GEOARCHAEOLOGICAL INVESTIGATION OF CITY WALL CONSTRUCTION TECHNOLOGY IN OYO ILE, OYO STATE, NIGERIA

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BY

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CERTIFICATION

I certify that, JIMOH NIYI ADEGOKE carried out this dissertation under my supervision in the Department of Archaeology and Anthropology, University of Ibadan, Ibadan, Nigeria.

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DEDICATION

I dedicate this work to my dear wife and my children who endured lots of vexation and discomfort while I was away to write this dissertation.

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ABSTRACT

Oyo-Ile, the capital of the Old Oyo Empire located on the extreme northwest of present-day Yorubaland, Nigeria was an important polity in West Africa between the 16th and 19th centuries A.D. The city walls, in their current conditions, are in need of restoration towards conservation of the wall system. Previous archaeological investigations on the palace walls had focused on their circumference, the areas covered, description of the types of walls, and elucidation of their functions. However, limited attention has been paid to construction techniques, the composition of materials used, and the mode of emplacement of the artefacts found in the walls. The aim of the study was to investigate the construction techniques, the composition of the sediment used, and the mode of emplacement of the potsherds in the wall.

A cross-section excavation was conducted on the palace wall remains which enabled the examination of the stratigraphy of the excavated units and the techniques used to build the wall and its foundation, and the collection of artefacts, and sediment samples. The sediment samples collected were subjected to granulometric analysis to determine their grain size. The pH, exchangeable cations of the sediments were determined by standard methods and minerals of the clay were determined from thin section. The mode of incorporation of the potsherds into the wall was determined using pottery analysis.

Stratigraphy of the excavation showed the composition of the soil to be lateritic clay comprising a very fine-grained gravely sand thoroughly kneaded with plant fibres. The construction technique of the palace wall was no more traceable because the wall has been reduced to a massive hillock. The colour characteristics of the sediments ranged from reddish gray, yellowish red to reddish brown. The pH of the sediments ranged from 5.5-7.5, and was consistent with the pH of the “brownearths” soil type characteristic of mixed deciduous woodland zone within which Oyo-Ile is located. The sediment was stable and resistant to erosion by the nature of its mineral assemblages (Quartz, Garnet, Tourmaline, Rutile and Rock fragment) and exchange cations (K^+, Na^+, Ca^{2+}, and Mg^{2+}). The potsherds were crude and poorly fired with thickness of 0.5-1.2 cm. The sherds were mainly undecorated and their emplacement in the wall remains was evenly spread across the stratigraphic layers. The features of the potsherds were not consistent with those used for domestic, ritual or industrial purposes; rather the sherds were intentionally added to the palace wall during construction

The palace wall at Oyo-Ile was built directly on a lateritic ground as its foundation. However, the specific technique used to construct the palace wall could not be established. Potsherds were deliberately mixed with the sediments to strengthen the wall.

Keywords: City palace wall, Oyo-Ile, Cross-section excavation, Exchange cations.

Word count: 441

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LIST OF ABBREVIATIONS

F.G.N: Federal Government of Nigeria

WHO: World Health Organisation

UNEP: United Nations Environment Programme

Pers. Comm.: Personal Communications

XPL: Cross Polarised Light

PPL: Plane Polarised Light

N.D: Not Detectable

I/S: Instrument Station

A: Instrument station A

B: Instrument station B

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The research investigates city wall construction technology of Oyo-Ile palace wall, especially the eastern section of the wall which is directly opposite Akesan market in Old Oyo National Park, with implication for Yorubaland. It examines and describes the sedimentary matrix from the excavated wall, the stratigraphic profiles and the artifacts collected from the excavated unit in order to understand the technology of its construction. In an effort to achieve this, geoarchaeological principles and techniques (sedimentology and stratigraphy) are employed to interpret the sedimentary matrix and its relation to archaeological data from the palace wall.

The study area has multiple wall systems; three of which are completely round with two other loops springing up the northern boundary (Soper and Darling, 1980). The palace wall (innermost (wall 1)) encloses an area of ca. 3.57 square kilometres (363 ha), main outer wall ((wall 2) defensive, with a deep ditch), roughly oval in orientation, 6 km by 5 km in diameter and enclosing 2010 ha., outer wall (3/4) about 6.5 km in diameter and enclosing 2975 ha. The wall systems also have a large ring of wall northerly (wall 6) which emerges from wall 2 and covers 2155 ha, within which an arc of wall (wall 5) concentric to the main system is located (Soper and Darling, 1980; Soper, 1993; Ogundiran and Agbaje-Williams, 2017) (Fig. 1.1).

In order to fully conceptualize the category within which the Oyo Ile palace wall falls into, it will be appropriate at this juncture to differentiate among various walls that exist in ancient communities. Thus, two lines of distinctions are necessary to be drawn regarding wall system of ancient societies in pre-colonial Nigeria, including Yorubaland (Connah, 1975, p 98). Firstly, distinction was made between the free-standing mud-built wall and the earthen rampart of the type known to archaeology as dump rampart (Connah, 1975; Ogundiran, 2018: personal communication). According to Connah and Ogundiran, the free-standing mud-built wall is usually located in a savanna environment with low rainfall, whereas dump rampart is of rainforest environment. Thus, Kano, Zaria, Bida, and Bauchi, Oyo Ile, and Koso all have free-standing mud-built walls. These are all located in the savanna zone of Nigeria, whereas Sungbo's Eredo at Ijebu Ode (Lloyd, 1959 cited in Connah, 1975), Orile Keesi, Ife, Owu, and Benin City all have dump ramparts located in the forest zone. The basic reason for the difference is probably environment and rainfall (Connah, 1975). Free-standing mud walls in any form do not survive long in the south. Secondly, distinction is made between city wall and linear earthwork. City wall is said to function as a defensive structure which constitutes a practical military barrier while a linear earthwork is concerned more with the delineation of boundaries-probably serving to delimit the agricultural territory of settlements (Connah, 1975). In other words, the second distinction was based on the function of the wall.

Oyo Ile palace wall is depicted by a linear bank, scarcely more than a metre high, and can be traced continuously north and south of the main gate, and constituted part of the inner wall (Soper and Darling 1980). According to Soper (1993), the track of the wall indicates that it was constructed to connect pre-existing buildings. Considering the entire palace features and hectares of land enclosed by this wall, it seems that it was something added later rather than a coherent design.

The palace gate of Oyo Ile, in its general form probably was similar to the main gate of the Afin (palace) at the present-day Oyo, which has a central archway flanked by side rooms, with broad verandas inside and out, supported by carved wooden posts; these verandas have rectangular projections *(kobi)* on either side of the entrance. A small rectangular building lies just inside the gate on the south side at Oyo Ile, which on modern parallels may have been a shrine (Soper and Darling, 1980; Soper, 1993).

Outside the wall, to the east and north of the palace gate, is an open space almost without buildings and some 300 square metre. The soil here is very shallow, with hard laterite only a few centimetres below the surface or actually exposed towards the north side (Soper, 1993). This open space in Oyo Ile and New Oyo is still called the Akesan market and its position outside the palace gate is typical of Yoruba towns (Mabogunje, 1962; Ojo, 1966)

These walls were always built as high and as wide as possible. The large dimension has incidental advantage of making the walls resistant to environmental deteriorations, mainly, rain to which it was exposed most of the time. Sometimes the nature of resources used in building these walls improved their quality so much that it could defy the vagaries of environment (Ojo, 1966). The walls of the Aremo's (the first son of the Alaafin) residence in Old Oyo, for instance, was still relatively preserved long after those of the other houses in town had disintegrated, probably because palm oil was used instead of water to mix the mud (Ojo, 1966). This might have been used to serve as waterproof against rainwater in order to ensure the longevity of the wall, since oil does not mix with water.

The technology of wall's construction followed upon the laying of the foundation or preparation of the area and the production of sufficient quantities of materials (Emery, 2011). In addition to these the understanding of material characterization is extremely important; to achieve this, some questions need to be asked and answered about a particular soil type, in order, to be able to ascertain the suitability or unsuitability such soil type for the construction, this will help to understand the material in particular, and the causes of constructions deterioration as a whole. However, soil type suitability for construction is based on various properties such as permeability, plasticity, compatibility, bulk density; *inter alia* (Houben and Guillaud, 1989). In other words, these above set of properties must be diagnosed for in a particular soil type to ascertain its suitability or otherwise for a construction work.

The choice of the palace wall for this study is because it represents one of the most elaborate city walls of all the ancient Yoruba walls. This perimeter wall was also one of the most monumental structures among others in the study area built during the Oyo imperial period, and this was the most demanding public work in the city whose technology of construction needs to be scientifically studied and understood (Ogundiran, 2018: personal communication). In other words, its construction might have required good management of skill, labour, and high level of technology by the Oyo people who built the palace wall. These among others are what this study is set out to deduce from both archaeological field methods and laboratory techniques employed in the research.

The resulting data from this study forms part of the framework for a larger collaborative Oyo Empire archaeological project directed by Professor Akin Ogundiran of the University of North Carolina at Charlotte, which focuses on deciphering the development of Oyo metropolitan urban landscape as an adaptive strategy in a fragile ecological setting; and the dynamics of social complexity and material experience that defined Oyo Empire as the largest political formation in West Africa south of the River Niger. Furthermore, owing to the general absence of detailed sediment studies on Oyo Ile mud-walls, this thesis is in part also an investigation of methodology, in regard to the contribution of particular geoarchaeological techniques to questions of archaeological interest.

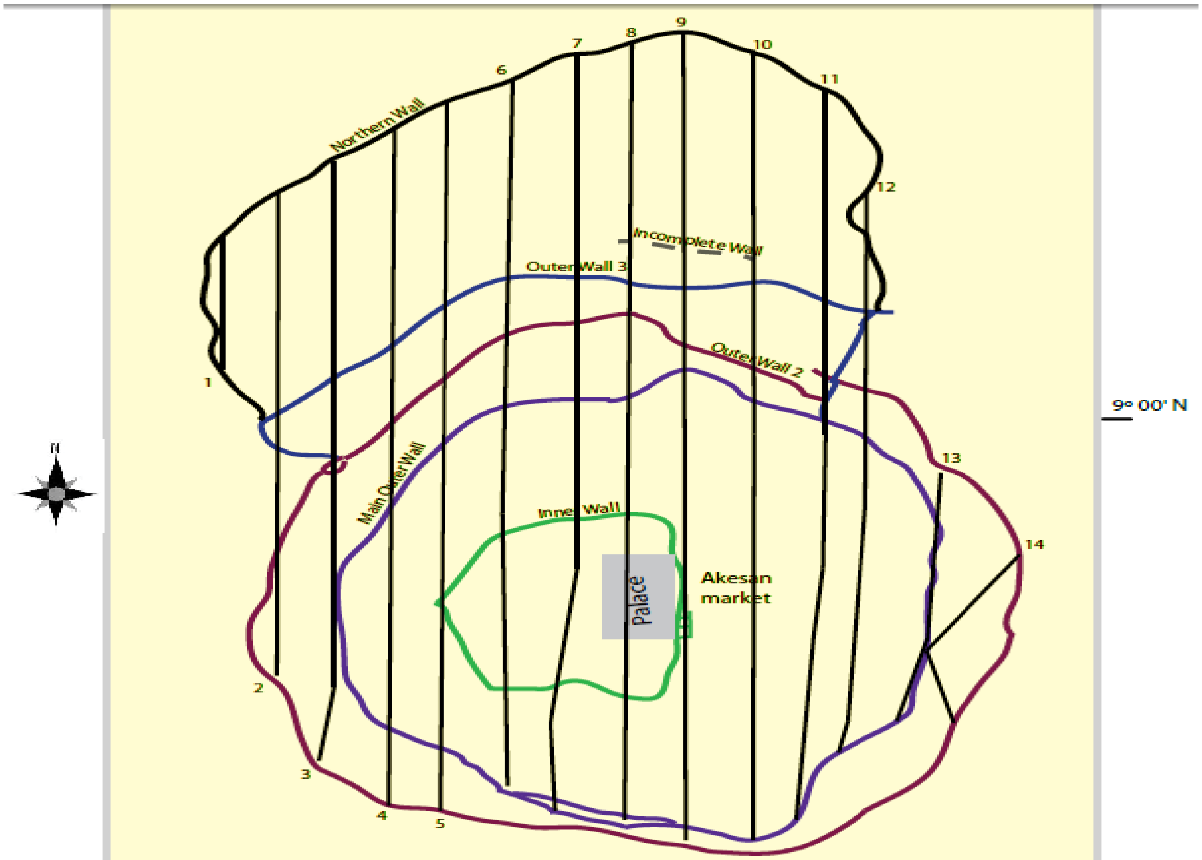


Fig. 1.1: Oyo-Ile Wall System and Survey Transects (Adapted from Agbaje-Williams and Ogundiran 2017).

1.2 Statement of Problem

Previous archaeological investigations on the city walls of Oyo-Ile have focused on measuring the length of the walls and the areas enclosed by them, describing the types of walls, whether free standing built walls or dump ramparts with ditches, and inferring their functions (Soper and Darling, 1980; Agbaje-Williams, 1983; Soper, 1993; Ogundiran and Agbaje-Williams, 2017). Much attention has not been paid to construction technique, raw materials used, style, layout and to the artefacts incorporated into the wall by the builders, whether intentional or not.

This current study is building on the previous works of the above mentioned scholars by focusing on Oyo-Ile palace wall in order to understand the technique of its construction, the composition of the materials used, whether foundations were laid for its construction and whether the artefacts (especially the potsherd) recovered from the wall were deliberately added to the raw material for its construction. The essence of this research work is to add new dimensions to the understanding of Oyo-Ile's most important public project and monument, Oyo-Ile palace wall.

1.3 Aim and Objectives

The research aimed at using geoarchaeological techniques and principles to understand the technology of city walls' construction in Oyo-Ile.

To achieve the above aim, the following objectives are set out:

1. To examine the techniques deployed in building the Oyo-Ile palace walls;
2. To determine the composition of the materials used in building the wall;
3. To determine whether the wall was constructed on any foundation or not;
4. To ascertain whether the potsherds recovered were deliberately incorporated into the earthen material used to build the wall.

1.4 Scope of the Study

The study focused on the eastern section of the inner wall (palace wall), opposite Akesan market in Old Oyo National Park. A cross-section excavation of the wall was carried out, and it encompassed the main wall and its collapsed debris. The excavation was carried out stratigraphically, artifacts and sediments were collected and subjected to laboratory analyses to achieve the research aim and objectives.

1.5 Limitations of the Study

Due to the study area's location in a dense forest, it is challenging to gather information about the area's historical background and the construction of the wall aside from a few pieces of information from hunters and park guards who are not very knowledgeable about the area's history. In some cases, the few pieces of information provided by these people need to be carefully considered in order to avoid the mistake of distorting the history of the area's previous occupants.

Insufficient financing for this study placed restrictions on its scope, making it challenging for the researcher to do this work more successfully. The work was prevented from dating several dateable items recovered from the excavation, which would have likely helped us to determine the date the wall was built, due to a lack of funding. In addition, the terrain made it difficult to move expensive equipment like excavators, and the distance also made it difficult to hire workers to help with laborious tasks. Equipment like these would have sped up the job and allowed it to be completed within a short time.

The study was limited in its ability to conduct community archaeology, in which the people whose past is being studied should have been involved in the entire process, but because the site was far from the nearest town and there were not enough field vehicles to move people, even the researchers were managing the one vehicle made available by the National Park Service, and fueling for that long distance into the forest was on the expensive side on a daily basis, all of these factors added up to limit the study in this aspect.

The researcher would have preferred to use blocks of undisturbed sediment to investigate the micromorphology of the sediment samples from the excavated unit, but the tools needed to gather these types of samples weren't accessible at the time of the fieldwork.

1.6 Environmental Background of the Study Area

1.6.1 Location

The site of Oyo-Ile is situated at some 130km north-east of the present day Oyo, in Irepo Local Government Area, Oyo State, Nigeria (Soper, 1993; Folorunso, *et al*. 2006; Okpoko 2006). The expanse of the area occupied by Oyo-Ile lies between Latitude 8˚ 56'-

9˚ 03' N and Longitude 4˚26'-4˚ 21'E (Fig. 3.1) (Soper, 1993, Folorunso, *et al*. 2006). The entire land covered of Oyo-Ile is 2,512 km^2. It is 300-900 m above sea level (Soper, 1993; Emielu, 2000:166; Folorunso, *et al*. 2006; Aremu, 2007).

