with at least 4 satellite receivers. A total of eleven (11) beacons were monumented with standard cadastral property beacons of size 18cm by 18cm by 75cm. The surveyed property has an area of 20.179 hectares, with a perimeter of 2,247.020meters. The perimeter survey was carried out with an accepted accuracy of over 1/13,000. The captured data were downloaded, and plotted using AutoCAD software. The final survey plan was printed at a scale of 1:5,000.

Key Words: Beacon, Cadastral Survey, Land and GPS

Introduction

Cadastral surveying answers the question where the land located is and what is the extent (size) of its boundaries and surface area? It also indicates the land parcel's separate identity both geographically on a map or record and physically on the ground by means of survey beacons. Cadastre on the other hand answers the questions concerning the ownership of the land and the conditions under which it is held (J.D. Dashe, 1987). It includes the preparation and interpretation of land description for incorporation into leases, deeds, and other legal registrable instruments.

Basically, cadastral survey creates marks, defines, and re-establishes land boundaries. Cadastral surveys, in the main, include property surveys, layout surveys and land in-dispute surveys, for legal documentation.

A common use of cadastral survey is to determine perimeter boundary of landed properties. A boundary is said to be defined as: A surface that divides one property from another, which in case of land parcels theoretically extends from the centre of the earth vertically upward to the infinite in the sky. It could also be defined as an imaginary line which marks the confines or line of division of two contiguous (adjoining) plots (Dashe, 1987). Perimeter survey is normally carried out to actually determine boundaries of contiguous plots. The aim of this project is to determine the extent of land boundary for proper planning and optimal use of the site. In this project, perimeter survey of a proposed Housing Estate in Enohia, Afikpo North L.G.A. Ebonyi State.was carried out solely for the demarcation and survey of boundary extent and size of the plot. This involved the establishing of the boundary pillars to demarcate the extent of the boundaries, perimeter traverse of the plot, and production of a survey plan of the plot.

This project was strictly guided by the specification for Large Scale Cadastral and Engineering Surveys in Nigeria, as published by Surveyors Council of Nigeria (SURCON) in April, 2003.

Material and Methodology

Study Area

The project is located at Enohia, Afikpo North L.G.A Ebonyi State. It lies between Longitude 7º 56′ 35.4″E - 7º 59′ 12.5″E and Latitude 5º 53′ 12″N - 5º 56′ 59.4″N. The project site covers an area of about 20.18 hecters.

Methodology

Reconnaissance

This is an important aspect of surveying that involve both planning and preliminary inspection of the area before the commencement of the actual data acquisition. T*he system of cadastral practice* in Ebonyi State is such that pillar numbers for any survey work are obtained from the Surveyor General of the state who is the Chairman of State ethics committee. The pillar numbers are issued to surveyors (practicing surveyors) who have registered with the state. To proceed with the perimeter survey of the project area, it was necessary to apply to the necessary authorities for the instruction to survey (I to S) in order to establish the boundary of the plot and also define the limit of the demarcation survey. Therefore application was made for pillar numbers. Likewise, the control around the area was located. The coordinate value of the control pillars close to the project site is shown in table 1.

Table 1: Coordinates of the Existing Controls Used

Control No.	Easting(m)	Northing(m)	Source
EB/MTN T23	380639.925	644935.463	Mobile Telephone Network (MTN) Nigeria.
EB/MTN T26	380793.328	644724.182	
EB/MTN T28	380836.304	645078.419	

The site was visited in company of the client's representatives, who took us round the boundary of the land. Controls were also navigated and sort for using a handheld GPS receiver, to ascertain their existence on ground. An assessment of the entire area had to be carried out to evaluate the various possible impediments to survey.

The choice of survey method, instrument and number of personnel required were decided at this stage. The equipment and materials used are: 2Nos. CHC GNSS receiver model X91 and accessories. Data logger, 2 Nos. Tripod, 1Nos. Tracking rod, 1Nos. external battery, 1 Nos. Steel tape (100m), Garmin 12 hand-held GPS, Other instruments and materials used on the field includes: Shovels, Cutlass, Hand-trowel, Head pans, Water Jeri-can, Iron rods, Cement, Sand, Gravel and Mould, Field Book and writing materials. Also, Hardware and software used includes:

1 Nos. HP laptop Computer, HP Design jet 800 series Plotter, HP Office jet 7213(all in-one series) Printer, Mobile device – for data downloading from the CHC GNSS Receiver, AutoCAD 2009– for graphic plotting and presentation, MS Excel and MS Word for report writing.

