Evalvaluating Geodetic Control Network of Awka Capital Territory of Anambra State for Sustainable Development

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SUMMARY

The Awka Capital territory is the defined and declared ten kilometre radius of capital of Anambra State of Nigeria. The Anambra state was created on 27th August, 1991. At inception of the state, GPS geodetic controls numbering forty seven were established for proper planning and development of the new Awka Capital territory. Further, they were to ensure orderliness that will propel sustainable development of the capital territory.

After twenty one years, this effort was assessed and evaluated to knowing the extent of achievement of this sustainable development objective. It was so astonishing to find out that many of the geodetic controls have either been destroyed or uprooted and some were completely defaced or mutilated in utter disregard of existing laws. Hence, the good intention of having the geodetic infrastructure has virtually been defeated. Consequently, there are disparate surveys and survey products and incoherent planning of the capital territory. Surveys carried out are not connected to approved national origin; buildings are erected with clear disregard to any development control regulations.

Hence, Slums are being created and therefore giving no sustainable future to the capital territory. It is recommended that the state government through its survey unit should re-establish these geodetic controls, extend and densify the controls to reach all areas in the capital territory. Also, in some instances, the geodetic controls should be repositioned to prevent destruction. The government should strongly empower the Awka Capital Territory Development Authority (ACTDA) to take-off for the orderliness, consistent and sustainable development of the capital territory. Further, to make the defaulters and destroyers of geodetic controls to face the law.

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1. INTRODUCTION

Survey activities are carried out in every meaningful and sustainable development, hence; it is regarded as the "bedrock of every meaningful and sustainable development". This implies that for any development to be sustainable, the services of a surveyor must be employed. Sustainable development remains the most widely mentioned phrase in the construction and engineering industries world over. Sustainable development has been defined severally, but Akindoyeni (2011) defined sustainable development as development that meets the need of the present without compromising the ability of future generations to meet their own needs. The idea of sustainable development raises a great number of questions relating to how the development is carried out. If the sustainability of any project or environment is dependent on the quality and accuracy of the survey operations, then proper survey operations with utmost accuracy should be the first step to achieving sustainable development.

The accuracy of the domestic survey operations in any area or region, which affects the small and medium scale developments, is highly dependent on the quality of the geodetic infrastructure in that region. Defining the relationship between geodesy and surveying, Vanicek and Krakiwsky (1992) stated that in most languages, no real distinction is made between the two but that the distinction inherent in English language, probably, causes more problems than it solves. Hence "Surveying is the practice of positioning and geodesy is the theoretical foundation of surveying". In his own attempt, Torge (2001) explained that geodesy may be divided into the areas of global geodesy, geodetic surveys (national and supranational), and plane surveying. He further defined that Global geodesy includes the determination of the earth's surface and gravity field over a region that typically spans a country or a group of countries, that the earth's curvature and gravity field must be considered in geodetic surveys and that in plane surveying (topographic surveying, cadastral surveying, and engineering surveying), the details of the earth's surface are determined on a local level, and thus curvature and gravity effects are generally ignored (Torge, 2001).