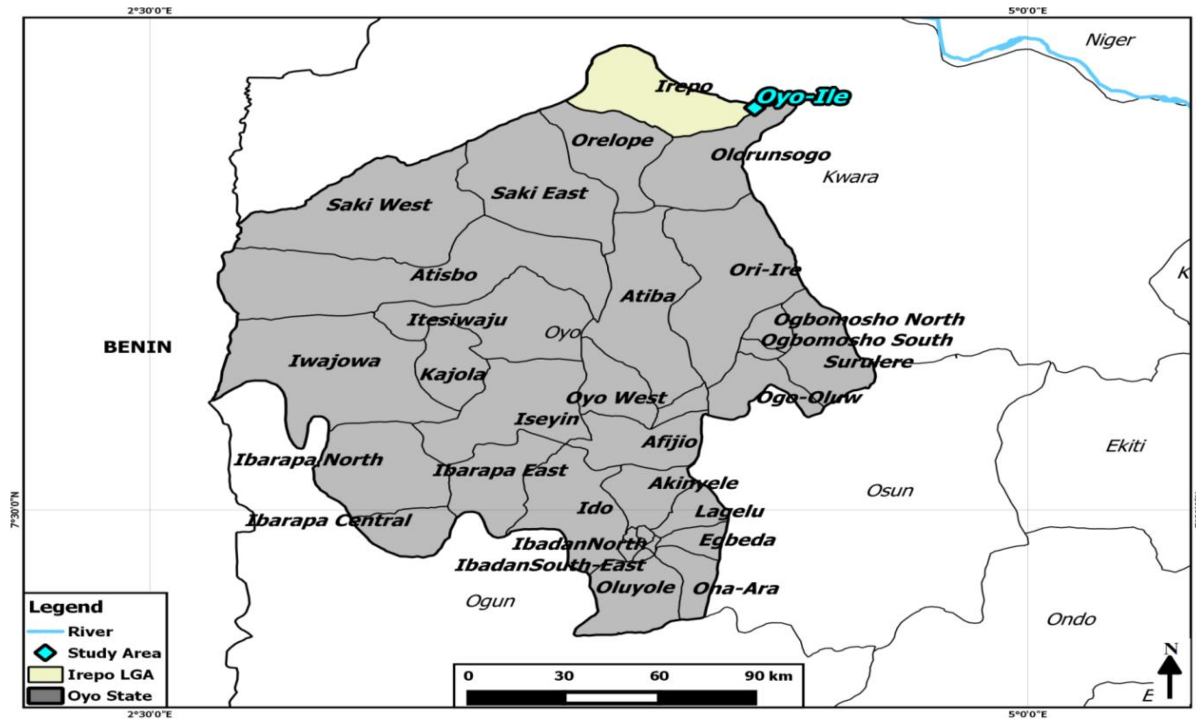


Fig. 1.2: Oyo Ile in Irepo Local Government Area, Oyo State (oyostate.gov.ng).

1.6.2 Climate

Oyo-Ile lies in the transition zone of the humid and sub-humid tropical climatic regime of Nigeria (Fig. 3.2). The climate is characterized by high but uniform temperature, heavy rainfall in the south decreasing to moderate in the north, with high relative humidity and intense cloud cover in the night. There are two distinct seasons: wet and dry, with the dry season alternating with the wet warm rainy season. The dry season occurs between November and February while the wet warm rainy season occurs between March and September with a period of lower rainfall in August usually referred to as the "August Break". The mean annual rainfall at Oyo-Ile is 1,220mm, and the mean annual temperature is 27.5˚C whilst the relative humidity is 60% on the average, and at nights the air is saturated (Agbaje-Williams, 1983; Emiolu 2000:128,166).

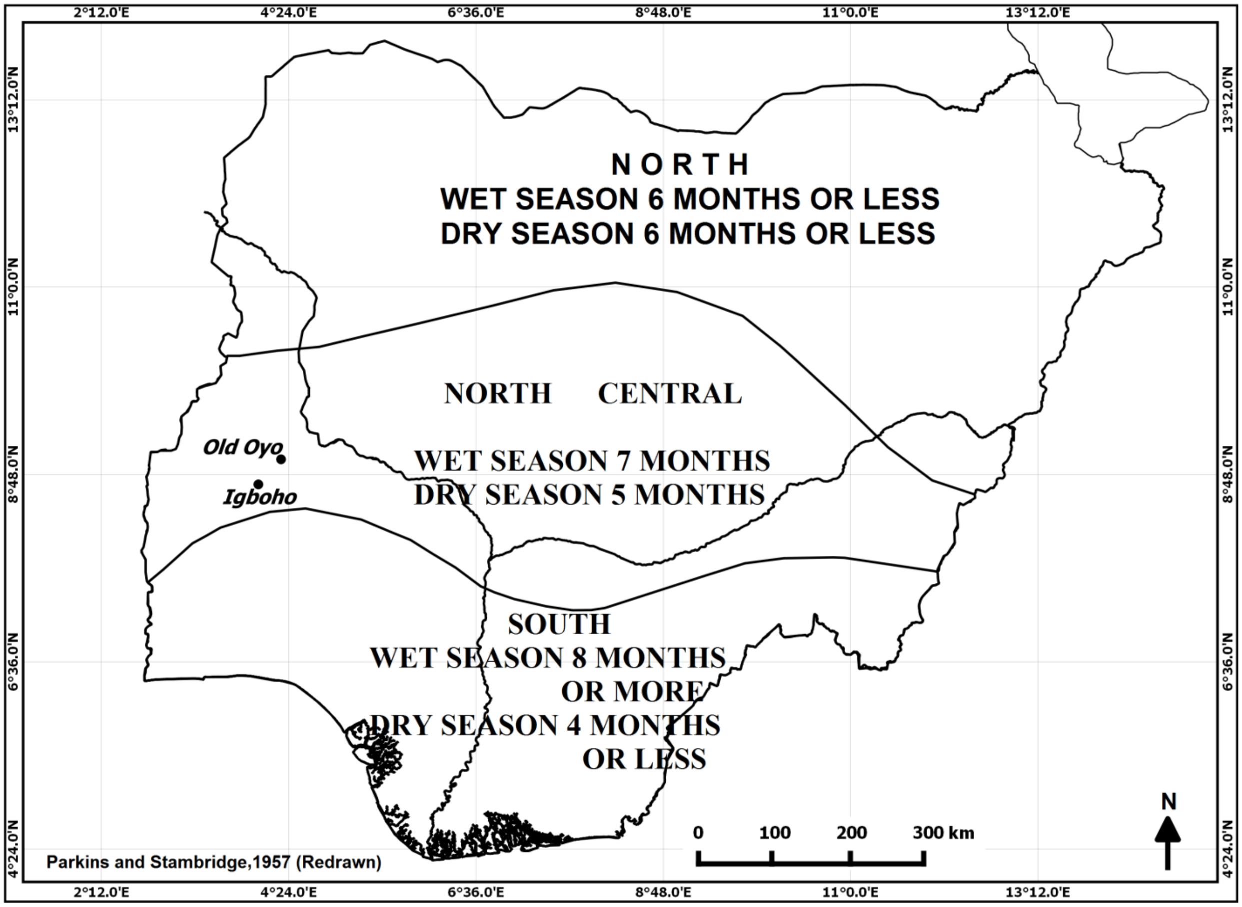


Fig. 1.3: Climate belts of Nigeria (adapted and modified from Perkins and Stambridge 1957).

1.6.3 Geology, Relief, and Soil

The geology of Oyo Ile is predominantly characterized by a group of inselbergs which is a continuation of range of rocks in the Igbeti-Old Oyo area. The hills are restricted to the southern part of the city with the exception of Amukoko in the north-west. These rocks are part of the Basement Complex (rocks of Precambrian age) characteristic of West Africa (Jeje, 1981; Agbaje-Williams, 1983; Emielu 2000: 128, 166) and occur in forms ranging from low outcrops to massive hills (Fig.3.3).

The relief of Oyo Ile is about 300m above sea level. Outside the area of inselbergs, the terrain becomes generally flat especially east and west of these hills (Agbaje-Williams, 1983 and 1990; Soper, 1993). Again, the only exception is nearer Amukoko and beyond. But after crossing the Lere River, the topography turns into a rolling country from west to east with anticlines. Nearer Amukoko hills, the ground rises sharply till one reaches the northern city wall (Agbaje-Williams, 1983 and 1990; Soper, 1993).

The soil of Oyo Ile is ferruginous and deeply weathered. Because most of the rain comes in the wet season, during that season the soil is leached of bases and silica, but the iron (Fe) is not leached (Jeje, 1981; Agbaje-Williams, 1983; Emiolu 2000: 128, 166). At the outset of the hot season, the high temperature makes it possible for organic materials to enrich the soil and whenever the sesquioxide rich soil is exposed, it is known as laterite (Jeje, 1981; Agbaje-Williams, 1983; Emielu 2000: 128, 166). This type of soil is characteristic of soils in wet tropical climate or hinterland tropical climate of Nigeria (Jeje, 1981; Agbaje-Williams, 1983; Emielu 2000: 128, 166).

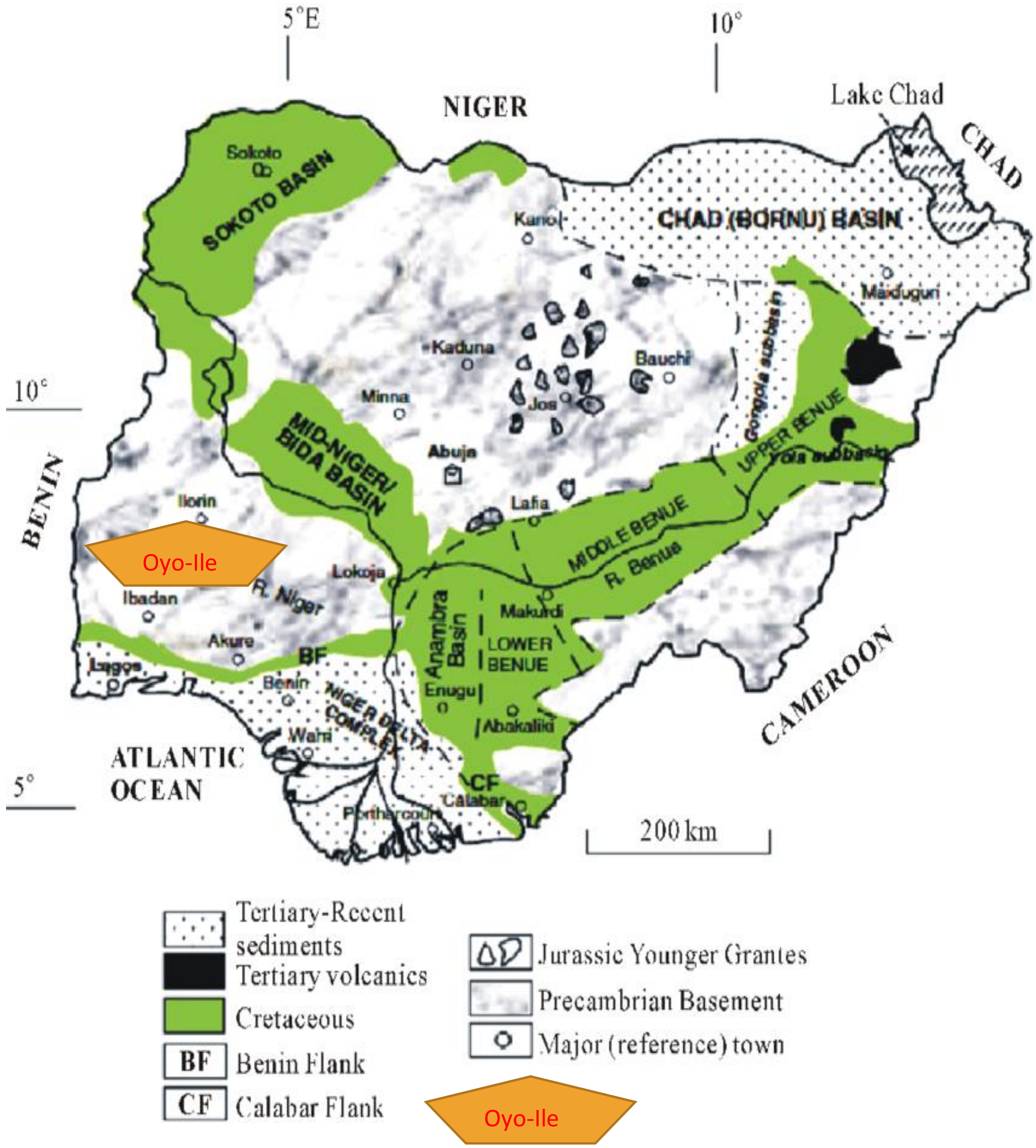


Fig 1.4: Geology of Oyo-Ile in Geological Map of Nigeria (Nigerian Geological Survey Agency, FCT, Abuja, 2000).

1.6.4 Vegetation

The site of Oyo-Ile is in the woodland savanna vegetation zone of Nigeria. The average heights of most of the trees in Oyo-Ile is between 20 and 30 m, comparable to those of the middle layer in equatorial forest and are regularly interspaced among grasses which therefore give it the appearance of a park (Soper, 1993; Agbaje-Williams, 1983; Emielu 2000: 128, 166). Oyo Ile is wooded savanna which is described as parkland. It is made up of abundance of tall grasses (sometimes over 5 metres) and luxuriant, especially during the rainy season (Soper, 1993; Agbaje-Williams, 1983; Emielu 2000).

Typical tree species in the more open areas are *Gardenia lutea, Prosopis africana, Vitex doniana, Burkea africana, Parkia biglobosa, Piliostigma thonningii, Hyphaene thebaica, Diospyros mespiliformis*, usually in rocky situations, and *Mitragina inermis* in areas liable to regular flood (Fig.3.4). Species of the denser woodland are *Pterocarpus erinaceus, Terminalia macroptera, Borassus aethiopum, Tamarindus indica, Olax subscorpioidea, Adansonia digitata, Acacia sieberians,* and more rarely *Kigelia spp, Cassipourea congolensis* and *Ochna membrancea* are typical of the flanks and crannies of inselbergs (Soper, 1993; Agbaje-Williams, 1983; Emielu 2000).

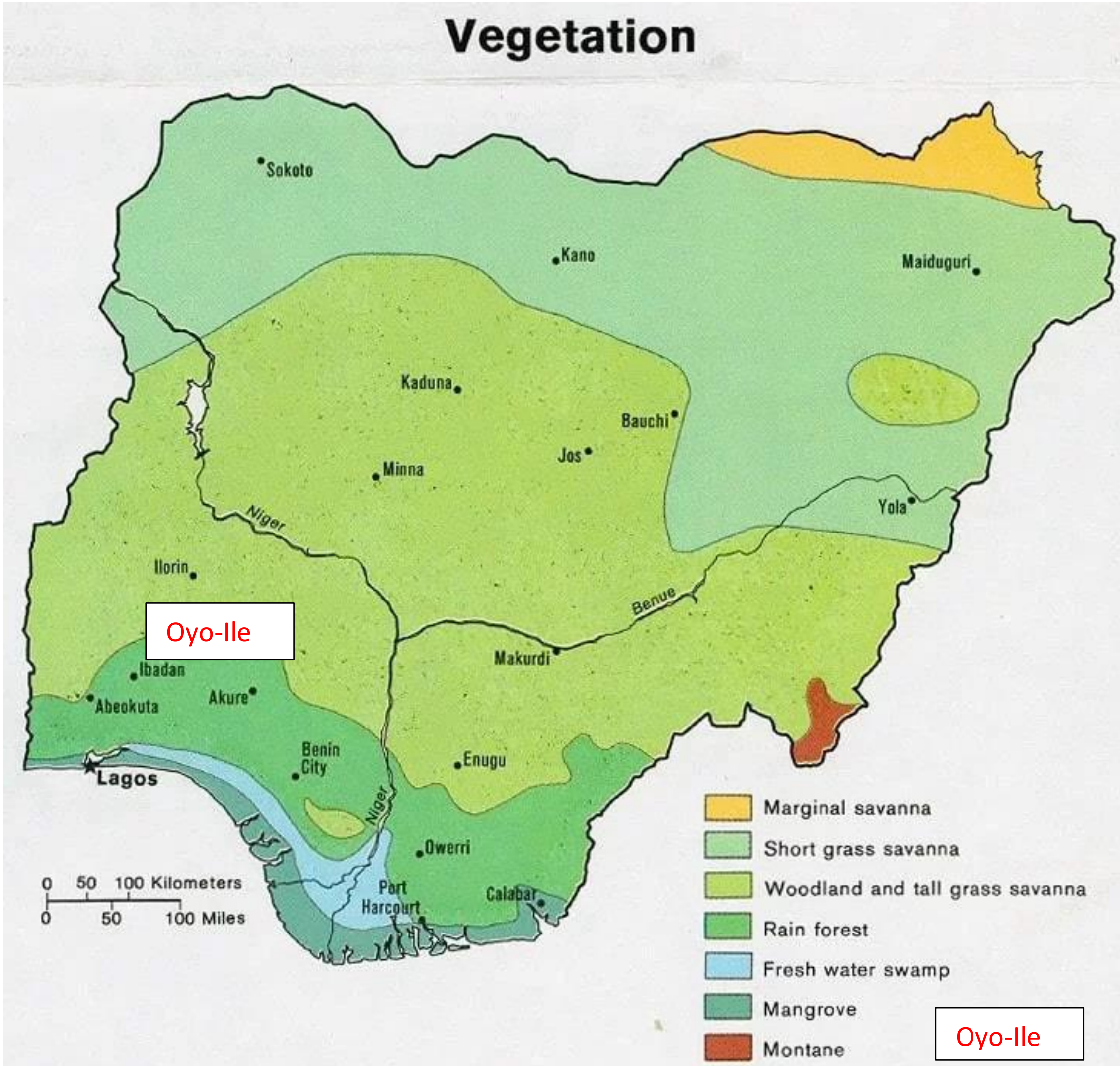


Fig. 1.5: Vegetation of Oyo-Ile in Vegetation Zones of Nigeria (F.G.N, 2002).

