PERIMETER SURVEY OF LEVEL II ARMY HOSPITAL DAMATURU, YOBE STATE, NIGERIA.

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Abstract

This paper, Perimeter Survey of level II army hospital Damaturu is a third order accuracy job. The survey involves the carved out, demarcation and survey of the site for preparation of title deed plans of the plot and subsequent processing of certificate of occupancy. The primary objective of this Perimeter Survey is to define the legal property boundaries and determine coordinates of all measured points. It also gives information on the size and shape of the land. . The job involved reconnaissance (office and field), instrument check, in-situ check, setting out, and emplacement of boundary beacons, perimeter traverse, data processing and production of survey plan. A Leica TS06 total station and its accessories were used for the execution of this job.

The traverse closed with an acceptable linear accuracy of 1/5,000.The final plan was plotted at scale of 1:2,500.

Introduction

Perimeter Surveys are carried out for the purpose of delineating the boundary of a parcel of land, determining its area and preparation of survey plan. The survey plan is usually the end product of a perimeter survey. The survey plan shows ownership and describes the land. It is a document required by law during processing of any land title. A perimeter survey is an important component of pre-construction due diligence. The perimeter survey establishes the perimeter of a property as it relates to a site's legal description. Partner's licensed surveyors will review recorded documents and do a physical inspection to determine the physical boundary of the site. A record of survey will

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be filed with any relevant agencies as required to help determine if there are any encroachments on or over the site boundary. If this is the case, partner can provide the expert services to resolve these issues by establishing an easement or boundary line agreement. The services of a licensed land surveyor are generally required to conduct perimeter surveys.

In facilitating the provision of affordable Healthcare service, land becomes an important element. It was on this premise that the newly approved Army barrack of Damaturu Yobe State set aside a land for Army level II hospital. The entire site for the proposed hospital is approximately 14.731 hectares. In executing this job the area was carved out for the developers to start work. The planners have also concluded their bit on it by providing the layout survey. Similarly like all other cadastral project the normal procedure or work packages of reconnaissance, station establishment, beaconing, data acquisition, data processing, and plotting were carried out. The purpose of this project is to set out and demarcate the parcel of land for Army level II hospital for the preparation of title deed plan which will be used for the processing of certificate of occupancy (C of O) and other land related transactions.

Study Area

The study area is Damaturu Local Government Area of Yobe State, located in the North East Geopolitical Zone of Nigeria. Damaturu Local Government is one of the seventeen local government's areas of the state with its headquarters area in the town of Damaturu, the state capital. The Local Government Area has an area of two thousand, three hundred and sixty six square kilometers (2,366 km^2) and a population of about eighty eight thousand and fourteen (88,014) at 2006 census. It is bounded to the north by Tarmuwa Local Government, to the south by Gujba Local Government Area, and to the west by Fune Local Government's Area of Yobe State, while to the East it is bounded by Kaga Local Government Area of Borno State. The study site is Damaturu metropolis, the capital of Yobe State, it lie between latitude 11° 39' 55"N to 11° 47' 01"N , and longitude 11° 55' 04"E to 12° 01' 47"E. The town is on A3 highway and has an estimated population of forty four thousand, two hundred and sixty eight (44,268) at 2006 census. The climate area can be described under Sahel Savannah which often characterized with short wet season that last for four months and long dry season of about eight months. The wet season occurs between August and September, with mean annual rainfall of 350-500mm. The temperature is fairly consistent, and the hottest months are

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March, April, and May with temperature ranges from 39°c-40°c. The vegetation cover in Damaturu is directly related to environmental factors such as soil, rainfall, and human intervention. The entire area fall within the Sahel Savannah; short grasses, thorny shrubs and trees are found dotted around. The study site is pluralistic in ethnic composition. Agriculture is the main occupation of the people, mainly crop production, livestock keeping. Inhabitants are mostly public servants, businessmen, and farmers. Map of Yobe State showing the seventeen local government areas is shown in figure 1, while the study area map is shown in figure below.
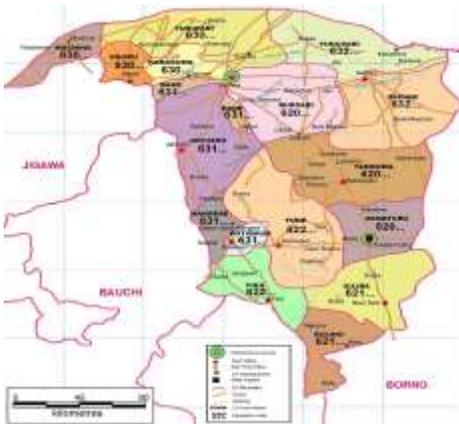