Data Acquisition

The survey involved demarcation of boundary pillars, perimeter traverse of the plot, and production of a survey plan of the plot. CHC model X91 GNSS receivers were used for data acquisition, with data picked using Real Time Kinematic mode, and ensuring coordinates were fixed while maintaining lock with at least 4 satellite receivers.

Test of Instrument and Control Check

Before embarking on the project, the instrument was subjected to basic tests to ensure the instrument was in good shape. The instrument test was carried out using three existing controls, namely: EB/MTN T23, EB/MTNT26, and EB/MTNT28, as shown in figure 1. The controls details were gotten from Mobile Telephone Network (MTN) Nigeria. The existing controls used are in

Universal Transverse Mercator (UTM) Coordinate System (i.e. referenced to Minna UTM Zone 32 Origin), and found to be in in-situ thus:.

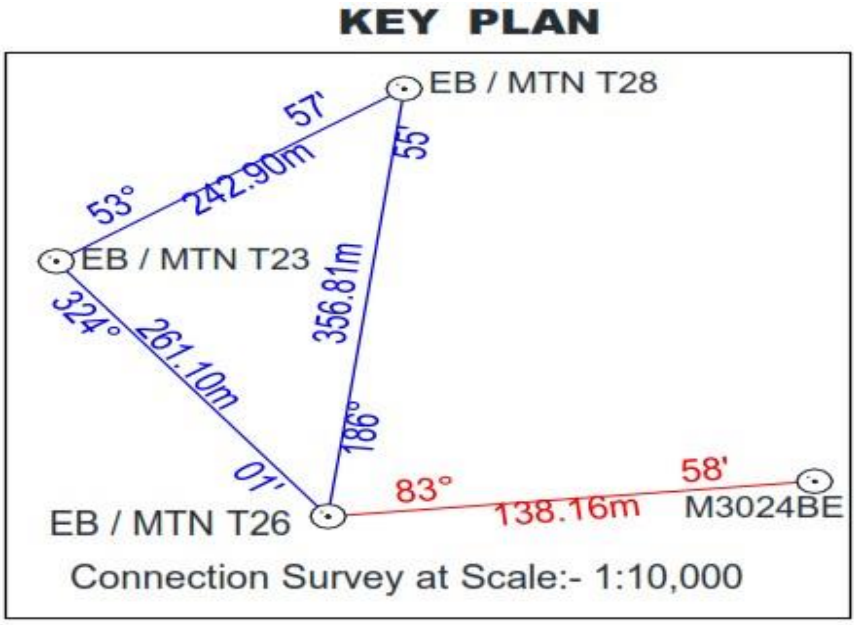


Figure 1: Controls used for In-Situ check.

The CHC GNSS Receiver and its accessories were carefully connected and was set on a pillar EB/MTNT26, as base station (reference), with the known coordinates inputted. After the required initialization, the control points EB/MTNT23 and EB/MTNT28 were measured using the roving receiver. The measured coordinates were then compared with the given coordinates and found to be in in-situ and reliable. The results are as shown in table 3.1.