1.6.5 Drainage

The drainage system of this area is controlled by irregular rivers and streams that have waters only during the rainy season. Lere River is the backbone of the drainage system, and it has many tributaries. The most important ones are the Keikuna, Alaheremeji, and Idiara streams. There are other minor tributaries plus a number of drainage gullies, mostly around Amukoko hill. The Idiara is the only stream draining from the west of the inselbergs while the Sun, which is one of the major streams of the drainage system of this area drains from the south (Fig. 3.5). And as one approaches the main outer wall, a number of tributaries flow to Iwa stream in the south-east, outside the wall of Old Oyo (Agbaje-Williams, 1983 and 1990).

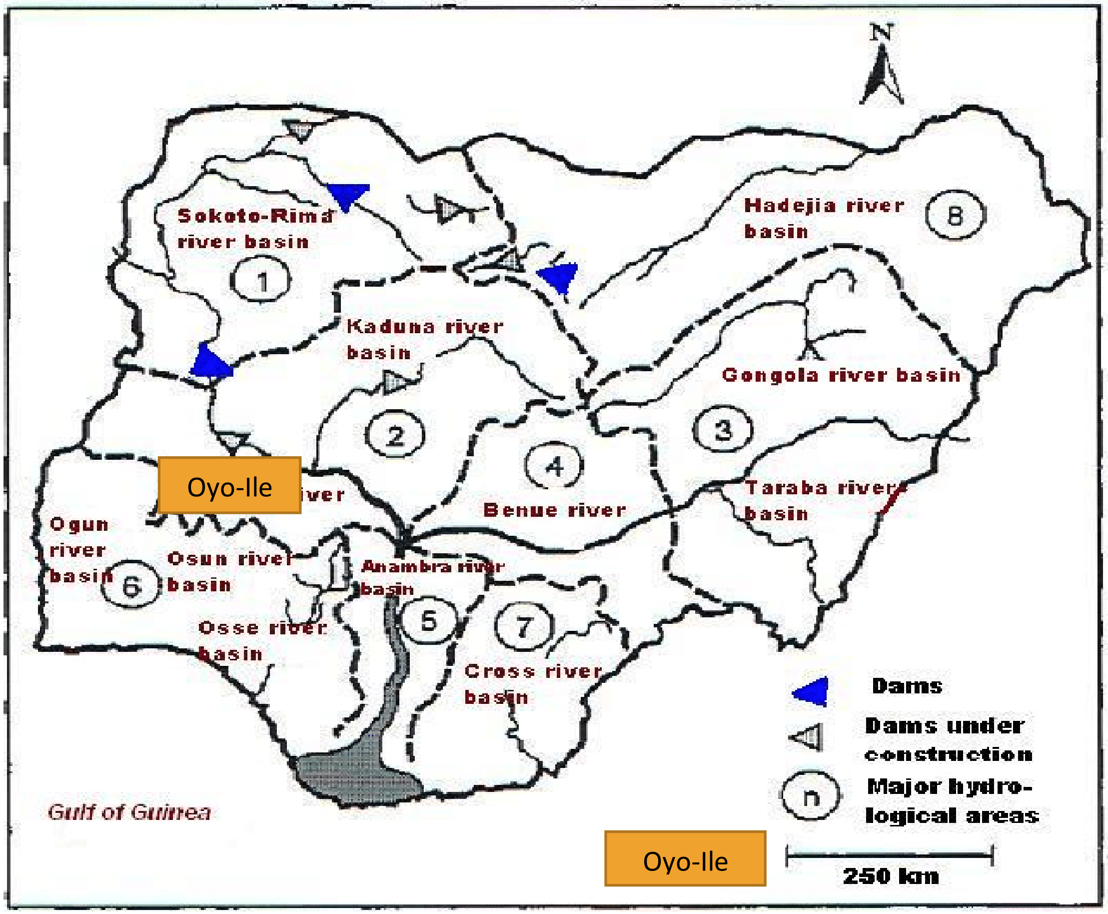


Fig. 1.6: Oyo-Ile Drainage in Nigeria (WHO/UNEP, 1997).

1.7 Historical Background

The late sixteenth century witnessed the rise of new power among the Yorubas of Oyo, lying just to the north of the deep forest. The origin of the power play was attributed to a disastrous encounter with the Nupes. The trading state of Nupe, north of the Benue River, conquered the Yoruba of Oyo around 1550, and drove their chief, headed by the Alaafin or king of Oyo, into exile (Davidson, 1966). When they returned they set about organizing an army based on the cavalry which had made their northern neighbours strong. Alaafin Orompoto is said to have begun with a thousand mounted men. His successors went further (Davidson, 1966). They extended the principle of maintaining long-service heavily equipped cavalry maintained by the state and ready for action in times of need, and in this way they made themselves unconquerable in the Yoruba lands to the north of the forest. By the end of the sixteenth century their rule had been powerfully established throughout the thinly-wooded country to the west of the Niger as far as the hills of Togo. By 1740, they had subdued and also established themselves among the Yoruba of Dahomey, the Yoruba of Ketu, as well as bringing the Fon people of that country under their dominion (Davidson, 1966; Oguntomisin, 2002; Okpoko, 2006).

The Alaafins of Oyo were strong rulers for nearly two hundred years. Wherever their cavalry could operate, their power became renowned. They were also capable of building a large and long-enduring political system without the use of literate bureaucracy. They extended the power of their Alaafin over many of the Yoruba states to the north of the dense forest country, operating through a system of permanent officials whose powers may be likened to those of colonial commissioners or 'residents' in later times, but whose authority was deepened by their being able to act within the community of Yoruba language and tradition (Davidson, 1966). The Oyo ruling families retained a king-making capacity, but their social and political organization absorbed many of the administrative advances of the sixteenth century. These included a sharper division of executive power within the Alafin's supreme governing council. By the middle of the 19th century Oyo Empire had begun to decline (Agbaje-Williams 1990). According to Agbaje-William (1990), the capital of Old Oyo was abandoned between 1830 and 1840. A combination of internal and external factors, particularly the pressure from Fulani jihad, forced the empire to be evacuated, and a new capital was set up at the present site of Oyo (Bascom, 1969**,** Agbaje-Williams, 1983 and 1990).

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Framework

This research revolves around two key concepts namely: geoarchaeology and technology. It is hoped that by attempting the definition of these concepts, the basic issues being addressed in this research will become more explicit.

Geoarchaeology has been an established sub-discipline of archaeological research and an integral part of archaeological sciences for the past half century. Geoarchaeology simply put is the application of earth science principles and methods such as pedology, sedimentology, geomorphology, and stratigraphy to investigate archaeological sites and to answer archaeological questions regarding human activity in the past (Pollard, 1999; French, 2003; Beach et al. 2008).

The basic principle and key concept upon which geoarchaeological practice is based is the fact that archaeological discipline appreciates that not only was human behaviour and the environment wherein people lived diverse and dynamic, but also that its expression in the archaeological record is disparately preserved (Keys, 2009). As such, rather than being seen as solely reflecting human behaviour, the material culture record should be regarded as part of the sedimentary matrix and therefore subject to influences from similar geomorphic processes (Butzer 1982; Waters 1992). Accordingly, before human behaviour can be reconstructed from incomplete remains the whole context of the archaeological deposit must be understood–this includes an understanding of geological, biological and anthropogenic processes that have acted to shape that context (Rapp 1987:98). To date, studies geared towards an understanding of site formation processes in Oyo Ile are rare. This dissertation explores the relationship between the preserved material culture record and site formation processes of Oyo Ile.

Technology in archaeology is concerned with many of the big questions such as who made the objects we find? What materials did ancient people use? Where did they obtain their raw materials, and how did they craft pottery, stone tools, buildings, clothing, and other useful items? How did they communicate technological knowledge to each other, and how and where did they trade raw materials and finished objects? Why did people value certain materials and products over others? The degree to which archaeologists can answer these questions depends upon the physical evidence left behind (e.g., pottery kilns, potsherds and broken glass vessels, chert debitage, scraps of preserved textiles), the context of the finds, and the nature of historical information, if any (Andah and Okpoko, 1994).

Technology within the context of this research is regarded as processes of social organization for labor mobilization, and the management of skills, the kind of raw materials procured, processed and used for their subsistence such as construction of residential houses, walls among other things.

2.2 Theoretical Review

Cultural ecology theory was employed as the theoretical framework in this research based on some of its basic assumptions which acted as a viable set of explanatory tools that guided this research method, analyses, interpretation and conclusion. This theory in its ecological concept identified human ecology as having both definite biological and cultural aspects, and that these are interrelated. The cultural aspect of this ecology was associated with technology, which set humans and their cultures above and separate from the rest of the environment (Steward 1955:31). According to this theory technology forms the "window" through which people look at their environment. Invariably, humans' adaptations are mainly technological, and how we interact with any given environment depends first of all on the tools societies bring to that environment (Steward 1955).

The key assumption of cultural ecology proposed that there are elements that mediate directly between humans and their environments and that these are essential to subsistence and other basic economic activities. Such features include technological, social, political, and ideological elements of culture. Core features are most heavily determined by environmental constraint and interaction (Steward, 1955).

The theory also underscored the effects of technology on patterns of social behavior, especially the organization of labour. It emphasizes the fact that in humans, subsistence is a social activity and this activity ultimately geared towards making a living this according to cultural ecology could only be achieved through division of labor between the sexes, with a cooperative household economy involving both men's and women's work (Steward, 1955). The theory makes clear that the organization of labour which resulted from the influence of technology and invariably on pattern of social behaviour to making a living varies between different societies. The theory assumed the variation to be ecological imperatives. Thus, given a certain environment and a certain type of technology, for instance, putting right technology into use in exploiting an environment will engender effective ways to organize the society to accomplish much task to sustain human community.

Furthermore, the theory explained that technology and work organization influence other parts of culture. For instance, the demography of a society, including such things as its total size and the size of individual settlements, affects economic productivity. It was used to explain the fact that the quantity of resources a society can obtain is a function of the environment, the technology, and how effectively work is organized (Steward, 1955). The assumption is also that the total size and settlement size in turn affect the economic division of labor. The submission is that large societies can support craft specialists, like weavers and potters who make tools for everyone else and trade for food whilst in small societies, craft specialization is curtailed; everyone has to make tools for themselves because the number of potential customers is too small to support a specialist (Steward, 1955).

In summary the main focus of this theory is the concept of the culture core. The culture core defined those cultural features that can be explained and understood using technological premise. And these features are linked to the work of making a living in a particular environment. The theory proposed that the aspects of social organization related to work is certainly part of the culture core. One way to fully interpret the key assumptions of this theory is to try to determine what does and doesn't belong in the culture core (Steward, 1955).

This provides explanation of the purposes perimeter walls construction served in ancient societies, especially in Oyo-Ile as highlighted by Akin Ogundiran, which includes the creation of community solidarity and political identity. This also includes the controlling, monitoring, and regulation of movement for the purpose of internal security and defense against external aggression. In addition walls construction serves the purpose of institutionalization of inequality and hierarchy-based social order by segmenting population into spatial ranks. This also engender the use of centralized political control and its bureaucracy to manage private and public space, and the basic routines of movement and social interactions, by determining whom to grant the right to pass through certain walls and use certain roads at particular time or season. This is also germane to the methodical urban planning for social and physical health of people and their valuables, especially livestock.

2.3 Empirical Review

Oyo-Ile as an archaeological site had been the subject of archaeological investigations since 1938 no excavation was conducted during these periods. The later archaeological investigations by Frank Willett between 1950 and 1959 were when the first excavation that was conducted on the site (Folorunso, *et al*. 2006). Willet categorically investigated mejiro rockshelter between 1956 and 1957 (Willett, 1960). He discovered that the shelter has one cultural phase (aceramic). The finds discovered in this rockshelter include: lunates, trapezes, microburins, scrapers, points, and baked blade which were mainly aceramic industry (Willet, 1962), however, unlike most other Late Stone Age sites in Nigeria and west Africa it was only mejiro rockshelter that has one cultural while others have two cultural phase of both ceramic and aceramic industry.

Robert Soper conducted several field schools in Oyo-Ile from 1973 to 1979, with the purpose of exposing students to practical archaeological field practices (Soper, 1975). From the findings of the archaeological field school, Soper constructed a good and complete map of Old Oyo wall system. Furthermore, Soper located the palace reservoir, 'a large depression of about 100 metres in diameter and probably with a capacity of two million gallons' (Soper, 1975).

A study was conducted between 1979 and 1983 in Oyo-Ile by Agbaje-Williams for his Ph.D dissertation. The investigation was mainly to show how cosmopolitan Old Oyo was (Agbaje-Williams, 1990). The research revealed a large number of surface finds spread over an expanse of land of 60 km^2 with other archaeological features. These features were used to estimate the population of Old Oyo in the 18th century as 60,000 to 140,000, because the features were considered to contain useful demographic and archaeological data (Agbaje-Williams, 1990). The excavations conducted during the investigations produced several radiocarbon dates ranged from (765±90 A.D.) to (1140±80 A.D.) from these dates the history of Oyo-Ile culture was pitched at 8th century (Agbaje-Williams, 1983). The research at Oyo-Ile facilitated our understanding of the spatial density of the Oyo-Ile occupation, urban configuration, and maximum population, estimated at ca. 100,000 in the second half of the 18th century.

In 2017, Ogundiran embarked upon a long term Old Oyo Archaeological Project with the intent to present new findings from the recent interdisciplinary archaeological research involving faculty members and graduate students from the University of Ibadan and University of North Carolina at Charlotte. This was tailored towards examining the development of Oyo metropolitan urban landscape using adaptive strategies in a fragile ecological setting, and the dynamics of social complexity and material experience that defined the Oyo Empire as the largest political formation in West Africa south of the River Niger (Ogundiran, 2017: personal communication).

Although earthworks are well-known from Cote d'Ivoire to Nigeria in the forest region of West Africa, little research has been done on them (Chouin, 2009). The international community hasn't shown much interest in this region of Africa's archaeology and cultural heritage, and financing hasn't been sufficient for West African universities to conduct systematic surveys and excavations (Chouin, 2009). A concise overview of archaeological studies on West African earthworks was published in 2004 by Kelly and Norman. The gap between the widespread nature of earthworks in West Africa and the scant quantity of archaeological research devoted to them was highlighted in this assessment (Norman and Kelly 2004:98-101).

In 1970s an archaeological investigation was conducted on the wall complexes in the Benin environs, four main sites in Benin were excavated during the fieldwork the excavated sites include: the Benin Museum, two places in the innermost of the earthworks and the palace site of the early Obas of Benin (Usama) (Connah, 1972). There were several dates from the excavations and these dates were found to correlate with oral tradition and historical sources earlier used by Egharevba in 1960 to estimate a probable date for the construction of ‘this huge earthwork to be the middle 15th century (Connah, 1972). The research revealed that the walls were made up of complex network of linear networks older than the innermost wall, Connah inferred from this discovery that the city came to be by gradual coming together of scattered village pledging their allegiance to a central authority which later developed to a true urban unit with a formal urban defence (Connah, 1972). It was inferred from the complexity of the defensive wall that the wall constructions would have required a considerable labour organised under a centralised government (Connah, 1972: 33).

The archaeological reconnaissance of Ipapo Ile, Kwara State, Nigeria reported that the wall here is not just very much in existence, but it is very prominent at some places. High sections of free standing wall (c.2m high and c.50 cm wide) are present. It is clear from this that the city was fenced by this sort of wall as at Old Oyo and Igboho (Agbaje-Williams, 1989). Ipapo Ile wall in this sense is similar to that of the northern wall of Old Oyo, not only because of the standing wall but because it is a single bank wall (with no intervening ditch). The wall is very prominent in more than half of the area, and this is mostly in the south and western parts of the site. In terms of morphology, the wall is just a linear mound on the ground surface with lots of trees around (Agbaje-Williams, 1989). The presence of the free standing wall, suggests that the original structure was a free standing wall built around the city. After the abandonment of the town, weathering set in and led to the collapse of the wall, which eventually forms the lineal wall at Ipapo Ile today (Agbaje-Williams, 1989). Taking into consideration the nature and the historical background to its abandonment, it is possible that Ipapo Ile was not walled until the war that led to its desertion was imminent. This is because the wall when compared to Old Oyo and Igboho was very small and unimpressive (Agbaje-Williams, 1989). A further examination of the wall in its present form suggests a possible explanation for the absence of the wall in the east. This area was probably more prone to attack from Ilorin in the course of the nineteenth century Fulani war against Old Oyo. The wall may have been pulled down then. According to Agbaje-Williams (1983), this was a tentative inference pending the time detailed archaeological excavations would be carried out on wall.