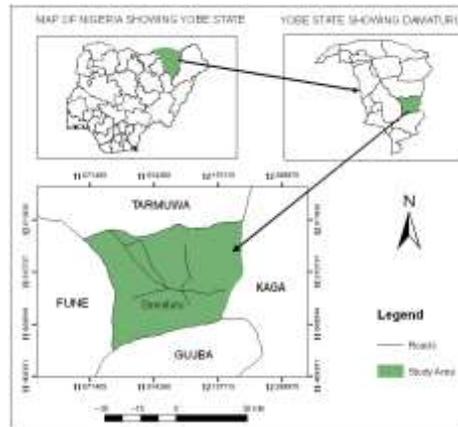Figure 1: Map of Yobe State

Figure 2: Map of Study the Area

The site for the project is located at off Patiskum road Damaturu, Yobe state. The total area of the project site is 14.731 hectares.

Reconnaissance Survey (Recce)

In planning stage the data needed for the execution of the survey project was collated and decisions on the choice of equipment, personnel and the most cost effective survey method to achieve the desired result and accuracy within the given time frame were made.

Office Reconnaissance

Office reconnaissance for the purpose of this project, involved getting the coordinates along Patiskum road from the Ministry of Lands and Housing Damaturu Yobe state. This coordinates were used for connection.

Field Reconnaissance

The survey team embarked on a reconnaissance survey to have an over view of the site. The coordinates of the control points used were collected during the

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office reconnaissance and the best method to carry out the survey was adopted. The following beacons, CSBT 033, CSBT 034 and CSBT 035 were located and found to be inter-visible. The coordinates of the beacons shown in table 1.1 were used to compute the bearings and distances between the controls which were subsequently used for in-situ check of the controls.

Table 1.10: Controls Points

Control Point	Easting (Metres)	Northing(Metres)
Csbt 033	807718.230	1296735.528
CSBT 034	808037.922	12966757.554
CSBT 035	808324.542	1296779.579

Source: Ministry of Land and Housing Damaturu, Yobe State.

Methodology

Cutting of Line Of Sight

The boundary lines were cut to a width of one meter to ensure ease of movement of personnel and equipment.

Establishment Of Perimeter Beacons

Since all the points to be established have design coordinates, the task simply involves deriving from the co-ordinates the bearing and distances that will be necessary to locate the point on ground.The stake-out technique was adopted in this survey. The design co-ordinates were used for the stake-out of the perimeter beacons on the field. At the site, the exact positions of the perimeter beacons were located using the set-out program of the Leica TS06 total station. The program calculates the setting out elements from the stored XY coordinates of the points of interest. The option to enter angles and distances also exist but for this task the coordinate method was used. The set-out program of the Leica TS06 total station supports the polar setting out technique in which the divergence between the computed direction and the measured direction is displayed first. For each point, the instrument was turned until a zero or near zero divergence was achieved and the target moved forward or backward till the difference in distance was zero then the point was marked with a peg.

Field Procedure for Setting Out

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In setting out the perimeter beacons, the co-ordinates of three control beacons and the temporary points established (TP) (CSBT 033 to CSBT 034 and CSBT 035, TP1 to TP 2, TP2 to TP3 and TP3 to TP 4) and the co-ordinates of the boundary beacons to be established were uploaded into the internal memory of the total station. The total station was set up over control point TP4, centered, levelled and telescope focused to eliminate parallax. Then in "Set out" menu of the instrument the parameters of the instrument station (TP4) and the reference station (TP3) i.e. station name, height of instrument over the station mark, height of target over the station mark and the XY coordinates of the stations were called up from the internal memory. With the instrument still on TP4, the reference control station (TP3) was then accurately bisected using the vertical and horizontal slow motion screws and the horizontal reading set to zero. Then the uploaded design coordinate of PBY 28992 was called from the internal memory of the total station. The enter key was pressed to confirm the displayed data and the instrument displayed the horizontal distance and angle to locate PBY 28992. The upper plate was unclamped and the total Station swung in the direction of PBY 28992 until dHA was $0°$ and the target was placed on line. The positions of Nail 1 and 2 were established along the traverse line. The prism was then moved forward and backward until the setting-out distance was 0m. Then the position of point PBY 28992 was marked on the ground with a peg .The general rule is to move the prism towards the instrument when the Δdist is "+ve" and to prism away from the instrument when the Δdist is "-ve". In this manner the other boundary beacons (PBY 28993, PBY 28994, up to PBY 28998) were traversed and closed back on Control pillar CSBT 033.

