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Establishment of Five Surveying Reference Stations Using GPS Technology and Management of Records Using GIS Database

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ABSRACT: A Control Point is a reference station with established horizontal and vertical position (in terms of longitude, latitude and height). Control points are therefore developed to create a framework around which other surveys can be justified. The absence of a precise control points within Unwana, in Ebonyi State Nigeria has hindered the attainment of high accuracy in survey jobs and has hence, prevented quality research work in the discipline of Surveying and Geoinformatics. The aim of this project is to establish five (5) Second order control points using Global Navigation Satellite System (GNSS) technology. Survey monuments/pillars were first established/planted at the approved specification of size and height in some selected positions while ensuring inter-visibility among consecutive control points. Differential Global Positioning System (GPS) observation in static mode was carried out, the data were download and processed using Leica Geo office software. A Geographic Information System (GIS) database was created to help manage the spatial and non-spatial data. The list of adjusted coordinate of the control points is presented alongside a map showing the spatial distribution of the control points around the campus. The spatial representation of the control points shall provide a guide on availability or proximity of a control point around an intended site or area to be surveyed. It is recommended that the database should be frequently updated subsequently as the controls are being densified.

KEYWORDS: Control Point, Database, GIS, GPS, and Map.

I. INTRODUCTION

A control point is a survey monument usually established as a reference point with known position in terms of longitude, latitude and height serving as a framework upon which other survey jobs can be justified. These control surveys are used for accurate mapping projects in the construction of underground utility systems, roadways, power lines, tunnels, and many other high precision projects [1].

Control point networks consist of stable, identifiable points tied together by extremely accurate observations. From these observations, coordinates are computed and published, these provide a common basis so important for all surveying and mapping operations to ensure a coherent product. Of particular importance is the requirement to connect to previously established control points. If this is not done, then the survey cannot be placed on the national datum. An adequate number of existing control point connections are often required in the specifications in order to ensure strong network geometry for other users of the control, and to provide several closure checks to help measure accuracy [2].

The existence of a very precise control points within Afikpo (with the school environment inclusive) has hindered the execution of proper research in the department of Surveying and Geoinformatics, hindering the attainment of high accuracy in survey jobs execution which poses a threat to the security of life and properties in terms of structural deformation and monitoring, land dispute between communities and even individual properties owners.

A Geographic Information System (GIS) is an automated information system for capturing, storing, analysing, displaying and managing data and associated attributes that are spatially referenced to the earth. GIS is a tool that allows users to create interactive queries (user created searches), analyse the spatial information, edit data, maps, and present results of all these operations [3]. In the work of Sherry and Charles [4], the use of Geographic Information system (GIS) to create a database for the control point and to also spatially show the distribution of control points was

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demonstrated. The developed GIS according to their work, allow users to easily locate National Reference System (NSRS) control points in Lackawanna County, Pennsylvania based on the desired type, quality, and location. It also provides background quadrangle map sheets to provide the user with additional map information that may be required when planning a survey.

The aim of this work is to establish GPS Second order control points within AkaniIbiam Federal Polytechnic Unwana, in Ebonyi State Nigeria. To achieve this aim, the following are the objectives: a reconnaissance survey to determine the suitability and intervisibility of the control stations, monumentation of the control stations, to carry out GPS observation in static mode of observation, data processing and adjustment, production of a map showing the location and distribution of the control points and also listing of the coordinates.

Hence, the control point when established will be very a useful tool for academic research within the institution and the entire community. It will be used for mapping, (for example; the administrative map of the school). The host community will benefit from it because there will now be precise control points that can be used for their cadastral jobs. The control points when established will serve as a framework for the monitoring of structures against deformation and collapse. Finally, the control points will serve as an added advantage for accreditation for Civil and Surveying department.