Some antiquities recognized during the reconnaissance of the Ijebu Ode and other archaeological remains help one to build up a few propositions (Momin, 1989). The archaeological remains of Ijebu Ode include archaeological mounds, a town wall or moat, and remnants of the Old palace (Momin, 1989). The written records of 1505 AD by Pereira referred to a great moat surrounding Ijebu Ode town. Today, among the Ijebu, a popular legend of Sungbo's eredo refers to the moat encircling the town (Lloyd, 1964:139). On the northeastern outskirt of Ijebu Ode is a village, Imodi, which means a settlement beyond the town wall, suggesting that Ijebu Ode had a town wall (Momin, 1989). Another village in the south of Ijebu Ode is Imodi Ijesu, which means a place beyond town wall where one gets yam to eat. This also suggests the presence of town wall on this southern side (Momin, 1989). Lloyd has noted that like other Yoruba capitals, Ijebu was a walled town but its walls are not massive ramparts. Their ruins today comprise a two-foot high mound already obliterated by buildings in many parts (Lloyd, 1964:151). According to Momin (1989), during reconnaissance of Ijebu Ode, on enquiring about the moat or town wall, the informant (Bishop Kali) took the team to parts where the moat had been filled up and the land leveled. The expansion in the modern times has apparently happened around the ancient town. This land has been used for various construction projects. These constructions would seem to be largely responsible for the ancient town wall having completely vanished (Momin, 1989).

The reconnaissance survey conducted at Orile-Owu was tailored towards the examination of the nature and patterns of construction of the walls and ditches, the actual widths and heights of the banks, as well as the depth of the ditch (Agbelusi, 2014). The research recovered several material remains and features associated with human occupation like fortifications, palace complex, rectangular house structures, pottery, stone remains, and mounds among other things. As regards the fortifications two were identified-the inner and the outer wall. The time frame for their construction is not known yet. But one thing that is certain from the nature of the walls is that the inner wall was built first and the outer one was constructed later to cope with the expansion of the settlement (Agbelusi, 2014). The fortifications are made up of ditches and embankments and their construction was explained against the background of a defensive mechanism. This defensive structure was said to have been very effective as enemies were not able to penetrate the town in times of war (Agbelusi, 2014). The research revealed also that the fortifications were constructed ca.18th century.

On the innermost wall of the Koso multiple wall system, an archaeological reconnaissance survey was carried out. Examining the historical and archaeological significance of this old wall system and the necessity to protect it for future generations were the main objectives. The results of the survey showed that the innermost wall system at the site has inner walls that range in length from 3 km to 4.5 km (Aremu, 2007). It was determined that both natural and human factors contributed to the worrisome degree of deterioration in these walls. The old city walls of Koso should be listed among UNESCO's most endangered sites, as has been done in other nations throughout the world like Peru, where "earthen sites or mud walls account for 10% of the UNESCO World Heritage list" (Aremu, 2007), in light of his discovery regarding the walls. In order to promote tourism attractions, he also makes suggestions for ways to restore the condition of the Koso walls. To conserve and defend the Koso wall going forward, the Federal Government should assist Old Oyo National Park (Aremu, 2007).

Usman Aribidesi from Arizona State University undertook an archaeological investigation in the Igbomina region of Northern Yorubaland. Its objectives were to offer a general description of the walls in the area and investigate how they might be used functionally (Usman, 2007). The survey's findings indicated fortifications dating back to the 18th century that were reminiscent to those found near the major cities of Ife, Benin, and Oyo.The author claimed that the fortifications were necessary to shield the city from an atmosphere of hostility against the backdrop of the geopolitical situation in Northern Yorubaland (Usman, 2007). The encircling nature of walls, ditches, abandoned settlements, and unearthed "weapons of war" from the sites supported the author's initial hypothesis (Usman, 2007). As a result of the survey's findings, it was determined that the Igbomina had most likely built enclosed walls and developed enhanced "centralized" power and "hierarchy" in response to the Nupe on its boundaries (Usman, 2007). "Walls were part of the regional socio-political and economic upheaval that occurred in Yorubaland and other parts of West Africa from the fourteenth century," the author claims (Usman, 2007).

In Benin, Kelly excavated Savi, the capital of the Hueda Kingdom before its destruction by Dahomean troops in 1727 (Kelly 2001, 2002). At Savi, he encountered entrenchments separating the king's palace from the rest of the town (Kelly 1997a:356-361, Kelly and Norman 2004:101). They were interpreted, probably correctly, as evidence of "a division in social fact in ancient Savi" (Kelly 1997a:360). Kelly mentioned the impressive nature of the ditches, "some in excess of 8m deep," but also noted that "despite their impressive scale and the considerable area included within the ditch system, documentary sources of eyewitnesses and visitors make no mention of their presence. This is curious, as traders were present in the town of Savi more or less continuously from 1670 until its destruction in 1727. Furthermore, the palace complex lies within the ditch system and the historical records are quite clear in asserting that the trading activities were carried out adjacent to the palace buildings" (Kelly 1997a:360).

A detailed study on processes of deterioration of mud walls was carried out in the forest/savanna mosaic of West Africa (McIntosh, 1974). This study focused on the relationships between patterns of mud wall decay in an archaeological context at Begho and at the nearby modern village of Hani, both in Ghana. The climate and pedology of this zone was discovered to largely inhibit the preservation of discernible wall features in an archaeological site (McIntosh, 1974). The processes of deterioration of mud walls and of the physical evolution and devolution observed at Hani, a contemporary West African village, is seen to facilitate the location of decayed mud structures at a nearby archaeological site (Begho) (McIntosh, 1974). McIntosh, therefore, suggested that the archaeologist wishing to obtain the fullest and least biased picture of the settlement configuration of the ancient community should therefore heed all the inferential lessons to be had from a focused ethnographic investigation. Given similar climatic situations and practices of house construction, the study of taphonomic processes and ethnographic analogies may both be necessary for a valid reconstruction of an archaeological settlement (McIntosh, 1974).

Excavation was carried out on Kokobin earthwork in Oda area of Ghana by Oliver Davies in 1953. He collated a list of all known earthworks available in this area in his report, and commented that most of entrenchments that exist in the district, has no detailed are information (Davies, 1967). He also observed that entrenchments are confined to high forest regions, and concluded that such a distribution might be a reflection of the fact that the area had been intensively prospected for diamond (Davies, 1967). According to the report and the site map, Davies is believed to have carried out excavations on the western rampart and a sizable test unit inside the earthwork. But it was reported “that the ditch in question, which was part of the entrenchment system, was not fully excavated and its stratigraphy remained poorly described” (Davies, 1967).

An intensive archaeological work was embarked upon on Ghanaian earthworks the 1970s and the objective of the research to investigate the builders and the earlier occupants of Birim valley region (Kiyaga-Mulindwa 1982). The research investigated a cluster of 21 earthworks in the area, and two of them were excavated namely Monsa and Batabi sites. The excavations produced six radiocarbon dates, including four directly dates related to the occupation of the earthworks. The research also revealed two cultural phases with distinct ceramic traditions, reflecting different periods of occupation of the region (Kiyaga-Mulindwa 1982). These cultural phases related the earthworks and ceramic recovered from the excavations, the earlier phase consists of ware types related in time with the construction of the earthworks, and the later phase comprised ceramic called 'Atwea Ware' was connected with the *Atweafo* similar in style and manufacture to contemporary ceramics of the district (Kiyaga-Mulindwa 1982). The later cultural phase (*Atweafo*) probably has resulted from the activities of the current inhabitants of the Birim valley, whose oral traditions claim they have always lived there (Kiyaga-Mulindwa 1982). However, the evidence revealed that current inhabitants of this region have no cultural connection with the construction or occupation of the earthworks, which was said to have been made by the *Tetefo*, who had earlier lived in the region (Kiyaga-Mulindwa 1982).

Archaeological research undertaken as part of the Central Region Project was specifically aimed at evaluating the age of the earthworks. Although some sites, such as the Monsa earthwork excavated by Kiyaga-Mulindwa, were reoccupied during historic times, others are only associated with early ceramics and, therefore, appear not to have been reoccupied after their abandonment (Chouin and Decorse, 2010). The Akrokrowa earthworks site, identified near Abrem Berase the capital of the Abrem Traditional Area, located in the Komenda-Edina-Eguafo-Abrem district of the Central Region of Ghana was studied in 2002, and this produced only early ceramics and no evidence of reoccupation after its abandonment which made this site a proper field to be archaeological explored (Kiyaga-Mulindwa 1982) (Chouin and Decorse, 2010). Excavations were conducted on the earthworks site and six dates were obtained. The dates provide the first series of radiocarbon dates undoubtedly entirely related to the construction and occupation of earthworks by the makers of the *Atetefo* pottery (Chouin and Decorse, 2010).

A corporation in charge of removing a portion of the high forest to build teak nurseries at la Séguié in Côte d'Ivoire evaluated a number of earthworks there in the late 1960s (Perrot 1968-9). A first site map and a plan for one of the earthworks, known as the "enceinten°1," were created in 1968 (Grandin 1968-9), and Bernard Saison sunk the first unit on the "enceinten°2" earthwork (Polet and Saison 1981:52). In "enceinten°2," Polet undertook more thorough excavations between 1969 and 1971. (Polet 1974, Polet and Saison 1981). The ten questions Triaud posed about the timing, construction, and purpose of the sites, as well as the identity of the earthworks' previous occupants, were addressed by archaeologists (Triaud 1968). Polet oversaw massive excavations that included two long, orthogonal trenches, the longer of which was at least 300 meters long. A short report on the findings, including pottery, pipes, spindle whorls, lithic material, and metallic artifacts, was written by Polet a few years after the excavations (Polet 1974). Polet surmised that the earthworks had not been inhabited for a very long period based on the shallowness of the archaeological deposit and the existence of nearby pipes. He hypothesized that the location had been inhabited at the close of the seventeenth or the start of the eighteenth century.

The major archaeological work and surveys carried out so far by the authors reviewed above have revealed the availability of a large number or network of earthworks in West Africa. But the archaeological studies on them have been limited, as reflected from the number of available publications and reports. And the few archaeological investigations on these earthworks in the region have focused mainly on descriptions and functions, estimating the circumference of the earthworks and hectares of land covered by them. The aspect of technology of construction, the analysis of the material used, period of construction, types of labour force, its post abandonment decay, anthropogenic and taphonomic factors that have influenced the decay and ways of preserving the remains of these walls are rarely considered in detail by most scholars. This work will, therefore, make an attempt to use geoarchaeological techniques to study Oyo Ile palace wall in order to fill the gap in literature.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Field Methods

3.1.1 Reconnaissance

Preliminary survey of Oyo-Ile archaeological site, in which the palace wall was marked out for special archaeological studies, was carried out using foot traversing, with important archaeological features identified, mapped and surface samples collected and possible excavation spots identified (Fig. 3.6).

3.1.2 Mapping and Excavation

A 30 metres (N-S) x 22 metres (E-W) area of the eastern wing of the inner wall was gridded, directly opposite Akesan market, the spot heights were taken, recorded and the contour map was drawn (Table 4.1 & Fig. 4.1). A 20 by 1 metre cross-section of the wall was delineated in an east-west orientation. This trench was then divided into ten 2x1 metre units for step-wise excavation (Plate.3.1-3.4). All the excavated units were referenced to a datum point in order to have a uniform control of the vertical orientation of the excavation. Excavation was conducted stratigraphically for each unit based on the colour, texture, sediment properties, hardness, and soil inclusions. The excavation was meant to uncover the whole or a large part of a specific phase in the building of the wall, in order to reveal fully its layout and techniques deployed in its building.

3.1.3 Collection of Artifacts

Artifacts and ecofacts were collected and recorded stratigraphically, and, when necessary, the depth of retrieval was recorded with reference to the excavation datum point, given the specific interest of this study in understanding the technology and materials used for building the inner wall.

3.1.4 Collection of Sediment Samples

Sediment samples were collected from the excavated units, which were dug to a depth of 200 centimetres (2 metres). The samples were collected from the natural layers of the southern wall of the excavated unit. In all, five samples were collected and were subjected to granulometric analysis, phosphate analysis, p^H, thin section and chemical analysis. Data obtained were subjected to statistical analyses.

3.2 Laboratory Methods

3.2.1 Granulometric Analysis

Preliminary Pre-treatment

The five samples were sun-dried for two days. After drying, the samples were disaggregated using mortar and pestle. The samples were subjected to further pre-treatment which included observing the sediments under the light stereo–microscope in order to detect the presence of extraneous materials such as charcoal specks, roots and rootlets. This is also to ascertain their shape, texture, structure, etc. The colour of the samples was determined with reference to the Munsell Soil Colour Chart. The following procedure was then undertaken:

100 g of each of the original sample was weighed on an electronic weighing balance and poured into 500 ml beakers. 50% dilute hydrogen peroxide was added to the sample in the beakers. The solution was left for four days and then sieved through a <63 mesh sieve into 300 ml beakers. The filtrate was left in the 300 ml beaker and allowed to settle completely under gravity. This solution was left for as long as a clear solution was obtained over the silt and clay that settled at the bottom. Effervescence still continued after many days of the addition of hydrogen peroxide which necessitated the addition of a few drops of Hydrochloric acid (HCl) to the solution in order to stop the effervescence, and to enhance the quick settling down of the required grains (silt and clay).

After this, the clear liquid on the residue was decanted and the remaining was sucked up with a pipette. The residue was then sun-dried to a constant weight for about 8 days and the final weight was determined and recorded using electronic weighing balance.

The coarse particles of the samples obtained on this wet sieving were also sun dried for dry sieving.

Dry Sieving

This was carried out in order to separate the sediment particles in the original samples into various size classes of gravel, coarse sand, find sand, and the remaining silt and clay present.

The dried coarse grained sediment samples were first weighed on electronic weighing balance and the weight recorded. The coarse grained sediments were then sieved using British Standard sieves arranged in order of size ranging from 2800 microns to < 63 microns, and pan at the bottom of the sieve. The sieves were shaken vigorously for about 10 minutes to ensure complete separation of particles into their size classes. Sediment particles retained in each mesh sieve were collected and the weight determined and recorded. The samples were grouped into textural classes to which they belong.

Organic Matter Content

The loss in weight of an original sample after analysis could be as a result of many accidents in the cause of the analysis, such as dropping some of the particles, which is still allowed within experimental error. But the greater loss comes from the breakdown of organic matters present in the sediment.

The appropriate quantitative value of the organic content is determined using the following simple mathematical formula:

Original sample weight = W_1 (g)

Weight of the sample after dry sieving = W_2 (g)

Weight of organic of matter = W_1- W_2 (g)

$$\text{Percentage composition of organic matter} = \frac{W_1 - W_2}{W_1} \times 100 \qquad \textbf{(3.1)}$$

Textural Classification

This is based on the British Standard Classification Method as shown below:

Gravel	-	5600 to 2000µm	(-2.5 to 1.0Ø)
Coarse sand	-	1400 to 710 µm	(-0.5 to 0.5 Ø)
Medium sand	-	500 to 250 µm	(1.0 to 2.0Ø)
Fine sand	-	180 to 63µm	(2.5 to 4.0Ø)
Silt and clay	-	<63µm	(>4.5Ø) ………………………. **(3.2)**

3.2.2 Phosphate Analysis

Phosphorus Determination was Carried out Using BRAY-1 Method

1 g of air-dried sediment was weighed in extraction cup and 30ml Bray-l solution was added. This was stirred on the mechanical shaker for 5 minutes and allowed to stand for 2 minutes and then centrifuged for 5 minutes at 3000 rpm. 1 ml of the clear supernatant or standard solution was pipetted into a set of clean glass vials, and 6 ml of distilled water was added and stirred well. 2ml of colour reagent was added and mixed again. Thereafter, 1 ml of ascorbic acid solution was added and mixed well. After about six minutes the colour was measured at 650 nm on a colorimeter or visible range spectrophotometer. Afterwards, graph absorbance versus ppm P (part per million phosphorous) was plotted. The unknown samples were read and ppm P obtained by interpolation on the graph R. The value of phosphate content present in each sediment sample was determined afterwards.