Pillar Emplacement /Beaconing

The pegged positions of the perimeter beacons were dug and standard property beacons measuring 18cm square at the surface with a length of 75cm were buried at the accurate positions of each of the 8 boundary points. The beacons were pre-cast and moulded by a mixture of one (1) part of cement with two (2) parts of gravel and three (3) parts of sand. A 12mm steel rod defines the center of the beacon. The property beacons were buried to a depth of 67.5cm with 7.5cm of the length above the ground surface. All the beacons were capped and numbered serially Fig 2.10 shows a cadastral property beacon.
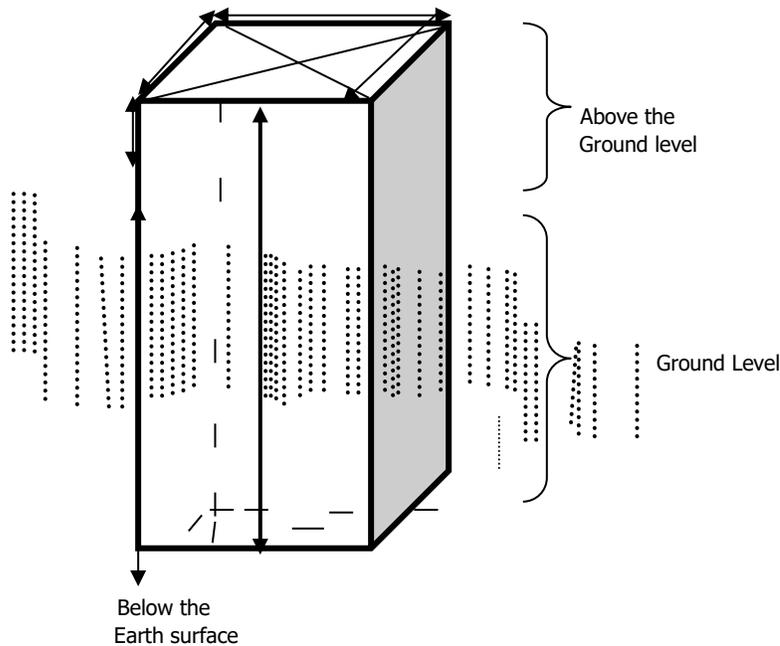
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Above the
Ground level

Ground Level

Below the
Earth surface

Figure 2.10: Property Beacon

Data Acquisition by Traverse Method

The traverse was run through the newly emplaced beacons, starting from TP4, with TP3 as reference point through PBY 28992,PBY 28993, PBY 28994, up to PBY 28998 and closed back on CSBT 034 .The total station was set up over the point TP4 centered, levelled and telescope focused to eliminate parallax. The parameters of the instrument station i.e. station name, height of instrument over the station mark, and the XYZ coordinates of the station were entered. The reference control point was then bisected and the station name TP3, height of target over the station mark, and the XYZ coordinates of the station were entered. Though the total station was set in coordinate mode it actually measured and recorded horizontal readings, vertical readings and distances automatically into the internal memory of the instrument which it used to compute and display preliminary coordinates. At every set up of the total station, the temporary adjustment was carried out and the following parameters measured: Height of instrument, Height of the back target, Height of the fore target and Distance to back and fore stations.

Data Processing
Data Download / Data Processing

The data acquired with the total station was downloaded to the computer with the aid of the downloading cable using the Data Exchange Manager of the Leica Survey Office. The following steps were taken to download the Data.

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- Connection of the instrument to the computer port using interface cable
- Launch Leica Survey Office software from the active desktop environment.
- Click Data Exchange Manager
- Communication setting appeared
- Create a folder at C:/ drive where a folder had already been created for data storage
- Click the icon; + com 1
- Click measurement data (G 12)
- Drag Measurement data to the new folder earlier created
- The data was transferred from the instrument to the computer
- The window was closed and the interface was returned to Leica Survey Office.
- Click coordinate editor
- The file menu was clicked to access the folder earlier created in C:\ drive.