II. MATERIAL AND METHODOLOGY

A. STUDY AREA

The study area is in Unwana in Afikpo North local government area of Ebonyi State, Nigeria. Precisely at AkanuIbiam Federal Polytechnic, Unwana (formerly The Federal Polytechnic, Unwana – Afikpo) which was established by Decree No.33 of 1979 [5]. Afikpo has a population of approximately half a million people and growing, its area is approximately 164 Sq Km in size. It lies between Latitude 7º 55′ 17.4″N - 7º 56′ 35.4″N and Longitude 5º 53′ 12″E - 5º 53′ 59.4″E. It is bounded to the north by the town of Akpoha, to the south by Unwana and Edda in Ubeyi and Afikpo South Local Government Areas respectively, to the East by the Cross River and to the West by Amasiri [6]

B. METHOD

List of some existing primary control points needed around the study area was sought from the Office of the surveyor general of the federation Abuja Nigeria in order for their coordinates to be used as reference controls. A Reconnaissance Survey was carried out on the study site, which involved a walk around the site to determine the suitability of the control stations and the intervisibility of consecutive control stations. The chosen points were thereafter marked out for monumentation.

AHTD [7], highlights the instrument requirement and the methods in the establishment of control points, description was also made regarding the monumentation process. Monumentation of the five control stations within the project site was done using rod, sand, cement, gravel, and water at the appropriate specification of size, shape and height. The concrete mixture for the beacons was in the ratio of 3:2:1 of sharp sand, crushed stone and cement by first preparing the form work at 40cm by 40cm and 150cm long using woods. 2mm rods were used to reinforce the precast concrete. Figure 1 shows the description of the beacon monumentation according to Surveyor Registration Council of Nigeria (SURCON) specification [8].

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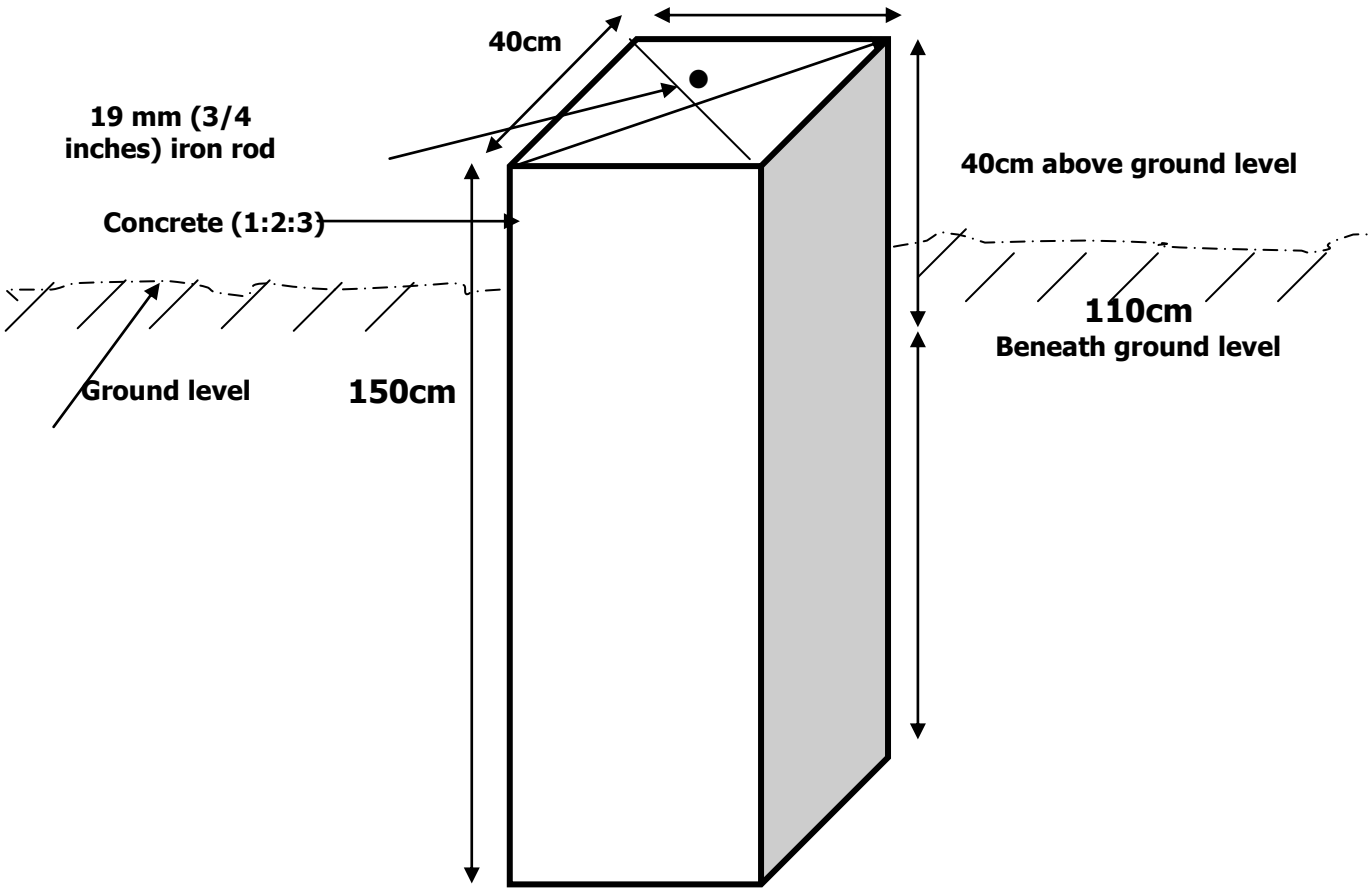