Table 2: Readings obtained from In-situ Check

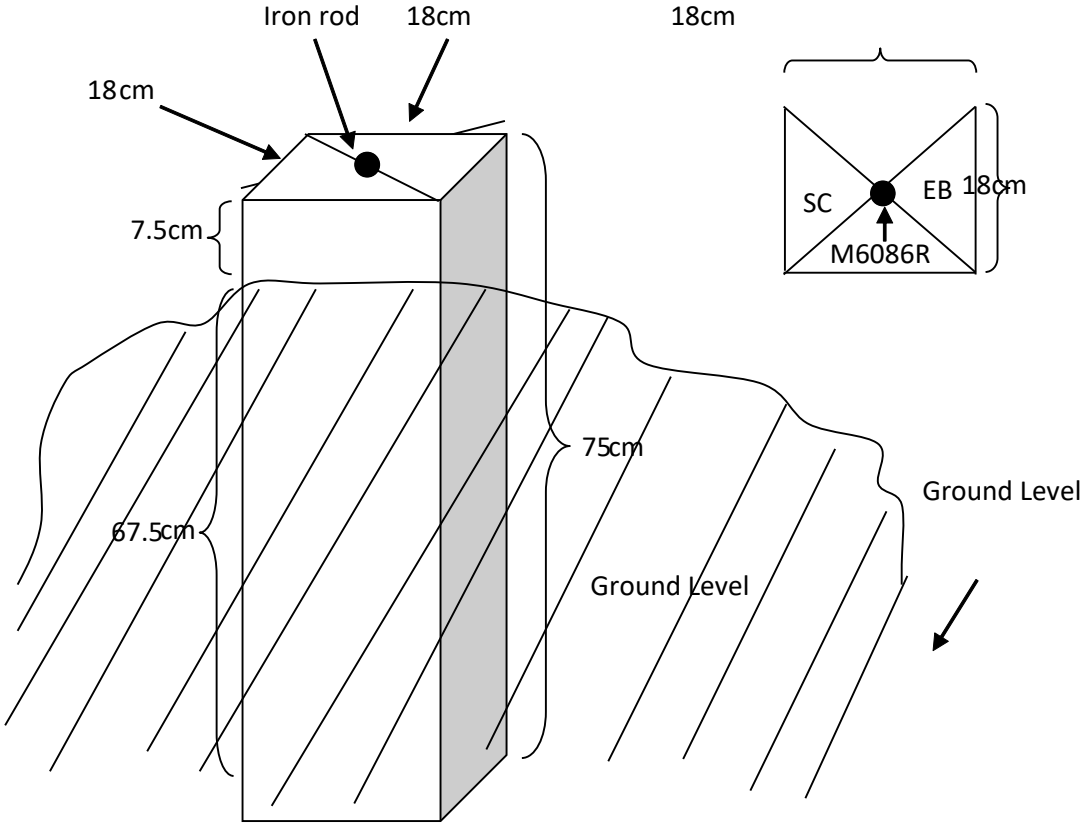
Control No. EB/MTN T23	**EASTINGS (m)**	**NORTHINGS (m)**
Known	380639.925	644935.463
Measured	380639.924	644935.460
Difference	0.001	0.003
Control No. EB/MTN T28	**EASTINGS (m)**	**NORTHINGS (m)**
Known	380836.304	645078.419
Measured	380836.306	645078.421
Difference	-0.002	0.002

The differences obtained were considered to be within acceptable limits for the job of this nature. Hence, the results obtained show that the equipment was in a good working condition, and the controls values were still within the allowable error displacement as indicated by the instrument test results.

Monumentation

The pre-cast property beacons 18cm x 18cm x 75cm were buried. As an aid to permanence, beacons constructed of durable materials were utilized. The concrete used for the pre-cast

beacons was in the ratio of three parts of sand, two parts of gravel to one part of cement (3:2:1) mixed with water. A capping mould of dimension 18cm by 18cm was used to cap the top of the beacon such that the pillar protruded 7.5cm above the ground level while the remaining 67.5cm went into the ground, and an iron rod of 10mm diameter was emplaced at the center of the beacon and made to protrude 5mm above the beacon. The pillar numbering was done with the usual inscription of Government property beacons. A total of thirteen (11) pillars were monumented, and the pillars were numbered from SC/EB/ M3024BE to SC/EB/ M3034BE where SC represents SURCON, EB represent Ebonyi, M represent pillar prefix,



and MB represents Surveyor's ID, see figure 2 for a typical property beacon.

Figure 2a: Typical property beacon. Fig.2b: Beacon top.

