PROJECT REPORT

ON

DIGITAL MAPPING OF INFRASTRUCTURAL FACILITIES OF PART OF ROYAL VALLEY ESTATE

AT KULENDE / AKEREBIATA ROAD, SANGO, ILORIN

ILORIN EAST LOCAL GOVERNMENT AREA

KWARA STATE

BY

POPOOLA BLESSING

HND/23/SGI/FT/0094

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF HIGHER NATIONAL DIPLOMA IN SURVEYING AND GEO-INFORMATICS TO THE DEPARTMENT OF SURVEYING AND GEO-INFORMATICS, KWARA STATE POLYTECHNIC ILORIN, KWARA STATE

JUNE, 2025

CERTIFICATION

This is to certify that the research work carried out by **POPOOLA BLESSING** with matriculation number **HND/23/SGI/FT/0094** in accordance with survey law's and departmental instructions.

…………………………….. **……………………………**

Surv. R. S. Awoleye **Signature &Date**

Supervisor

…………………………….. **……………………….**

Surv. R. S. Awoleye **Signature &Date**

Project coordinator

…………………………….. **…………………………….**

MR. I. I. Abimbola **Signature &Date**

Head of Department

DECLARATION

I hereby conclude that I **POPOOLA BLESSING** with matriculation number **HND/23/SGI/FT/ 0094** fully participated on this project and acquired more experience about Digital surfacing modelling.

NAME OF STUDENT: POPOOLA BLESSING

STUDENT SIGNATURE: …………………………………………………………………….

DATE: ………………………………………………………………………………………….

DEDICATION

This project is dedicated to Almighty God for His goodness endures forever, for His wisdom, knowledge and understanding for the completion of the project.

ACKNOWLEDGEMENT

My great appreciation goes to God almighty my Maker, The Alpha and Omega who has given me the rare opportunity to be among the living souls.

I am also grateful and thankful to my supervisor surv. R. S Awoleye for his wonderful assistance and contributions despite his tight schedules, he still finds time to attend to me.

To my lecturers people of selfless interest thank you so much Surv. R . O Asonibare, Surv A. G Aremu, Surv. Abdulsalam, Surv. kabir ,Mr Abimbola Isaau, Surv. Baniji and Surv. R. S Awoleye l pray God almighty will be and abide with you and your families forever.

I will be ungrateful If fail to appreciate the efforts and labour of my irreplaceable, amazing, and supportive parents Dn and Mrs POPOOLA, for your parental care and support since the inception of my educational carrier, you stood by me when things were tough and rough for me, you gave me hope when others mock me, I will forever love and cherish you. You shall reap the fruit of your labourijn. AMEN

To my amazing and lovely siblings Popoola Theophilus olamilekan, Popoola Precious David and Popoola mayokunNoami I love you so much. Thanks for being amazing and supportive blood.

To my wonderful sister MrsOyunwola Emily Christiana Thanks for all you do ma

I really appreciate your support and advice.

To my BSF family Bro Reuben, Sis opeyemi and Bro Samson Ayomide and everyone who has make an impact in the journey of my academics I really appreciate you all thank you so much.

To my coursemates and project mates thank you so much. I really appreciate your your support and advice.

MAY GOD ALMIGHTY BLESS YOU AND REWARD YOU ALL IJN (AMEN)

ABSTRACT

This paper shows a detailed methodology for creating 2D and 3D visual facility map of the campus. The purpose of this study work is to develop an interactive interface containing the 2 and 3-Dimensional features of all the facilities within the Royal Valley Estate. The spatial attributes of the facilities were collected with the aid of total stations. The most recent Google earth software was used as source of data to produce 2-dimensional facilities of the study area through digitization process. SRTM Digital elevation model image was downloaded from United State Geological Survey website to give the elevation data required for the 3-dimensional representation. All these data were processed with ArcGIS 10.2.1.

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CHAPTER ONE

1.0 INTRODUCTION

Infrastructural development is a cornerstone of economic growth and societal well-being. From transportation systems and energy supply to healthcare, education, and communication networks, the availability and quality of infrastructure significantly influence national development indicators. In recent years, the need for efficient planning, management, and monitoring of infrastructural facilities has become increasingly urgent, especially in the face of rapid urbanization, climate change, and growing population demands.

Traditional methods of infrastructure inventory and planning, which often rely on manual mapping, paper-based records, and sporadic field surveys, are increasingly proving inadequate. These methods are time-consuming, prone to errors, and difficult to update or integrate with other data sources. Consequently, they limit the ability of decision-makers to respond effectively to infrastructural needs, plan future expansions, or manage existing assets efficiently.

The integration of digital technologies into spatial data management has given rise to a powerful tool: digital mapping. Digital mapping involves the use of Geographic Information Systems (GIS), Remote Sensing (RS), and Global Positioning Systems (GPS) to capture, store, analyze, and visualize geospatial data in a dynamic, interactive format. Through these tools, infrastructural facilities can be accurately mapped, monitored, and analyzed across time and space, enabling more precise and data-driven decision-making processes.

Digital mapping not only enhances planning and monitoring, but also supports transparency, citizen participation, disaster response, and sustainable development. For instance, governments can use digital maps to identify areas lacking basic amenities, monitor maintenance needs, or track infrastructure expansion projects. NGOs and researchers can leverage digital maps for advocacy and policy analysis. In disaster-prone areas, emergency response teams can use real-time infrastructure maps to prioritize rescue operations and resource allocation.

Despite the potential benefits, the adoption of digital mapping in many regions, especially in developing countries, remains limited. Challenges such as lack of technical capacity, high implementation costs, weak institutional support, and poor data sharing frameworks continue to hinder widespread use. Addressing these barriers requires a deeper understanding of the technology, its applications, and its relevance to local and national development agendas.

This study, therefore, explores the concept, tools, and practical applications of digital mapping in the context of infrastructural facilities. It aims to assess the current practices, evaluate the benefits and limitations of digital mapping, and propose strategies to improve its implementation for sustainable infrastructure management. The study ultimately seeks to demonstrate how digital mapping can serve as a catalyst for more inclusive, efficient, and informed infrastructural development planning.

1.1 BACKGROUND TO THE STUDY

Infrastructural facilities such as roads, water supply networks, electricity grids, health centers, schools, and communication systems form the backbone of socioeconomic development in any society. Accurate, up-to-date, and accessible information about these facilities is crucial for effective planning, resource allocation, maintenance, and emergency response. Traditionally, data on infrastructure has been collected and managed manually, often resulting in outdated, fragmented, and inefficient records that hinder decision-making and development efforts.

The advent of digital mapping technologies—powered by Geographic Information Systems (GIS), Remote Sensing, and Global Positioning Systems (GPS)—has revolutionized how spatial data is collected, analyzed, and visualized. Digital mapping allows for the creation of detailed, accurate, and interactive maps that can be easily updated and shared across various platforms. This technological shift has opened new possibilities for urban planning, rural development, disaster management, and infrastructure monitoring.

Digital mapping of infrastructural facilities not only enhances transparency and accountability in public infrastructure projects but also supports evidence-based policy formulation. By integrating various data layers, planners and decision-makers can identify gaps in infrastructure, assess the quality and accessibility of services, and prioritize investment areas more effectively. Furthermore, digital maps provide valuable tools for communities, researchers, and NGOs working towards sustainable development goals.

Despite its benefits, the implementation of digital mapping in many regions, particularly in developing countries, remains limited due to challenges such as lack of technical expertise, inadequate funding, and weak institutional frameworks. This study seeks to explore the role, process, and impact of digital mapping in infrastructural development, highlighting its potential to transform planning and governance practices.

Infrastructure is widely recognized as a fundamental pillar of national development, directly influencing the quality of life, economic productivity, and social well-being of a population. The efficient functioning of roads, water distribution systems, electrical grids, telecommunication networks, healthcare facilities, educational institutions, and waste management systems is essential for sustainable development and poverty alleviation. Accurate and up-to-date data about these infrastructural facilities is critical for effective planning, monitoring, and management.

Traditionally, infrastructure data collection has been a labor-intensive process involving physical surveys, paper maps, and fragmented records. These conventional methods are often plagued by inaccuracies, redundancy, and limited accessibility, particularly in rapidly urbanizing or remote rural areas. As a result, planners and policymakers frequently operate with incomplete or outdated information, leading to inefficient resource allocation, delays in project execution, and missed development opportunities.

The emergence of digital mapping technologies—especially Geographic Information Systems (GIS), Remote Sensing (RS), and Global Positioning Systems (GPS)—has significantly changed how spatial data is collected, analyzed, stored, and presented. Digital mapping provides dynamic, scalable, and highly interactive tools for visualizing infrastructure and spatial patterns. These technologies allow for the real-time updating of maps, the integration of diverse data sources, and multi-layer analysis of environmental, social, and economic variables. With these capabilities, digital mapping has become an indispensable tool in infrastructure planning, disaster risk reduction, environmental management, and smart city initiatives.

Moreover, digital maps are not only useful to government institutions but also to private sector actors, researchers, non-governmental organizations (NGOs), and the general public. For instance, utility companies can use digital maps to monitor and manage service delivery infrastructure; researchers can analyze spatial inequalities in infrastructure distribution; while emergency services can plan more efficient responses during disasters.

In the context of sustainable development goals (SDGs), particularly those related to infrastructure (Goal 9), sustainable cities (Goal 11), and partnerships (Goal 17), digital mapping plays a crucial role in tracking progress and identifying gaps. The ability to visualize infrastructure data spatially enhances transparency, accountability, and stakeholder engagement in development processes.

However, the adoption of digital mapping is not without challenges. In many developing countries, constraints such as limited financial resources, inadequate institutional capacity, poor data sharing practices, and lack of trained personnel hinder its effective implementation. In addition, issues related to data privacy, standardization, and interoperability need to be addressed to fully realize the benefits of digital infrastructure mapping.

Given these realities, this study investigates the concept, tools, applications, and challenges associated with the digital mapping of infrastructural facilities. It seeks to understand how digital mapping can improve infrastructure planning and management, and what strategies can be adopted to overcome the existing barriers to its adoption and sustainability.

Infrastructural facilities form the bedrock of any nation's socioeconomic development. They encompass physical systems such as transportation networks, water supply and sanitation systems, energy grids, communication infrastructure, healthcare facilities, and educational institutions. The availability, accessibility, and functionality of these facilities have a direct influence on the quality of life, public health, economic productivity, and social equity. For policymakers, planners, and development agencies, accurate information on the location, condition, and distribution of these assets is essential for informed decision-making, efficient service delivery, and sustainable development planning.

However, in many parts of the world—particularly in developing countries—there are significant challenges associated with the documentation, tracking, and management of infrastructural assets. Traditional methods for recording infrastructure data often involve manual surveys, paper records, and static maps, which are prone to errors, inconsistencies, and rapid obsolescence. In fast-growing urban centers or remote rural regions, the lack of reliable data hampers effective infrastructure planning and investment, exacerbating service delivery gaps and spatial inequality.

With the advancement of digital technologies, digital mapping has emerged as a powerful tool for addressing these challenges. At the heart of digital mapping are technologies such as Geographic Information Systems (GIS), Remote Sensing (RS), and Global Positioning Systems (GPS). These tools enable the collection, integration, analysis, and visualization of geospatial data in a dynamic and interactive manner. By converting physical infrastructure information into digital spatial formats, users can produce accurate maps that depict the location, status, and interrelationships of infrastructural elements in real-time.

Digital mapping brings a multitude of benefits. It facilitates evidence-based planning, where decisions regarding infrastructure development and maintenance are grounded in spatial data analysis. It supports asset management, helping government agencies and utility providers monitor the condition and usage of infrastructure over time. Furthermore, digital mapping enhances disaster preparedness and response, allowing emergency teams to quickly identify critical infrastructure and develop effective contingency plans.

The relevance of digital mapping extends to several critical sectors:

Urban and Regional Planning: Enables planners to visualize growth patterns and plan for future infrastructure expansion.

Public Health: Assists in mapping health service delivery points and identifying underserved areas.

Education: Supports mapping of school locations and helps optimize student access and resource allocation.

Utilities and Services: Facilitates monitoring and maintenance of water, electricity, and waste management systems.

Transportation: Allows real-time mapping of road networks, traffic flows, and public transit systems.

Globally, the integration of digital mapping into national and local planning frameworks has become an important strategy for achieving the United Nations Sustainable Development Goals (SDGs). Particularly, Goal 9 (Industry, Innovation, and Infrastructure), Goal 11 (Sustainable Cities and Communities), and Goal 17 (Partnerships for the Goals) highlight the importance of robust infrastructure and data-driven planning tools for sustainable development.

Nevertheless, several obstacles continue to impede the full adoption of digital mapping technologies. These include:

High initial costs of hardware, software, and data acquisition.

Lack of technical expertise and training among government personnel and local planners.

Institutional resistance to change and limited collaboration among data custodians.

Inadequate policies and frameworks for geospatial data governance and standardization.

Limited internet connectivity and electricity, particularly in rural areas.

This study is therefore conceived to bridge the knowledge gap in understanding how digital mapping technologies can be effectively utilized for infrastructure development. It aims to investigate the current state of digital mapping practices, evaluate their impact on infrastructure planning and management, and identify the key challenges and opportunities for broader implementation. The insights from this study will contribute to a deeper understanding of the role of spatial data in modern governance and provide practical recommendations for enhancing infrastructural development through geospatial technologies.

1.2 STATEMENT OF PROBLEM

Governments, urban planners, and utility providers face significant challenges with traditional infrastructure mapping and monitoring methods, which rely on manual inspections, paper-based records, and static maps. These outdated approaches are inefficient, time-consuming, and prone to inaccuracies, leading to poor decision-making, maintenance delays, and increased operational costs. This ultimately affects service delivery and public safety. This study investigates the potential of digital mapping to improve infrastructure management, examining its benefits, challenges, and providing recommendations for effective implementation.

1.3 AIM AND OBJECTIVES

1.3.1 AIM:

The study aims to determine how digital mapping can enhance decision-making, optimize resource allocation, and improve the long-term sustainability of infrastructural facilitie of ROYAL VALLEY ESTATE.

1.3.2 OBJECTIVES:

The following objectives were considered in order to accomplish the above aim:

1Project planning which include office planning and field reconnaissance

2 Monumentation

3 Data acquisition (geometric data with TOTAL STATION, Social survey through oral interview and pillar description inclusive).

4 Data processing: This include downloading and processing of data using appropriate software

5 Information presentation: It involved plotting of survey data on both soft copy and hard copy showing correct location of points.

1.4 SCOPE OF THE PROJECT

Based on the purpose and significance of this project, the scope includes;

1 Project planning

2 Station selection and monumentation

3 Data Acquisition

4 Data downloading and Data processing

5 Data Analysis and information presentation

1.5 PERSONEL

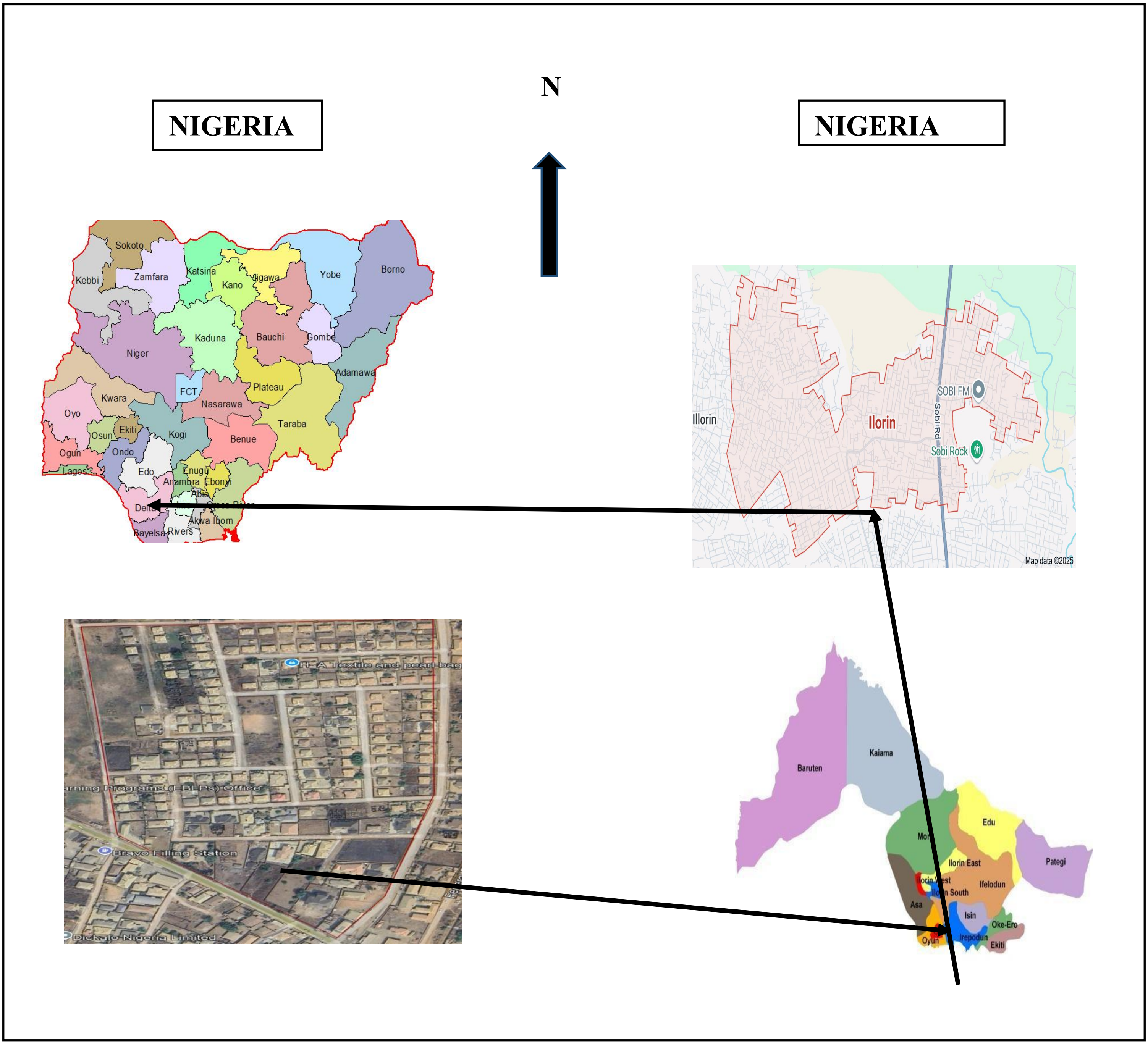
The underlisted students of HND II 2024/2025 set are the personnel that participated in the execution of this project. They are: -