Fig. 1: Description of control pillar. (Source: SURCON [8])

According to SURCON [8], national horizontal control accuracy standards is expected to be at an accuracy of 1: 100,000 (10ppm), with the method of realization to be any of the following; Triangulation, Doppler, GPS, Triangulation, or Traverse observation. Using differential GPS (GS10 GNSS Receiver and its accessories), GPS observations were carried out in static mode of observation with the GPS master receiver placed at the reference control point. Static positioning implies that both receivers are stationary during the entire period of data collection [9]. The duration of observation per station was two (2) hours per station. The data were downloaded and processed using Leica Geo office software and the final (refined) coordinates were gotten.

A satellite imagery of the study area was acquired to serve as a base map. This imagery was imported into the ArcGIS 10.2 environment where different layers were created using the ArcCatalog, it was georeferenced and thereafter digitised using the ArcMap. The spatial and attribute data obtained (Control point coordinates, as well as the description of location, the class of control point, and other information) were first entered in MicrosoftExcel (2013) software to create a simpledatabase and was exported to ArcMapenvironment of ArcGIS. This data was thereafterconverted to shape file and used to perform allthe required analysis. A map showing the distribution of the control points was produced and different queries were created.

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III. RESULTS AND ANALYSIS

The result of the final coordinates obtained (in three dimension- 3D) for the five established control points is tabulated (as shown in table 1) alongside the beacon number/station identity. This table shows the list of coordinates in both Universal Transverse Mercator (UTM) projected coordinates system, geographic coordinate system as well as the ellipsoidal heights of the stations.

Table 1: List of Coordinates of Control Points

Station	Easting (m)	Northing (m)	Height (m)	Latitude	Longitude
AIFPU 001	379787.027	641746.672	59.327	5° 48' 17.43"	7° 54' 51.15"
AIFPU 002	379969.418	641542.394	65.882	5° 48' 10.79"	7° 54' 57.10"
AIFPU 003	380523.887	641386.754	64.025	5° 48' 05.76"	7° 55' 15.13"
AIFPU 004	380339.064	741116.815	72.441	6° 42' 13.02"	7° 55' 2.45"
AIFPU 005	380539.775	641098.576	70.093	5° 47' 56.38"	7° 55' 15.67"

A map showing the spread of the five control points is shown in figure 2. From this map, decisions can easily be reached as to which control points are suitable in terms of proximity to an intended site/job (depending on the type of survey to be done and the instrument to be used).