Back Computation
The downloaded field data (X, Y) of the established points were used to compute in order to determine the bearing and distances between various points. A survey computation program called "SurvCAD" was used to carry out most of the computation in this project, however a check was carried out to ascertain that the result obtained from the programme are correct. This program still follows the basic principle of computing bearing and distances from a set of coordinate of a point.
The software uses the following formular for the computations.

$\Delta E_{AB} = E_B - E_A$

$\Delta N_{AB} = N_B - N_A$

Where E_A = Easting of Coordinate A

E_B = Easting of Coordinate B

N_A = Northing of Coordinate A

N_B = Northing of Coordinate B

ΔE_{AB} and ΔN_{AB} are the errors in Eastings and Northing respectively.

Bearing = $\text{Tan}^{-1} \dfrac{\Delta E}{\Delta N}$, Distance = $\sqrt{(\Delta E)^2 + (\Delta N)^2}$

Area Computation
One of the major tasks of cadastral surveying is the determination of extent and sizes of the plots. In this project; Area of the parcel of land was computed using surveying software, "SurvCAD";

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Area computation is commonly done in two ways namely:-

    (i)   By Departures and Total Latitude

    (ii)   Area obtained from coordinates

The formula for calculating departures and total latitude is stated below as: Twice the area of a figure equals the algebraic sum of the products of the total latitude (Northings) of each station and the algebraic sum of the departure (Eastings) of the two lines which adjoin the station.

The formula for calculating area from the coordinates are stated below as: Twice the area of a figure equals the algebraic sum of the products of the latitudes or (Northings) of each line and the sum of the Eastings of each end of that line; which may be expressed as follows: $2A = (N_1E_2 + N_2E_2 + \ldots\ldots\ldots\ldots N_nE_1) - (N_1E_n + N_2E_1 + \ldots\ldots\ldots\ldots N_nE_n-1)$

Where A = Area

 E = Coordinate of Easting

 N = Coordinate of Northing

Analysis of Results

A comparison of the given control coordinates with the co-ordinates obtained from field observation revealed a measure of closeness of value indicating that the boundary points were accurately set out. The differences in the Easting and Northings values were 0.365mE and 0.553mN respectively. The closeness of the figures confirmed the reliability of the job executed in term of creating a level of confidence in the observational procedures.

Accuracy Achieved

Before the data acquired was accepted, the "misclosure report" command of the SurvCAD software was used to check whether the survey met the accuracy standard for a third order survey job. The misclosure report obtained is as shown below.

Where **ΔN**   **=**   misclosure in northings (0.553) m

     ΔE   **=**   misclosure in eastings (0.365) m

The misclosure obtained was used to calculate the accuracy of the job as shown below:

Accuracy Obtained

      ❖ Traversing

      ❖ Linear Accuracy $= \sqrt{\dfrac{(\Delta N)^2 + (\Delta E)^2}{\Sigma TD}}$

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Where **ΔN**   =   misclosure in northings (0.553)

       ΔE   =   misclosure in eastings (0.365)

ΣTD   =   Total distance (5699.527m)

$$\therefore \text{Linear Accuracy} = \frac{\sqrt{(0.365)^2 + (0.552)}}{5699.527}$$

$$\text{Linear Accuracy} = \frac{\sqrt{(0.1332) + (0.3047)}}{5699.527}$$

$$\text{Linear Accuracy} = \frac{\sqrt{0.318024}}{5699.527}$$

$$\text{Linear Accuracy} = \frac{1}{\frac{0.563936}{1}}$$

$$= \frac{1}{\frac{5000}{5699.527}}$$

A Linear accuracy of 1:5000 was obtained.

Results/Summary

The data was analysed and found to meet with the survey laws and regulations. The results are as shown in table 4.40 below. The final boundary coordinates were used to calculate the area of the property.