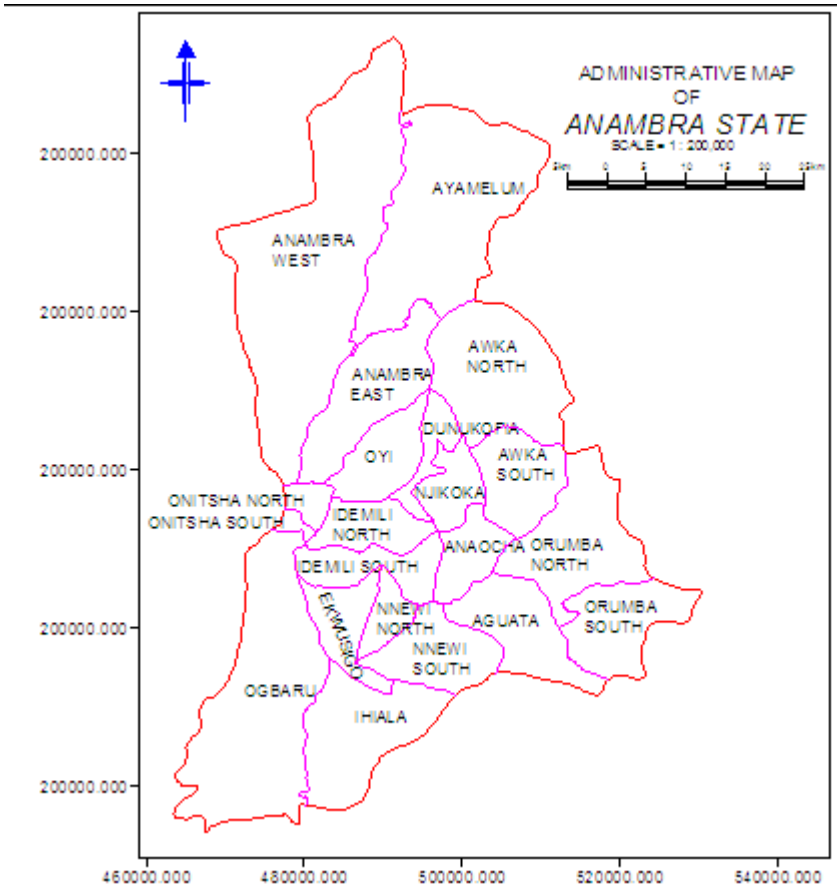

Fig. 1: Map of Anambra State with the SCT Controls

Anambra state is one of the South Eastern states of Nigeria (Fig. 1). The state lies between coordinates $6^{o}35'$E - $7^{o}30'$E and $5^{o}40'$N – $6^{o}48$N. It was created on 27 August 1991 and has an approximate area of 4,844 km^2 (1,870.3 sq mi). Based on 2006 population census, it has a population of about 4,055,048. Records of the local Agro-Meteorological records since 1987, shows that the average humidity of the area is 80%, with Mean Daily Temperature of 27^{o}C and Mean Annual Rainfall of 200cm. In the wisdom of the State Administration at inception, lots of projects were commissioned, with the establishment of the State Capital Territory GPS Controls, numbering forty seven, as one of them. This was done in order to unify the surveys, for proper planning and development of the new Awka Capital territory and in order to ensure orderliness that will propel sustainable development in the capital territory. Geodetic surveys were carried out to establish geodetic controls to which every survey activity in the state was to be tied to. The importance of these controls cannot be over emphasized since all survey activities were to be connected or tied to them. This is because for any survey work to be valid, it has to be connected to already existing or established control points, which are parts of a network of controls and must have been tied to a more accurate and sensitive network of geodetic controls (Onwuzuligbo, 2008). These controls were established in 1992 (Fig. 2) and have been useful to the surveyors in the state and the development in the state by extension, but it is very essential to carry out this study to evaluate the existence and services of these controls in the state capital territory for twenty one years after the establishment.

2. NEED FOR THE EVALUATION OF THE NETWORK

One of the major principles in surveying is the principle of 'working from whole to part'. This principle simply indicates that all surveys must be connected to an already existing survey which forms a part of a network of controls of a higher order. Also, the principle of propagation of error indicates that if the field measurement have errors, then it is inevitable that the quantities computed from them will have errors (Mikhail and Gracie, 1981). It therefore implies that whereas the surveys in the state are connected to a network of controls, care should be taken not to be connecting field observations to controls that are deficient. Furthermore, if these controls or even their network gets tampered with and is not adjusted and fixed, then the surveys connected to the controls by extension becomes deficient and the effect of this can be detrimental to the rest of the developmental efforts in that locality as a whole.

This, therefore, makes it very necessary for the survey control networks to be evaluated from time to time, the controls themselves be visited and In-situ check ran in order to ascertain their physical conditions. It is in this vein that this research was carried out.