3.2.3 Thin-Section Preparation

Fresh loose samples were air-dried for 24 hours; the samples were then impregnated with epoxy A & B and left to core for 24 hours. The cored samples were then trimmed to fit on a glass slide, and the trimmed surfaces were lapped on a glass plate using water and silicon carbide 600 grits. This was done so as to have a very smooth surface for bonding with the glass slide; one surface of the glass slide is also lapped and made smooth for bonding with the sample. The samples were then allowed to bond to the glass slide using epoxy on a hot plate for 24 hours; the samples were then trimmed to 50 micron on the glass slide using the cut-off saw machine and later transferred to the lapping plate and lapped to 30 micron using silicon carbide and water. 30 micron lapped slides were studied with stereomicroscopes and petrographic microscopes at magnifications ranging from 1 to 500×.

3.2.4 Chemical Analysis

The chemical analysis involves the determination of the qualitative and quantitative amount of the exchangeable bases (Cations) present in the sediment, that is, potassium (K^+), Sodium (Na^+), Calcium (Ca^{2+}) and Magnesium (Mg^{2+}). The procedures for determining the amount of exchangeable Cations was carried out using individual determination bases and summing up the values or a result that proffers combining all the elements. The equipment for this experiment include analytical balance (accuracy 0.01 g min), reciprocating or rotary shaker, capable of 180 oscillations per minute (opm), 50 ml polyethylene centrifuge tubes, measuring cylinder, centrifuge machine and volumetric flasks. The procedure is as follows:

(i) 3.0 g of air-dried sieved sediment sample was weighed into 50 ml centrifuge tubes.

(ii) 30 ml of Melich 3 extraction solution was dispensed into each bottle so as to dispense to all samples within two minutes.

(iii) The mixture was shaken for ten minutes on a reciprocating shaker.

(iv) The filtrate was then analyzed for the Cations Calcium, Magnesium, Potassium and Sodium.

3.2.5 The p^H Determination Method

The pH of each of the sediment samples is measured in the laboratory using an electronic pH meter which is the most reliable method of determining soil pH. The pH scale ranges from 1 to l4.7 while is neutral. Values less than 7 are acidic and, greater than 7 are alkaline.

The determination of the pH involved measuring 20 g of each sample into an extraction cup, and adding l00 ml of distilled water. This mixture was allowed to stand for 15 minutes, after which it was shaken on a mechanical shaker for 30 minutes at 150 rpm and then was allowed to stand for 10 minutes. The pH value was read using a pH meter standardized with 7.0 and 4.0 buffer solutions.

3.2.6 Pottery Analysis

Procedure

In analyzing the potsherds recovered from the excavation carried out in this research morphological/typological approach was adopted. The steps are as follows:

The potsherds were spread out according to the layers and they were mainly body sherds. The decorative techniques and motifs of the potsherds were critically observed– single decorative motif or composite decorative motif (more than one form of decorative motif), undecorated or plain-burnished sherds. And they were separated into their various decorative techniques and motifs.

The quantification of the sherds from each layer was used in assessing the total number of potsherds in the specific layer and total potsherds recovered from the excavation. The sherds were critically examined some of their character on the basis of their crudeness and how well-fired they were. Along this line, the decorative techniques and motifs will draw our attention to find out if any relationship existed between the quantities of sherds found in the layers.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Reconnaissance Survey

The preliminary survey of Oyo Ile covered several including the study area. During this exercise the palace wall was marked for special archaeological studies, important archaeological features were identified and mapped; surface samples were collected and excavation spots were identified and contour map drawn (Fig. 4.1, Appendice 1.1 and Fig. 4.2)

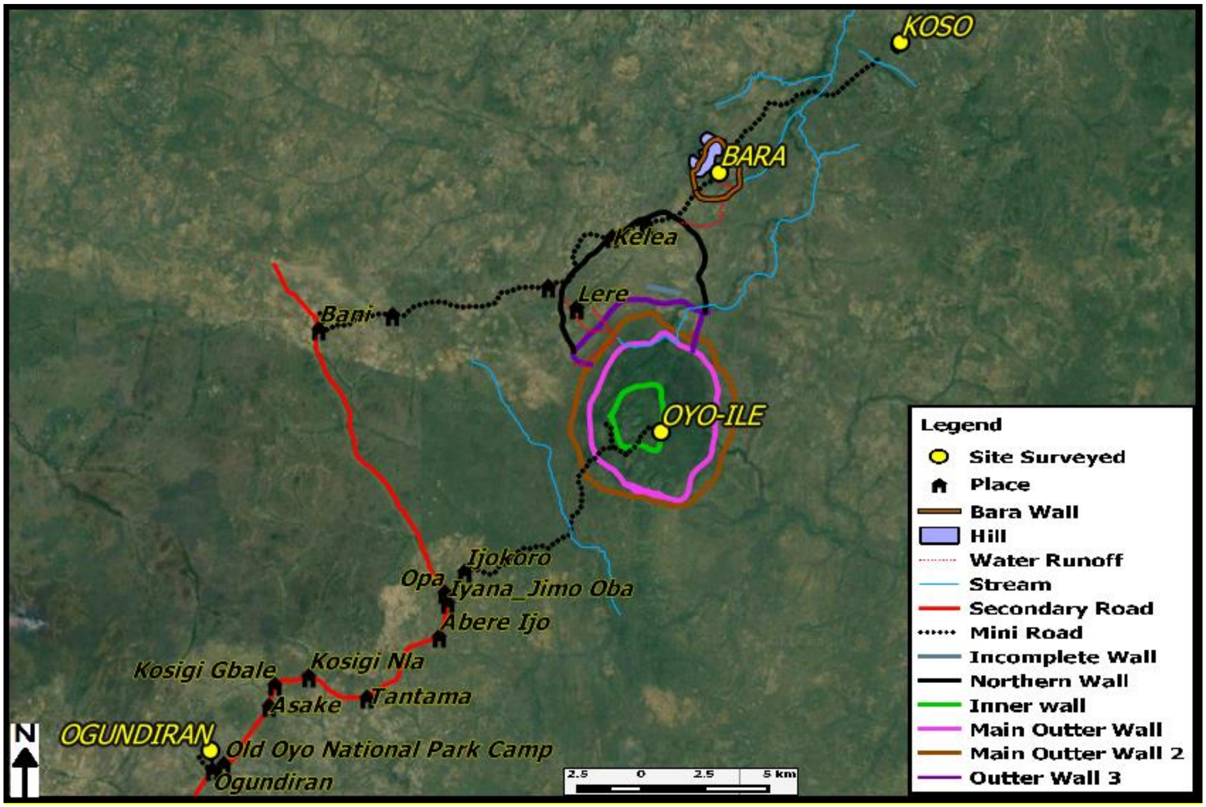


Fig. 4.1: Places Covered during Reconnaissance including the Study Area.

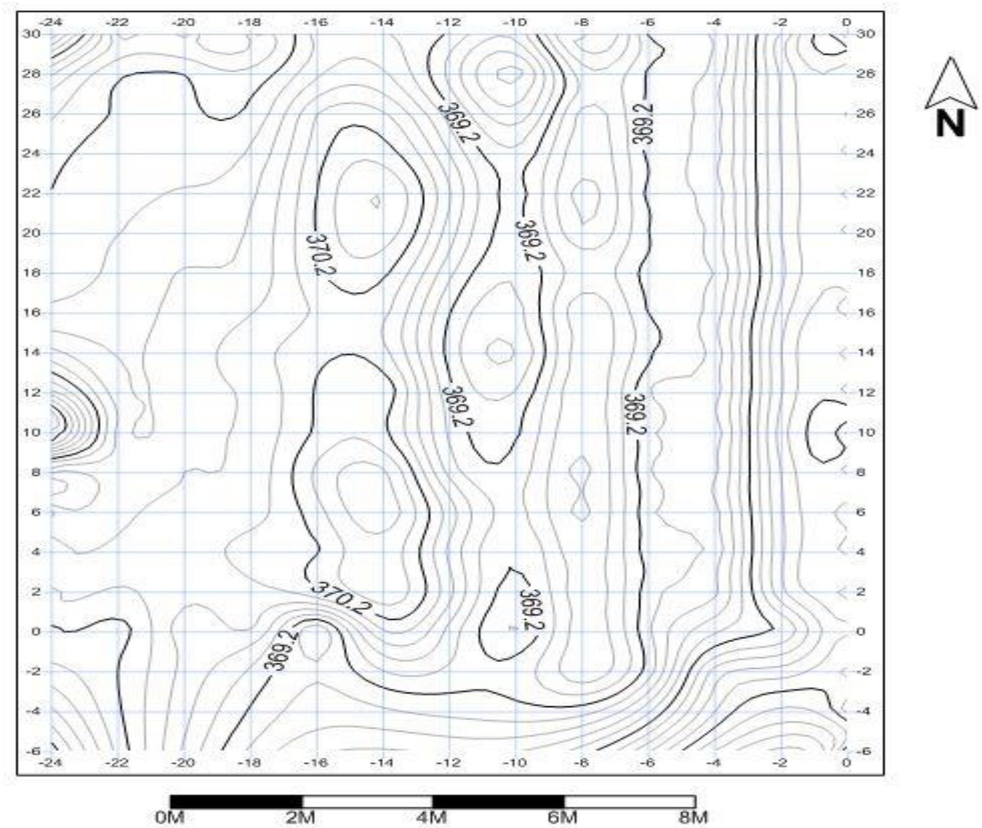


Fig. 4.2: Contour Map Showing Topography of Study Area

4.1.1 Mapping and Excavation

The excavation uncovered the remains of the inner wall which is now reduced to a massive hill of earth. It also revealed stone counterforts retaining wall on the interior side which shows evidence of buttressing to improve the strength of the inner wall against side sliding and to resist high loads. Evidence for a foundation was not revealed by the excavation (Plate 4.1-4.4).

Plate 4.1: The Cleared Section of the Wall before Excavation.

Plate 4.2: Terracing Techniques of Excavation (Initial Stage of the Excavation).

Plate 4.3: Terracing Techniques of Excavation (Final Stage of the Excavation).

Plate 4.4: Stone Counterfort Retaining Wall on the Interior Side.

4.1.2 Stratigraphy

Five stratigraphic layers were delineated on the basis of colour, texture and content, disregarding the topsoil (4-5cm thick) which is loose sandy-silt and powdery with many roots and rootlets. The colours of the sediments, determined using the Munsell soil colour chart are reddish gray, yellowish red to reddish brown (Fig.4.2). The following section summarises each stratigraphic unit based on field observations and descriptions.

SL1–The uppermost unit varies between 4 and 20 cm in depth and is relatively homogenous throughout. It comprises a loose, dry gravelly-sand matrix with some macro-organic content (e.g. roots and rootlets) and small quantities of charcoal. The colour of the sediment is reddish gray (5YR 5/2). The boundary with the underlying next layer is clearly defined by an increased level of compaction.

SL2–Consists of a dry, charcoal-rich and moderately compacted gravelly sand matrix. The deposit is interspersed with charcoal, small roots and small holes from decayed root system, and while largely homogenous in nature, the quantity of charcoal increases in its lower levels. The thickness of SL2 is between 25 cm and 90 cm. Sediment's colour of this layer is reddish brown (5YR 5/3).

SL3–This is a stratum of dry, charcoal rich gravelly sand which increases in compaction with increasing depth between 80 and 120 cm. Several small roots and root holes are present in the upper levels of the unit. The colours of the sediments are uniformly yellowish red (5YR 5/6).

SL4–This deposit consists of dry and compact, gravelly-and rich sediments with few big stone artefacts. Charcoal is restricted to the upper levels of the unit, which also coincides with colour variations of sediments. The colour is yellowish red (5YR 5/8).

SL5 – A stratum of dry, gravelly-sand rich sediments, SL5 is characterised by a vertical unit of relatively homogenous sediments, which was noticeable very compact. The colour of this layer is reddish brown (5YR 5/4). These few big stone artefacts in SL4 also extended into this layer.

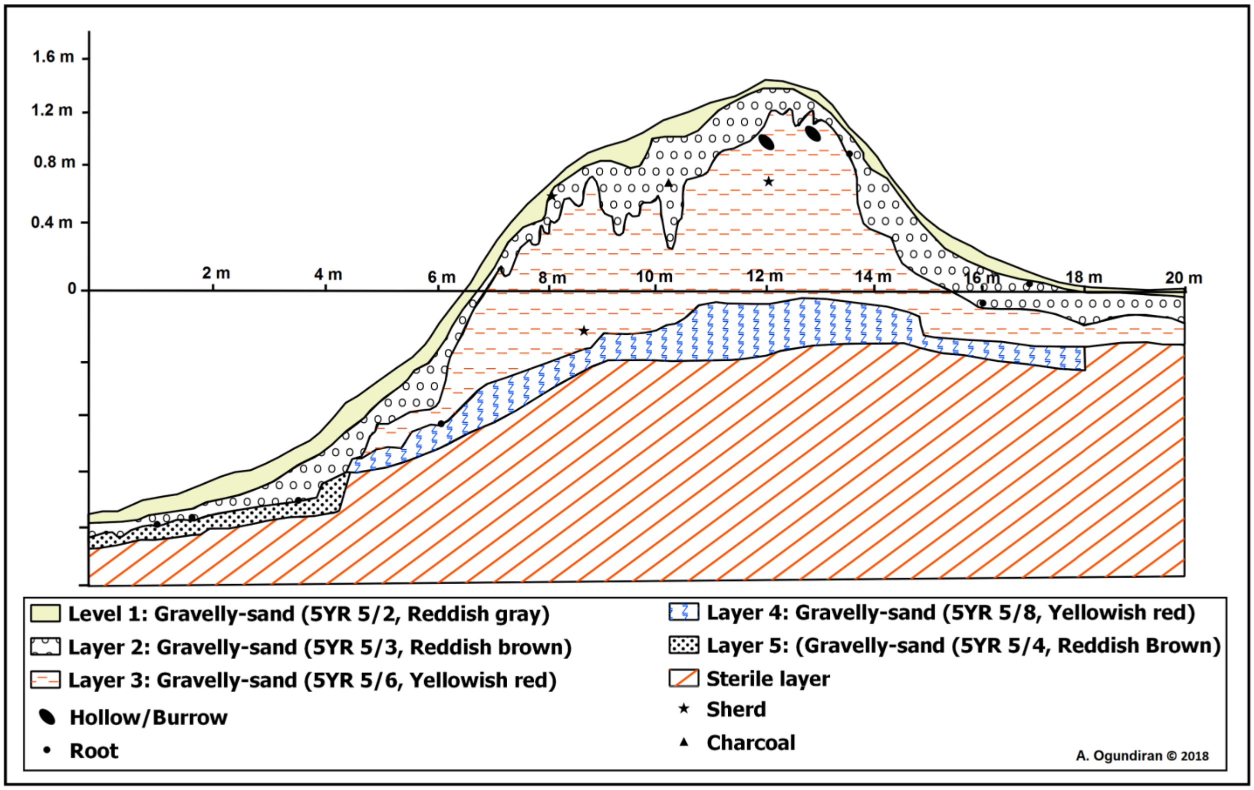


Fig. 4.3: The Sketch of Stratigraphy of the Palace Wall Excavated.

4.2 Results of Laboratory Methods

4.2.1 Granulometric Analysis

The graphical size parameters, as determined by the Folk and Ward, 1957, demonstrate that generally the sediment grains are moderately sorted to poorly sorted (Table 4.10 and Fig. 4.8-4.12). The mean grain size values range from 0.17-1.13. Median grain size values ranged from -0.65-0.40. The grain size mode has a single value of -1.0 and the histogram showed unimodal variations across the layers (Table 4.9 and 4.10, Fig.4.3-4.7). The inclusive standard deviation (sorting) ranged from 0.81-1.57. L1 has inclusive standard deviation of value 0.81 while L3 has 1.57. Inclusive Graphic Skewness indicates skewness values that range from 0.25-1.22 (Table 4.10).

The analysis also showed that the sediments are made up of large amount of sand grains (coarse, medium and fine) and gravel, with appreciable amount of silt and clay throughout the layers (Table 4.2- 4.6 and 4.7). The characteristic colours of the sediments range from reddish gray (layer 1) to reddish brown (layer 2 and 5) and yellowish red (layer 3 and 4). The shapes of sediment particles are angular to sub-rounded; the sediments contain appreciable amount of organic matter.

Particle Size Distribution

Table 4.1: Particle-size Distribution.

Sample Name: L 1			Sample Location: Oyo-Ile (Place wall)	
Original Sample Weight:100 g				
Weight of Silt and Clay: 5.3 g				
Microns	Phi	Weight (g)	Weight (%)	Cumm. Weight (%)
16000	-0.4			
11200	-3.5			
8000	-3			
5600	-2.5			
4000	-2			
2800	-1.5			
2000	-1	25.6	25.9	25.9
1400	-0.5	17.8	18.02	43.92
1000	0	12.3	12.45	56.37
710	0.5	5.8	5.87	62.24
500	1	15.5	15.67	71.91
355	1.5	6.1	6.17	84.08
250	2	3.8	3.85	87.93
180	2.5	2.1	2.13	90.06
125	3	1.9	1.92	91.98
90	3.5	1.3	1.32	93.3
63	4	1.3	1.32	94.62
<63	Pan	5.3	5.36	99.98
Total		9.9		
% loss	0.02			

Composition	Percentage
Gravel	25.9
Sand	68.72
Silt and Clay	5.36

Table 4.2: Particle-size Distribution.