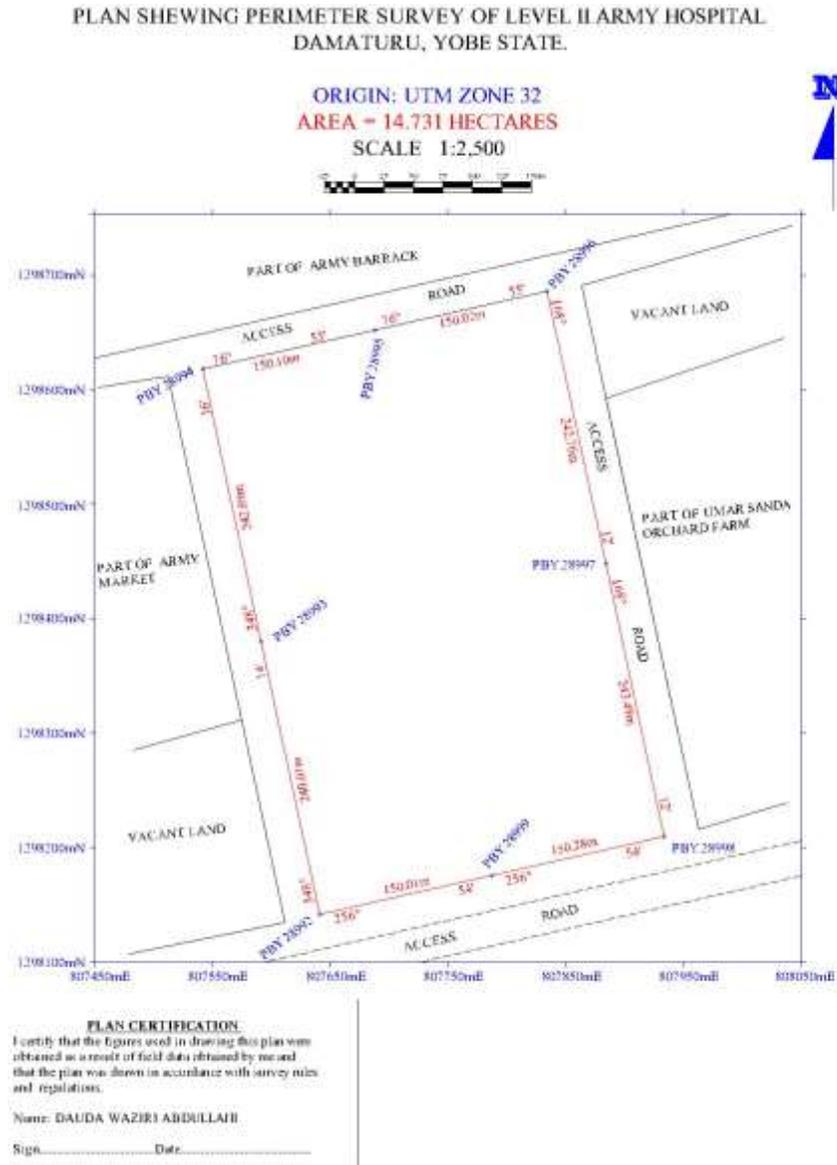|	Expected	Obtained	Remark
Linear accuracy	1/3000	1/5000	Within the allowable limit.

Table 4.10: Summary Of Results Achieved

The results obtained above were all within the allowable accuracy limits for a third order survey hence the survey and data were accepted.

Plan Preparation

The final coordinates derived from the survey were exported to the AutoCAD 2007 environment. A script file was created for it, so that the plan can be plotted. After

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the necessary processing, editing and lettering of the AutoCAD plot, the plan was finally plotted.

The perimeter survey was drawn at a scale 1:2,500.

PLAN SHEWING PERIMETER SURVEY OF LEVEL II ARMY HOSPITAL DAMATURU, YOBE STATE.

ORIGIN: UTM ZONE 32
AREA = 14.731 HECTARES
SCALE 1:2,500

Recommendation

The project execution was successful and based on the field realities the following recommendation is made:

The Military should make it a law that any project should be proper surveyed before execution. Vehicle and security should be made available to surveyors especially in the troubled areas.

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Conclusion

The exercise was carried out in accordance with survey rules and regulations. The aim and objectives of the project were achieved and that at the end of the exercise a plan of the project site was produced. An accuracy of 1:1000 was achieved as against the expected accuracy of 1:3000.

Co-Ordinate Register

STATION	EASTING	NORTHING
CSBT 033	807718.230	1296735.528
CSBT 034	808037.922	12966757.554
CSBT 035	808324.542	1296779.579
TP1	807647.983	1296986.092
TP2	807716.828	1297342.635
TP3	807538.639	1297662.980
TP4	807657.079	1297941.851
PBY28996	807640.800	1298141.767
PBY28997	807591.145	1298380.139
PBY28998	807541.654	1298617.726
PBY28999	807687.843	1298651.770
PBY28992	807833.949	1298685.795
PBY28993	807883.583	1298448.160
PBY28994	807933.365	1298209.815
PBY28995	807786.998	1298175.771
TP5	807808.023	1297891.102
TP6	807954.345	1297428.814
TP7	808089.234	1296930.324

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