S/N	NAMES	MATRIC NO	REMARKS
1	POPOOLA BLESSING	HND/23/SGI/FT/0094	AUTHOR
2	ALAI ABDULLAH AKANNI	HND/23/SGI/FT/0105	MEMBER
3	ADEYEMO MARIAM O.	HND/23/SGI/FT/0095	MEMBER
4	OGUNDEPO QUADRI O.	HND/23/SGI/FT/0102	MEMBER
5	ADEKANBI ABIGAEL BIMBO	HND/23/SGI/FT/096	MEMBER
6	OKE TEMITOPE JOHN	HND/23/SGI/FT/103	MEMBER
7	ALADA TOLUWANI O.	HND/23/SGI/FT/126	MEMBER
8	OLAREWAJU OLUWATOSIN D.	HND/23/SGI/FT/131	MEMBER

Table 1.5.1: Shows the group personnel

1.6 STUDY AREA

Royal valley estate Sango Ilorin, kwara state, Ilorin south local government area



ROYAL VALLEY ESTATE

ILORIN

Table 1.5.1: Show the group personnel involved

1.7 SPECIFICATIONS

The project speciation's were referenced to the speciation for land information system using total station which was sources from the Higher National Diploma. The specification includes the following:

i. Total station (YE00240)
ii. Minimum number of datum control required- three (3)
iii. Traverse should run between secondary or higher order control point.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 CONCEPTUAL FRAMEWORK OF DIGITAL MAPPING

Digital mapping refers to the process of collecting, compiling, and visualizing spatial data in a digital format using geospatial technologies. It encompasses the use of tools such as Geographic Information Systems (GIS), Global Positioning Systems (GPS), and Remote Sensing (RS) for mapping physical features, analyzing spatial relationships, and facilitating informed decision-making. According to Longley et al. (2015), digital mapping provides an integrative platform for spatial analysis, modeling, and visualization, especially in fields that rely heavily on locational data such as urban planning, environmental management, and infrastructure development.

2.2 GEOSPATIAL TECHNOLOGIES IN INFRASTRUCTURE MAPPING

The application of geospatial technologies in infrastructure management has grown significantly in recent decades. GIS, in particular, is widely used to map and analyze infrastructure such as roads, water supply systems, sewage networks, electrical grids, and public buildings. It enables the layering of different datasets, allowing for complex spatial analysis. GPS technology aids in accurate ground data collection and real-time tracking of infrastructural assets, while remote sensing provides large-scale, high-resolution imagery for monitoring land use and infrastructure changes over time (Campbell & Wynne, 2011).

Several studies, such as those by Bolstad (2016) and Foody (2002), have emphasized the role of remote sensing in infrastructure monitoring and change detection. These technologies provide the necessary data for decision-makers to assess infrastructure conditions, plan maintenance, and prioritize investments.

2.3 APPLICATIONS IN URBAN AND REGIONAL PLANNING

In urban planning, digital mapping is utilized to design, assess, and monitor the development of physical infrastructure. It enables the identification of underserved areas, analysis of spatial accessibility, and simulation of future development scenarios. Scholars such as Batty (2013) and Goodchild (2007) argue that digital mapping supports "smart city" planning by integrating infrastructure data with demographic, environmental, and economic datasets.

In rural contexts, digital mapping has been instrumental in locating and planning essential services such as health centers, schools, and water facilities. A study by UNICEF (2018) showed how digital mapping of water points in Sub-Saharan Africa helped identify functional and non-functional systems, thereby improving water service delivery and planning.

2.4 INFRASTRUCTURE AND THE SUSTAINABLE DEVELOPMENT GOALS (SDGS)

The relevance of digital mapping in achieving the Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation, and Infrastructure) and SDG 11 (Sustainable Cities and Communities), is well-documented. According to the United Nations (2019), geospatial technologies play a crucial role in tracking progress, identifying gaps, and enabling evidence-based decision-making in infrastructure development. By offering spatial insights into infrastructure accessibility and inequality, digital mapping contributes to more inclusive and equitable development.

2.5 CHALLENGES IN THE ADOPTION OF DIGITAL MAPPING

Despite its potential, digital mapping faces several barriers, especially in low- and middle-income countries. A major challenge is the lack of skilled personnel and technical capacity to develop and manage digital mapping systems. Additionally, the cost of acquiring high-resolution satellite imagery, software licenses, and data collection equipment remains a significant constraint (Kuffer et al., 2016).

Data availability and quality are also recurring concerns. In many countries, infrastructure data is often fragmented, outdated, or not publicly available. Institutional challenges, including poor inter-agency collaboration and weak geospatial data governance, further hinder the effective adoption of digital mapping (Williamson et al., 2010).

2.6 CASE STUDIES AND BEST PRACTICES

Several countries have successfully integrated digital mapping into infrastructure planning and management. For example:

In India, the Smart Cities Mission has incorporated GIS-based platforms for infrastructure and urban service monitoring (Government of India, 2020).

In Kenya, digital mapping of health facilities has improved the allocation of health resources and outreach programs (World Bank, 2018).

In Estonia, one of the most digitally advanced nations, geospatial data integration across government departments has enhanced infrastructure maintenance and planning transparency.

These case studies highlight the importance of political will, investment in capacity-building, and the establishment of national spatial data infrastructures (NSDIs) in promoting successful implementation.

2.7 IDENTIFIED RESEARCH GAPS

While considerable literature exists on the technical and practical aspects of digital mapping, several gaps remain. Few studies offer localized evaluations of the effectiveness of digital mapping in improving infrastructure delivery in rural or peri-urban areas. There is also limited research on community participation in infrastructure mapping, as most initiatives are government- or donor-driven. Moreover, the socio-political dynamics influencing the adoption of geospatial technologies in different institutional settings remain underexplored.

2.8 UNDERSTANDING DIGITAL MAPPING AND SPATIAL DATA INFRASTRUCTURE

Digital mapping is a transformative process that involves the digitization of geographic data to produce visual representations of spatial phenomena. It goes beyond traditional cartography by enabling real-time updates, user interaction, and the integration of attribute data with spatial features. At the core of digital mapping is the Spatial Data Infrastructure (SDI)—a framework of policies, technologies, standards, and people necessary for effective collection, sharing, and utilization of geospatial data (Rajabifard et al., 2006).

National and regional SDIs are instrumental in supporting infrastructure mapping initiatives. For instance, the European Union's INSPIRE Directive mandates standardized spatial data sharing across member states for environmental and infrastructure-related decision-making (European Commission, 2007). In contrast, many developing nations still lack coordinated SDI strategies, impeding seamless data sharing and multi-agency collaboration.

2.9 SECTOR-SPECIFIC APPLICATIONS OF DIGITAL MAPPING

a. Transportation and Roads

GIS-based road infrastructure mapping has been widely used for traffic analysis, road condition monitoring, and transport route optimization. According to Elrahman& Abraham (2016), GIS applications have enhanced the ability of governments to prioritize road rehabilitation based on wear patterns, accident data, and connectivity

b. Water and Sanitation

In water infrastructure, GIS and remote sensing tools are applied for mapping water pipelines, boreholes, and distribution points. Digital mapping facilitates leak detection, coverage analysis, and service equity assessments. A study by the World Health Organization (2017) demonstrated how GIS-based planning significantly improved water access in underserved rural communities in Uganda and Malawi.

c. Electricity and Energy

Utility companies globally have adopted Geospatial Asset Management Systems to monitor electrical grids and optimize service delivery. GIS enables tracking of load centers, identification of outage-prone areas, and strategic expansion of the grid to new locations. In countries like Nigeria and India, such tools have been used in planning rural electrification (IRENA, 2019).

d. Healthcare and Education

Digital mapping is vital for locating health and education infrastructure and assessing accessibility. For example, studies have used spatial accessibility models to identify disparities in school access in rural South Asia (Ahmed et al., 2020) and hospital locations in remote Latin American regions (Paez et al., 2018). These applications inform decisions about where to invest in new facilities.

2.10 PARTICIPATORY AND COMMUNITY-BASED MAPPING

Emerging literature emphasizes the value of participatory GIS (PGIS) and volunteered geographic information (VGI) in infrastructure planning. Community members, through tools such as OpenStreetMap (OSM) and mobile apps, can contribute infrastructure data, especially in informal settlements or disaster-hit regions where official data may be lacking (Goodchild, 2007; McCall & Dunn, 2012).

For instance, the "Map Kibera" project in Nairobi, Kenya, empowered local youth to map their informal community, revealing the location of roads, schools, toilets, and water points that had previously been invisible on official maps. Such grassroots mapping fosters inclusiveness and empowers marginalized populations to participate in local development planning.

2.11 DATA INTEGRATION, INTEROPERABILITY, AND GOVERNANCE

An essential theme in digital mapping literature is the interoperability of data across agencies and platforms. Many researchers highlight the need for open data standards (e.g., OGC, ISO 19115) and metadata frameworks to facilitate integration and reuse of spatial data (Williamson et al., 2010).

Poor data governance, including the hoarding of geospatial data, lack of licensing clarity, and absence of national repositories, has been a persistent barrier in several developing countries. Strengthening institutional frameworks and enforcing open data policies is critical to unlocking the full potential of digital mapping.

2.12 REAL-TIME MONITORING AND SMART INFRASTRUCTURE

The integration of Internet of Things (IoT) technologies with digital mapping platforms is creating smart infrastructure systems that can self-report their condition or usage. For example, sensor-based monitoring of road traffic or water flow is increasingly being visualized through GIS dashboards in real-time (Kitchin, 2014).

Cities like Singapore and Barcelona have adopted such smart technologies to enable predictive maintenance, optimize service delivery, and support sustainability goals. The combination of real-time data with spatial analysis represents the frontier of digital infrastructure mapping.

2.13 POLICY INTEGRATION AND INSTITUTIONAL ADOPTION

Policy documents from international organizations such as the World Bank, UN-Habitat, and African Development Bank emphasize the strategic integration of digital mapping into national development plans. The World Bank's Geo-Enabling Initiative for Monitoring and Supervision (GEMS) is one such example that promotes GIS use in fragile and conflict-affected countries to monitor infrastructure investments and service delivery projects (World Bank, 2020).

However, institutional inertia, political interference, and a lack of long-term planning often limit the sustainability of such initiatives. Literature points to the need for capacity building, political will, and legal frameworks to institutionalize digital mapping within government structures.

2.14 DIGITAL TWINS AND SMART INFRASTRUCTURE MANAGEMENT

An emerging advancement in the digital mapping space is the use of digital twins—virtual models that replicate real-world infrastructure systems using real-time spatial and sensor data. Digital twins allow for predictive analysis, performance monitoring, and scenario simulation, particularly in urban infrastructure. As described by Batty (2018), digital twins are revolutionizing how cities manage roads, buildings, transit systems, and utilities by creating continuously updated spatial models that inform smart governance.

For example, the city of Singapore has implemented a nation-wide digital twin (Virtual Singapore) that integrates 3D spatial data with real-time environmental and infrastructure sensors, enabling advanced urban simulations and scenario testing (Singapore Government, 2021).

2.15 DISASTER RISK REDUCTION AND RESILIENCE PLANNING

Digital mapping plays a crucial role in disaster preparedness, risk assessment, and post-disaster recovery. Through the integration of hazard maps, vulnerability data, and critical infrastructure locations, decision-makers can identify at-risk populations and prioritize interventions. GIS has been applied in mapping flood-prone zones, earthquake impacts, and pandemic spread in relation to infrastructure capacity (Cutter et al., 2003).

After the 2010 Haiti earthquake, for example, crowdsourced mapping platforms like Ushahidi and OpenStreetMap provided up-to-date maps of affected areas, helping responders locate hospitals, blocked roads, and shelters. These examples show the importance of spatial data for crisis coordination and infrastructure recovery planning.

2.16 AI AND MACHINE LEARNING IN DIGITAL MAPPING

Recent literature highlights the integration of Artificial Intelligence (AI) and Machine Learning (ML) in analyzing geospatial data for infrastructure management. AI-powered image classification and object recognition techniques can automatically detect roads, buildings, or damaged infrastructure from satellite imagery (Zhu et al., 2017).

Google's Project Sunroof, for instance, uses machine learning on satellite imagery to map rooftop solar potential across cities. In other applications, AI models predict road deterioration, assess building quality, and even analyze traffic congestion patterns when integrated with real-time spatial data.

Despite these innovations, the literature also points to challenges in model accuracy, data bias, and interpretability, especially in areas with limited high-resolution data or cloud-free imagery.

2.17 ETHICAL CONSIDERATIONS IN DIGITAL MAPPING

While digital mapping offers numerous benefits, ethical concerns arise, particularly around privacy, data ownership, representation, and informed consent. In some contexts, the mapping of informal settlements or religious facilities has led to tension, surveillance, or exclusion from services (Craglia et al., 2018).

There is also a risk of data colonialism, where external organizations collect and control local spatial data without involving local communities or institutions. Scholars advocate for open geospatial ethics, inclusive participatory mapping approaches, and data sovereignty principles to ensure that digital mapping respects local rights and contexts (Tuckwood, 2014; Taylor & Broeders, 2015).

2.18 DIGITAL MAPPING IN THE CONTEXT OF THE GLOBAL SOUTH

Studies across the Global South reveal varying levels of adoption and adaptation of digital mapping technologies. In Nigeria, for example, the National Space Research and Development Agency (NASRDA) has made efforts to map public facilities using satellite imagery and GIS tools. However, limited access to high-resolution imagery, irregular updates, and poor institutional coordination remain persistent obstacles (Aderogba, 2013).

In Ethiopia, participatory mapping has been integrated into rural health planning with notable success, but sustainability has been challenged by turnover in trained personnel and dependence on donor funding (Tulu et al., 2017). These regional studies underscore the need for context-specific strategies that address governance, financing, and capacity building.

2.19 GENDER AND SOCIAL INCLUSION IN INFRASTRUCTURE MAPPING

The gendered dimensions of infrastructure access have prompted scholars to explore how digital mapping can highlight inequalities in service provision. For example, mapping the distance women travel to access water or health services in rural areas reveals spatial and social barriers not captured by aggregate statistics (O'Neill et al., 2020).

Gender-sensitive mapping also informs infrastructure design—for instance, by ensuring that street lighting or public toilets are positioned to improve women's safety. Despite these insights, gender-inclusive mapping remains limited, and more research is needed on how spatial tools can support inclusive planning.

Synthesis of the Literature

From the literature reviewed, several key themes emerge:

Technological advancement has made infrastructure mapping more precise, dynamic, and scalable.

Institutional frameworks are crucial for integrating digital mapping into national infrastructure planning systems.

Participatory approaches improve data richness and ensure local relevance.

Ethical and social concerns must be addressed to ensure responsible and inclusive use of spatial data.

Cross-sector collaboration between government, academia, private tech firms, and communities is essential for sustainable digital mapping efforts.

However, the application and impact of digital mapping remain uneven across regions and sectors. While urban centers and well-funded programs have adopted advanced tools, rural and marginalized communities are often left behind due to infrastructural, financial, and institutional constraints.

2.20 MAPPING INFORMAL SETTLEMENTS AND URBAN MARGINALITY

A growing body of research focuses on the digital mapping of informal settlements, where official infrastructure data is often lacking or outdated. These areas, often excluded from formal urban planning processes, present complex challenges due to their dense, unregulated, and rapidly changing nature.

Digital mapping has emerged as a critical tool for:

Visualizing infrastructure gaps (e.g., lack of sanitation, roads, or drainage systems),

Supporting community-led upgrading projects, and

Documenting tenure claims or hazards (e.g., landslide or flood-prone zones).

Tools like Drone-based photogrammetry and mobile data collection apps (e.g., KoboToolbox, Survey123) have empowered NGOs and residents to produce high-resolution maps. Projects such as

Slum Dwellers International (SDI)'s Know Your City campaign exemplify how participatory digital mapping is used to advocate for infrastructure investment in informal urban areas (Patel et al., 2012).

2.21 OPEN-SOURCE GIS AND MAPPING PLATFORMS

Open-source software has dramatically expanded access to digital mapping, particularly in resource-constrained settings. Tools such as:

I. QGIS (a free, community-developed GIS platform),

II. OpenStreetMap (OSM) (a global editable map),

III. Leaflet and Mapbox (for web-based visualization),

allow governments, NGOs, and communities to bypass expensive proprietary platforms.

Studies by Sieber (2006) and Budhathoki et al. (2008) highlight the democratizing effect of open-source mapping, enabling broader stakeholder engagement and reducing dependency on external consultants. However, challenges persist in terms of technical support, data accuracy, and integration with formal government systems.