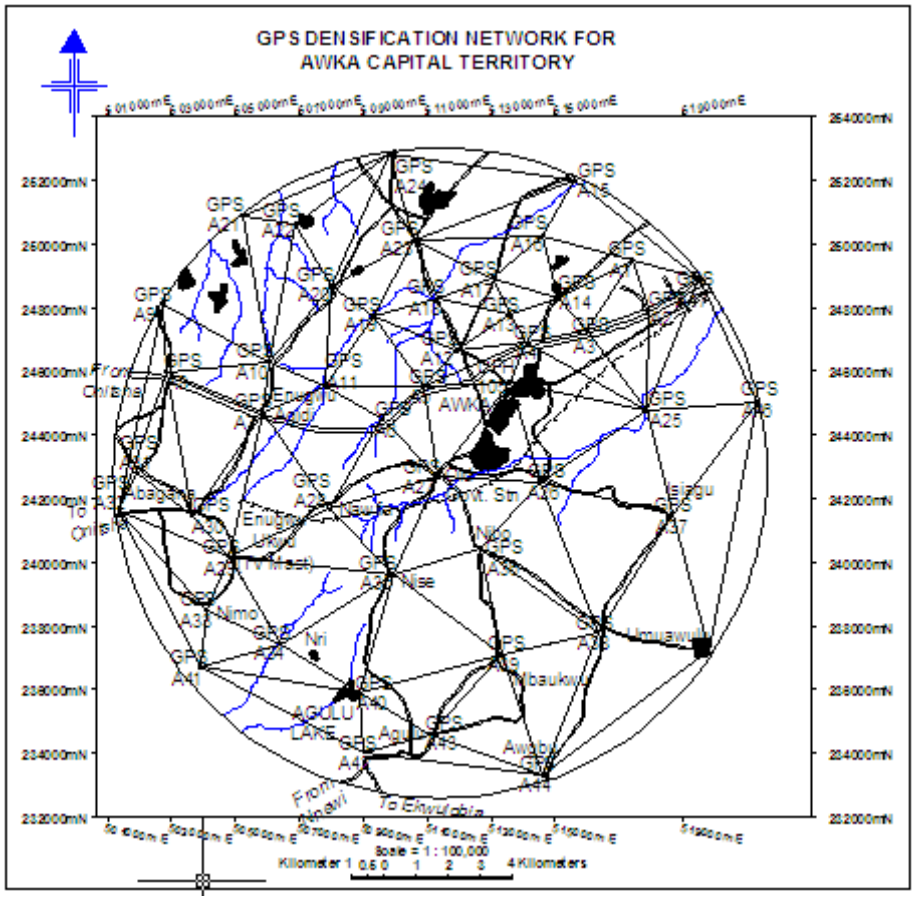

Fig. 2: Map of the Anambra State Capital Territory Showing the SCT Control Network

3. EVALUATION OF THE CONTROLS

In order to physically evaluate the network, the control points were visited, this was to ascertain the present physical condition of the controls. The Survey Department of the Ministry of Lands, Survey and Town Planning was visited and the officials interviewed in order to get abreast with the goings-on in the survey practice in the state.
A research carried out by Ono et.al. (2011) indicated that out of the thirty controls visited in 2008, only twelve of the controls were still in place. These controls were revisited to analyse their present condition. Typical among the visited controls were the eight (8) controls positioned along the Enugu-Onitsha Expressway. Out of the three controls confirmed to be existing by Onwuzuligbo (2008), none of the controls were found to be existing.
Also a visit to the Survey Department of the Ministry of Land, Survey and Town Planning in Awka, Anambra state indicated that these controls were destroyed mostly by different construction companies while embarking on different road projects. Also it was discovered that irrespective of the loss of the controls, that Practicing Surveyors still connect their surveys to these controls on paper. Also, it appeared that there is nothing being done about the loss of the controls. The status of some of the controls is as shown in Table 1 and Fig. 3.
In Fig. 3, the control monument is completely uprooted.

Table 1. Status of Some of the Visited Controls Stations

S/N	CONTROL POINT	STATUS (2008)	PRESENT STATUS (2012)	REMARK
1.	GPS A1	On ground though shifted	Uprooted and displaced completely	Needs to be re-established
2.	GPS A2	Not on ground	Not on ground	Needs to be re-established
3.	GPS A3	Fixed	Uprooted and displaced Completely	Replaced by another control from another Network
4.	GPS A4	Not on ground	Not on ground	Needs to be re-established
5.	GPS A5	Not on ground	Not on ground	Needs to be re-established
6.	GPS A6	Not on ground	Not on ground	Needs to be re-established
7.	GPS A7	Not on ground	Not on ground	Needs to be re-established
8.	GPS A8	Fixed	Not on ground	Needs to be re-established
9.	GPS A28	Fixed	On ground but Defaced	Needs to be Readjusted and Recapped
10.	GPS A35	Fixed	On ground but shifted	Needs to be re-established
11.	GPS A15	Fixed	Fixed	Needs to be readjusted
12.	GPS A16	Uprooted and Displaced Completely(fig 3)	Uprooted and Displaced Completely (fig 3)	Needs to be re-established.