Sample Name: L 2			Sample Location: Oyo-Ile (Place wall)	
Original Sample Weight:100 g				
Weight of Silt and Clay: 7.2 g				
Microns	Phi	Weight (g)	Weight (%)	Cumm. Weight (%)
16000	-0.4			
11200	-3.5			
8000	-3			
5600	-2.5			
4000	-2			
2800	-1.5			
2000	-1	28	28.2	28.2
1400	-0.5	17.6	18.03	46.23
1000	0	10.9	10.98	57.21
710	0.5	5.2	5.24	62.45
500	1	13.2	13.29	75.74
355	1.5	6.0	6.04	81.78
250	2	3.9	3.93	85.71
180	2.5	2.2	2.2	87.91
125	3	1.7	1.71	89.62
90	3.5	1.6	1.61	91.23
63	4	1.5	1.51	92.74
<63	Pan	7.2	7.25	99.99
Total		99.3		
% loss	0.01			

Composition	Percentage
Gravel	28.2
Sand	64.54
Silt and Clay	7.25

Table 4.3: Particle-size Distribution.

Sample Name: L 3			Sample Location: Oyo-Ile (Place wall)	
Original Sample Weight:100 g				
Weight of Silt and Clay: 18.8 g				
Microns	Phi	Weight (g)	Weight (%)	Cumm. Weight (%)
16000	-0.4			
11200	-3.5			
8000	-3			
5600	-2.5			
4000	-2			
2800	-1.5			
2000	-1	27.2	27.7	27.7
1400	-0.5	14	14.25	41.95
1000	0	8	8.14	50.09
710	0.5	3.5	3.56	53.65
500	1	8.4	8.55	62.2
355	1.5	4.0	4.07	66.27
250	2	3.7	3.77	70.04
180	2.5	3.0	3..06	73.1
125	3	2.8	2.85	75.95
90	3.5	2.3	2.34	78.29
63	4	2.5	2.55	80.84
<63	Pan	18.8	19.14	99.98
Total		98.2		
% loss	0.02			

Composition	Percentage
Gravel	27.7
Sand	53.14
Silt and Clay	19.14

Table 4.4: Particle-size Distribution.

Sample Name: L 4			Sample Location: Oyo-Ile (Place wall)	
Original Sample Weight:100 g				
Weight of Silt and Clay: 2.3 g				
Microns	Phi	Weight (g)	Weight (%)	Cumm. Weight (%)
16000	-0.4			
11200	-3.5			
8000	-3			
5600	-2.5			
4000	-2			
2800	-1.5			
2000	-1	24.3	24.3	24.77
1400	-0.5	16.2	16.51	41.2
1000	0	9.3	9.48	50.76
710	0.5	4.1	4.18	54.94
500	1	9.5	9.68	64.62
355	1.5	4.2	4.28	68.9
250	2	3.7	3.77	72.67
180	2.5	3.0	3..06	75.73
125	3	2.7	2.75	78.48
90	3.5	2.6	2.65	81.13
63	4	3	3.06	84.19
<63	Pan	15.5	15.8	99.99
Total		98.1		
% loss	0.01			

Composition	Percentage
Gravel	24.77
Sand	69.9
Silt and Clay	9.33

Table 4.5: Particle-size Distribution

Sample Name: L 5			Sample Location: Oyo-Ile (Place wall)	
Original Sample Weight:100 g				
Weight of Silt and Clay: 2.3 g				
Microns	Phi	Weight (g)	Weight (%)	Cumm. Weight (%)
16000	-0.4			
11200	-3.5			
8000	-3			
5600	-2.5			
4000	-2			
2800	-1.5			
2000	-1	20.5	20.79	20.79
1400	-0.5	14.5	14.71	35.5
1000	0	10.1	10.24	45.74
710	0.5	4.6	4.67	50.41
500	1	12.5	12.68	63.09
355	1.5	6.2	6.29	69.38
250	2	5.6	5.68	74.98
180	2.5	4.6	4.67	79.65
125	3	4	4.67	83.71
90	3.5	3.5	3.55	87.26
63	4	3.3	3.35	90.61
<63	Pan	9.2	9.33	99.94
Total		98.6		
% loss	0.06			

Composition	Percentage
Gravel	20.71
Sand	69.9
Silt and Clay	9.33

Table 4.6: Percentage Composition of Particle Size of Sediment Samples

Composition (%)	Gravel	Sand	Silt and Clay	% total	% loss
L1	25.9	68.72	5.36	99.98	0.02
L2	28.2	64.54	7.25	99.99	0.01
L3	27.7	53.14	19.14	99.98	0.02
L4	24.77	56.42	15.8	99.99	0.01
L5	20.71	69.9	9.33	99.94	0.06

Table 4.7: Measures for Statistical Parameters of Particle Size of Sediment Samples

Percentile (%) Sample No.	5	16	25	50	75	84	95
L1	0.00	0.00	0.00	-0.60	0.55	1.10	3.55
L2	0.00	0.00	0.00	-0.65	0.60	1.55	3.95
L3	0.00	0.00	0.00	-0.40	2.60	3.80	4.10
L4	0.00	0.00	-1.10	-0.65	2.10	3.70	3.95
L5	0.00	0.00	-1.10	0.40	1.90	3.00	4.05

Table 4.8: Statistical Calculation of Parameter of Particle Size Sediment Samples

Sample No.	Mode	Median	Mean	Standard Deviation	Skewness	Kurtosis
L1	-1.0	-0.60	0.17	0.81	1.22	2.65
L2	-1.0	-0.65	0.30	0.99	1.09	2.94
L3	-1.0	-0.40	1.13	1.57	0.71	0.65
L4	-1.0	-0.65	1.02	1.53	0.85	0.52
L5	-1.0	0.40	1.13	1.36	0.25	0.55
Average	**-1.0**	**-0.38**	**0.75**	**1.25**	**0.82**	**1.46**

Table 4.9: Description of Grains' Character of Sediment Samples

Sample No.	Mode	Standard Deviation	Skewness	Kurtosis
L1	Unimodal	moderately sorted	Strongly positive	very leptokurtic
L2	Unimodal	moderately sorted	Strongly positive	very leptokurtic
L3	Unimodal	poorly sorted	Strongly positive	very platykurtic
L4	Unimodal	poorly sorted	Strongly positive	very platykurtic
L5	Unimodal	poorly sorted	Positive	very platykurtic

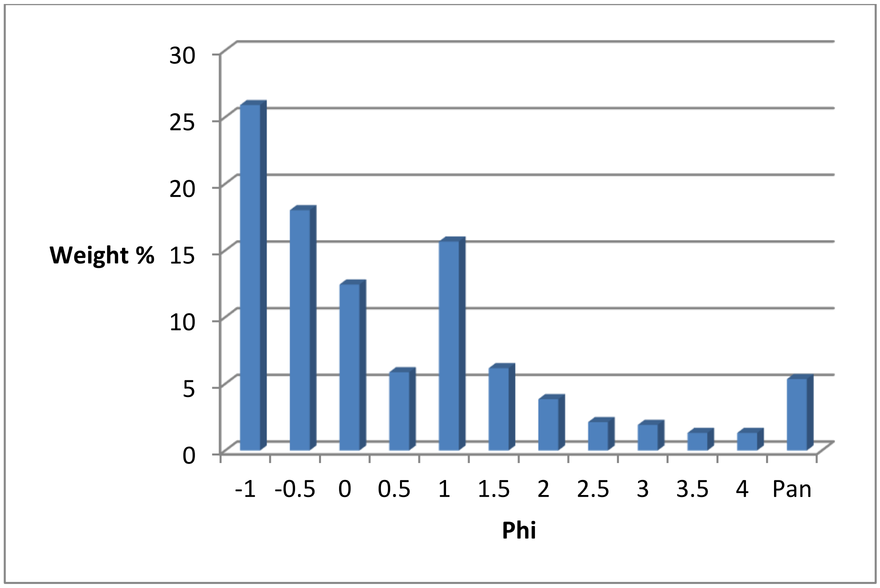


Fig. 4.4: Histograms of Particle-size Distribution of sample L1.

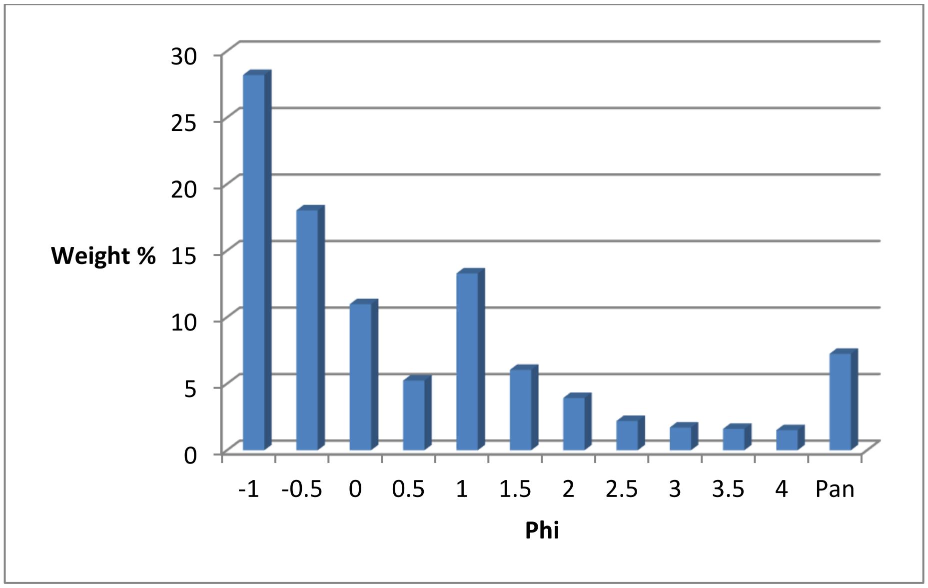


Fig. 4.5: Histograms of Particle-size Distribution of sample L2.

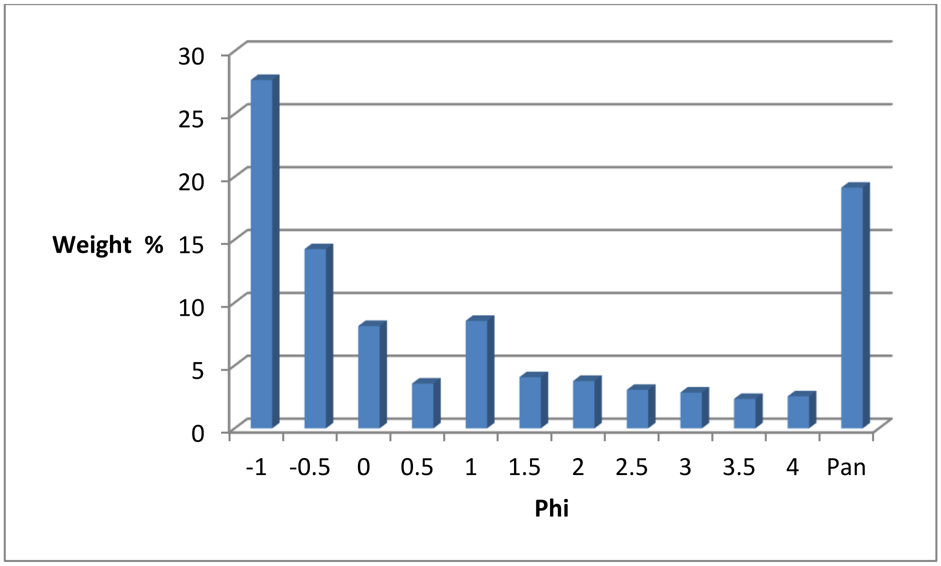


Fig. 4.6: Histograms of Particle-size Distribution of sample L3.

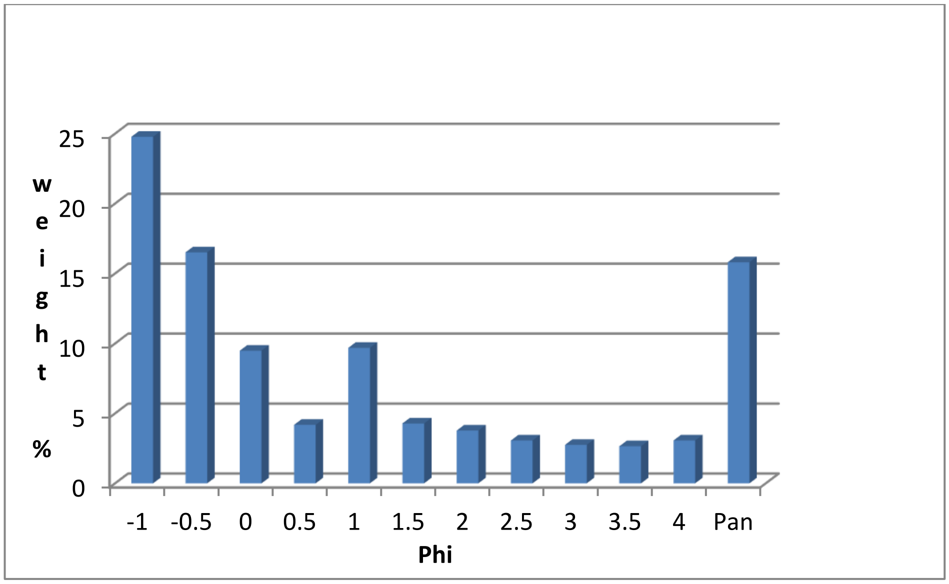


Fig. 4.7: Histograms of Particle-size Distribution of sample L4.

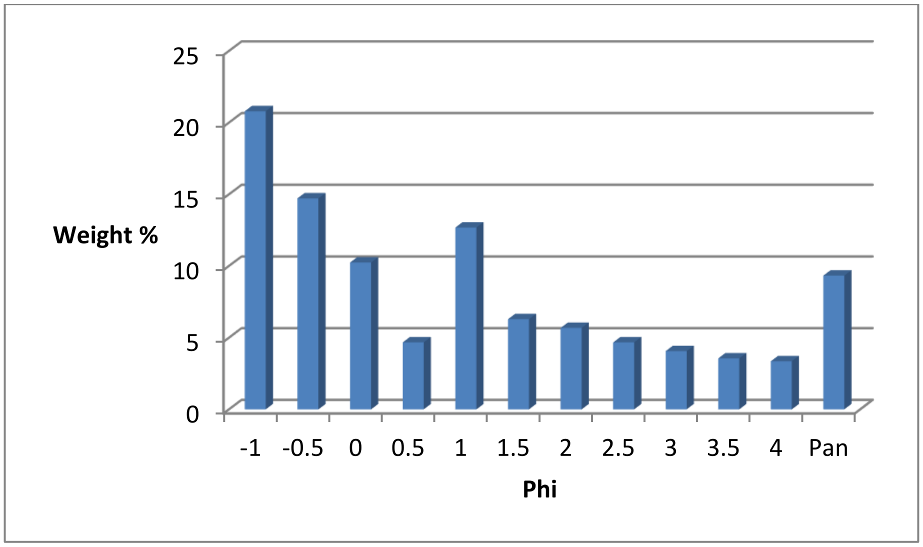


Fig. 4.8: Histograms of Particle-size Distribution of sample L5

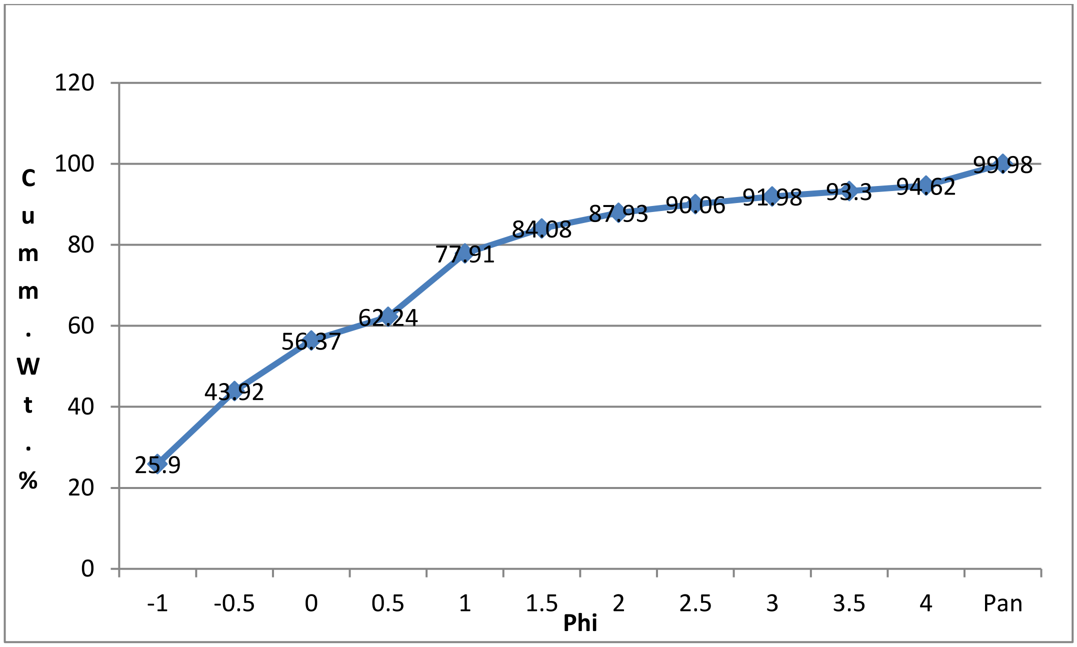


Fig. 4.9: Cumulative Weight % Graph of Particle-size Distribution of sample L1.