2.22 Climate Change and Environmental Infrastructure Mapping

Digital mapping also plays a central role in climate resilience and environmental infrastructure planning. For instance:

Green infrastructure (e.g., parks, wetlands, tree cover) is mapped to analyze heat islands or stormwater retention capacity.

Climate vulnerability indices combine infrastructure data with socio-environmental indicators to guide adaptive planning.

Remote sensing has been used to track deforestation, coastal erosion, and floodplain expansion—critical for planning protective infrastructure such as levees, sea walls, or storm drains (Adger et al., 2005). GIS has also been instrumental in mapping carbon emissions and renewable energy infrastructure (e.g., wind farms, solar plants).

In Africa, the Africa Risk Capacity (ARC) initiative uses satellite mapping to trigger parametric insurance payouts for droughts—highlighting a practical, finance-linked application of digital mapping in infrastructure-related resilience.

16. Mobile and Crowdsourced Mapping Innovations

The rise of mobile GIS and crowdsourcing tools has led to a wave of decentralized data collection. Innovations such as:

GPS-enabled mobile apps (e.g., Locus, Epicollect5),

Field-based asset mapping tools (e.g., Fulcrum, ODK),

Participatory platforms (e.g., Mapillary for street-level imagery),

allow infrastructure data to be collected quickly and accurately, even by non-experts.

For example, during the Ebola outbreak in West Africa, mobile mapping helped track the locations of health centers, road access, and quarantine zones, facilitating quicker intervention. Studies such as those by Meier (2015) emphasize the efficiency of mobile mapping in both humanitarian and development contexts.

2.23 HUMAN CAPACITY AND INSTITUTIONAL DEVELOPMENT

Effective implementation of digital mapping requires not only technology but also institutional commitment and human resource development. Research shows that lack of trained GIS professionals, unclear data mandates, and fragmented institutions hinder the full integration of mapping tools into infrastructure governance (Enemark et al., 2005).

Capacity-building initiatives—such as short courses, professional certifications, and university programs in geospatial technologies—are vital. International organizations (e.g., UN-GGIM, Esri, GSDI) emphasize the need to embed spatial literacy within government departments, especially those managing roads, health, education, and utilities.

Additionally, institutional partnerships—between local governments, universities, and NGOs—are increasingly seen as a model for sustainable mapping programs. These collaborations ensure that infrastructure data remains relevant, updated, and actionable.

2.24 GEOSPATIAL DATA IN INFRASTRUCTURE FINANCING AND INVESTMENT

One of the newer frontiers of digital mapping is its integration into infrastructure financing, particularly in public-private partnerships (PPPs) and international development programs. Multilateral development banks, such as the World Bank and African Development Bank, increasingly require geospatial evidence to guide, monitor, and evaluate infrastructure investments.

Digital maps are used to:

- Demonstrate project feasibility and coverage,
- Identify beneficiary populations and environmental impacts, and
- Enhance transparency and accountability.

Tools such as Geo-Enabling Initiative for Monitoring and Supervision (GEMS) provide spatial dashboards to monitor infrastructure project progress. This not only supports better governance but also helps investors and donors assess risk and optimize returns based on spatial demand and connectivity.

2.25 EQUITY IN INFRASTRUCTURE DISTRIBUTION

Digital mapping has become a powerful instrument for evaluating the equity of infrastructure access across social, economic, and geographic lines. Spatial inequality studies use GIS to assess disparities in access to:

I. Clean water and sanitation,

II. Roads and public transport,

III. Health and education services,

IV. Internet connectivity and electrification.

These studies often integrate socio-demographic data (e.g., income levels, gender, disability) with infrastructure maps to uncover hidden forms of exclusion. The concept of "spatial justice" has gained traction, highlighting the need for infrastructure planning that prioritizes underserved and marginalized communities (Soja, 2010).

2.26 DIGITAL MAPPING AND LAND INFORMATION SYSTEMS (LIS)

Digital mapping is at the core of modern Land Information Systems, which integrate cadastral, tenure, and land use data to support planning and property management. Infrastructural development often intersects with land ownership issues—necessitating accurate spatial records for:

- Land acquisition,
- Compensation,
- Resettlement,
- Rights-of-way determination.

In countries like Rwanda and Ghana, digital land mapping reforms have significantly improved tenure security, enabling infrastructure projects to proceed with less conflict. The Fit-for-Purpose Land Administration model (Enemark et al., 2014) promotes low-cost, scalable mapping solutions to support both land and infrastructure planning in developing countries.

2.27 REMOTE SENSING FOR INFRASTRUCTURE MONITORING

Advancements in satellite remote sensing and aerial technologies (e.g., drones, LiDAR) have dramatically improved the monitoring of infrastructure assets. Applications include:

- Monitoring construction progress,
- Detecting unauthorized land use changes,
- Assessing the structural condition of roads and bridges.

Open-access programs like NASA’s Landsat, ESA’s Sentinel, and Google Earth Engine provide long-term satellite data that can be harnessed for infrastructure change detection. High-resolution commercial imagery (e.g., from Maxar or Planet Labs) allows for micro-level analysis, albeit at a cost.

Remote sensing is especially useful in conflict zones, disaster-hit areas, or regions with limited field access, where on-the-ground surveys may be impossible or dangerous.

2.28 INFRASTRUCTURE MAPPING AND THE SUSTAINABLE DEVELOPMENT GOALS (SDGS)

There is growing scholarly attention on how digital mapping contributes to monitoring and achieving the UN Sustainable Development Goals (SDGs), particularly:

- SDG 6 – Clean water and sanitation,
- SDG 7 – Affordable and clean energy,

- SDG 9 – Industry, innovation, and infrastructure,
- SDG 11 – Sustainable cities and communities.
- Spatial data enables precise measurement of indicators such as:
- Proportion of population with access to paved roads, Geographic disparities in healthcare infrastructure,

Percentage of population connected to the electric grid or the internet.

The UN GGIM (Global Geospatial Information Management) framework emphasizes the integration of digital mapping into national SDG reporting systems, advocating for interoperable and policy-aligned spatial data infrastructures.

2.29 SPATIAL DECISION SUPPORT SYSTEMS (SDSS) IN INFRASTRUCTURE PLANNING

The literature increasingly highlights the use of Spatial Decision Support Systems (SDSS) to aid infrastructure planning and prioritization. These systems combine GIS with multicriteria decision analysis (MCDA), simulation modeling, and stakeholder inputs to:

- Evaluate multiple infrastructure scenarios,
- Optimize locations based on environmental and social constraints,

Support participatory planning processes.

For instance, an SDSS could help a local government decide where to place new health centers based on population density, road access, land availability, and disease incidence. Such tools make digital mapping actionable and evidence-based, rather than just descriptive.

2.30 GOVERNANCE AND INSTITUTIONAL INTEGRATION OF DIGITAL MAPPING

Finally, institutional and governance literature stresses the importance of embedding digital mapping within national infrastructure systems. This includes:

- Designating spatial data custodians (e.g., Ministries of Works or Land),
- Establishing national geospatial agencies or registries,
- Developing legal frameworks for data sharing and privacy.

Countries like Estonia and South Korea have fully digitized public infrastructure inventories that feed into national digital governance platforms. In contrast, many low-income nations face fragmented, donor-driven systems with limited sustainability. Institutional coordination and leadership are key to long-term mapping success.

Key Takeaways from the Expanded Literature Review

Theme	Contribution to Infrastructure Mapping
Finance & Investment	Enhances project viability and monitoring transparency
Equity & Access	Exposes spatial inequalities and improves planning fairness
Land & Tenure	Supports legal certainty and reduces conflicts in infrastructure deployment
Remote Sensing	Enables large-scale and inaccessible-area mapping
SDGs Alignment	Facilitates progress tracking on global development goals
SDGs Alignment	Facilitates progress tracking on global development goals

Decision Support	Enables evidence-based, optimized infrastructure decisions
Governance	Institutionalizes and sustains mapping systems through policy and capacity

2.31 SPATIAL DATA GOVERNANCE

As digital mapping becomes more integral to infrastructure management, governance and policy frameworks for spatial data have become a crucial area of study. Spatial data governance involves the management of how geospatial data is collected, stored, shared, and used across sectors. A robust governance framework ensures:

Data quality control and standardization (e.g., accuracy, timeliness),

Clear ownership and access rights,

Data privacy and security concerns, especially regarding sensitive infrastructure data,

Interoperability between different data systems and organizations.

Countries like Australia and Canada have pioneered the development of national spatial data infrastructures (SDIs), which coordinate the collection and sharing of geospatial data across federal, state, and local governments. These frameworks enable diverse stakeholders, from private developers to public health agencies, to access and utilize spatial data in a harmonized way (Rajabifard et al., 2006).

However, in many developing regions, weak institutional frameworks, fragmented data systems, and lack of trust in data-sharing agreements pose significant challenges. The introduction of open data policies and geospatial data commons could improve data access and integration, but these need careful regulatory oversight to avoid misuse (De Lange, 2015).

2.32 URBAN MOBILITY AND INFRASTRUCTURE MAPPING

The integration of digital mapping technologies with urban mobility is one of the fastest-growing applications in infrastructure planning. The rise of smart cities and mobility-as-a-service (MaaS) platforms has led to an increased demand for real-time infrastructure data related to transportation networks, pedestrian pathways, public transport hubs, and bicycle lanes.

Smart cities leverage sensors, IoT devices, and digital maps to monitor and manage traffic flow, parking availability, and transit operations. Data from platforms like Google Maps, Waze, and Citymapper are integrated into urban management systems to optimize mobility and reduce congestion. These platforms generate vast amounts of data that help urban planners make informed decisions about infrastructure improvements, road repairs, and public transport scheduling.

The European Union's Urban Mobility Framework is an example of how regional governance can support the mapping and management of urban mobility through coordinated policies, funding, and data-sharing agreements (EU Commission, 2020). This trend is expanding rapidly as more cities explore autonomous vehicles, electrification of public transport, and multi-modal transport networks.

2.33 SMART INFRASTRUCTURE AND DIGITAL MAPPING

The concept of smart infrastructure revolves around integrating digital technologies into the physical built environment to enhance the functionality and efficiency of infrastructure systems. Digital mapping is central to the management and operation of these smart systems, particularly in areas like:

- Energy grids (smart grids for electricity distribution),
- Water networks (smart water meters and leak detection),
- Transportation systems (smart traffic signals, autonomous vehicle lanes),
- Waste management (smart bins and waste sorting).

Technologies like 5G networks, edge computing, and AI-powered analytics are revolutionizing infrastructure management by allowing for real-time monitoring and decision-making. Building Information Modeling (BIM) and Geographic Information Systems (GIS) are increasingly being integrated to form Integrated Infrastructure Management Systems (IIMS), which help in the design, construction, and operation of infrastructure assets (Kamara et al., 2017).

An example of this in action is Smart Dubai, which uses digital mapping in combination with IoT sensors to manage everything from water usage to traffic congestion. This combination of technologies allows for predictive maintenance, energy optimization, and urban health improvements.

2.34 DATA VISUALIZATION IN INFRASTRUCTURE MAPPING

Effective data visualization is essential for translating complex spatial data into actionable insights for policymakers, urban planners, and the general public. Visualization tools such as interactive maps, 3D city models, and spatial dashboards enable stakeholders to engage with infrastructure data and make better-informed decisions.

Heatmaps, density maps, and animated overlays are commonly used in urban infrastructure planning to identify areas in need of improvement. For instance, transportation planners use heatmaps to visualize traffic patterns and congestion, which guides the construction of new roads or public transit routes. Similarly, climate adaptation planners use dynamic maps to visualize flood risk areas and implement flood protection infrastructure.

Tools like Tableau, Power BI, and ArcGIS Online allow infrastructure data to be visualized and interpreted at various levels, from regional to micro-level. The ability to interact with these visualizations fosters more transparent, inclusive, and participatory decision-making processes.

2.35 CASE STUDIES OF DIGITAL MAPPING IN INFRASTRUCTURE DEVELOPMENT

Several international case studies highlight how digital mapping has been applied to enhance infrastructure development and management in diverse geographical and socio-economic contexts:

I. The Netherlands' Flood Protection Infrastructure: The Netherlands employs advanced digital mapping techniques to maintain its extensive flood protection systems, which include dikes, sea walls, and dams. Using a combination of remote sensing, LiDAR, and GIS, the country monitors the condition of its flood infrastructure and predicts the impacts of sea-level rise (Veraart et al., 2019).

II. India's Smart Cities Mission: As part of its Smart Cities Mission, India has integrated digital mapping to enhance urban planning and governance. Cities like Bhubaneswar and Surat have used GIS to map infrastructure assets, improve waste management, and enhance public service delivery (Sharma et al., 2021).

III. Brazil's Infrastructure and Environmental Monitoring: In Brazil, satellite-based mapping is used to track deforestation and land degradation, which directly impacts the infrastructure needed for sustainable development. This is essential for planning transportation networks that avoid environmentally sensitive areas and mitigate climate-related risks (Alves et al., 2018).

IV. Rwanda's Land Registration Program: Rwanda's national land registration program employs digital mapping technologies, including GPS-based surveying and satellite imagery, to formalize land ownership and improve infrastructure development. This program has led to more secure tenure and more equitable access to resources (Davis et al., 2017).

CONCLUSION

The literature establishes a strong theoretical and practical foundation for the use of digital mapping in infrastructural development. Geospatial technologies have proven benefits in enhancing planning, monitoring, and equitable service delivery. However, barriers related to cost, capacity, governance, and data quality persist, particularly in developing contexts. These gaps provide justification for further research aimed at exploring localized applications, evaluating the effectiveness of digital mapping, and developing strategies for broader adoption.

CHAPTER THREE

3.0 METHODOLOGY

This stage involves the methods and procedure used in planning, data acquisition, data processing, and creation of database, creation of database management system and information presentation. These operations were logically structured and carried out in stages involving database design. It is normally considered to involve a spatially referenced and structured digital database and appropriate application software for geospatial analysis. This basically describes the techniques and principles adopted in carrying out the project.

Geographic information system methods were adopted in accomplishing the desired results.

3.1 DATABASEDESIGN

The design of any data base involves three stages namely;

i Conceptual design

ii Logical design

iii Physical design

3.1.1 VIEWOF REALITY

In database design, there is need for reality which is referred to as the phenomenon that actually exists, including all aspects which may or may not be perceived by individuals. The view of reality however, is the mental abstraction of the reality for a particular application or group of applications.

For this application, the view of reality is made of the topography of the project.Since it is not possible to represent the real world, the only option is to conceptualize and model it in a specified manner to represent the real world. The area of interest to us in this project

Includes; Green Reserve, Roads, Electric poles, Trees, Water Facilities, Buildings, Football pitch, Streams.

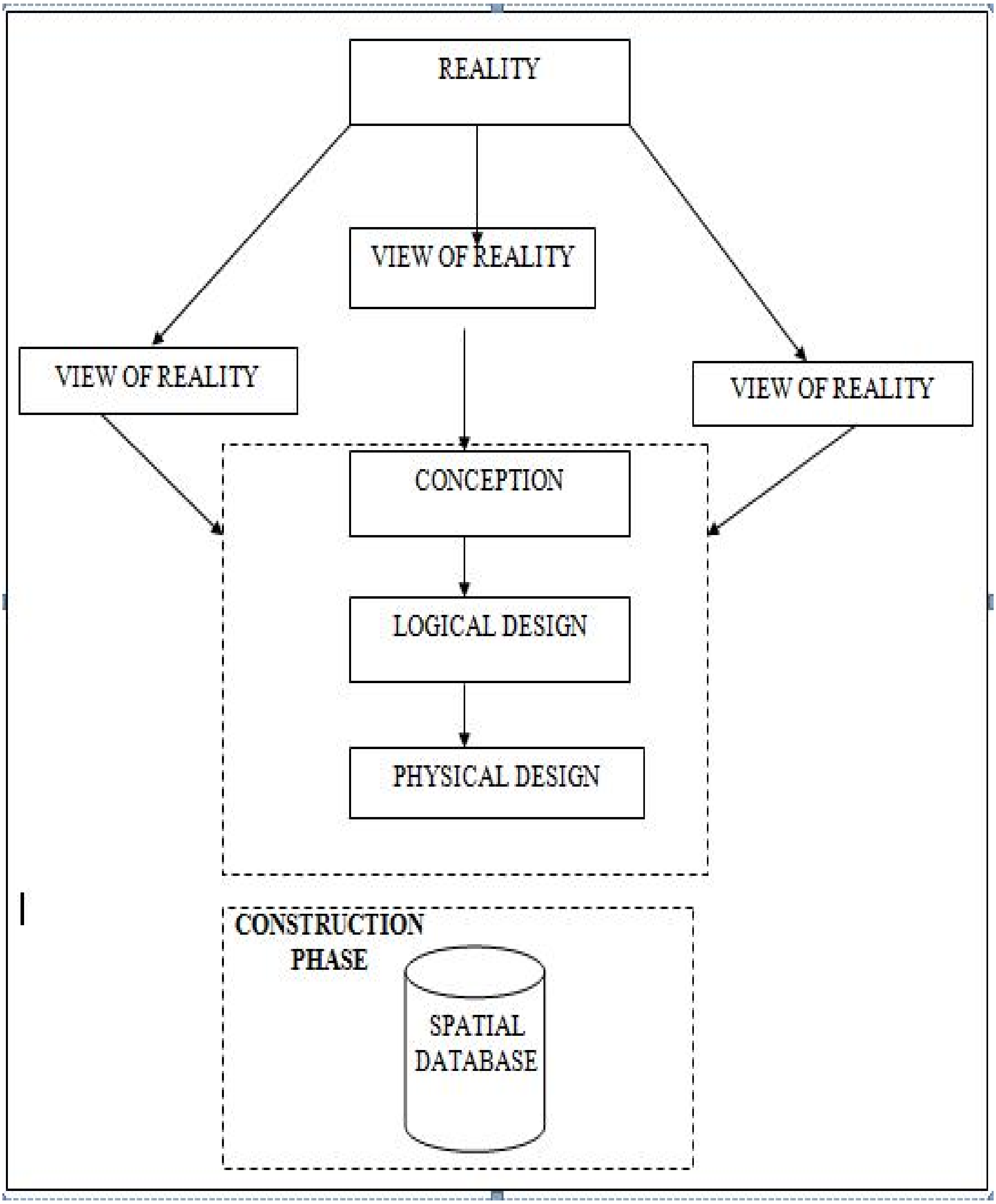


Fig.3.1 Design and Construction Phases in Spatial Database

3.1.2 CONCEPTUAL DESIGN

Vector data model is the data type adopted for this project, which is represented, by points, lines and polygon. The identified entities are:-

a. Vegetation area (polygon)

b. Roads (line)

c. Trees(point)

d. Boundary line (polygon)

e. Buildings (polygon)