Perimeter Survey

The perimeter survey started from two controls namely ~~EB/MTN T23~~ and EB/MTN T26. The instrument was set up on EB/MTN T26 as a base station. The base station GNSS receiver was connected with its accessories via the available port cables. After initialization, the roving receiver was then placed on control station EB/MTN T23 to again confirm the observed values to given values. With this satisfactorily successful, the roving receiver was then used in capturing of defined and monumented boundary points:

Results

Data Downloading

This is the process of transferring the captured data stored in the memory of the instrument via the data transfer port of the equipment through the cable (downloading cable) to the

computer. Data downloading of CHC GNSS Receiver, involved the transfer of the locational data stored in the equipment memory to the computer. The locational (X,Y,Z) data stored in the equipment were downloaded using Mobile device software, for data downloading from the CHC Receiver. This enables the management of the data collected in the field. All the raw data were downloaded into the computer. From this raw data, the actually X and Y coordinates (Eastings and Northings) of each boundary points was extracted. Hence, the details were copied into an excel sheet for preliminary editing as show in table 3.

Table 3: Boundary Points Coordinates.

POINT ID	EASTINGS (m)	NORTHINGS (m)	DESCRIPTION
M3024BE	380930.726	644738.697	Boundary Beacon
M3025BE	380940.674	644826.959	Boundary Beacon
M3026BE	381022.178	645037.999	Boundary Beacon
M3027BE	381105.175	645056.708	Boundary Beacon
M3028BE	381083.998	645265.92	Boundary Beacon
TP01	381163.004	645422.662	Traverse Point
M3029BE	381287.395	645563.128	Boundary Beacon
M3030BE	381346.997	645397.407	Boundary Beacon
M3031BE	381427.326	645197.565	Boundary Beacon
M3032BE	381308.574	645115.146	Boundary Beacon
M3033BE	381349.537	644842.218	Boundary Beacon
M3034BE	381150.49	644794.968	Boundary Beacon

Analysis of Results

Upon completion of the survey, the field measurements were obtained and computed to obtain the area of the plot and accuracy of the Survey. The area of the plot was computed using cross coordinate method as shown in table 4, Back computation was done from which the bearings and distances were obtained as shown in table 5

Table 4: Area Computation Using Cross Coordinate Method

Points ID	Eastings (m)	Northings (m)	E(n) * N(n+1)	E(n+1) * N(n)
M3024BE	380930.726	644738.697		2.45607E+11
M3025BE	380940.674	644826.959	2.45634E+11	2.45693E+11
M3026BE	381022.178	645037.999	2.45721E+11	2.45827E+11

M3027BE	381105.175	645056.708	2.45781E+11	2.45821E+11
M3028BE	381083.998	645265.92	2.45914E+11	2.45951E+11
TP01	381163.004	645422.662	2.4596E+11	2.46092E+11
M3029BE	381287.395	645563.128	2.46065E+11	2.46184E+11
M3030BE	381346.997	645397.407	2.46082E+11	2.46172E+11
M3031BE	381427.326	645197.565	2.46044E+11	2.46019E+11
M3032BE	381308.574	645115.146	2.46065E+11	2.46014E+11
M3033BE	381349.537	644842.218	2.45884E+11	2.45782E+11
M3034BE	381150.49	644794.968	2.45892E+11	2.45622E+11
M3032BE	380930.726	644738.697	2.45742E+11	

Area = |(Sum**(E(n) * N(n+1)) – Sum(E(n+1) * N(n))**) / 2|
=| -403588.7412 / 2|
= 201794.3706 Sq.mtrs
= 20.18 hectares.

