APPLICATIONS OF GEOINFORMATICS AND MAPPING IN THE DEVELOPMENT OF DIVINE HECTARES ESTATE AT ENUGU LIFESTYLE AND GOLF CITY, NIGERIA.

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SUMMARY

Geoinformatics and mapping are the bedrocks and foundations of every sustainable development; the role of Geoinformatics and mapping in real estate development cannot be overemphasised. The Real Estate sectoris one of the most stable and reliableramifications ofthe Nigerian Economy despite the retrogressionin the value of the Nigerian currency against the dollar.In recent times, studies have shown that the real estate sector in Nigeria has evolved into a huge economic hub where investors feel safe. Despite the profuse evolution in the Nigerian real estate and housing sector, statistics still show that there is still insufficient housing for the growing population of the middle class and the low income earners in Nigeria; Thus the need for more low cost housing over luxury housing.These trendsinformed the decision of the management of Geo-squaremeter Innovative Limited to develop the Divine Hectares Estate. The estate is developed on approximately 6.9Hectares of land. The land was parcellated into parcels of approximately 500sqrm each to suit the needs ofthe Nigerian middle class; and the whole estate is about 106 parcels. This paper is aninquiry into the Geoinformatics and mapping inputs in the processes and stages of the development of the Divine Hectares Estate. The studyalso looked into ramifications of survey works carried out at different development stages in the estate, therein;the engineering survey challenges and the laying out of the estate were discussed as well as recommendations which were made for future surveys in estate developments and further studies.

Keywords: Divine Hectares Estate, Mapping, Geoinformatics, Real Estate Development, Construction Economy.

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1.0 INTRODUCTION

Surveying is the technique, profession, act and science of determining the terrestrial or three-dimensional positions of points and the distances and angles between them. (FIG General Assembly, 2004). Surveying also involves plotting the survey information to scale on a map, plan, chart or a computer.

Geoinformatics is the science and the technology which develops and uses information science infrastructure to address the problems of Surveying, cartography, geosciences and related branches of science and engineering. It has been described as "the science and technology dealing with the structure and character of spatial information,its capture,its classification and qualification, its storage, processing, portrayal and dissemination (Roy 2007).Mapping, on the other hand, is best understood as the creation of maps to scale through a branch of surveying called cartography. It is a graphic and symbolic representation of the significant features of a part of the surface of the Earth to scale on a map.

Real estate is property consisting of land and the buildings on it, along with its natural resources such as crops, minerals or water; immovable property of this nature; an interest vested in this (also) an item of real property, (more generally) buildings or housing in general. The business of real estate entails the profession of developing, buying, selling, or renting land, buildings, or housing. The real estate market in Nigeria has metamorphosed into a very robust hub; this is as a result of emerging technological trends in Geoinformatics, mapping, engineering and online marketing; as a result, Geoinformatics and mapping, have opened up series of opportunities for practitioners to explore in other sister professions.

Herein, the authors, who are surveyors, tried to give an insight to the function of a surveyor and the application of Geoinformatics and Mapping in the development of Divine Hectares Estate.These applications include, but are not limited to, reconnaissance, perimeter and detail surveys, topographic surveys, estate layout design, parcellation survey/ setting out of estate layout design, route surveys, and buildings setting out.

2.0 STUDY AREA

Divine Hectares Estate is Located within Enugu Lifestyle and Golf City, Nigeria. It is located around Kilometre 7, Enugu-Portharcourt Express Road, It lies within longitudes 7^0 31' 46.7"E - 7^0 31' 48.1"E and latitudes 6^0 23' 14.9"N - 6^0 23' 3.6"N. its area is about 6.99 Hectares.Enugu Lifestyle & Golf City is arguably one of the most beautifully planned cities in Nigeria. It is set on 1,065 hectares of lush green savannah in Enugu. It is designed around the style and comforts offered by the most advanced cities whilst retaining broad African influences (ELGCPE, 2017).
Enugu is the capital of Enugu State in Nigeria. It is located in south-eastern Nigeria. The city had a population of 722,664 according to the 2006 Nigerian census. The name Enugu is derived from the two Igbo words ÉnúỤgwụ meaning "hill top" denoting the city's hilly geography. (Duckworth, 1961).

Owing to the generally hilly terrain of Enugu, the Estate is gradually sloppy with elevations ranging between 183m to 194m above the sea level. The site is about 6.99Hectares. See the figure below for the location of the study area.