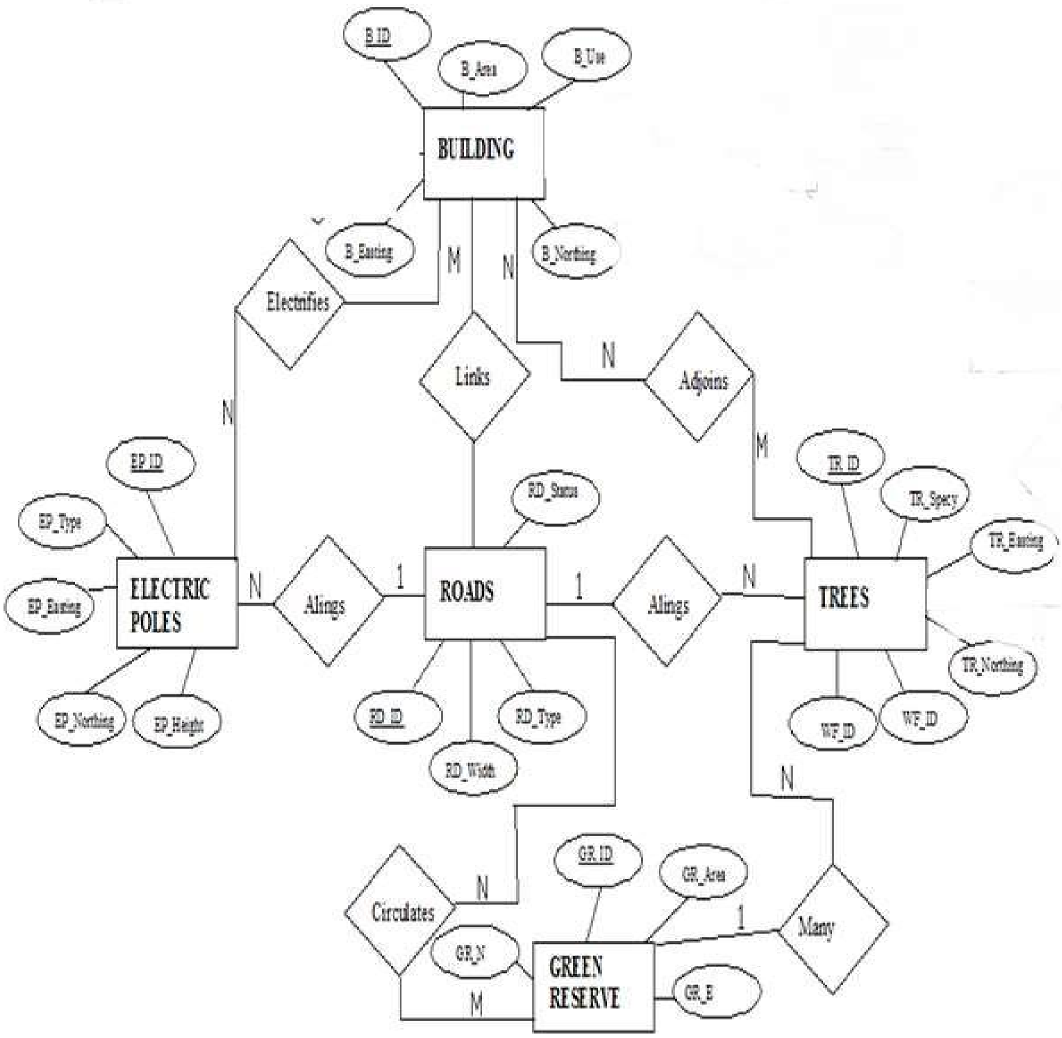


Fig.3.2.:E-R Diagram (Entity relationship diagram)

3.1.3 LOGICALDESIGN

This is the design aspect of the data base refers to the process of creating a conceptual framework or model that represents the structure and organization of spatial data within the system. It involves defining the data element, their relationship, and the rules for data manipulation and analysis. In this phase, the entities, their attributes and their relationships are represented in a single uniform manner in form of relation in such a way that would be no information loss and at the same time no unnecessary duplication of data. In this study, theological database design is employed to generate a geo-relation database structure. Each entity has unique identifier in bold type. An attribute type or combination of attribute types that serves to identify an entity type is termed an identifier.

i Building (B_ID,B_Area, B_Name,B_Easting, B_Northing)

ii Roads (R_ID,R_Width,R_Type,R-Condition, R_Easting, R_Northing)

iii Vegetation (V_ID,GR_Area,)

iv Tree (TR_ID,TR_spp, TR_Importance, TR_Easting, TR_Northing)

v Electric Pole (EP_No, EP_Type, EP_Height, EP_Easting, EP_Northing)

vi Water Facility (WF_ID,WF_Depth,WF_Type,WF_Easting,WF_Northing)

vii Football Pitch (FP_ID, FP_Area, FP_Status)

viii Stream (S_ID, Length,Width)

3.1.4 PHYSICAL DESIGN

Table3.1: Building and its attribute

ENTITY	DESCRIPTION
B_ID	Building Identification
B_name	Building Name

B_Area	Building Area
B_Easting	Building Easting
B_Northing	Building Northings

Table3.2:Road and its attributes

ENTITY	DESCRIPTION
R_ID	Road Identifier
R_Length	Road Length
R_Width	Road Width
R_Type	Road Type
R_Condition	Road Condition

Table3.3:Trees and its attributes

ENTITY	DESCRIPTION
TR_ID	Tree Identifier
TR_Spp	Tree specy
TR_E	Tree_ Easting
TR_N	Tree Northing

3.2 RECONNAISSANCE

This is the preparatory stage before the execution of this project; it involves collection of available information about the project area.

The necessary step taken for the successful execution of the project involves two stages, which are:-

1. Office Planning
2. Field reconnaissance

3.2.1 OFFICE PLANNING

This involves the collection of information about the study area, testing the instrument to be used in execution of the project and itemizing the numbers of equipment needed, number of days to be use, how each activity is to be carried out, delegation of works to each team members based on supervisor's guide/instructions.

Table 3.4 Coordinates of Controls

Station	Northing(m)	Easting(m)	Height(m)
KWCS 625T	941451.040	674200.278	255.212
KWCS 623T	941753.095	673845.702	250.532
KWCP 690	94I802.041	673810.314	249.087

Source:Surveyor general office Kwara

3.2.2 FIELD RECONNAISSANCE

The field reconnaissance is the first visitation to the projects ite to get intimated with the environment.

i. Boundary points was selected
ii. The distribution of features was studied
iii. Controls to be used were located
iv. Method and type of instrument to be uses was determined
v. Subsidiary point for Ground control Points were picked and define using nail and bottle cock
vi. Adiagram of the study area was drawn.

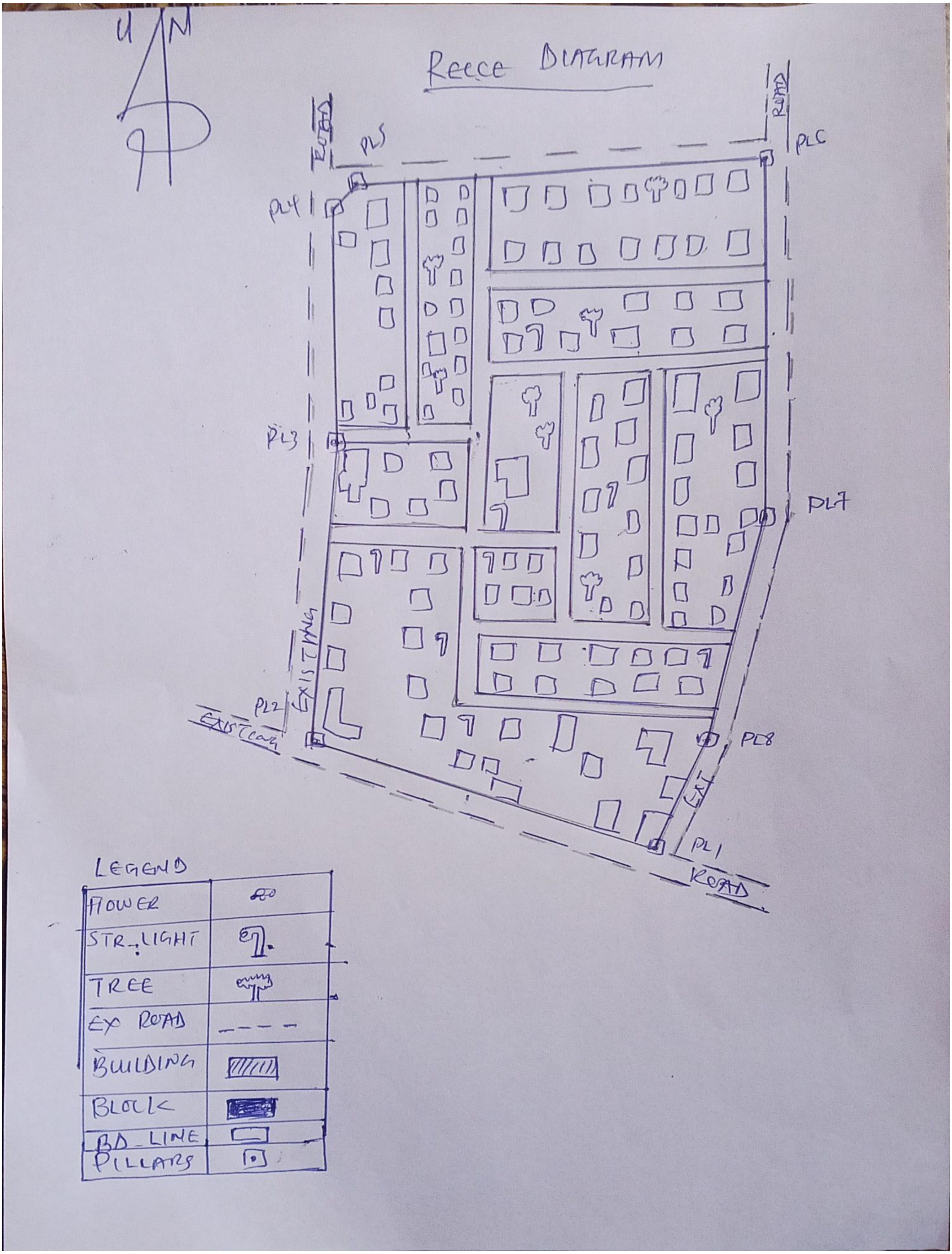


Fig.3.3: Recce diagram of the study area (not drawn to scale).

3.3 EQUIPMENT USED/SYSTEM SELECTION AND SOFTWARE

3.3.1 HARDWARE USED

i. Total station
ii. 1reflector with a tracking rod.
iii. 1Tripod
iv. One (1)50m tape
v. One(1)umbrella
vi. 1cutlass
vii. Handheld GPS
viii. Hammer
ix. Nails and bottle cover
x. Field book and writing materials
xi. 1-Noof Personal ComputerHP655 and its accessories
xii. 1-Noof HP Desk JetK7100 A3 printer
xiii. 1-Noof HPDesk Jet 1110 A4printer

3.3.2 SOFTWARECOMPONENT

i. Note pad.
ii. Microsoft Excel.
iii. AutoCAD2007
iv. ArcGIS10.3
v. Microsoft Word.

3.4 INSTRUMENTTEST

To ensure data quality ,the Total Station used for this project was tested for both vertical index and horizontal collimation errors.It was also to ascertain the efficiency and reliabilityofthe instrument. The procedure used is described below.

3.4.1 HORIZONTALCOLLIMATIONTEST

This test was conducted to ensure that the line of sight was perpendicular to the trunnion axis.The Total Station was positioned over a specific point, and initial adjustments were made to ensure proper alignment, leveling, and focus(to eliminate parallax in the telescope). Avertical target was placed at a distance of 100 meters from the Total Station. To access the configuration menu of the Total Station, the menu key was pressed an held for approximately 2 seconds. From the main menu, the calibration sub-menu was selected, and within that, the horizontal collimation test option was chosen. The target was then observed and divided into two halves, with horizontal readings recorded for Face left and Face right. The readings are shown in Table 3.4.1 below.

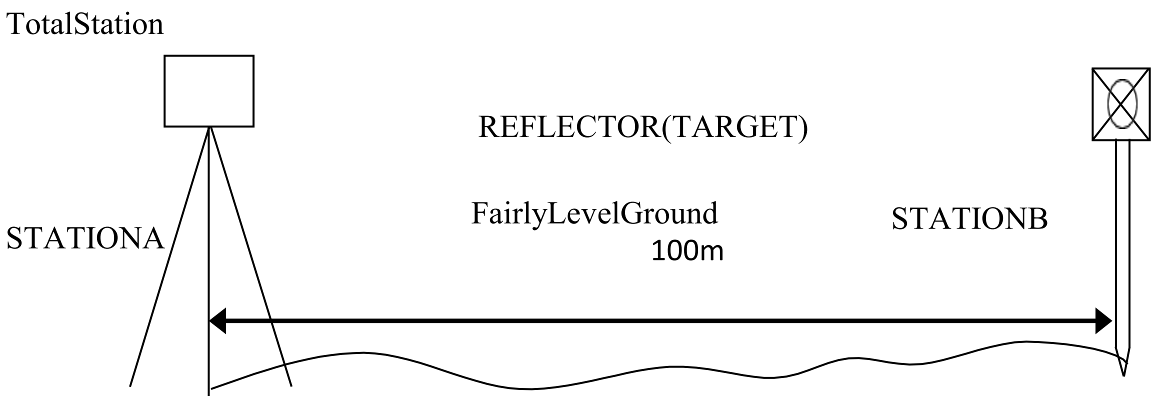


Fig3.4:HorizontalCollimation andVerticalIndexerrortest.

Table3.5:HorizontalCollimation Data

Station	Target	Face	HzReading	Difference	Error
A	B	L	38˚42‟32”		
		R	218˚42‟35”	180˚00‟03”	03”

3.4.2 VERTICAL INDEX ERROR TEST

This test was conducted to verify the accuracy of the vertical reading when the line of sight is horizontal .The desired measurement for this test is exactly ninety degrees (90˚),any deviation from this value is referred to as the vertical index error.

The Total Station was positioned over a specific point, and necessary temporary adjustments were made to ensure proper alignment and functionality. A target was placed approximately100 meters away from the Total Station ,and the instrument was aimed at the target .The target was bisected by aligning the instrument on the face left, and the corresponding readingwas recorded. Similarly, the target was then bisected on the face right, and the respective reading was also recorded. The recorded readings are provided below:

Table 3.6: Vertical Index Data

Instrument Station	TargetStation	Face	Vertical	Sum	Error
A	B	L	90˚00‟00”		
		R	270˚00‟02”	360˚00‟02”	02”

3.4.3 ANALYSISOFCOLLIMATIONANDVERTICALINDEXDATA

The reading obtain during calibration were reduced to obtain new collimation and vertical errors.

Horizontal collimation={(FR–FL)–180}/2={(00˚00‟03”}/2=1.5”

Vertical collimation={(FL+FR)–360}=(90˚00‟00”+270˚00‟02”)-360}=02”Theresult shows that the instrument is still in good working condition.

3.5 CONTROL CHECK

Three control beacons (KWCS 625T, KWCS 623T and KWCP 690) were used.In order toascertain the in-situ of the control beacons, a check was carried out on them by observing theangle between them and comparing the result obtained with the computed angles from the giving coordinates.

The total station instrument was set on the control beacon KWCS 623T. After performing all the necessary temporary adjustment, the reflect or was placed on the control beacon KWCS 625T which served as the back station. The horizontal angular reading was taken andrecorded while the instrument was on face left. The reflector was then taken to the controlbeacon KWCP 690 which serves as the forward station, the horizontal angle reading wasthen taken and recorded on both face left and face right. The reflector was taken back to thebackstation, the horizontal angle wasthenrecorded on face right.