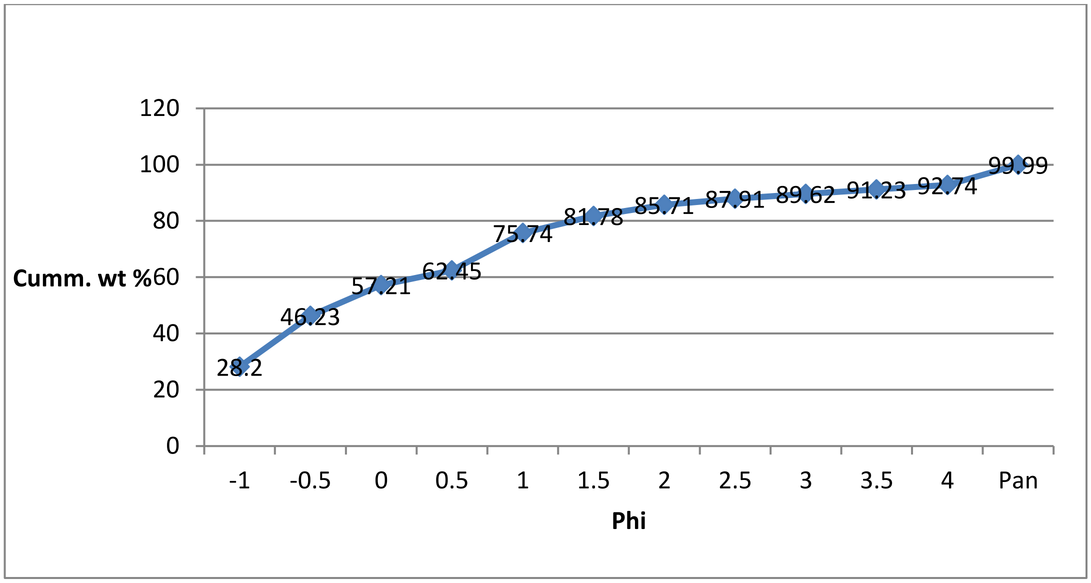


Fig. 4.10: Cumulative Weight % Graph of Particle-size Distribution of sample L2.

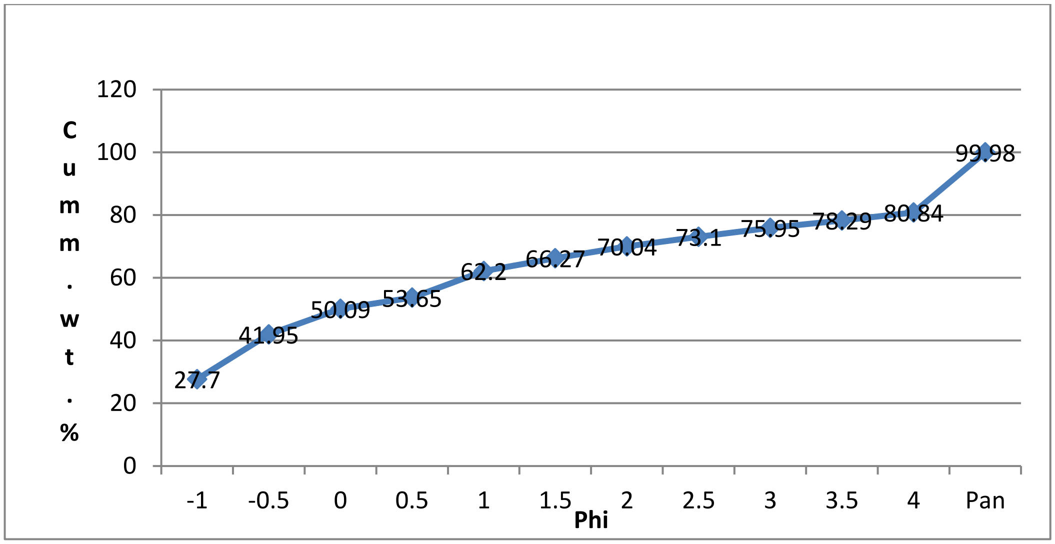


Fig. 4.11: Cumulative Weight % Graph of Particle-size Distribution of sample L3.

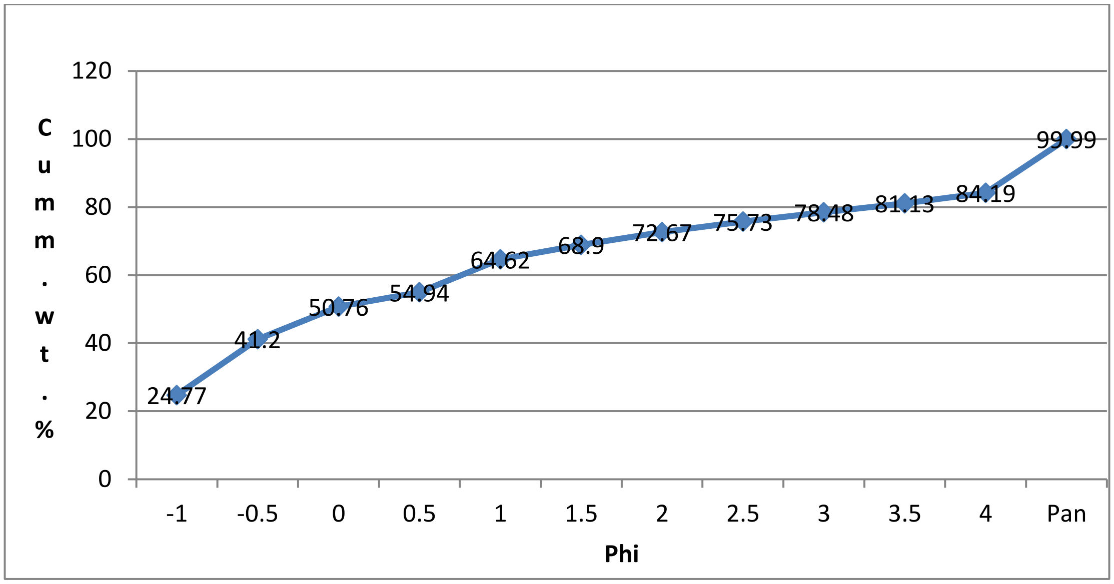


Fig. 4.12: Cumulative Weight % Graph of Particle-size Distribution of sample L4

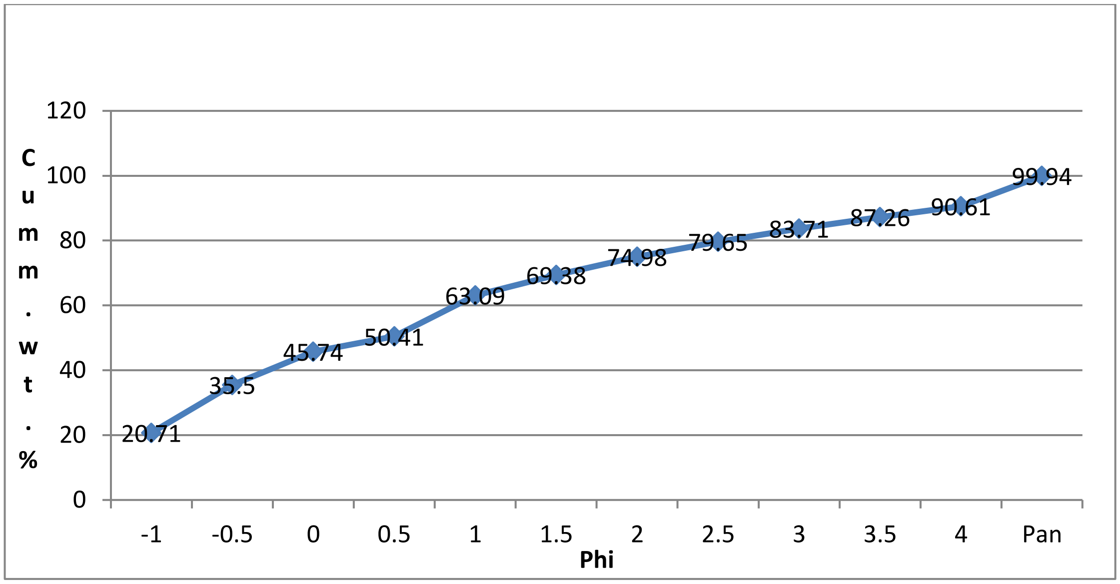


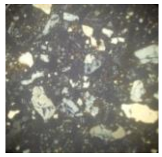
Fig. 4.13: Cumulative Weight % Graph of Particle-size Distribution of sample L5.

4.2.2 Mineralogy of the Sediments

Thin sections of the sediments showed the presence of quartz mineral, which formed the highest proportion of mineral assemblage of these sediments. Other minerals identified include Feldspar, Rutile, Garnet, Tourmaline and Rock fragment. The quartz mineral is white under the petrographic microscope. Feldspar, Rutile, Garnet, Tourmaline and Rock fragment, which are ultra-stable minerals that can withstand prolonged abrasion and survive many reworkings (Plate 4.1) (Feo-codecido, 1956) are found in all the samples except L1, L2 and L5 where Rutile was absent in the mineral assemblage.

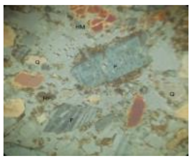
Table 4.10: Results of Thin Section Analysis of the Sediment Samples (%)

Sample No.	Quartz	Feldspar	Rutile	Garnet	Tourmaline	Rock fragment
L 1	93	2	-	1	2	2
L 2	93	3	-	1	1	2
L 3	91	3	1	1	1	3
L 4	90	2	1	1	2	4
L 5	90	3	-	1	2	4

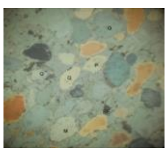
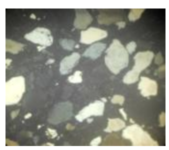
(a) L1: PPL (b) L1: XPL

Photomicrograph of Sediments in Location L1 Showing in (a) Plane Polarised Light (b) Crossed Polarised Light

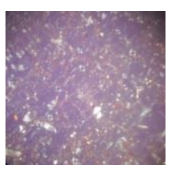
(a) L2: PPL (b) L2: XPL

Photomicrograph of Sediments in Location L1 Showing in (a) Plane Polarised Light (b) Crossed Polarised Light

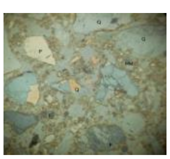
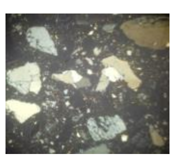
(a) L3: PPL (b) L3: XPL

Photomicrograph of Sediments in Location L1 Showing in (a) Plane Polarised Light (b) Crossed Polarised Light

(a) L4: PPL (b) L4: XPL

Photomicrograph of Sediments in Location L1 Showing in (a) Plane Polarised Light (b) Crossed Polarised Light

(a) L5: PPL (b) L5: XPL

Photomicrograph of Sediments in Location L1 Showing in (a) Plane Polarised Light (b) Crossed Polarised Light

Plate 4.5: Photomicrograph of Sediments' Thin Section

4.2.3 Phosphate content

The phosphate concentration of the soils was very low across the layers (Table 4.12). The availability of phosphorus in the sediment though low suggests that additives might have been used especially fecal matter such as cow, horse or camel dung which can contain chemicals such as phosphoric acid, potassium minerals and fibers that can improve the cohesion and plasticity of soils.

4.2.4 Chemical Analysis (Soil-exchangeable cations)

Across the soil depths, both exchangeable Ca and Mg concentrations were not detectable, except for L2 with Ca^{2+} concentration of 1.55 and, L4 and L5 with Mg^{2+} concentration of 1.25 and 4.75 respectively, and these were in appreciable amount (Table. 4.12). Soil-exchangeable Na^{+} has the highest value in L3 followed by L1, then L4 and L5 across the soil depths. The Soil-exchangeable K^{+} has appreciable concentration throughout the layers with the highest on L3.

4.2.5 Soil pH

The sediments show pH variations with no distinct pattern. The pH of the soil ranged from slightly acidic to slightly basic (Table 4.12).

Table 4.11: P^H, Phosphate, and Chemical Analysis of sediments

Sample No.	P^H	Phosphate mg/kg	(Ca^{2+}) mg/kg	Mg^{2+} mg/kg	(Na^+) mg/kg	(K^+) mg/kg
L1	6.8	0.93	ND	ND	1500	295
L2	7.1	2.55	1.55	ND	859	242
L3	6.7	2.75	ND	ND	2310	671
L4	6.9	2.88	ND	1.25	1180	322
L5	7.3	1.53	ND	4.75	1050	215

ND= Not dectectable

4.2.6 Result of Pottery Analysis

Various sherds are sorted out to show the pattern of their occurrences. A glance at Table 4.13 shows decorative motifs on the potsherds.

Decorated Techniques and Motif

From the analysed potsherds the following techniques were identified: rouletting, stamping/incision, channelling and cross hatched, burnished, applied and a combination of different techniques. Table 4.13 shows the various techniques and motifs.

Rouletting

The major roulette decorative motifs in this category are double string roulette, single string roulette, carved roulette, twisted cord roulette, maize ear roulette and maize cob roulette. Two of the six motifs occur throughout the levels while carved roulette occurs only at two levels. The two constitute 1.75%, and 6.01% respectively of the total sherds (Table 4.13**)**. The only multiple decoration is single string roulette and striation. It constitutes 0.22% of the total decorative category.

Incision-Stamping

These set of techniques are found in various motifs throughout the level. These are: incision, striation, wavy incision, grooving, cross-hatched, channelling, circular stylus and punctate. (Table 4.13 and Plate 4.2) shows the different motifs as described. Of all the motifs in this category, it is only groove that does not occur throughout the levels. They are also multiple decorations, for example, curved incision + painted and punctate + straition that constitute 0.11% and 0.22% of the total decorations respectively.

Impression

The only impressed motif from this excavation is finger nail impression which occurs as multiple decorations with channels (finger nail impression + channel) and also with striations (finger nail impression + striation). They constitute 0.11% and 0.11%, respectively of the total decorated sherds (Table 4.13 and Plate 4.2)

Burnishing

In addition to form and decoration, burnishing is one of the characteristics. Burnished potsherds represent a group of fine fabric usually black, brown or grey, shiny, black surface. They constitute 7.54% of the total potsherd assemblage (Table 4.13).

Plain sherds

These are body sherds without decoration of any type. This does not mean that they are from undecorated pots. On the contrary many of them come from undecorated areas of pots which were otherwise decorated. These dominate the % potsherd assemblage (Table 4.13 and Plate 4.2).

Unidentified Sherds

These are the body sherds that do not satisfy any category for classification. These might have either been eroded or affected in the excavation process. They also form a larger part of potsherd assemblage (Table 4.13).

Applied Techniques

Bossessing

This is formed when extra clay is added to the surface of a vessel to form a particular pattern. It also includes ridges formed by raising the existing clay of the vessel instead of adding new clay.

Perforated pots

Punched holes through the body of a vessel were made before firing and these types of pots were likely used as suspended vessels for the drying of meat and fish, rather than as strainers. The modern parallels are common in Nigeria.

Table 4.12: Pottery Decoration Class and Their Percentages

Decoration class	Level 1	Level 2	Level 3	% of decoration class
Unidentified	72	66	278	**45.77**
Plain	46	42	143	**25.25**
Double string roulette	4	5	7	**1.75**
Maize ear	-	-	1	**0.11**
Striation	12	3	31	**5.03**
Carved roulette	-	4	5	**0.98**
Maize cob	-	4	11	**1.64**
Single string	13	9	33	**6.01**
Punctuate	1	1	2	**0.44**
Groove	3	-	4	**0.77**
Painted red	-	2	10	**1.31**
Wavy incision	3	2	2	**0.77**
Incision	2	1	3	**0.66**
Burnished	19	4	46	**7.54**
Channel	1	1	2	**0.44**
cross-hatched	2	1	3	**0.66**
Punctuate +striation	2	-	-	**0.22**
Curved incision +painted	-	1	-	**0.11**
Striation + single string	-	-	2	**0.22**
circular sylus	1	-	1	**0.22**
finger nail + striation	-	-	1	**0.11**
finger nail + channel	-	-	1	**0.11**
twisted cord	-	-	1	**0.11**
circular sylus + wavy	-	-	1	**0.11**
Total No. of Sherds on each level	181	146	588	

Maize ear roulette

Punctate & striation

channel

Wavy incision

plain

Fingernail impression

Plate 4.6: Decorated Techniques and Motif of Potsherd from the Excavation.