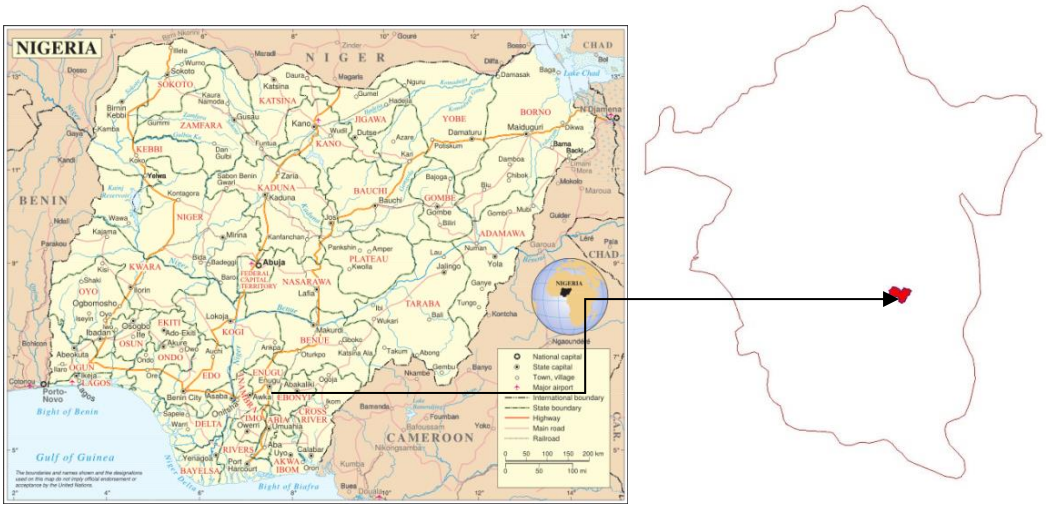

Figure 1.0.The location of Divine Hectares Estate in Nigeria.

3.0 SURVEYING EQUIPMENTS USED

The following Surveying Equipments were used in the course of this study**;**

1. Hi – Target Dual Frequency Global Positioning System (DGPS) V30
2. Garmin Handheld GPS78SC
3. Hi – Target Total Station ZTS–320R

4. METHODOLOGY

Surveying, Geoinformatics and mapping are in phases as well as estate development. The figure below shows the stages/phases of the development of the Estate and the Geoinformatics methods applied.

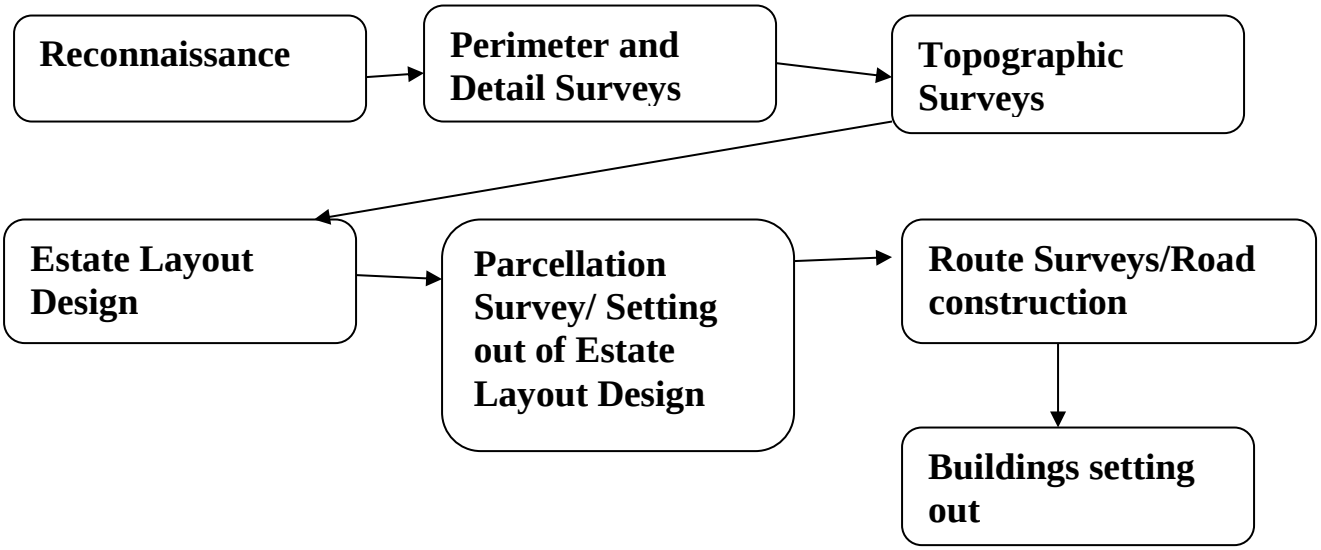

Figure 2.0.A flow chart showing the stages of the methodology of the development

4.1 Reconnaissance

The relevance of reconnaissance surveys cannot be underestimated. It is done as a preliminary survey in order to note some salient and pertinent physical features in the site, this includes its topography, permanent natural or manmade features. In the past decades, reconnaissance surveys were done with a compass, recee field sheets and drawing materials. In this study, the recee started by a site visit and using a hand held GNSS receiver to take position of salient features, then the coordinates of the features were plotted on satellite imageries downloaded from Google earth. These guided the company in choosing the best suiting location within the centenary city to site the Estate project.

Figure 3.0 Google Earth Satellite Image of Divine Hectares Estate

4.2 Perimeter and Detail Surveys

Perimeter survey is a form of cadastral surveying whereby the defined boundary of the property is marked with permanent concrete beacons, measurements are taken and plotted in order to produce a registerable cadastral instrument. Detail survey is the survey of the positions of permanent natural features within a cadastral boundary. In this study, the perimeter survey and the detail surveys, fig 4.0, were done simultaneously. The boundary of the acquired land was first defined with concrete beacons, and then the beacons were capped by imprinting the unique number obtained from the office of the state Surveyor General for the beacons on a concrete mix emplaced on the beacons. After capping the beacons, the Hi-Target differential GNSS equipment was used on a Real Time Kinematic (RTK) mode to observe the capped beacons.