Table3.7: showing the back computation of the control coordinates

From STN	**Bearing**	**Dist (m)**	**ΔN**	**ΔE**	**Northing(m)**	**Easting (m)**	**ToSTN**
					941451.040	674200.278	KWCS 625T
KWCS 625T	130°25'37"	**465.791**	302.055	-354.576	941753.095	673845.702	KWCS 623T
KWCS 623T	149°38'02"	**60.399**	48.946	-35.388	941802.041	673810.314	KWCP 690

Table3.8: showing the distance observation result of the control check

FROM	**OBSERVED DISTANCE (m)**	**COMPUTED DISTANCE (m)**	**TO**
KWCS 625T	465.902	465.791	KWCS 623T
KWCS 623T	60.521	60.399	KWCP 690

Table 3.9 showing the observation result of the control check

STN	SIGHT	FACE	OBSERVED HZANGLE	REDUCED HZANGLE	MEAN
	KWCS 625T	L1	195° 14'07"		
KWCS 623T	KWCP 690	L2	64° 47'29"	130°26'38"	
	KWCP 690	R2	15° 14'13"	130°26'22"	
	KWCS 625T	R1	145° 40'35"		130°26'30"

Difference in angle (observed - computed)=188°31'40"-188°31'36"

=00° 00'04"

Since the allowable accuracy (angular) of third order traverse of one station is 00° 00' 30" and the result obtained from the control check (00°00'04") is less than allow able error. Therefore, the controls were angularly intact.

3.6 MONUMENTATION

The boundary of the area carved out was demarcated with the precast concrete beacons, after clearing the required line of sights. The identified points of changes indirections were dug and beacons were buried on it, leaving about 15cm part of the beaconabove the ground level. The beacons were buried at convenient distances as dictated by the nature of the boundary

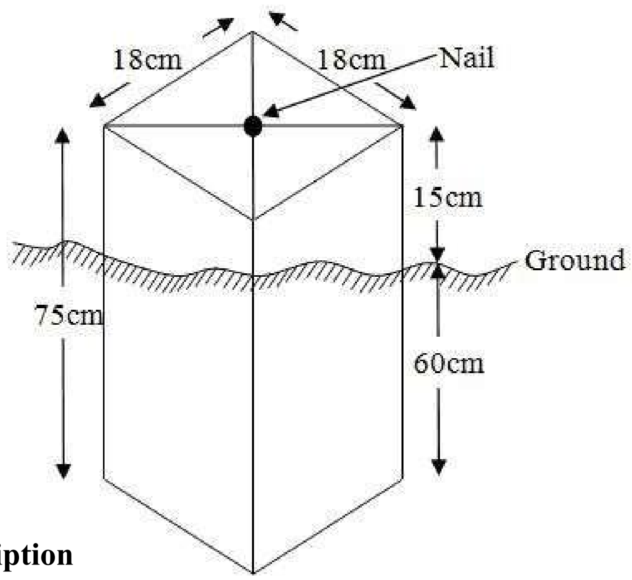


Fig.3.5: Pillar Description

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3.7 DATA ACQUISITION

PRIMARY DATA SOURCE

Field observation was the primary source of data for this project. Ground based method was used in acquiring data with the use of Total Station Instrument, which involved the collection of X, Y, Z data through coordinated Ground control Points (GCP) established at conspicuous points within the study area.

SECONDARY DATA SOURCE

An imagery of the area was acquired through Updated Google earth; this was used to ascertain the extent of coverage of the project area.

3.7.1 GEOMETRIC DATA ACQUISITION

The total station instrument was set carefully on control point KWCS 623T back sight taken to KWCS 625T after necessary station adjustments has been carried out on it. The adjustments includes; centering, leveling and focusing. The following procedures were then followed to determine the position of the next point KWCS 623T and the same procedure were repeated until all we come close to the site. The method used inacquiring data on site was radiation method where two or more points are coordinated from one point.

i. Having setup the instrument and temporary adjustment carried out, the instrument was powered „on" and a job was created under job menu in the internal memory of the instrument. The job created was named GRP6B

ii. On the job, the coordinates of the three (3) control points were keyed in to the memory of the instrument and some codes were also saved. The codes include

iii. „RD" for road„, SP" for spot height„, BD for buildings, etc.

iv. The height of the instrument was measured and saved on the memory of the instrument as well as the reflector height.

v. On coordinate menu,orientation was set by inputting the coordinates of the instrument station and back sight. The reflector at the back station was perfectly bisected before theories station was confirmed by clicking„ yes".

vi. Having done the orientation, the reflector at the next nail; was bisected and „obs ‟(observe) option was clicked. The three dimensional coordinate of the point (E,N, H) were displayed on the display unit of the instrument and „rec‟ (record) was clicked to save the data into the memory of the instrument. For subsequent observation after this„ all ‟option was used instead of pressing„ obs ‟and pressing

vii. „Record‟ later.

viii. It was ensured that the center of the prism of the reflector was bisected and that it was set perfectly on the tripod in order to minimize the error on height determination.

ix. The instrument is been shifted to another nail after all details, spot height and boundary point visible from the instrument station have been picked, set over it and temporary adjustments carried out.

x. Nonetheless, the above operations were repeated until all the boundary points with heights were coordinated.

xi. In this project all spot height are not in grid intervals but randomly acquired. Three edges (3) of building were picked. At the end of data acquisition process all details were acquired and properly recorded to be shown in their respective positions on the plan.

3.7.2 ATTRIBUTES DATA ACQUISITION

Attribute data is information about spatial features. They provide the characteristics, description and nomenclature about spatial objects. Thus the attributes data acquired includesnames of buildings and their uses such as classrooms, roads, water facilities and prominentnatural features likes river and trees found and vegetation were properly identified within andaroundthe studyarea.

3.8 DATA DOWNLOADING AND PROCESSING

3.8.1 DATA DOWNLOADING AND EDITING

This is stage whereby all data acquired which were automatically stored in the Total Station were downloaded into personal computer. This was done with the aid of downloading cable connected to the computer and some associated complementing software installed on theSystem.

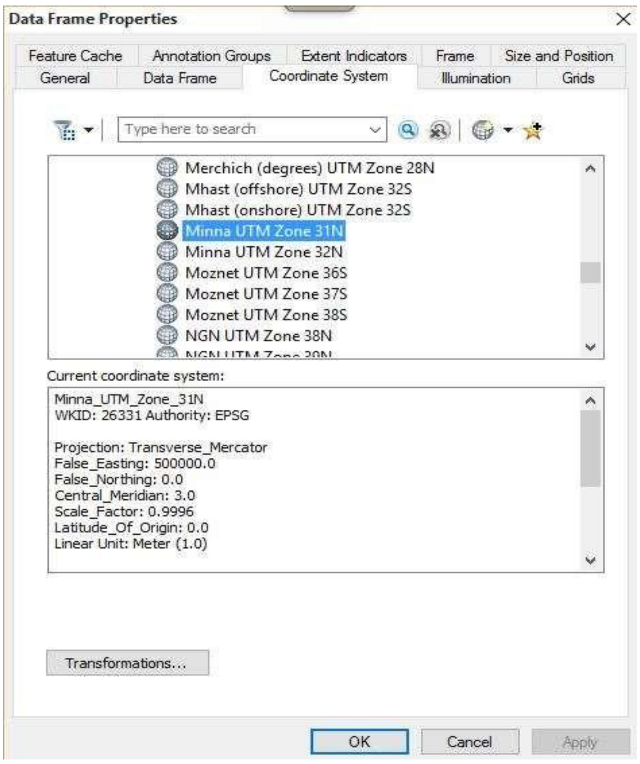
3.8.2 DATA PROCESSING AND DATA EDITING

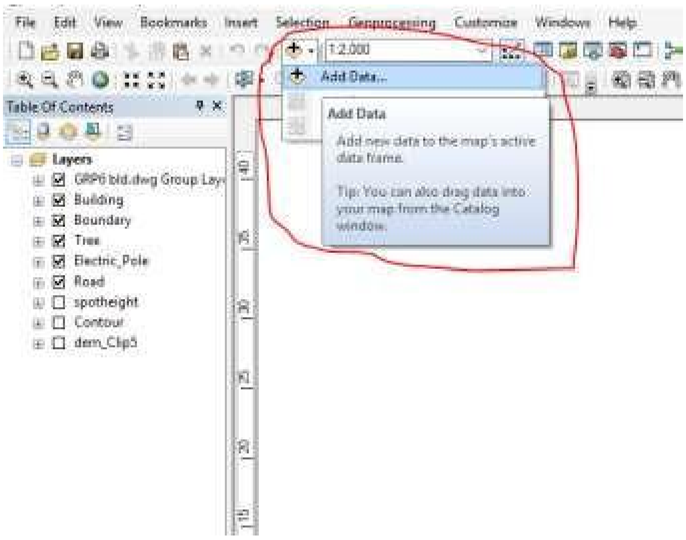
The geometric data downloaded were further processed in order to convert it to auseful format and to enhance its accuracy. The output coordinates, were edited and exported in *.txt, *.xls and *.pdf format. Thereafter, they were imported into Arc GIS 10.3 for further operations and to carryout spatial analysis.

3.8.3 DATA PROCESSING USING ARC GIS10.3

Before launching of ArcGIS AutoCAD was used in plotting of feature data saving them separately in different file named road, boundary line, buildings, trees and electric poles.

- Launch the Arc Map in Arc GIS10.3
- Click on ANEWEMPTY MAP on the dialog box displayed after loading
- Click on Tools on the menu bar, then select extensions, mark all and close.
- At the LHS, right click on layers, and then select properties.
- Click on coordinate system to set the projection system to MINNA DATUM ZONE 31N and general to set the unit, then apply and okay.
- Add data was selected at the tool bar all saved Auto CAD field was selected and load on to the table of content layer section

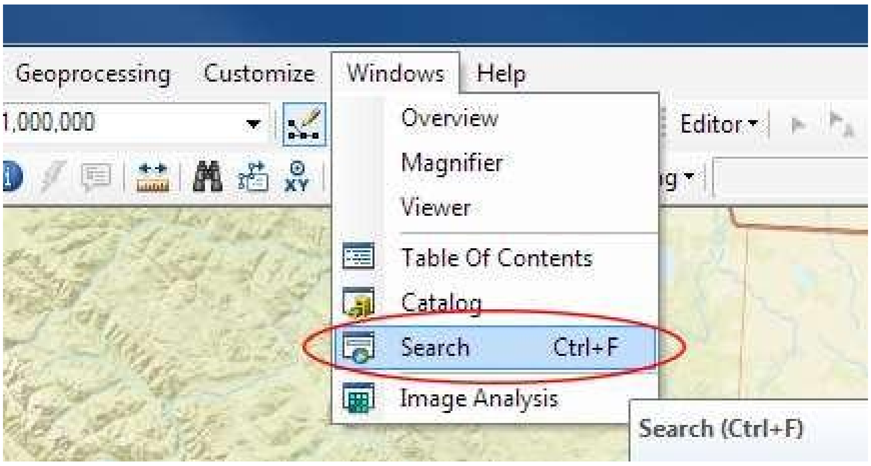




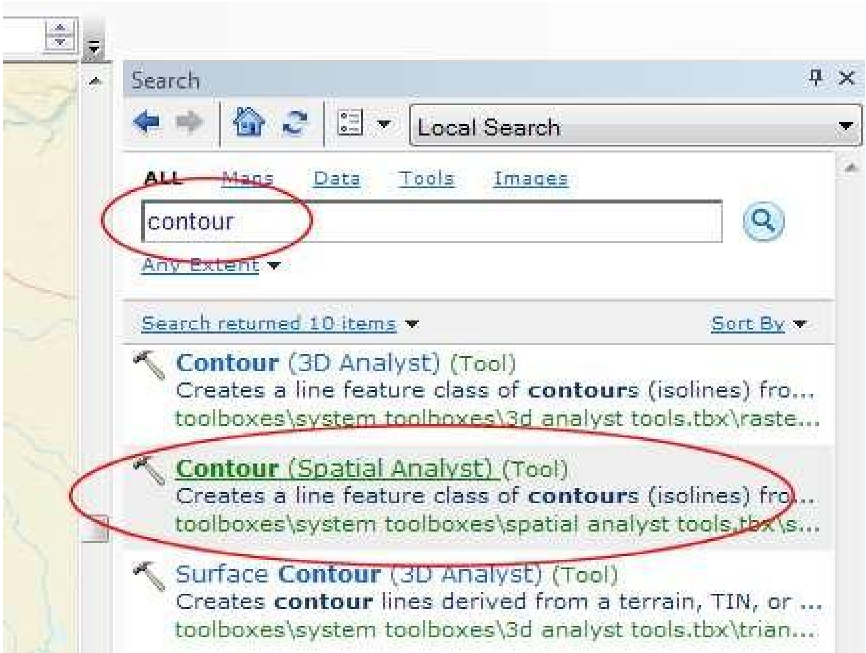
All drawing was exported to shape file. After the feature class has been creates, click on Editor to start Editing, and then click on the load object.

3.8.4 Topographical Map (DEM)

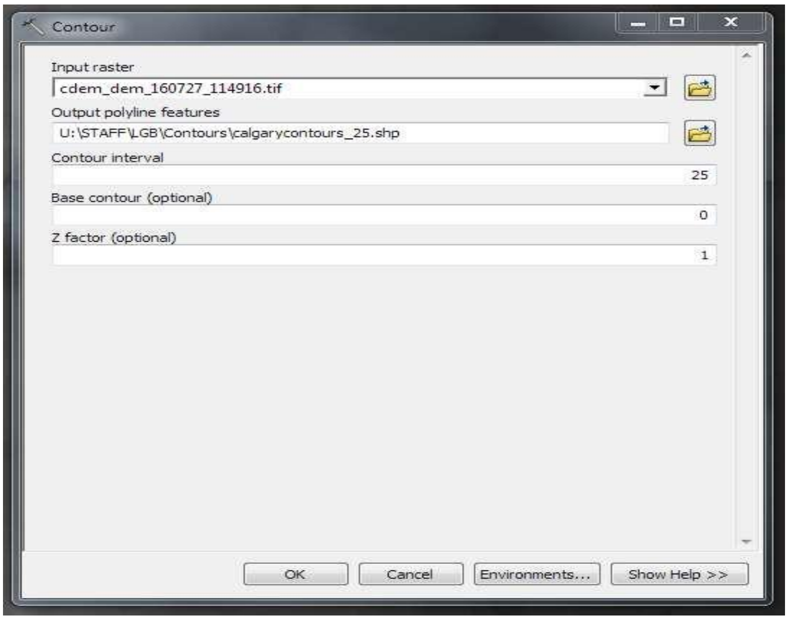
CRATING CONTOUR: Firstly DEM was created by searching in the search icon INTERPOLATION> NATURAL NIGHBOR and selecting THE XYZ data for creation of DEM in respect to the boundary line as extent. In order to create contours, you will need to enable the Spatial Analyst toolbar, which can be found by going to Customize > Toolbars > Spatial Analyst or open the search bar. You can do this by clicking Windows > Search, or by clicking on the search icon.



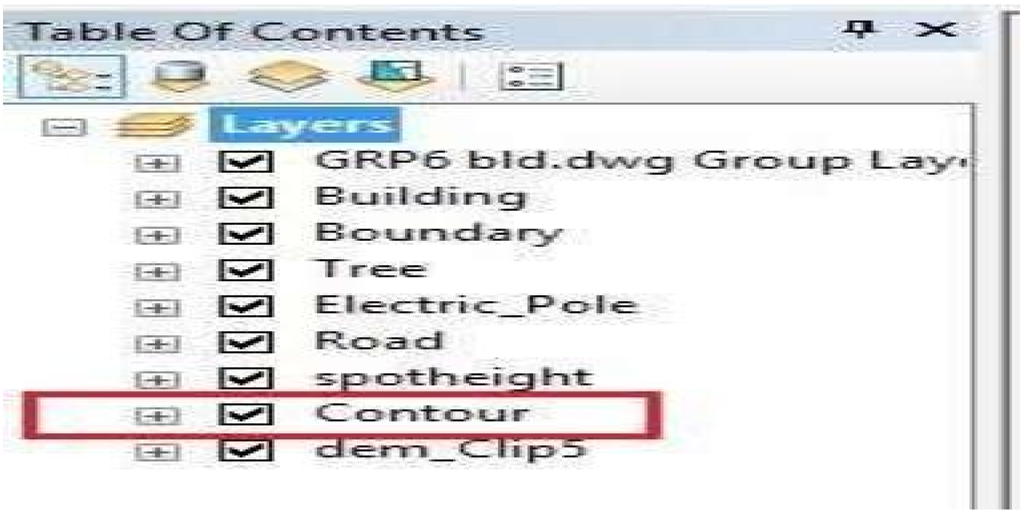
In the search bar type **Contour**, and select **Contour (Spatial Analyst)** from the search results list



After choosing Contour, a dialogue window will appear, prompting you for five settings: **Input raster:** select the DEM file from which you want to generate contours by locating it onyour hard drive or in the dropdown menu, showing layers present in the Table of Contents **Output poly line features**: indicate where you want to save your output contours **Contourinterval:** set the distance between contour lines in meters – the smaller the number, thegreater the number of lines **Base contour (optional):** the starting point from which the linesare generated – for example, the default is 0 so with an interval of 25 meters, the contours aregenerated at 25, 50, 75, 100…, but ifthe base contour is set at 40, then the contours aregenerated at 65, 90, 115, 140 and so on **Z factor (optional):** can be used to adjust the unitsof data; for example, if you have data in meters and you want to produce your contours infeet,useaz-factor of 3.28 because 3.28 feet equals one meter.



The generated contours will automatically be added to themap.



Input the data which is the AutoCAD drawing and select the feature type you want to load,

- Click Add and Next, then select the Target layer you want it to be
- Load it into from the feature class created on the ARCGLS.
- Click on Next, then select "only the features that satisfy the
- Query" and click on Query Builder to query for the feature to be loud e.g. "layer"=Boundary".
- Click on Next..... Then finish

Right click on the Boundary In the table of content and click on zoom to layer to display the feature.