Table 5: Back Computation

Station From	**Bearing (d m' s")**	**Dist. L(m)**	**Lsinθ**	**Lcosθ**	**Eastings (m)**	**Northings (m)**	**Station To**
					380930.726	644738.697	M3024BE
M3024BE	006 25 50	88.821	9.948	88.262	380940.674	644826.959	M3025BE
M3025BE	021 07 00	226.232	81.504	211.04	381022.178	645037.999	M3026BE
M3026BE	077 17 49	85.08	82.997	18.709	381105.175	645056.708	M3027BE
M3027BE	354 13 12	210.281	-21.177	209.212	381083.998	645265.92	M3028BE
M3028BE	026 45 02	175.528	79.006	156.742	381163.004	645422.662	TP01
TP01	041 31 36	187.627	124.391	140.466	381287.395	645563.128	M3029BE
M3029BE	160 13 07	176.113	59.602	-165.721	381346.997	645397.407	M3030BE
M3030BE	158 06 06	215.382	80.329	-199.842	381427.326	645197.565	M3031BE
M3031BE	235 14 16	144.551	-118.752	-82.419	381308.574	645115.146	M3032BE
M3032BE	171 27 52	275.985	40.963	-272.928	381349.537	644842.218	M3033BE
M3033BE	256 38 46	204.578	-199.047	-47.25	381150.49	644794.968	M3034BE
M3034BE	255 38 16	226.854	-219.764	-56.271	380930.726	644738.697	M3024BE

3.3 Plan Production and Presentation

The final coordinates obtained from the boundary points surveyed with the CHC GNSS receiver were used to plot the boundary of the plot using Autodesk Land Desktop 2009. The final survey plan was plotted on scale 1: 5,000. See figure 3for the certified Survey Plan.