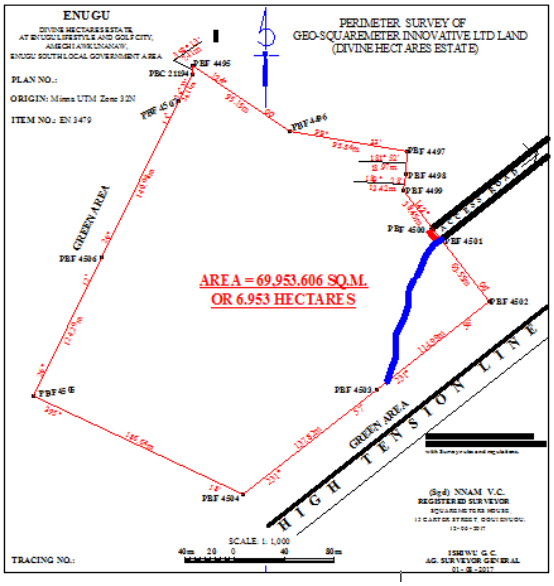

Figure 4.0 Plan Shewing the Perimeter and detail Survey of the Study Area.

4.3 Topographic Surveys

Topographic survey is a very vital survey in engineering and construction. In this study, because of the ruggedity of the terrain, a topographic survey was painstakingly done using a Hi-Target total station. The spot heights were taken in a grid of 5mX5m; this interval was used in order to get more graphic details of the terrain. The spot heights were downloaded into the system and plotted using AutoCAD Land Development, as seen in fig 5.0 and also global mapper software shown in fig 6.0. The results were saved in AutoCAD format for the Use of the surveyors and town planners.

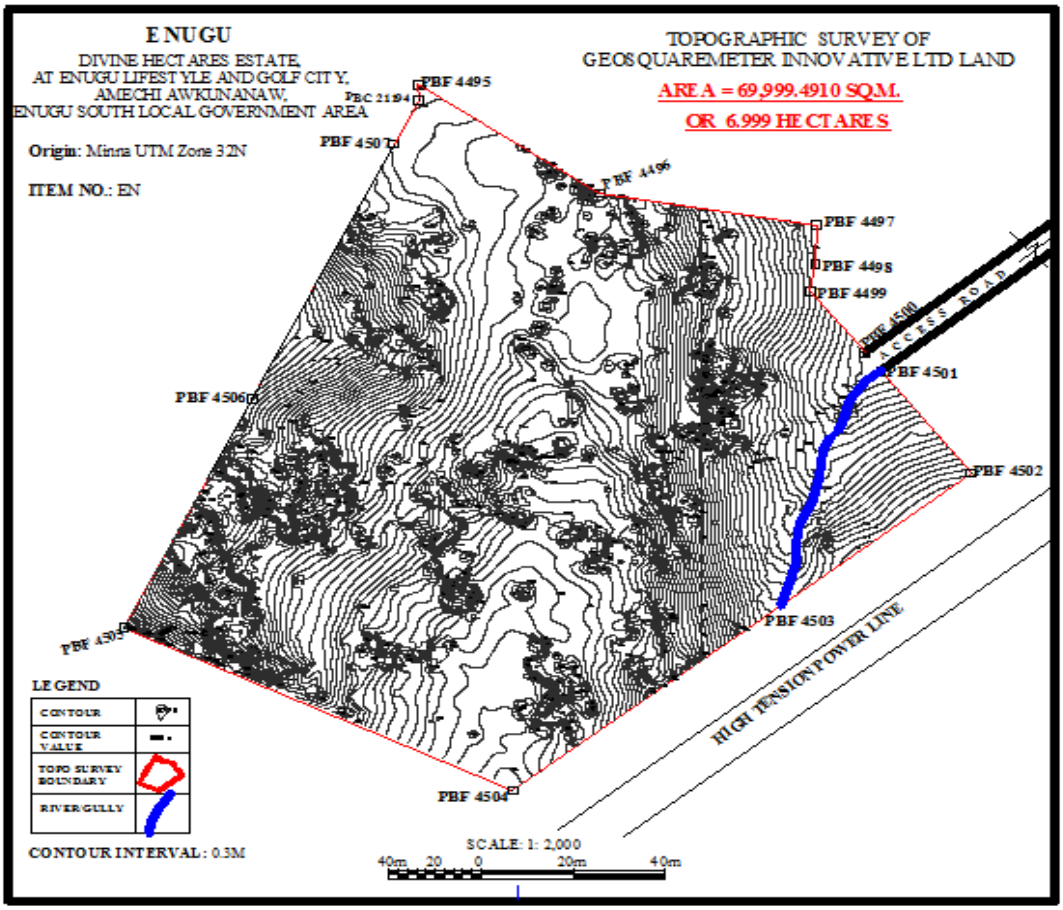

Figure 5.0: Topographic and Detail Survey of Divine Hectares Estate in CAD format

The spot heights were later exported through spreadsheet into global mapper software, an application specially designed for the analyses and interoperation of geoinformation in three dimensions. The software displayed the three dimensional illustration of the terrain of the study area. This information helped the planners to make informed decisions about routes and drains.