EDITING, CONVERTING AND MERGING GEODATABASE

- Remove all necessary features by right clicking on it and press "REMOVE"
- Convert some features that are not in their correct„ features-type ‟like point, line, and polygon features etc.
- To convert a GOEDATA BASE FEATURE CLASS tanother the following steps were taken:
- FOR LINE FEATURE CLASS TO POLYGON FEATURE CLASS
- Go to WINDOW on the menu bar and select ARC Toolbox.
- Select DATA MANAGEMENT TOOLS, click on FEATURES, and then Select FEATURE TO POLYGON.
- ON INPUT FEATURES, select feature to be converted, on OUTPUT FEATURE CLASS, then save on the GRP6C FOLDER, press OK and CLOSE.
- Then remove the converted feature class in the LAYER Menu and ARC DATA LOG files.
- On INPUT DATA SETS, select features to be merged, on OUT PUT DATA SETS, then save on the GRP6C folder, press OK and CLOSE.
- Then remove the converted feature class in the LAYER Menu and ARC DATA LOG files.

ADDINGS POT HEIGHTS DATA

- NOTE: STOP EDITING on the EDITOR MENU before adding data field,
- Go to FIELD ON THE MENU BAR, scroll to add Data and then ADDXYZ DATA
- Browse the EXCEL FILE for SPOT HEIGHTS, select EASTING VALUE on X-FIELD and NORTHING VALUE on Y-IELD and ELEVATION

- « Select DATA the EXPORT DATA, locate the folder created and give it name then YESANDOK, remove the previous layer by right clicking on it and select REMOVE.

TIN,ASPECTANDSLOPECREATIONUSINGARCMAP

NOTE: Making sure the 3D Analyst Extension is active, select VIEW on MENU bar, then click TOOLBARS and MARK the3D Analyst EXTENTION Then X, Y Data

TO CREATE TIN

- Click on 3D Analyst arrow, select create TIN and then create TIN from FEATURE.
- On layers mark the SPOT HEIGHT LAYER, select height data on HEIGHT, the nok.

TO CHANGE THE FACE OF THE TIN ACCODING TO ITS ELEVATION

- RIGHT CLICK on the TIN, select PROPERTIES, and click on SYMBOLOGY.
- Then ADD, select FACE ELEVATION WITH COLOR RAMP, click ADD, and then select APPLYand OK.

TO CREATE ASPECT

- Click on 3D analyst arrow, select SPATIAL ANALYST TOOLS, SURFACE and THEN DOUBLE CLICK on ASPECT.

- Browse to where the raster format of all the acquired data created from the surfer wassavedto.

- Browse to where you want the OUT PUT RASTER to be saved
- You can change the OUT PUT MEASUREMENT to Degree OR percent
- Click OK [then it displays on the data view screen], then Close.

3.8.5 Facility Map Production

The buildings were digitized from the downloaded Google earth image using ArcGIS 10.2.1. Shape files for the facilities were created in Arc Catalogue. The created shape files were added to Arc Map and editor was started to digitize out to facilities. The road network, buildings are extracted using polyline and polygon respectively while street lights and trees are represented by point data for 3D map production the generated 2D map is shown in Figure 3.6, Figure 3.7 shows the old 2D CAD map of the campus.

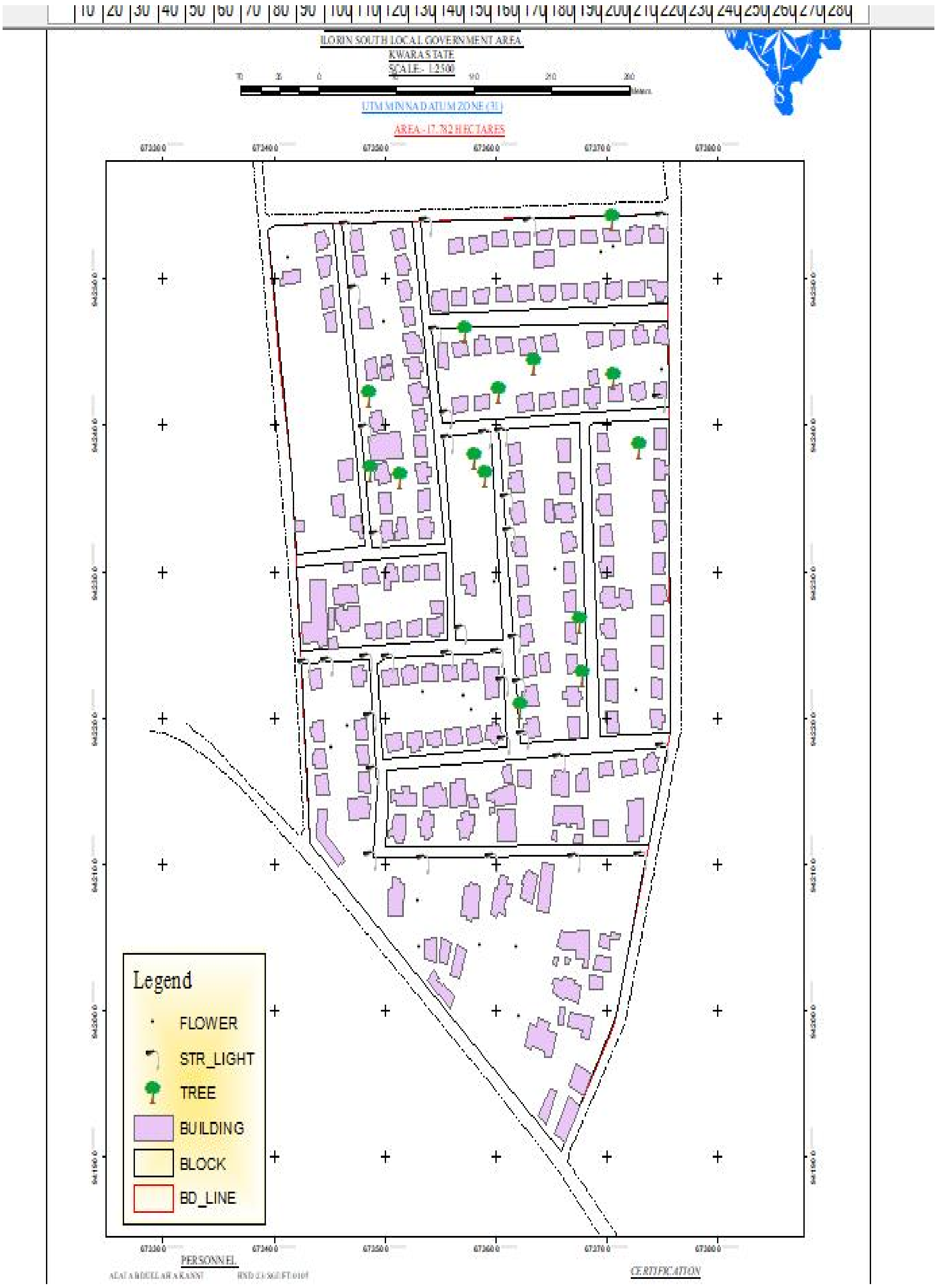


Figure 3.6 showing the 2D facility map of the study area.

3.8.6 3D Map Production

The 3D image was done Arc Scene using the created DEM; the created DEM was added to Arc Scene and extruded with the heights gotten on the field. Extrusion incorporates the height of these features in their representation to give them 3D look and was made to float on DEM to have a true land representation.

The created DEM was also added to Arc Scene, The height of the buildings gotten from the field was added to the already created height field in the attribute table of each of the facility shape file in Arc Map. Arc Scene was launched and all the shape files were added, from the table of content each shape file was right clicked on to access the property dialog box, from the property dialog box the shape files were extruded to give them 3D look and were made to float on the DEM to have a full 3D visualization.

3.8.7 Findings

This study has demonstrated a capability of GIS in facility mapping with different visualizations techniques i.e. 2D and 3D visualization, Figure 3.6 shows the generated 2D map while Figure 4(a) and Figure 4(b) show cross-sections of the generated 3D map of the campus. All the facilities were geo-located with the aid of total station and imported into ArcGIS 10.2, the facilities were also digitized from the Google earth image downloaded for the study area. 3D topographic maps of the study areas were created from the point data gotten from field-work and also from the downloaded SRTM DEM image downloaded from USGS, Figure 5 shows the 2D Topographic map generated from the point data gotten from the field using Total station while Figure 6 shows the 3D topographic map generated using the same data source. Figure 7 shows the 2D topographic map generated from SRTM 30 m while Figure 8 shows the 3D topographic map generated using the same data source. The 2D facility map was produced by digitizing all the facilities out as features from the Google earth image downloaded using Google downloader. The 3D model of the campus was produced by exporting all the features created in Arc Map to Arc Scene for extrusion; the extruded features were made to float on the 3D topography map created through interpolation using Kriging method. The 3D visualization gives the study area a near real life view.

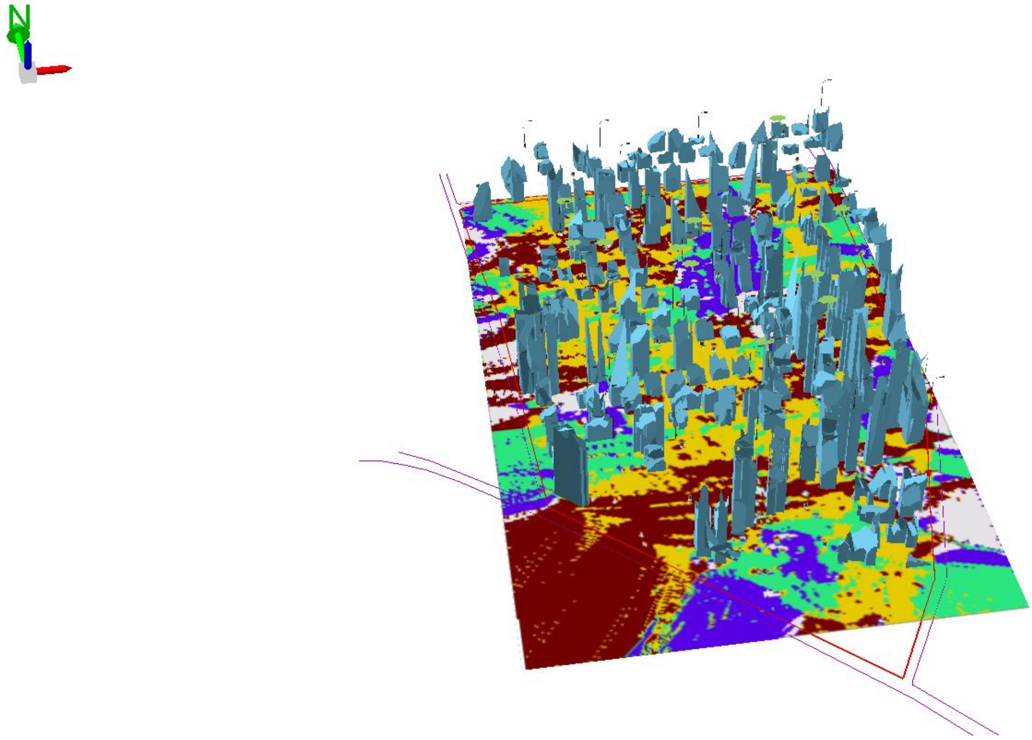


Figure 3.7 (a) Showing 3D model of the study area area

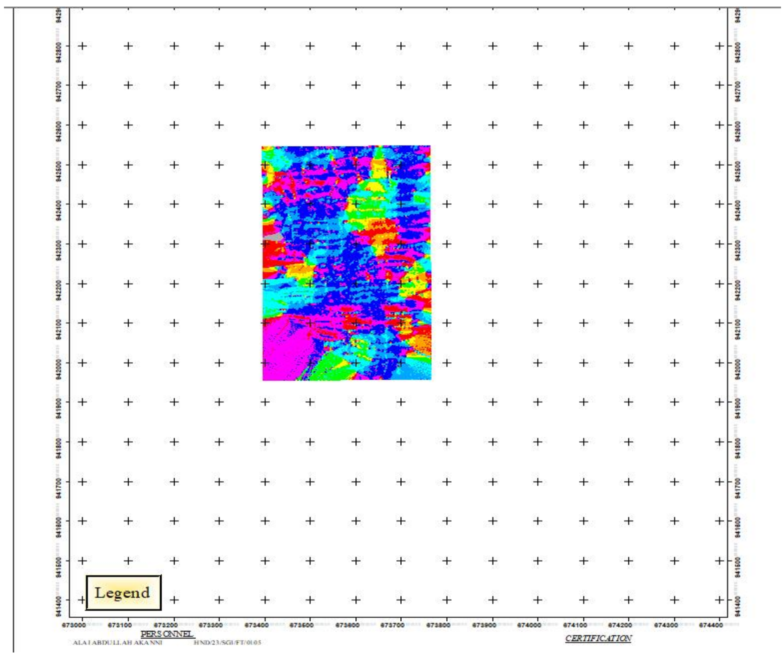


Figure 3.8 showing the 2D DEM (Digital elevation model) of the study area (derived from the field data).

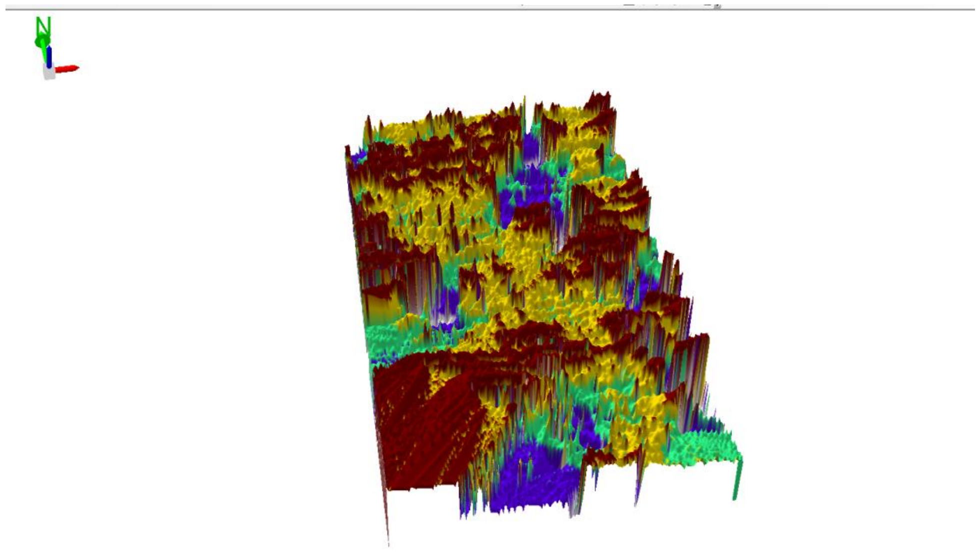


Figure 3.9 Showing 3D DEM (Digital Elevation Model) of the study area (derived from the field data).

3.8.8 Attribute data creation

There is need to create attribute tables for the features so as to be used for queries.NOTE: The editor on the menu bar must be stopped before adding field to its table. **THE FOLLOWING PROCEDURES WERE FOLLOWED:**

- Right click on the feature class, then select OPEN ATTRIBUTE STABLE click on OPTIONS and select ADD FIELD.
- Give it FIELD NAME, click on TYPE and select [SHORT INTEGER or LONG INTEGER for SHORT or LONG WHOLE VARIABLES or DOUBLE FOR DECIMAL VARIABLES OR TEXT variable or DATE for DATE], then enter precision or LENGTH for text width and scale for DECIMAL PLACES, and then click OK
- To input variables on the ATTRIBUTE TABLE, go to the EDITOR on Menu bar, select START EDITING,
- Click on ATTRIBUTE on menu bar [behind the TARGET], click on the features onthe DATA VIEW display,and then input the variables of data acquired through

SOCIAL SURVEY or DATA ACQUIRED ON THE FIELD.

- Save it after the input by selecting SAVE EDITS on the editor menu. To switch toother layers, select STOP EDITING on the EDITOR menu. Then repeat the above step to create other fields. Populatethe table and save.

Table3.10: Building

ENTITY	FIELDALIAS	DATATYPE	FIELDSIZE
B_ID	Building Identification	Numeric	-
B_name	Building Name	Text	10
B_Area	Building Area	Numeric	-
B_E	Building Easting	Numeric	-
B_Northing	Building Northings	Numeric	-

Table3.11:Road

ENTITY	FIELDALIAS	DATATYPE	FIELDSIZE
R_ID	RoadIdentifier	Numeric	-
R_Length	RoadLength	Numeric	-
	Road Width	Numeric	-
R_Type	RoadType	Text	10
R_Condition	RoadCondition	Text	10

Table3.12: Trees

ENTITY	FIELDALIAS	DATATYPE	FIELDSIZE
TR_ID	TreeIdentifier	Numeric	-
TR_Spp	Treespecy	Text	10
TR_E	Tree_Easting	Numeric	-
TR_N	TreeNorthing	Numeric	-

Table3.13: Electric Poles

ENTITY	FIELDALIAS	DATATYPE	FIELDSIZE
EP_ID	Electric pole Identifier	Numeric	-
EP_Type	Electric pole Type	Text	10
EP_Height	Electric pole Height	Numeric	-
EP_E	Electric pole Easting	Numeric	-
EP_N	Electric pole Northing	Numeric	-

3.8.9 DATA BASE IMPLEMENTATION

This is the database creation phase. Having completed the three stages of design phase (i.e. Reality, Conceptual and Logical design), the data base was created using Arc GIS 10.3 software. It involves the combination and storage of acquired graphic data and attributes dataincreating the database forthe purposeofspatial analysisand query.