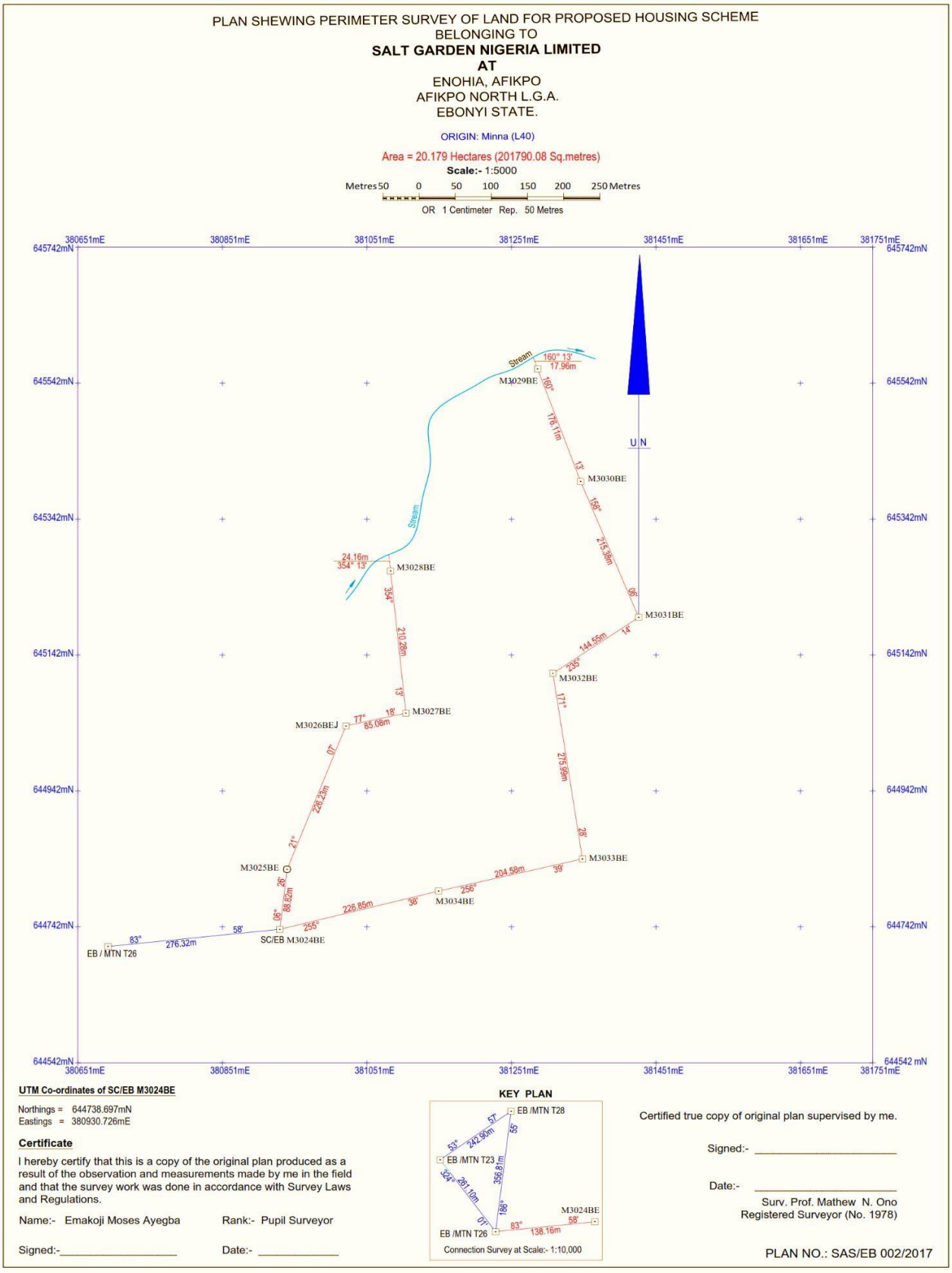

PLAN SHEWING PERIMETER SURVEY OF LAND FOR PROPOSED HOUSING SCHEME
BELONGING TO
SALT GARDEN NIGERIA LIMITED
AT
ENOHIA, AFIKPO
AFIKPO NORTH L.G.A.
EBONYI STATE.
ORIGIN: Minna (L40)
Area = 20.179 Hectares (201790.08 Sq.metres)
Scale:- 1:5000
Metres 50 0 50 100 150 200 250 Metres
OR 1 Centimeter Rep. 50 Metres
380651mE
380851mE
381051mE
381251mE
381451mE
381651mE
381751mE
645742mN
645542mN
645342mN
645142mN
644942mN
644742mN
644542mN
Stream
M3029BE
160° 13'
17.96m
176.11m
M3030BE
156°
215.38m
M3031BE
144.55m
235°
M3032BE
171°
275.99m
M3033BE
39'
204.58m
256°
M3034BE
38'
226.85m
255°
SC/EB M3024BE
58'
276.32m
83°
EB / MTN T26
88.62m
06°
M3025BE
226.23m
07'
M3026BEJ
85.08m
77°
18'
M3027BE
210.28m
354°
M3028BE
24.16m
354° 13'
U N
UTM Co-ordinates of SC/EB M3024BE
Northings = 644738.697mN
Eastings = 380930.726mE
Certificate
I hereby certify that this is a copy of the original plan produced as a result of the observation and measurements made by me in the field and that the survey work was done in accordance with Survey Laws and Regulations.
Name:- Emakoji Moses Ayegba
Rank:- Pupil Surveyor
Signed:-
Date:-
KEY PLAN
EB /MTN T28
EB /MTN T23
EB /MTN T26
M3024BE
242.90m
358.8m
261.10m
138.16m
Connection Survey at Scale:- 1:10,000
Certified true copy of original plan supervised by me.
Signed:-
Date:-
Surv. Prof. Mathew N. Ono
Registered Surveyor (No. 1978)
PLAN NO.: SAS/EB 002/2017

Figure 3: Plan showing Perimeter Survey

Conclusion

The desired results were satisfactory obtained using appropriate procedures that were in agreement with the needed accuracy. Also, use of modern day survey equipments also reduced the number of days and personnel used in the project and thereby reducing drastically the cost of the project execution as well as meeting up with the project submission deadline stipulated by the client. Though, every survey work has its own challenges, the surveyed landed property had one of its side bounded by a river, this resulted to the non-fixing of Property pillars/numbers along the river route, hence posing a challenge to the exact area computation.

The produced map of the perimeter survey will help in decision making especially to the environmental sector. This has helped in the knowledge of the actual area size of the property, the shape of the property and the bearing toward which it is positioned to the true north. The monumentation of the surveyed parcel of land will help in the avoidance of conflicts resulting from land encroachment. The survey plan produced serves as a registrable legal instrument in any court of law.

It is therefore recommended that; Modern surveying equipment should be seen as indispensable tools to ensure: Time effectiveness, reduced cost implications; and Better accuracy due to less human involvement during observation and processing. The densification and re-establishment of controls should be encouraged, to help reduce the distance, time and stress encountered during field reconnaissance for the purpose of connection survey.

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