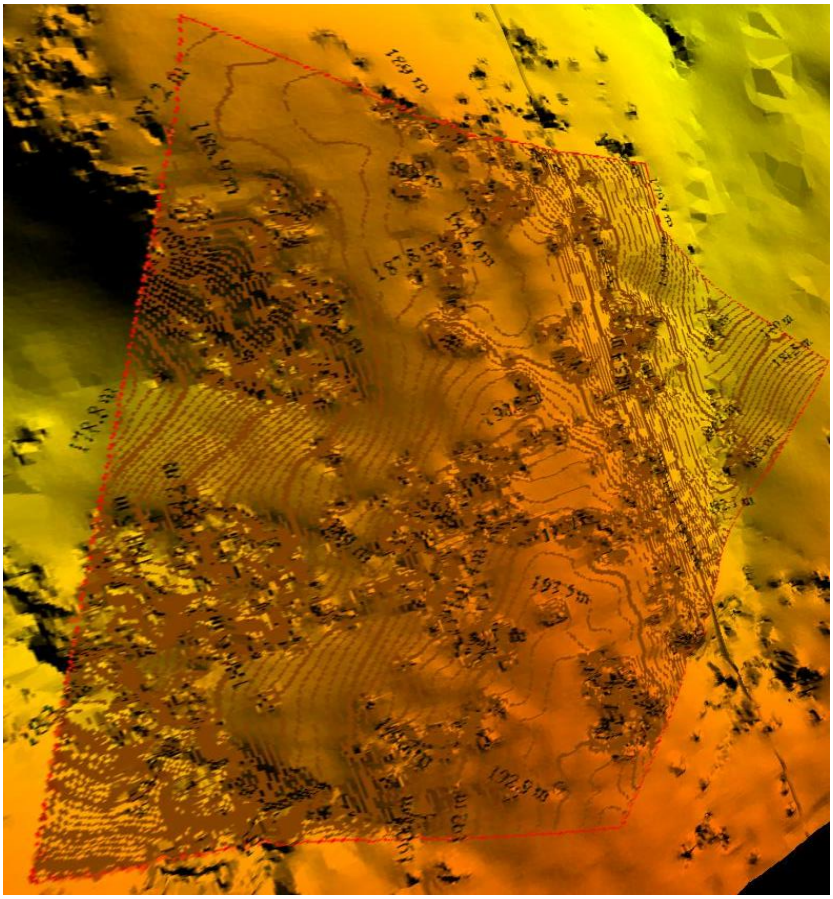

Figure 6.0: The 3D topographic survey in Global mapper environment.

4.4 Estate Layout Design

The perimeter, detail and topographic surveys were handed over to a Licensed Town Planner in an AutoCAD format for designing, planning and scheming. The estate was planned as a medium density housing community for the Nigerian middle class. The plots were designed to the area of approximately 500sqrm. It was designed with amenities such as security house, shopping centre, clinic, volley/basket ball court, car wash, refuse dumpsites, electric transformer point, etc. All the professional planning codes were observed in order to deliver a functional housing estate. The town planner delivered his work in a CAD format.