13.	GPS A27	Uprooted and Displaced Completely	Uprooted and Displaced Completely	Needs to be re-established
14.	GPS A9	Fixed	Fixed	Needs to be readjusted
15.	GPS A29	Fixed	Fixed	Needs to be readjusted

Fig. 3: The Status of GPS A16 (Uprooted)

4. EFFECT OF THE STATE OF THE NETWORK

The shoddy state of the Anambra State Capital Territory Control Network has a major effect on the quality of surveys in the state. Owing to the costly nature of the Differential GPS, the Surveyors in the State resorted to the use of the Hand-Held GPS Receivers, most times not minding the attendant errors. The effect of this is that the reliability of the survey measurements is in doubt. It also implies that a proper charting of the cadastral survey plans submitted to the Survey Department of the State Ministry of Lands and Surveys and Town Planning exposed a whole lot of errors in these surveys. Landed properties were seen to overlap themselves and sometimes neighbouring land parcels were also seen to have spaces between them.

More technically, some of the surveyors and survey assistants do not understand the dynamism of the ellipsoidal datum as configured in the GPS receiver. Nigeria uses the Minna datum which is based on the Clarke 1880 ellipsoid. Some GPS receivers have the capability of supplying positional values in this system, but needs to be configured first. Also, an on-

going research is trying to ascertain the accuracy level of coordinate transformation done by the GPS receivers as against that of some software and programs. As indicated by International Association of Oil and Gas Producers (OGP) (2008), although the WGS 84 and ED 50 coordinates of the Effiel Tower share the exact same latitude and longitude values (48°51’29’’N, 2°17’40’’E), they do not represent the same physical point on the earth’s surface (the yellow dot representing the correct location) as shown in figure 4.
Comparing the difference between the WGS 84 coordinate and the Clarke 1880 coordinates, using the same coordinate values, it was discovered that their physical locations differ by 55meters on the average. It is as a result of this that one cannot depend solely on the use of the hand-held GPS receivers without properly educating the users through training and retraining from time to time.
Furthermore, the poor state of this network goes a long way to affect the development in the State Capital Territory. Since survey is the first operation in every development, then it is pertinent to note that if the quality of the survey is in doubt, then the inherent errors in that survey measurement will be transferred to the design and implementation stages of the developmental project thereby hampering sustainable development. This is very evident in the fact that there are disparate surveys and survey products. Also the planning of the capital territory has been disregarded and no specific model is being adopted.

Fig. 4: Difference in Position with Respect to Datum.Source: OGP (2008)

Because this control network established for the planning of the SCT is in a devastated condition; surveys carried out are not connected to approved national origin; individual and families demarcate and mortgage landed properties without regards to approved schemes; and buildings are erected with clear disregard to any development control regulations. Hence, Slums are being created and therefore giving no sustainable future to the capital territory.

5. CONCLUSION

The establishment of the Anambra State Capital Territory Control Network was a good step in the right direction. The network as shown in Figure 2 effectively covers the ten kilometre (10km) radius Capital Territory. These controls have been very useful and improved the accuracy of the surveys carried out within the territory, till recently when a review indicated that most of the controls in this network were destroyed. Since the network directly affects the quality of the survey measurements, it can be said that the poor state of the controls as exposed by this evaluation is an indication that the quality of the survey operations is non-satisfactory.

Even so, it was evident that the level of education among Practising Surveyors in the state as regards the use of the GPS is poor as some of them mix up the datums. Furthermore, some use the device in user grid mode giving rise to rectangular coordinates notwithstanding the fact that the hand-held GPS does not display the decimal part of the Eastings and Northings. This therefore introduces a great deal of error in to the measurement.

6. RECOMMENDATION

Having looked at the present state of the control network under review, it is very vital to state the following recommendations:

i. All stakeholders (Nigerian Institution of Surveyors, State Ethics Committee of Surveyors Council of Nigeria, Office of the Surveyor General, the State Government, etc) should initiate effort to re-establish the controls as this will improve the quality of survey in the State.

ii. For some of the control stations that are situated in positions that are vulnerable and can be easily destroyed, the geodetic controls should be repositioned to prevent destruction in future.

iii. A law should be enacted by the State Legislature, with necessary penalty, to protect the indiscriminate destruction of geodetic controls and the re-establishment of the controls when accidentally destroyed.

iv. The government should strongly cause the Awka Capital Territory Development Authority (ACTDA) to take-off for the orderliness, consistent and sustainable development of the capital territory and also to make the defaulters and destroyers of geodetic controls to face the law.

v. The public should continuously be sensitized on the importance of the geodetic controls and the dangers of their destruction.

vi. Further, people should make use of Survey and Survey Products and comply to the development control regulations.

vii. Now that almost ¾ of the geodetic control points are not physically in-situ, the State Survey should immediately embark on re-establishment and re-observation of these points.

viii. The government should urgently implement the master plan for Awka Capital Territory if any, and stop developing slums and defeating all principles of sustainable development.

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