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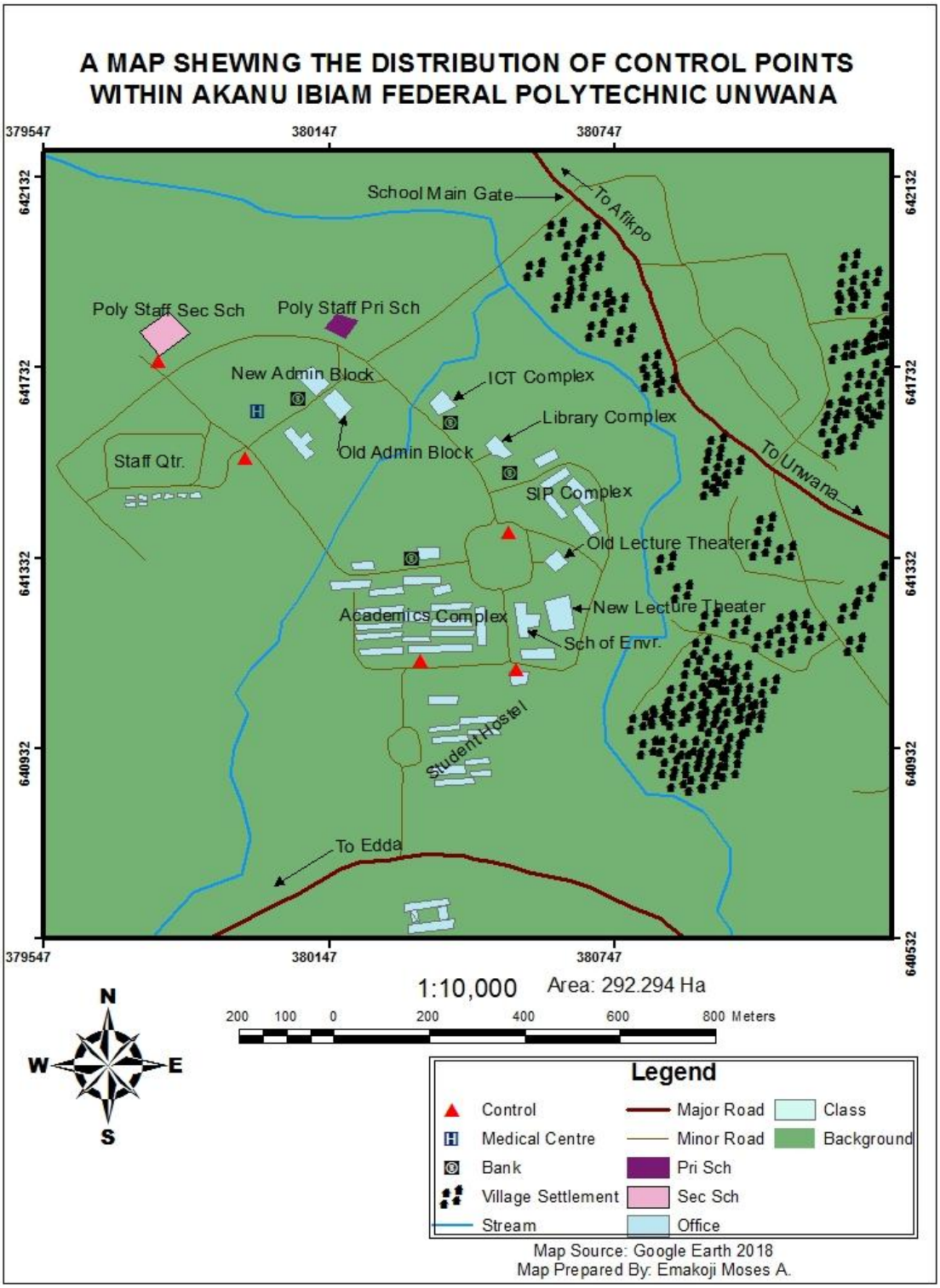

Fig. 2: A Map Showing the Spatial Distribution of Control Points within Unwana.

A Screen shot of the GIS database created to manage information about the control points is shown in figure 3. This database is expected to be updated as the control points are being densified in the future.