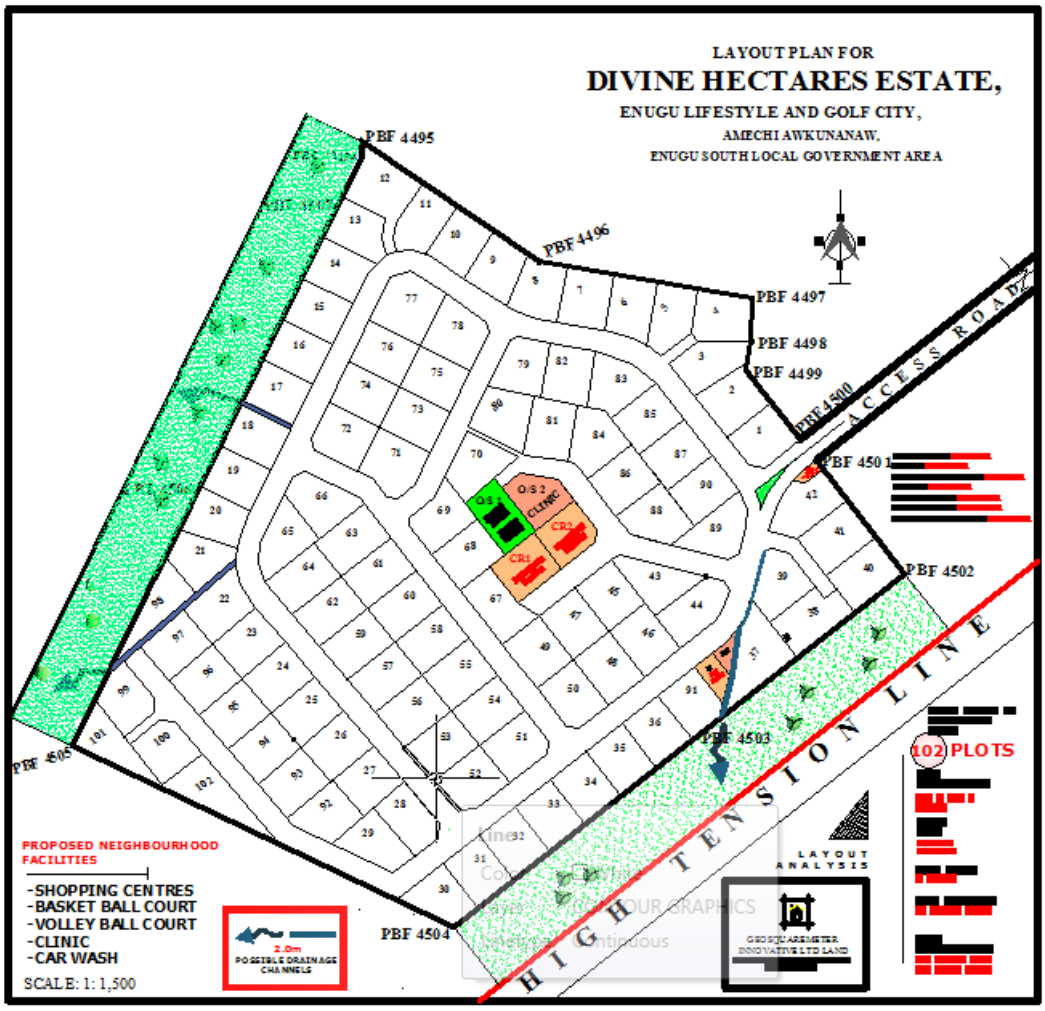

Figure 7.0 Estate Town Planning Design of Divine Hectares Estate

4.5 Parcellation Survey/ Setting out of Estate Layout Design

Parcellation surveys are carried out in order to subdivide a property into cadastral parcels which shall be registerable with their unique identifiers. When the Layout design of the estate was received from the town planners, the design was first edited to survey format, and then point features and line features were created. Beacons were numbered on the computer, and then the survey points were extracted with the beacon numbers as unique identifiers and exported to spreadsheet format. The spread sheet (.csv) data sets were uploaded into Hi-target differential GNSS equipment for setting out. The setting out was the done with the GNSS equipment on Real

Time Kinematic (RTK) mode. The beacons were buried as the points were being set out, they were also capped and numbered after being buried, as shown in figure 7.