Database is an organized integrated collection of data stored so as to be capable of use by revenant application with data being accessed by different logical part. After the Attribute table was populated via the keyboard, some attributes such as areas of settlements were automatically displayed by special command in the Arc GIS 10.3version.The Arc GIS software was used to link the graphic data and table for query generation.

3.8.10 DATA BASE MANAGEMENT SYSTEMS

Data base management is a collection of software for creating, storing, manipulating, updating, organizing and querying of information in a database (Kufoniyi, 1998). It is a software package whose function is to manipulate a data base on behalf of the user.

Agood DBMS must provide the following functions:

- Storage and retrieval of data.
- Access to by several users at a time.
- A standardized interface between database and application programmed.
- Standardized access to data and separation of data storage and retrieval functions from the program using the data.
- Maintenance of data security and integrity.

3.8.11 DATABASEMAINTENANCE

Having created the database, proper maintenance epractice was made to meet its stated objectives. The ability to include more data and remove irrelevant data was possible by way of maintenance. There is every need for the data to be updated regularly because of thephysical changes that may occur on the landscape with time. Both security and integrity were also exercised to ensure maintenance and to meet its stated objectives.

Proper observance, updating and management of database ensure its currency and quality tostand a profound chance in Spatial Decision Support System (SDSS). The quality of anydatabase depends on the currency and fitness for use as a decision support system (SDSS).The quality of database depends on its ability to generally fit and use as a decision system(DSS). The storage media should be from time to time justified if otherwise could necessitatedata inaccessibility or physical deterioration of the storage media.Also care must be takenduring populating any database system, as a database is only good as the data supplied. Inarchivingstable media should be used. Examples of these are:-

- Computer compatible tape reader
- Magnetic tape
- Optical disc and compact disc

3.8.12 AREA COMPUTATION Table

Table3.14: shows area computation

	A	B	C	D	E
1	STATION			NORTHING	EASTHING
2	PT1			673432.2	942113.78
3	PT2	-28.25	334.19	673403.95	942447.97
4	PT3	-9.51	84.96	673394.44	942532.93
5	PT4	5.48	3.7	673399.92	942536.63
6	PT5	354.5	6.58	673754.42	942543.21
7	PT6	32.15	-353.52	673757.24	942189.69
8	PT7	-32.15	73.28	673725.09	942064.55
9	PT8	-17.82	-73.28	673707.27	941991.27
10	PT9	-48.37	-87.43	673658.9	941903.84
11	PT1				
12			AREA	177816.4103	
13					
14			HECTARES	17.78164103	
15					
16					

CHAPTER FOUR

4.0 SPATIAL ANALYSES AND PRESENTATION

GIS is distinct among other information system because of its spatial analytical capability; especially overlay operation, buffering, spatial search, topographic operation, and neighborhood and connectivity operations. GIS uses this spatial analytical capability to answer fundamental generic question of location, condition, trend, routing, pattern and modeling by the manipulation and analysis of input data. The major analyses performed inthisproject wereoverlayoperations, topographic operations andspatial search.

4.1 TESTING OF DATABASE

This is the test carried out to determine whether there exists a relationship between data modeled about entities in a spatial data base as well as putting into test its retrieval capabilities. This was done by designinga sample query with certain conditions attached andthequerywill beran to seeif desired result is achieved.

4.11 ANALYSIS OF RESULT

The contour whose value is greater or equal to350 meters depicts the likelihood that sucharea may not be prone to flood in the project area as shown in Fig. 4.5(Query 1). This represents the elevation of points that are greater than to 350m. The displayed attribute table confirmed that North-East part of the institute had the highest elevation. Height is an important factor when considering the surface or slope of the terrain. The South-west part of the school had the lowest elevation which is very prone to erosion. Buildings that will be sited in that region must have a very high foundation above the ground level. The result of the query will afford the school management to decide concisely the terrain characteristics and the kind of building that should build in every region of the project area looking critically attheterrain of thearea.

SINGLE SELECTION CRITERION

Query1: shows the completed building

SELECT* **FROM** Building **WHERE** "BLD_STATUS" LIKE COMPLETED

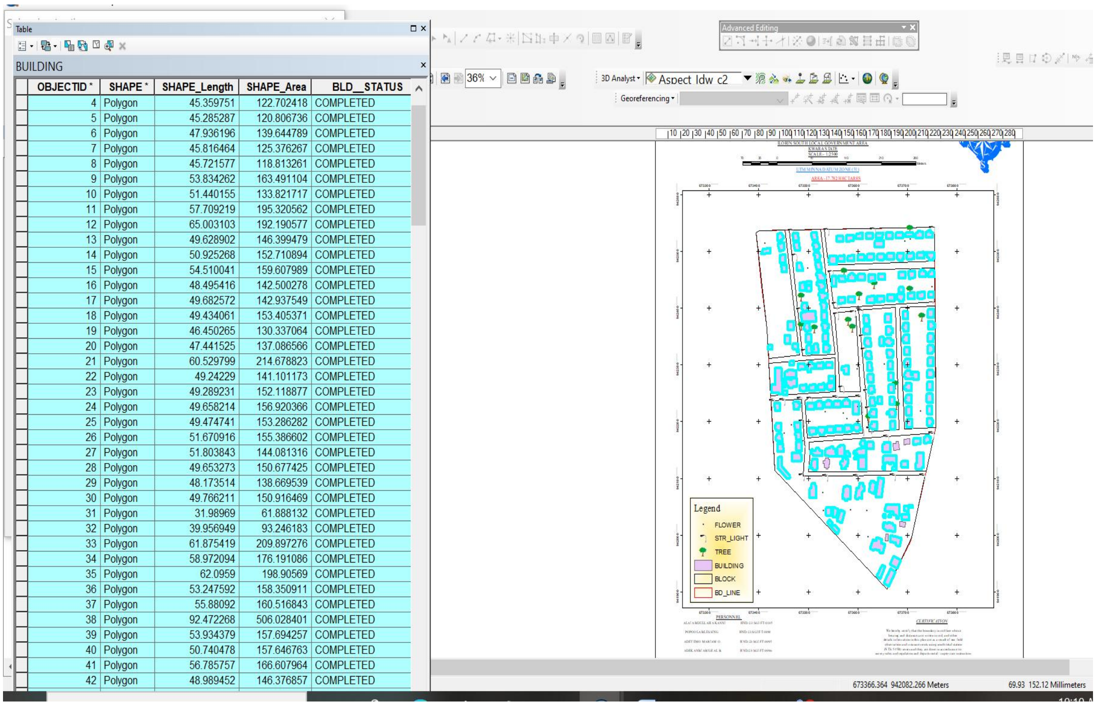


Fig4.1:shows the completed building

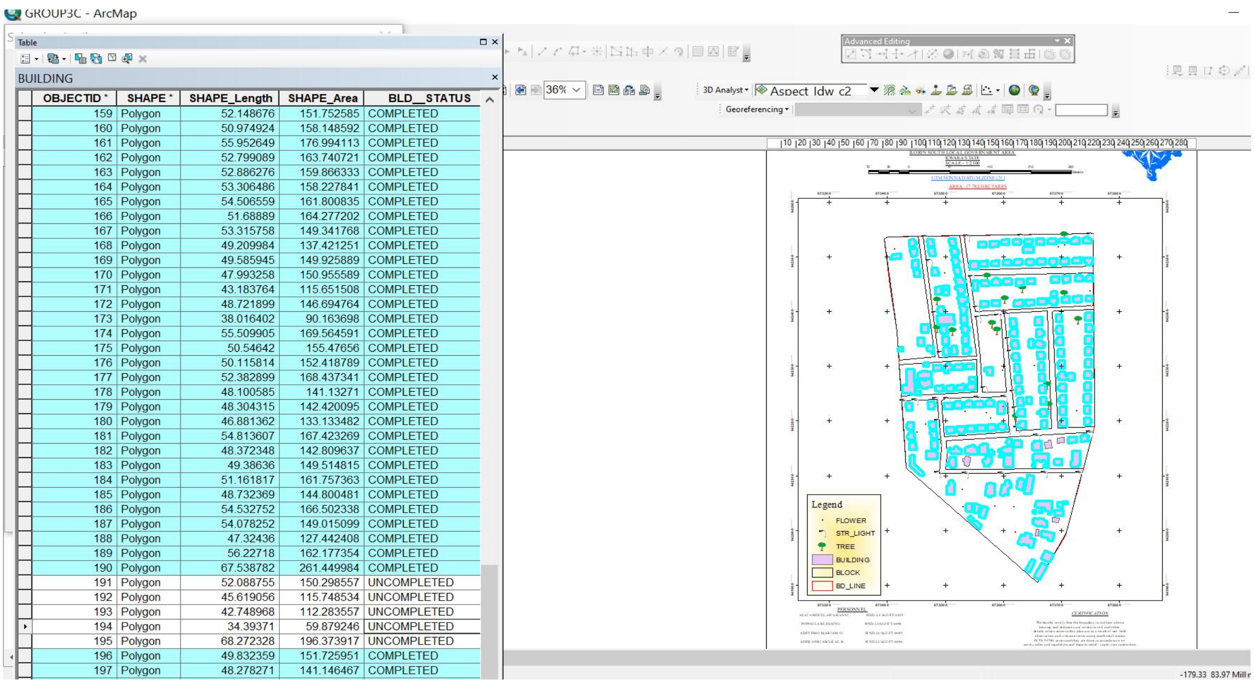
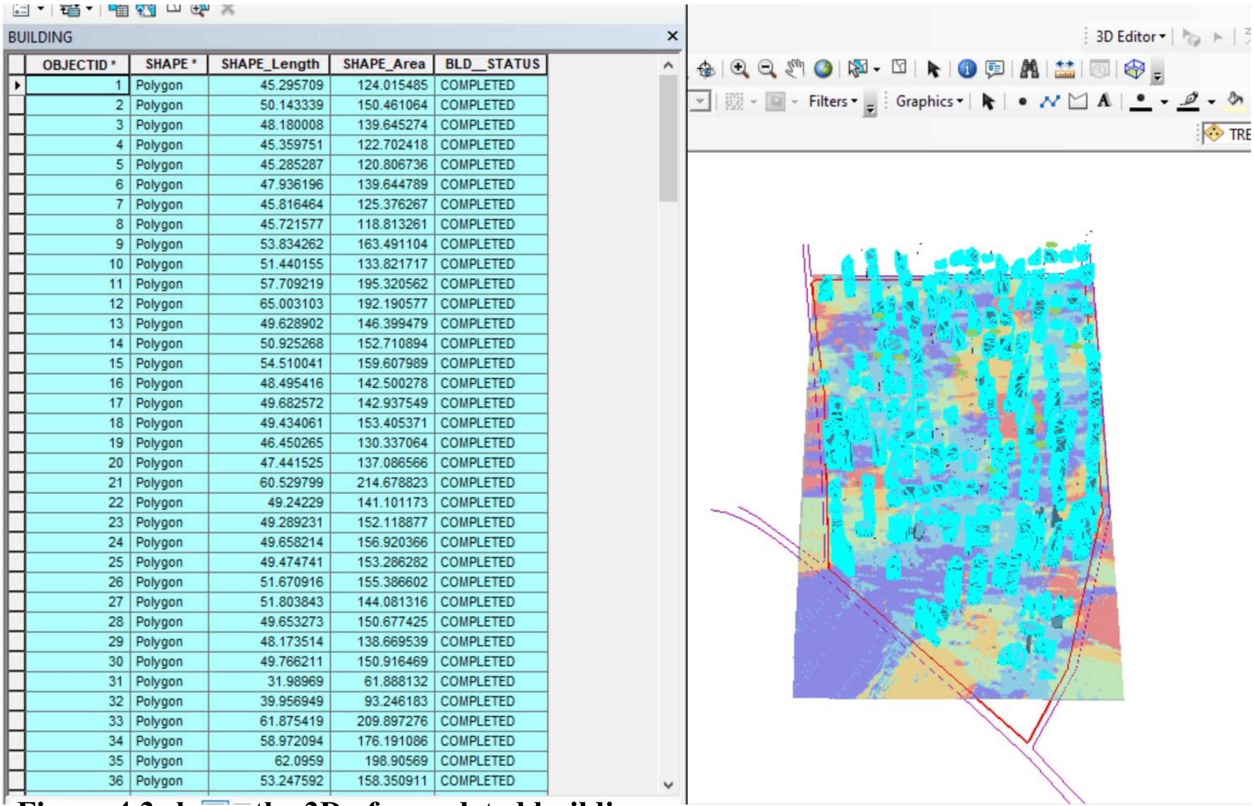


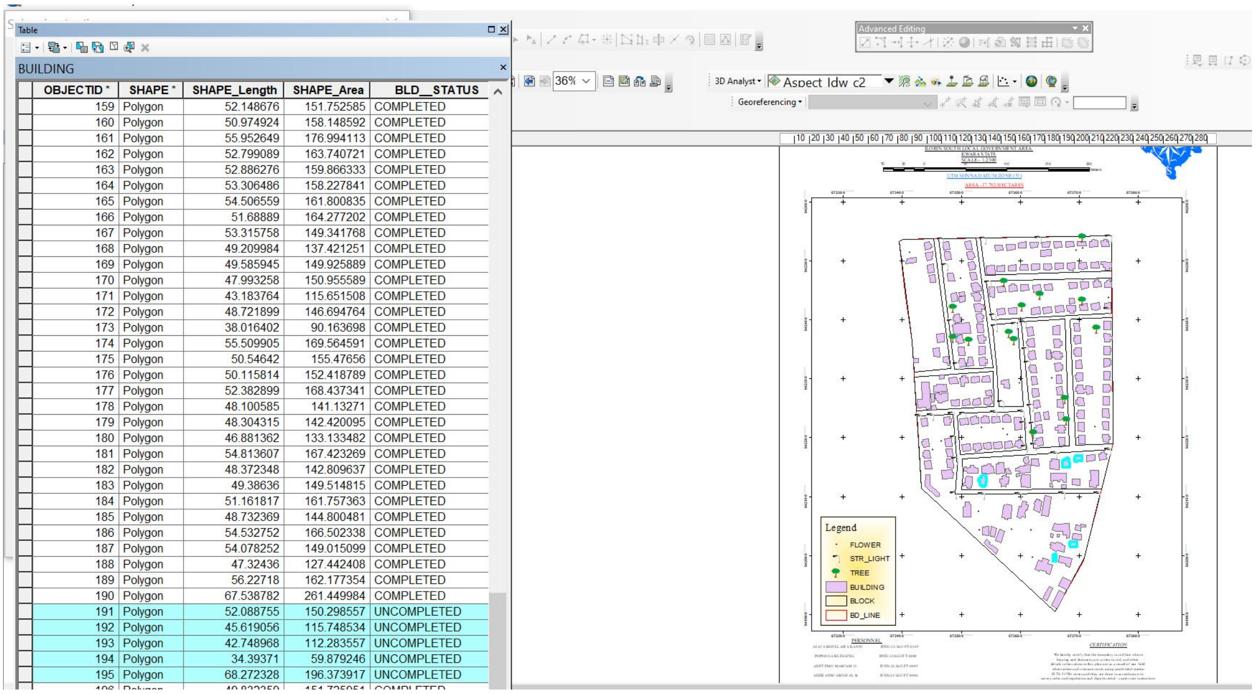
Fig4.2:shows the 2D completed building



BUILDING

OBJECTID *	SHAPE *	SHAPE_Length	SHAPE_Area	BLD__STATUS
1	Polygon	45.295709	124.015485	COMPLETED
2	Polygon	50.143339	150.461064	COMPLETED
3	Polygon	48.180008	139.645274	COMPLETED
4	Polygon	45.359751	122.702418	COMPLETED
5	Polygon	45.285287	120.806736	COMPLETED
6	Polygon	47.936196	139.644789	COMPLETED
7	Polygon	45.816464	125.376267	COMPLETED
8	Polygon	45.721577	118.813261	COMPLETED
9	Polygon	53.834262	163.491104	COMPLETED
10	Polygon	51.440155	133.821717	COMPLETED
11	Polygon	57.709219	195.320562	COMPLETED
12	Polygon	65.003103	192.190577	COMPLETED
13	Polygon	49.628902	146.399479	COMPLETED
14	Polygon	50.925268	152.710894	COMPLETED
15	Polygon	54.510041	159.607989	COMPLETED
16	Polygon	48.495416	142.500278	COMPLETED
17	Polygon	49.682572	142.937549	COMPLETED
18	Polygon	49.434061	153.405371	COMPLETED
19	Polygon	46.450265	130.337064	COMPLETED
20	Polygon	47.441525	137.086566	COMPLETED
21	Polygon	60.529799	214.678823	COMPLETED
22	Polygon	49.24229	141.101173	COMPLETED
23	Polygon	49.289231	152.118877	COMPLETED
24	Polygon	49.658214	156.920366	COMPLETED
25	Polygon	49.474741	153.286282	COMPLETED
26	Polygon	51.670916	155.386602	COMPLETED
27	Polygon	51.803843	144.081316	COMPLETED
28	Polygon	49.653273	150.677425	COMPLETED
29	Polygon	48.173514	138.669539	COMPLETED
30	Polygon	49.766211	150.916469	COMPLETED
31	Polygon	31.98969	61.888132	COMPLETED
32	Polygon	39.956949	93.246183	COMPLETED
33	Polygon	61.875419	209.897276	COMPLETED
34	Polygon	58.972094	176.191086	COMPLETED
35	Polygon	62.0959	198.90569	COMPLETED
36	Polygon	53.247592	158.350911	COMPLETED