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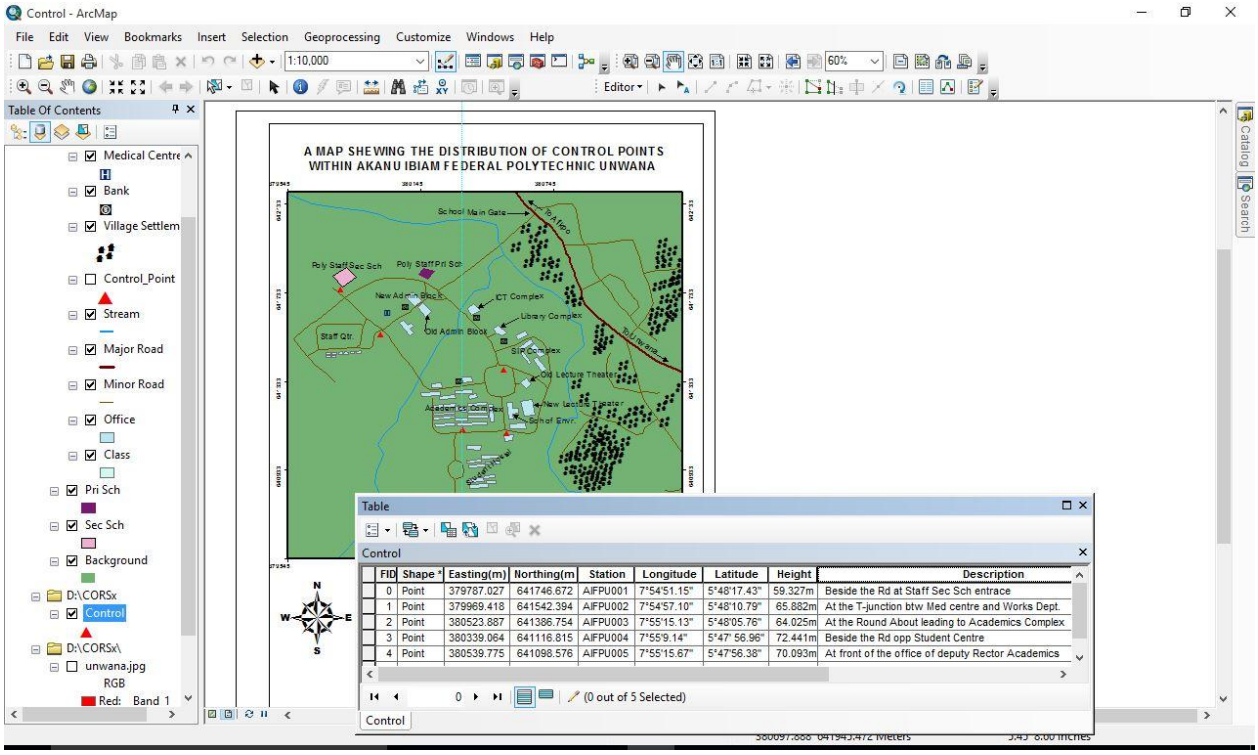

Fig. 3: A Screen Shot of the Database of Control points Created in ArcGIS 10.2

IV. CONCLUSION AND RECOMMENDATION

With the establishment of control points, some surveying related research work will now be realistic since reference points now exist to which such work can be referred to. Hence, the map produced is a quick guide to showing available control points around any intended survey site. It is recommended that the database of control points created should be frequently updated subsequently as the controls are being densified.

REFERENCES

[1] Gresham and Associate international. Surveying and Mapping. (n.d). Retrieved from: http://www.gresurv.com/hvcontrol.html. Accessed on 12/05/2017.
[2] NOAA. Standards and Specifications for Geodetic Control Networks. 1984. Available at www.ngs.noaa.gov/FGCS/tech_pub/. Accessed on 27-11-2016.
[3] USDA. Geographic Information Systems; 2008. Available at:http://egsc.usgs.gov /isb/pubs/gis_poster/index.htm. Accessed on 13/10/2008
[4] Sherry A, Charles D. GIS of Control Points in Lackawanna County, Pennsylvania. 2001; an Undergraduate Project, Penn State Surveying Program
[5] AIFPU. History and Overview. Available at: http://www.polyunwana.net/new/polytechnic.php?id=17. Accessed on 14/12/2018
[6] Mbey G. Origin of Afikpo (Ehugbo). Ebonyionline; 2009. Available: http://www.ebonyionline.com/origin-of-afikpo-ehugbo/#. Accessed: June 15 2017.
[7] AHTD. (2013). Requirements and Procedures for Control, Design, and Land Surveys. Arkansas Highway and Transportation Department.
[8] SURCON. Specifications for Geodetic Surveys in Nigeria. 2010. A publication of Surveyors Registration Council of Nigeria.
[9] Chalermchon S. Improving the GPS Data Processing Algorithm for Precise Static Relative Positioning. 2002. A thesis submitted to The University of New South Wales in partial fulfilment of the requirement s for the degree of Doctor of Philosophy Available at: https://www.researchgate.net/publication/267971851_Improving_the_GPS_Data_Processing_Algorithm_for_Precise_Static_Relative_Positionings. Accessed: 11/10/2018.