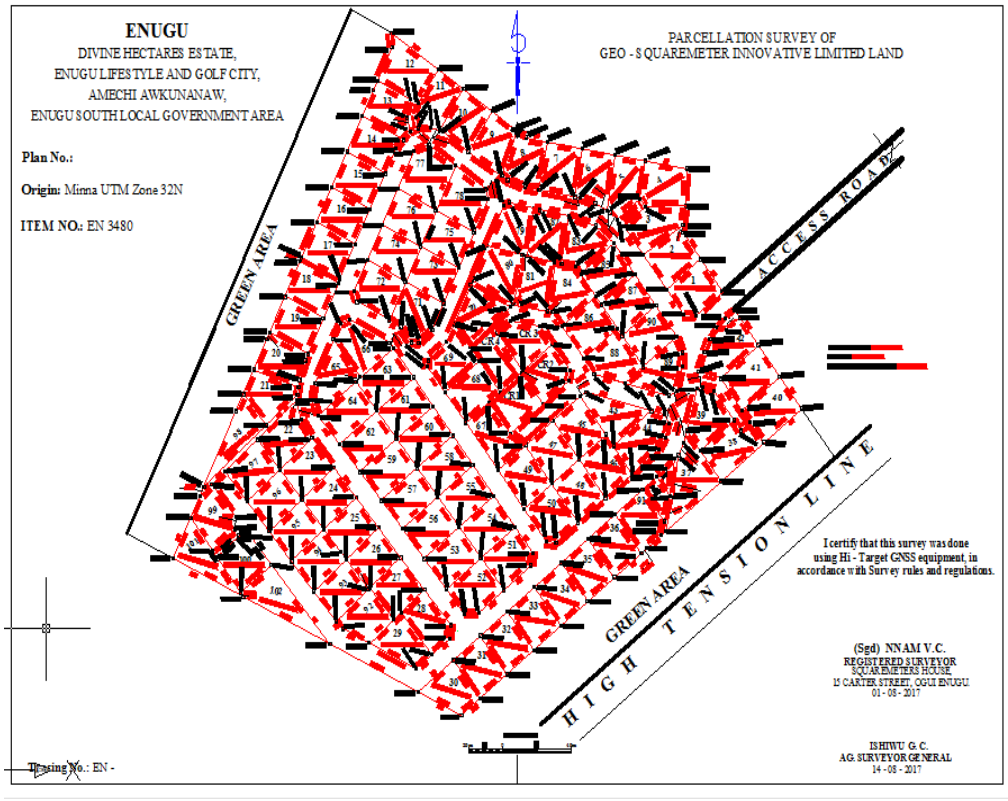

Figure 7.0 Layout Survey Plan of Divine Hectares Estate

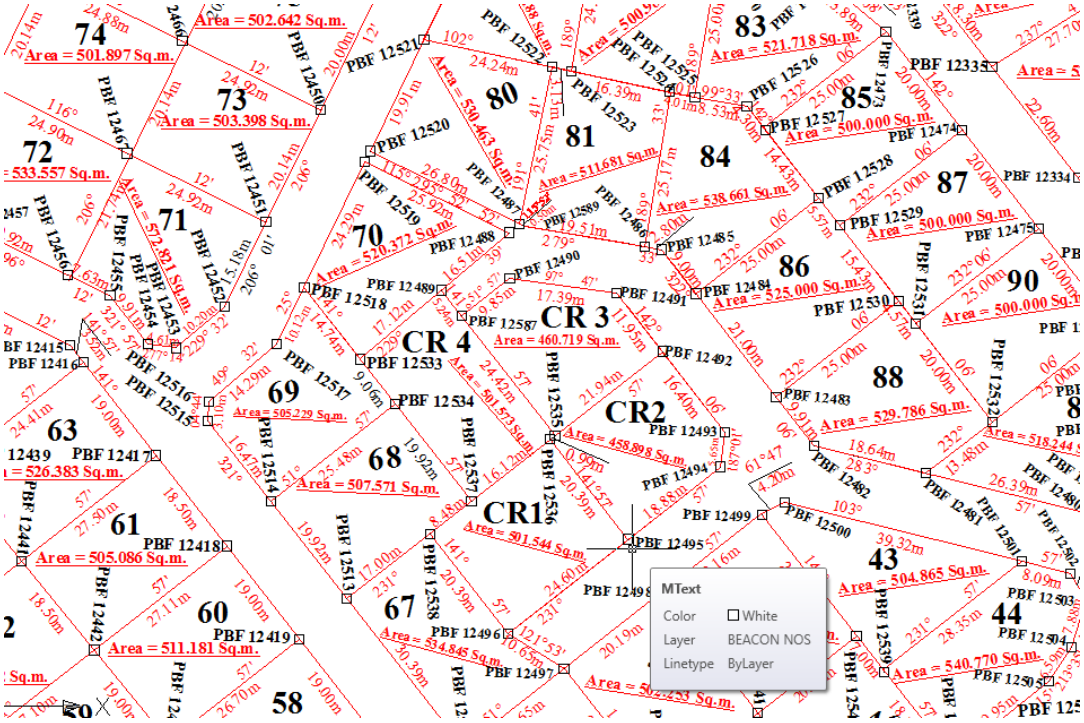

Figure 8.0: A section/window showing the details in the layout survey planof the study area.

4.6 Route Surveys

After the parcellation surveys, boundaries of plots were defined and the routes were clear.The beacon points along the routes were flagged with red ribbons; this helped the route surveyors to be properly guided on the route boundaries. The centre lines of the routes were marked at 10m chainages and the route plan was surveyed along the centre lines; the longitudinal section profiles were carried out in 10m chainages while the cross sections were carried out in 2.5m intervals. A Hi – Target Total Station ZTS–320R used in carrying out the route surveys.
As shown in figures 9, 10, and 11, the results of the route surveys were used by the civil engineers to design the roads.