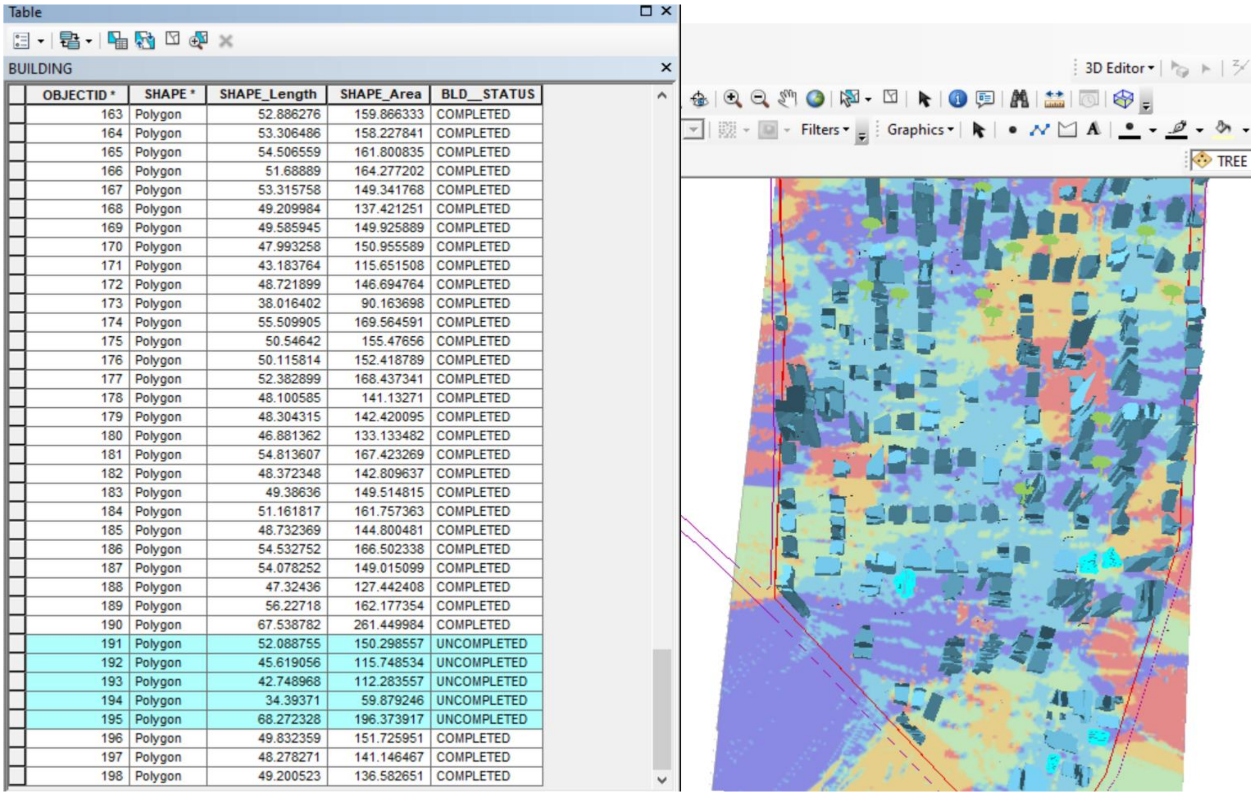
Figure 4.3 shows the 3D of completed building



BUILDING

OBJECTID *	SHAPE *	SHAPE_Length	SHAPE_Area	BLD__STATUS
159	Polygon	52.148676	151.752585	COMPLETED
160	Polygon	50.974924	158.148592	COMPLETED
161	Polygon	55.952649	176.994113	COMPLETED
162	Polygon	52.799089	163.740721	COMPLETED
163	Polygon	52.886276	159.866333	COMPLETED
164	Polygon	53.306486	158.227841	COMPLETED
165	Polygon	54.506559	161.800835	COMPLETED
166	Polygon	51.68889	164.277202	COMPLETED
167	Polygon	53.315758	149.341768	COMPLETED
168	Polygon	49.209984	137.421251	COMPLETED
169	Polygon	49.585945	149.925889	COMPLETED
170	Polygon	47.993258	150.955589	COMPLETED
171	Polygon	43.183764	115.651508	COMPLETED
172	Polygon	48.721899	146.694764	COMPLETED
173	Polygon	38.016402	90.163698	COMPLETED
174	Polygon	55.509905	169.564591	COMPLETED
175	Polygon	50.54642	155.47656	COMPLETED
176	Polygon	50.115814	152.418789	COMPLETED
177	Polygon	52.382899	168.437341	COMPLETED
178	Polygon	48.100585	141.13271	COMPLETED
179	Polygon	48.304315	142.420095	COMPLETED
180	Polygon	46.881362	133.133482	COMPLETED
181	Polygon	54.813607	167.423269	COMPLETED
182	Polygon	48.372348	142.809637	COMPLETED
183	Polygon	49.38636	149.514815	COMPLETED
184	Polygon	51.161817	161.757363	COMPLETED
185	Polygon	48.732369	144.800481	COMPLETED
186	Polygon	54.532752	166.502338	COMPLETED
187	Polygon	54.078252	149.015099	COMPLETED
188	Polygon	47.32436	127.442408	COMPLETED
189	Polygon	56.22718	162.177354	COMPLETED
190	Polygon	67.538782	261.449984	COMPLETED
191	Polygon	52.088755	150.298557	UNCOMPLETED
192	Polygon	45.619056	115.748534	UNCOMPLETED
193	Polygon	42.748968	112.283557	UNCOMPLETED
194	Polygon	34.39371	59.879246	UNCOMPLETED
195	Polygon	68.272328	196.373917	UNCOMPLETED

Fig4.4 Query shows the 2D of uncompleted building



OBJECTID *	SHAPE *	SHAPE_Length	SHAPE_Area	BLD__STATUS
163	Polygon	52.886276	159.866333	COMPLETED
164	Polygon	53.306486	158.227841	COMPLETED
165	Polygon	54.506559	161.800835	COMPLETED
166	Polygon	51.68889	164.277202	COMPLETED
167	Polygon	53.315758	149.341768	COMPLETED
168	Polygon	49.209984	137.421251	COMPLETED
169	Polygon	49.585945	149.925889	COMPLETED
170	Polygon	47.993258	150.955589	COMPLETED
171	Polygon	43.183764	115.651508	COMPLETED
172	Polygon	48.721899	146.694764	COMPLETED
173	Polygon	38.016402	90.163698	COMPLETED
174	Polygon	55.509905	169.564591	COMPLETED
175	Polygon	50.54642	155.47656	COMPLETED
176	Polygon	50.115814	152.418789	COMPLETED
177	Polygon	52.382899	168.437341	COMPLETED
178	Polygon	48.100585	141.13271	COMPLETED
179	Polygon	48.304315	142.420095	COMPLETED
180	Polygon	46.881362	133.133482	COMPLETED
181	Polygon	54.813607	167.423269	COMPLETED
182	Polygon	48.372348	142.809637	COMPLETED
183	Polygon	49.38636	149.514815	COMPLETED
184	Polygon	51.161817	161.757363	COMPLETED
185	Polygon	48.732369	144.800481	COMPLETED
186	Polygon	54.532752	166.502338	COMPLETED
187	Polygon	54.078252	149.015099	COMPLETED
188	Polygon	47.32436	127.442408	COMPLETED
189	Polygon	56.22718	162.177354	COMPLETED
190	Polygon	67.538782	261.449984	COMPLETED
191	Polygon	52.088755	150.298557	UNCOMPLETED
192	Polygon	45.619056	115.748534	UNCOMPLETED
193	Polygon	42.748968	112.283557	UNCOMPLETED
194	Polygon	34.39371	59.879246	UNCOMPLETED
195	Polygon	68.272328	196.373917	UNCOMPLETED
196	Polygon	49.832359	151.725951	COMPLETED
197	Polygon	48.278271	141.146467	COMPLETED
198	Polygon	49.200523	136.582651	COMPLETED

Figure 4.5 shows the 3D of uncomplted building

CHAPTER FIVE

5.0 COSTING ESTIMATION, SUMMARY, CONCLUSION, RECOMMENDATION AND PROBLEM ENCOUNTERED

5.1 COSTING ESTIMATION

RECCONNAISSANCE

S/N	PERSONNEL	QTY	DAILY RATE	NO OF DAYS	REMARK
1	Group leader	1	5000	1	5000
2	Ass group leader	1	2500	1	2500
3	Basic equipment	1	25000	1	25000
4	Transportation	1	3000	1	3000

Subtotal = #35,500

MONUMENTATION

S/N	PERSONNEL	QTY	DAILY RATE	NO OF DAYS	REMARK
1	Group leader	1	5000	1	5000
2	Ass group leader	1	2500	1	2500
3	Skilled labor	3	1500	1	4500
4	Basic equipment	1	25000	1	25000

5	Transportation	1	7500	1	3000

Subtotal = #40,000

Beaconing

S/N	PERSONNEL	QTY	DAILY RATE	NO OF DAYS	REMARK
1	Group leader	1	5000	1	5000
2	Ass group leader	1	2500	1	2500
3	Basic equipment	1	5000	1	5000
4	Transportation	1	3000	1	3000

Subtotal = #5,500

BEACON

S/N	PERSONNEL	QTY	DAILY RATE	NO OF DAYS	REMARK
1	Group leader	1	5000	1	5000
2	Ass group leader	1	2500	1	2500
3	Beacon	10	1000	1	10,000
4	Transportation	1	3000	1	3000

Subtotal = #19,500

TRAVERSING

S/N	PERSONNEL	QTY	DAILY RATE	NO OF DAYS	REMARK
1	Supervisor	1	6000	1	6000
2	Group leader	1	5000	1	5000
3	Ass group leader	1	2500	1	2500
4	Skilled labour	6	1500	1	10,000
5	Basic equipment	1	25000	1	5000
6	Transportation	1	10,500	1	10,500

Subtotal = #43,500

SPOT HEIGHT

S/N	PERSONNEL	QTY	DAILY RATE	NO OF DAYS	REMARK
1	Supervisor	1	6000	2	12,000
2	Group leader	1	5000	**2**	10,000
3	Ass group leader	1	2500	2	5000
4	Skilled labor	6	1500	2	20,000
5	Basic equipment	1	25000	1	5000

6	Transportation	1	10,500	2	21,000

Subtotal = #73,000

DATA PROCESSING

S/N	PERSONNEL	QTY	DAILY RATE	NO OF DAYS	REMARK
1	Group leader	1	5000	1	5000
2	Ass group leader	1	2500	1	2500
3	Basic equipment	1	10,000	1	10,000
4	Generator and fuel	1	10,000	1	10,000

Subtotal = #27,500

TECHNICAL REPORT

S/N	PERSONNEL	QTY	DAILY RATE	NO OF DAYS	REMARK
1	Group leader	1	5000	1	5000
2	Ass group leader	1	2500	1	2500
3	Basic equipment	1	10,000	1	10,000
4	Generator and fuel	1	10,000	1	10,000

Subtotal = #27,500

Sum total = 271,500.00

$$\textbf{Contingency allowance} = \frac{271{,}500.00 \times 5}{100} = 13{,}575$$

$$\textbf{VAT} = \frac{271{,}500.00 \times 7.5}{100} = 20{,}362.5$$

$$\textbf{ACCOMODATION} = \frac{271{,}500.00 \times 1.5}{100} = 4{,}072.5$$

$$\textbf{MOB/DEMB} = \frac{271{,}500.00 \times 10}{} = 27{,}150$$

GLEARANCE TAX =65,159.5

5.2 Summary

This project focused on the digital mapping of the Federal Royal Valley Estate located in the Sango Kulende area of Ilorin, Kwara State. The survey was executed in compliance with third-order specifications. A thorough reconnaissance both office and field-based was conducted to facilitate effective planning and execution. This included identifying suitable control points for orientation, selecting appropriate instruments, and preparing a preliminary sketch of the survey area.

The scope of the project encompassed traversing, perimeter survey, leveling, detailing, and the acquisition of spot heights, with the Total Station serving as the primary surveying instrument. Traversing was employed to determine the coordinates (Northings and Eastings) of survey stations, while the elevation data for these stations were derived from perimeter leveling. Tachometric methods were applied to determine the positions of new points.

Subsequent data processing was carried out, and the final plan was produced in both manual and digital formats. The resulting title plan clearly delineated the perimeter and detailed features of the entire project area. A comprehensive technical report was also prepared, documenting the methodology, execution, and outcomes of the project.

5.3 CONCLUSION

The literature establishes a strong theoretical and practical foundation for the use of digital mapping in infrastructural development. Geospatial technologies have proven benefits in enhancing planning, monitoring, and equitable service delivery. However, barriers related to cost, capacity, governance, and data quality persist, particularly in developing contexts. These gaps provide justification for further research aimed at exploring localized applications, evaluating the effectiveness of digital mapping, and developing strategies for broader adoption.

5.4 RECOMMENDATIONS

Having actively participated in this practical project and gained valuable hands-on experience, I hereby offer the following recommendations based on the outcomes and products generated:

1. Utilization of the Survey Plan:

The government is encouraged to utilize the produced plan for effective decision-making concerning the premises. It is also recommended that the school premises be properly fenced, as it is bordered by multiple roads, which may pose safety and security concerns.

2. Improved Resource Management:

Adequate supervision and maintenance should be provided for existing facilities such as the borehole, furniture (chairs and tables), and staff welfare, to ensure their continued functionality and longevity.

3. Integration of Computer Programming:

The application of computer programming tools in data processing should be fully adopted. This will enhance the efficiency and speed with which students handle survey data and improve the overall learning experience.

4. Accessibility of Project Outputs:

The outputs of this project, including the final plans and report, should be made available for future reference and review, particularly for academic and administrative purposes.

5.5 PROBLEMS ENCOUNTERED

Several challenges were encountered during the course of the fieldwork, many of which were unavoidable. One major issue was the constant movement of vehicles and the presence of students within the project area, which caused interruptions and made it difficult to maintain consistent measurements during surveying operations.

Additionally, the Total Station experienced intermittent battery issues, with the battery frequently running low. This led to delays and increased stress, as it required sourcing and replacing batteries more often than anticipated, thereby affecting the workflow and overall efficiency of the project..

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APPENDIX

ID	EASTINGS	NORTHINGS
B1	666472	937402.5
B2	666484.9	937400.9
B3	666483.2	937390.2
B4	666470	937391.8
B5	666488.5	937412
B6	666516	937406.7
B7	666514.7	937395
B8	666486.5	937399.9
B9	666493.4	937431.3
B10	666505.4	937428.8
B11	666501.4	937411.7
B12	666489	937414.4
B13	666502.4	937464.7
B14	666512.1	937462.9
B15	666505.4	937428.8
B16	666495.4	937431.5
B17	666496.1	937473.4
B18	666501.2	937472.2
B19	666499.9	937465.1
B20	666494.2	937467
B21	666502.1	937480.3
B22	666555	937468.8
B23	666553.3	937459.1
B24	666501	937470.5
B25	666556	937468.2
B26	666563.7	937466.8
B27	666560.9	937455.8
B28	666553.1	937457.4
B29	666536.1	937394
B30	666550.7	937457.5
B31	666563.2	937454.9
B32	666548.6	937390.6
B33	666520.1	937405.8
B34	666536.3	937403.6
B35	666534.7	937393.3
B36	666516.3	937395.6
B37	666516.6	937401.6
B38	666519.4	937401.4
B39	666512.5	937495.1
B40	666559	937484.2
B41	666556.4	937472
B42	666509.4	937484.4
B43	666508.3	937512.3
B44	666546	937503.8
B45	666541.7	937489.7
B46	666505.1	937499.1
B47	666512.5	937530.7
B48	666550.1	937522.3
B49	666546	937506.4
B50	666508.8	937514.8
B51	666552.2	937521.6
B52	666564	937518.3
B53	666556.3	937489.5

B54	666545.2	937493.2
B55	666566.8	937517.6
B56	666577.2	937515
B57	666569.7	937485.5
B58	666559.1	937489.6
B59	666574.3	937526
B60	666604	937520
B61	666601.9	937508.7
B62	666572.4	937516.2
B63	666612.9	937520.2
B64	666617.9	937519.7
B65	666617.2	937510.3
B66	666611.8	937511.1
B67	666612.3	937503
B68	666617	937502.6
B69	666615.9	937491.5
B70	666611.5	937492
B71	666470.8	937486.2
B72	666474.4	937486.1
B73	666474.1	937481.5
B74	666470.7	937481.7
B75	666473.3	937500.4
B76	666476.9	937500.3
B77	666476.9	937497.6
B78	666473	937497.8
B79	666472.1	937517.6
B80	666476.4	937517.2
B81	666475.8	937510.8
B82	666471.9	937511.4

B83	666472.7	937535
B84	666478.9	937534.7
B85	666478.1	937526.2
B86	666472.2	937526.3
B87	666479.4	937539.6
B88	666485.9	937539.1
B89	666485.9	937535.6
B90	666479.2	937536.3
B91	666495	937536.2
B92	666508	937534
B93	666505.6	937519.6
B94	666492.6	937522.1
PL1	666472.2	937540.7
PL2	666618.3	937521.3
PL3	666607.4	937371.4
PL4	666468.4	937392
RD 1	666651	937536.1
RD2	666470.5	937557.3
RD3	666469.8	937584.6
RD 4	666651.8	937521.6
RD 5	666469.2	937545.7
RD 6	666463.1	937332.5
RD 7	666445.1	937341.2
RD	666452.1	937584.6

8		
RD 9	666464.5	937381.6
RD 10	666609.9	937359.6
RD 11	666464.5	937381.6
RD 12	666609.9	937359.6
RD 13	666624.2	937525.6
RD 14	666608.8	937346.4
RD 15	666637.5	937523.5
RD 16	666619.4	937345.5