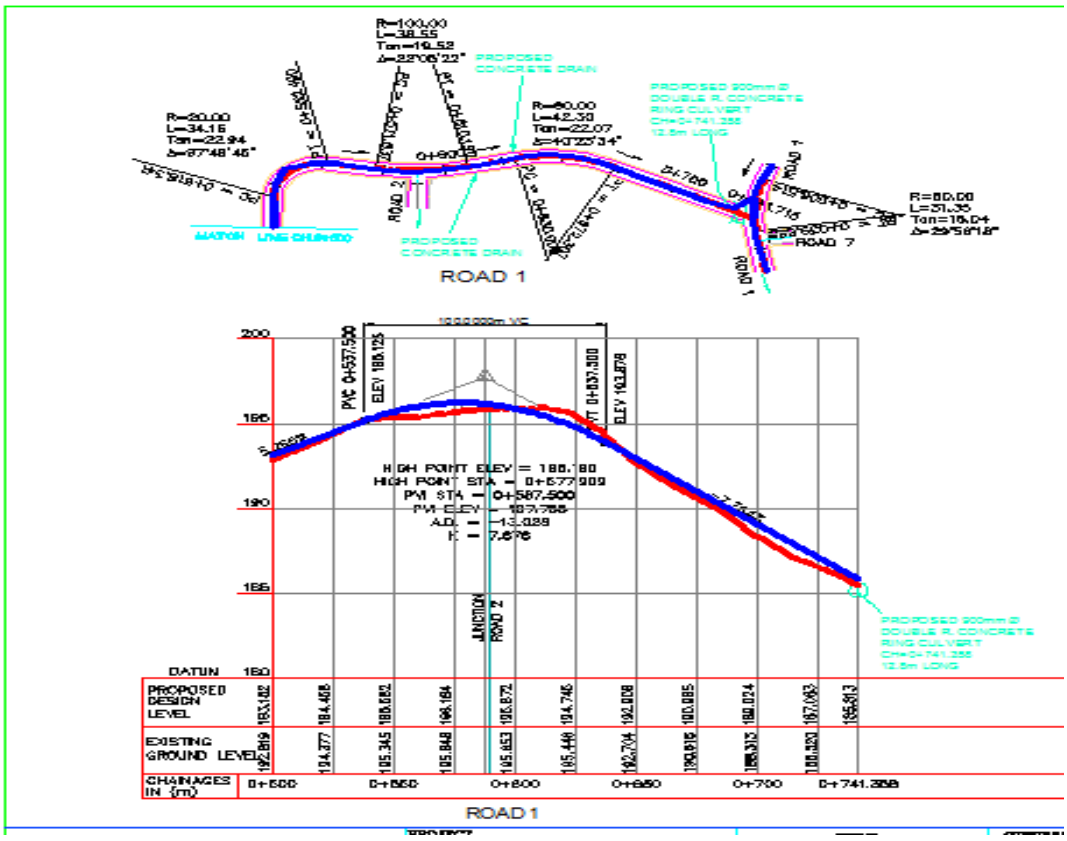

Figure 9.0: Route Plan and Profile of part of Divine Hectares Estate. The red line shows the natural profile while the blue line shows the design profile.

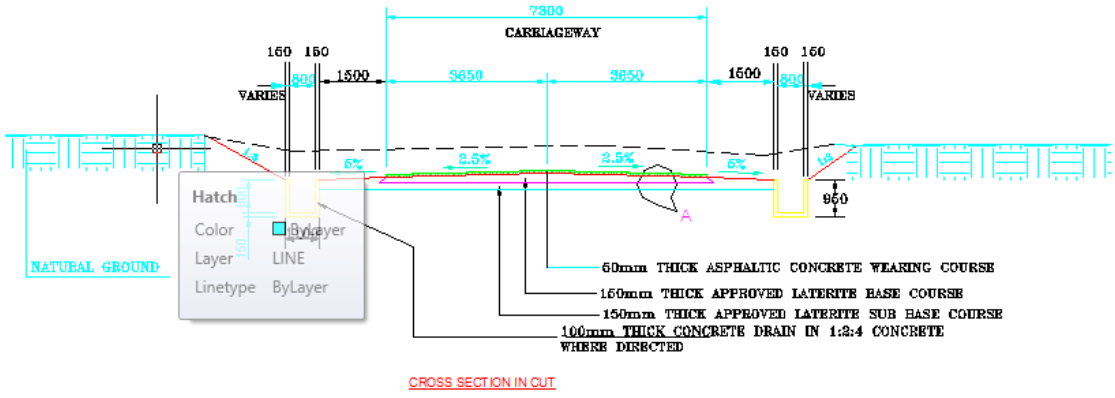

Figure 10.0 Natural and design route cross section of part of Divine Hectares Estate. The red line is the designed surface while the dotted line is the natural surface.

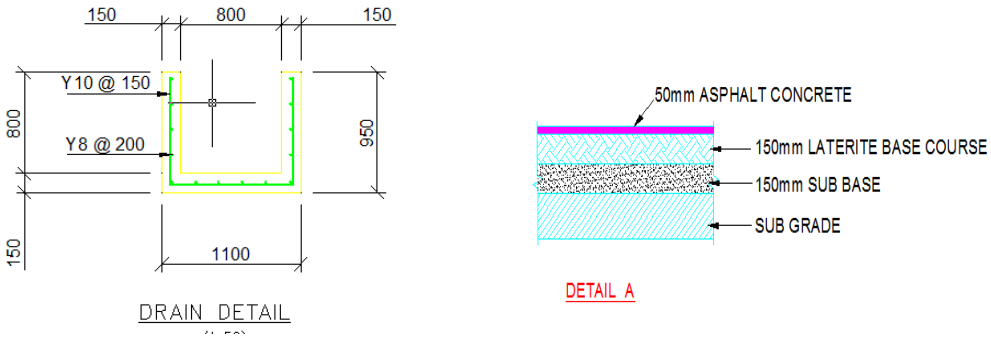

Figure 11.0 Designed Drain Detail and Roads finishing details for part of Divine Hectares Estate

4.7 Buildings setting out

After the route construction, the building prototype design was received from the architects in CAD format; it was digitally interoperated with the estate geodatabase which contains all details in CAD format. In the CAD environment, the building design was fixed in each parcel, adjusted and rotated to face the road since all plots are not of the same orientation. Point and line features were created on the building corner points and their coordinates extracted into a spread sheet (.csv) formats. The building point coordinates were uploaded into the total station and were set out.

During construction, the building point's coordinates were used in monitoring the development to ensure compliance with the design. Figure 12.0 depicts the details for one of the plots.

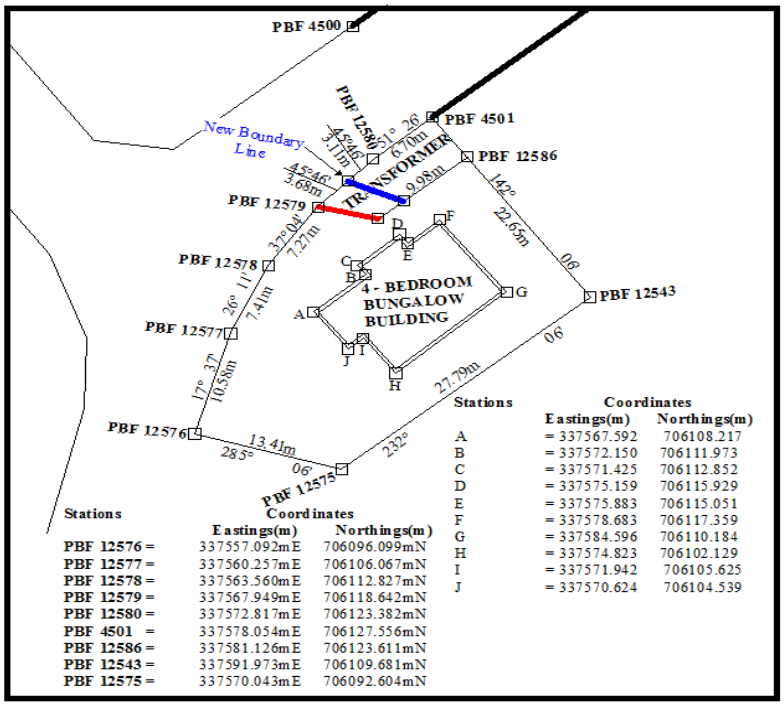

Figure 12.0 Building setting out details for Plot 44, Divine Hectares Estate.

4.0 GEOINFORMATION INPUTS

The authors have been able to showcase the relevance of Geoinformatics and Mapping in real estate development, using Divine Hectares Estate as a case study. The digital method of reconnaissance survey demonstrated a lot of advantages over the old analogue methods; it was faster and gave more reliable information which aided in informed decision making towards the project. Because of the Hi-Target Differential GNSS equipment used in the perimeter survey, it was faster, more accurate and more reliable than traditional methods of traversing. The Differential GNSS equipment on a rapid survey (RTK) mode facilitated the speed of the detailing. The perimeter survey plan provided a ready instrument for the registration of the land and layout design.

Mapping possibilities were showcased in the topographic survey Phase. It was required in order to present an optical presentation of the terrain of the study area. It gave a clear picture of the areas to be cut and that to be filled. With the Perimeter, Detail and topographic surveys, the Town Planner was able to do an exquisite design of the Estate. This designing was easy because of the Geoinformation form in which survey data were convertible and usable by the Town planner. Analogue data would have been more tedious and time consuming for them.

After the Estate Layout Design, since the design were in digital form, it was easy to convert point data to coordinates and extract the coordinates into a total station for setting out. Thus the whole estate layout was set out.

Because the Estate Layout is set out and marked with beacons and metal pegs, it was easy to run the route survey. The results of the route survey were a plan, a longitudinal and a cross section. The results of the route survey were submitted to a consultant Civil Engineer for route design. The route wasproperly designed for the construction economy of the project. The cut and fill volume was determined based on the difference between the natural route surface and the designed route surface.

The settings out and monitoring of the building were the last stages. This was easy and fast because of the data interoperability between the building design and the layout design. The building points were simply converted to coordinates and uploaded to a total station, the same uploaded coordinated were used in monitoring the building during construction.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In conclusion, metamorphosis is a virtue for adaptation in flora and fauna; the ones who do not change, improve or adapt to a constantly changing weather die off in the times of adverse weather. This is applicable in the realm of professionalism, professionals who do not update and improve in this fast and constantly changing digital world may lose relevance in the near future. Digital possibilities have metamorphosed the surveying, Geoinformatics, geomantic and mapping profession from taking and plotting measurement to managing, analysing and interoperating geoinformation.

This study has been able to depict the application of Geoinformatics and mapping in the development of Divine Hectares Estate in its entire ramification. It is also evident from this study, that the surveyor is meant to be part of the entire processes of the estate development. This is against the backdrop of just carrying out the cadastral survey, setting out of the layout plan and disappears in to the thin air. This paper demonstrated the position of the authors on what the application of Geoinformatics and Mapping in real estate development should be. These applications include which are data acquisition and capture, processing, manipulation, interoperation and management. Design implementation and monitoring are also one of the vital roles surveyors play in real estate development.

5.2 Recommendations

From what has been realised in this study, the following are strongly recommended;

1. From the foregoing, it is crystal clear how important Geoinformatics and Mapping are in real estate development, the undergraduate Surveying academic curriculums in Nigeria needs a review in order to incorporate more recent digital methods of surveying as well as service courses to improve the knowledge base of the graduate surveyors and make their skills robust for a constantly changing labour market.
2. The survey communities in different countries needs to influence legislations which will give surveyors more edge in real estate projects, this is because, real estate developers cannot do without surveyors.
3. Survey practitioners in Nigeria are advised to develop competence and proficiency in other ramifications of the profession outside cadastral surveying.
4. Surveyors are encouraged in engage themselves in more training and personal development in order to meet up to the continuously emerging trends in technology in order to gain competitive advantages over other professionals and quacks.
5. It is highly recommended that Survey firms and professionals develop a synergetic relationship with Real Estate developers and other professionals in order to fully harness the potentials this industry possesses.

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