4.3 Discussion

The excavation revealed the entire profile of a massive wall complex. Among materials recovered from these excavations are pottery, charcoal samples, and stones. The bulk of the artefacts were recovered from level 3, after which the sterile level was reached. The quantity of artefacts recovered on this level especially the potsherds were probably deliberately added to the mortar in order to strengthen the first course (underlying stratum) of the wall to be able to support the superstructure (upper courses) as the construction progressed.

There was no evidence of a foundation trench for the palace wall, probably because the soil of the area is lateritic which might have provided the builders with a readymade foundation. To them it might be a waste of time, resources and energy to attempt to cut through the hard laterite, a task difficult to achieve then, and even in the present day without a machine. In other words, this is reflective of the ability of Oyo Ile people to identify the available natural resources and show prudency in putting them to use without wasting both human and time resources, despite the fact that most of these tasks were usually performed by slaves.

The excavation could not show the technique that was used to construct the wall, because the wall is now reduced to a massive hillock of earth but this research only alluded to the statement of Agbaje Williams 1983 to deduce the technique deployed in constructing it. According to Agbaje Williams "Of all the five walls, the inner wall is the only one built with rammed clay and mud puddling. The other walls were either embankment or built with stone (northern wall only) (Agbaje Williams 1983)." In other words, the technique used for the construction of the palace wall could be said to be the rammed earth method, the technique in which two parallel planks are held firmly apart by small crosspieces of wood. A piece of well-prepared mud is thrown in between the two planks and rammed down with a wooden ramrod. As soon as one section is completed and hard, the two boards are moved along and the process is repeated until the whole plan is completed. It requires moderately skilled and unskilled builders and a well-planned division of labour which may include people of different ages and sexes in the Oyo-Ile community. Thus, Oyo-Ile people must have been very discrete in their process of social organization for labor mobilization and this also has implication on Yoruba in general.

The stratigraphy showed that the wall was built of lateritic clay comprising a very fine-grained gravely sand thoroughly kneaded with fibres (Ogundiran and Tubosun, 2018 per. Comm.). The characteristic colour of the soils range from reddish gray, yellowish red to reddish brown and the soils were very compact. Soil colour can provide a lot of information on whether a particular type of soil is good or bad for construction. Soil types with colours from deep yellow, orange and red, ranging to deep rich brown indicate iron content and would imply a good building mud. Clays with a greyish or dull fawn colour ranging down from dirty white to dull browns with a slightly greenish colour indicate too much organic matter and not suitable for construction (Baker, 2000). The fibrous nature of the soils could have resulted from the probable additive used.

The results of grain size analysis (Table 4.2-4.7and Fig. 4.8-4.12) revealed sediments with grain sizes which are moderately sorted and therefore indicative of sub-mature sediments (Joshua and Oyebanjo, 2009). The sediments have an average skewness of sediments indicate that they came from an environment with appreciable energy, as well as sediments of fine grained materials (Joshua and Oyebanjo, 2009; Akintola et al. 2013:89). The average kurtosis showed that the sediments came from a single source (Table 4.2-4.7 and Fig. 4.8-4.12). The average mode of the sediments and their histograms show unimodal variations (Table 4.10 and Fig. 4.8-4.12). The unimodality of histograms of the sediments implies that they came from a single source (Akintola et al. 2013:90). The sediments have an average median of **-0.38 (**Table 4.3)**.** The percentage proportion of the grain size of the sediments (Table 4.2-4.7 and Fig.4.8-4.12), indicates that the sediments are gravelly sand (gravel>sand>10) after Wentworth (1922). The sediments contain roots and rootlets with appreciable amount of charcoal specks. The particle size analysis shows that the sediment composition is gravelly sand meaning that it contains a large amount of sand with some gravel mixed in it and an appreciable amount of clay (Table 4.2-4.7& Fig.4.8-4.12). The percentage composition on Table 4.7 is reflective of sediments' grain sizes within suitable mixture and proportion necessary for various types of earthen materials required for good construction to ensure the durability and optimal strength output of the wall (Baker, 2000). In other words, the procurement and processing of raw materials used in constructing this wall were skillfully carried out by the builders.

The sediments within the pH value 6.7-7.3 is indicative of “brownearths” which forms on subsoil with pH of around 5.5 to 7.5; that are more or less neutral to slightly acidic (Evans, 1978). These types of sediments are characteristic sediments of the mixed deciduous woodland zone. This type of vegetation helps to maintain the alkaline status of the sediments, their structure and drainage (Evans, 1978). It also prevents the effect of microclimate: that is, of alternating wetting and drying at the soil surface resulting in partial breaking down of the crumb structure (Evans, 1978). Also, chemical loss by leaching are prevented by transporting these chemicals from the subsoil into the root system of the trees and replenished via leaf fall (Evans, 1978). In sum, the sediments possess the properties that enable them to retain the main processes of maintaining microclimatic stability, the recycling of chemicals and drainage system, which are vital to earth material stability for construction purposes. The characteristics of this sediment are in consonance with the observations and descriptions made from the stratigraphy above.

Phosphate content analysis carried out showed the availability of phosphorus in the soil though at very low concentration. This suggests that additives might have been used especially fecal matter such as cow, horse or camel dung which often contains chemicals such as phosphoric acid, potassium minerals and a lot of fibrous material to improve the cohesion and plasticity of earthen material used for the construction. Traditionally, these additives are often used in all sorts of mud buildings to prevent mud structure against the attack of termites which is one of the enemies of mud buildings (Baker, 2000; Basin et al. 2002). The low concentration might have resulted from the amount added to the mortar for the construction and this might have been deliberate because usually a small amount of animal additives (fecal matter) is required to meet the required proportion of additives to earthen material for construction, for instance, plaster technique, used mainly to fill up surface cracks. The mixture is 1 part of cow dung and 5 parts of earth (in mass) (Basin et al. 2002).

From the chemical analysis carried out, available amount of alkali elements in the investigated soils indicated low concentration; for instance, Ca^{2+}. Soil types with low calcium content have a mineral composition with dominant quartz, and lower content of calcium bearing minerals, particularly calcite and dolomite. This correlates with high quantity of quartz from the thin section analysis (Homsey and Capo, 2006). In general, available magnesium is quite low in the sediment. Soil types with low available magnesium are said to be more weathered and more acidic, with progressive transformation of mica and illite to clay minerals with subsequent leaching of magnesium as well as other base elements (Homsey and Capo, 2006). The values of available potassium for sediments investigated could be explained against the background of an even and uniform distribution of potassium bearing minerals (orthoclase, micas and illite) in the soils. The amount of available sodium in the sediments is very high, indicative of the occurrence of sodium-bearing minerals (Homsey and Capo, 2006).

The thin section analysis carried out revealed the presence of quartz, Garnet, Tourmaline, Rutile and Rock fragment in the mineral assemblages of the sediments throughout the layers. The mineral assemblages showed that the sediments used for the construction of Oyo-Ile palace wall could have been derived principally from metamorphic rocks with a significant contribution from acidic igneous rock (Folk, 2002: 65-68; Nichols, 2009:23-24). In sum, the available mineral assemblages are from crystallized rocks and usually these are durable and stable to weathering and erosion (the arch enemies of mud structure). Procurement of these types of soil materials by the Oyo-Ile people implies that they had technical knowledge of suitable soil for buildings with stability and durability.

From the result of the pottery analysis, it appears that the ancient people of Oyo-Ile who built the palace wall deliberately added the sherds to the earthen material used for the construction and that more potsherds were added to the substructure of the wall in order to support the load of upper courses, considering the quantity of cultural materials such as sherds and other artefacts recovered from the underlying stratum. Moreso, the analysed potsherds exhibited the same character of thickness, crudeness, poor firing, mainly non-decoration and evenly distributed across the levels. The potsherds showed that the decorations are mainly impressions such as incision, stamping and roulettes. Level 3 produced the highest number of potsherds. The pottery is similar to the standard Oyo ceramic assemblages that Frank Willett, Robert Sopert, Babatunde Agbaje-Williams, and Akin Ogundiran have discussed.

The results presented and discussed above are used to draw the necessary conclusion in the following chapter, in terms of their implications for our understanding of the technology of city walls' construction in Oyo Ile.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary

The excavation of Oyo-Ile palace wall revealed the entire profile of the massive hill of earth. No foundation trench was evident. The excavation also revealed the stone counterfort retaining wall on the interior side, which showed evidence of buttressing to improve the strength of the inner wall against side sliding and to resist high loads. It could not reveal the techniques deployed in building the Oyo-Ile palace walls because the wall is now reduced to a massive hillock of earth.

The field study of the stratigraphy showed five stratigraphic layers disregarding the topsoil, which is loose sandy-silt and powdery with many roots and rootlets. This revealed lateritic soil comprising of a very fine-grained gravely sand thoroughly kneaded with fibres. This showed that the soil was very high in plasticity, density, and compactness. Invariably, this method has enabled this research to ascertain the composition of the soil used.

Granulometric analysis showed composition of the earthen material used for the wall's construction is gravely sand. Available phosphorus could account for the fibrous nature of the materials used, which would have resulted from animal additive and also to improve the cohesion and plasticity of sediment used for the construction of the wall. The sediment's pH range shows that the soil procured for the construction could maintain physical and chemical characteristics which are vital to soil stability and suitableness for construction work. The exchangeable bases (cations) determination provides a valuable insight into the fact that the soil was stable and resistant to sediment biogeochemical processes, such as, weathering. Petrological study has enabled this research to the identification of the mineral assemblages of the sediment hence the parent rocks of the materials used in building the wall. This shows that the soils came from stable rocks, which produce sediments with stable mineral compositions. Invariably the sediment is suitable, durable and highly resistant to element of weathering (erosion).

The result of the pottery analysis showed the pattern of their occurrences. A glance at Table 4.7 shows decorative motifs on the potsherds. The analysis identified the following techniques: rouletting, impression of a stamping/incision, channel and cross hatched, burnished applied and a combination of different techniques.

5.2 Conclusion

It could be concluded that the Oyo Ile palace's wall was built directly on the ground without laying any foundation. The technique used in the construction of the wall could not be ascertained but by alluding to Agbaje Williams' (1983) the wall was built by rammed earth technique. The stone counterfort recovered from the excavation was used to support the interior side of the wall in order to improve the strength of the wall against side sliding and to resist high loads (Plate 1).

Through the laboratory techniques and field observation of the sediment stratigraphically, it was possible to ascertain the compositions of the earthen material used, p^H, colour, mineral assemblage and hence its parent rocks, available phosphorus, exchangeable bases (cations) and the proportion used for the construction of the wall. Thus, it could be concluded that the wall was built of lateritic clay comprising of a very fine-grained gravely sand thoroughly kneaded with fibres and with the resulting mortar very high in plasticity, density, and compactness. This could indicate that the builders skillfully carried out the procurement and processing of raw materials used for the construction, in order to achieve the stated characteristics.

From result of the pottery analysis, it could be concluded that the ancient people of Oyo Ile deliberately added the sherds to the earthen material used for the construction and that more potsherds were added to the lower part of the wall in order to be able to support the load of subsequent courses, considering the quantity of cultural materials, such as, sherd and other artefacts recovered from underlying strata.

In summation, the outcomes of this research revealed that the ancient people of Oyo Ile and Yorubaland had the knowledge of their environment and the resources available and showed how sophisticated they were in their process of social organizati on for labour mobilization, procurement and processing of raw materials, management of skills and technology.

5.3 Recommendations

Oyo-Ile walls are constantly been exposed to agents of deterioration which must be quickly attended to, to prevent total destruction of these massive cultural heritages. The wall eroded in places as each subsequent rainy season washed it from the top to the foundation level. The plants that grow near the wall have developed branches and roots which penetrate parts of the wall and cause serious damages. In hunting for small games, hunters dug holes around the wall without considering how much damage their act will do to the walls. Bush burning is carried out every season, since the walls are usually covered with bush; this is done yearly, which includes burning the walls. If this continues and it is not curtained on time by the agency in charge it might lead to the total destruction of the wall without any trace.

Government should give Old Oyo National Park staff necessary support to be able to protect and preserve these ancient walls' remains. The member of staff immediate duty concerning these walls' remains should be the clearing of the bushes around the walls on both sides. The clearing should be on a regular basis. This has the potential of preventing the constant yearly bush burning around the wall by the games' hunters and creates a cleaner atmosphere for tourists. This will enable them to see the wall more clearly. The vegetation and other disturbing roots need constant attention of members of staff to prevent deterioration of the walls. Mud wall pillars should be built by local people of the area who are skilled in mud building construction to support the areas where the walls are particularly weak.

The majority of the world's stone and mud wall structures have undergone various preservation procedures carried out by specialists in this field. Thus, advice on how to conserve the remains of these walls could be sought from these specialists to supplement whatever procedures exist in the preservation of the walls in order for them to last a long time. The National Historic Preservation Act and the Archaeological Resources Protection Act should both be strictly enforced by the Federal government across the country, but especially in the Oyo-Ile region of the Park. These will allow the National Commission for Museum and Monuments (NCMM) to execute a nation-wide conservation and restoration of cultural properties, by providing, developing, promoting and supporting enabling environment for such project. The NCMM should synergise with other people from related fields, such as, architectural and conservation departments to deal with such concerns.

5.4 Contributions to Knowledge

The findings of the investigation have improved our knowledge of the types of raw materials and techniques that characterize the monumentality of the palace wall of Oyo-Ile in particular and ancient city walls in Yorubaland in general, with implications for West Africa. They have also helped us determine what type of wall is palace wall. This would inevitably advance our understanding of the Oyo Empire's historical development and social structure.

The findings and recommendations of the research had generated the much needed items of information that might be employed by many researchers in the field of archaeology to improve on the quality of their ways of investigating earthworks. The conclusions of the study might be guideposts for archaeologists, and others who deal with monuments studies, to identify their areas of strength and weaknesses so there could be adjustment of techniques in their endeavor at preserving and protecting these earthworks.

The evaluation would also assist archaeologists in comprehending type of excavation techniques for earthworks of this kind. The research has consequently highlighted the suitable archaeological excavation techniques for researching settlement/city perimeter walls. The outcomes of the study could enlighten the policy makers on the value of these earthworks to our cultural identity; consequently better policies surrounding the caretaking of these wall systems might be established.

The study has added to the existing body of knowledge in similar studies conducted elsewhere in the past. It would also help future scholars in similar research study in the area, or elsewhere in Nigeria and West Africa at large, thereby contributing to archaeological methodologies for the region.

5.5 Future Research

While this research has given some valuable insights into geoarchaeological inquiry of city wall construction technologies in Oyo-Ile, it cannot claim to be a final judgment on the subject. In order to aid future research on geoarchaeological analysis of city wall building technology in Oyo-Ile, the following guidelines are provided.

It is necessary to conduct a micromorphological study of the excavated unit's stratigraphy, which is still being preserved to an increasing degree. This was not done because the equipment needed to take soil samples for this type of study was not available. Instead of loose soil, the soil sample should be an undisturbed sediment block.

Though it is known that Oyo-Ile dates to the 16th century, the exact date of the wall's construction should be determined. This research was unable to do so due to a lack of funding for this endeavor. This is an issue that needs more attention. Since this work only focuses on the eastern section of the wall from Akesan Market in Old Oyo National Park, it is very likely that additional information will be provided through similar excavations are carried out on other sections of the wall's remains. The reason for this is that, similar to the layout of modern Oyo Palace, this section was believed to be the palace's main gate.

Last but not least, future work should be focused on conducting excavation elsewhere around this wall, conducting intensive sedimentology on the soil samples from the newly excavated units, and comparing it with the soil obtained from the excavated wall to be sure on whether the builders of the palace wall got the soil materials from their immediate surroundings or was imported from somewhere, which can further inform us on how much these people knew their environment in antiquity.

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APPENDIX

APPENDIX 1.1: Spot Height Readings of the Site (Akesan Market)

I/S	Staff Station	Back Sight	Intermediate	Fore Sight	Rise	Fall	Reduced level	Remark (Bench mark)
A	N0S6	4.52					367.52	363m
N10W14	4S		4.48		0.04		367.56	
	2S		4.52			0.04	367.52	
	0SNWE		4.47		0.05		367.57	
	2N		4.48			0.01	367.56	
	4N		4.47		0.01		367.57	
	6N		4.42		0.05		367.62	
	8N		4.52			0.10	367.52	
	10N		4.60			0.08	367.44	
	12N		4.52		0.08		367.52	
	14N		4.50		0.02		367.54	
	N16		4.48		0.02		367.56	
	N18		4.42		0.06		367.62	
	N20		4.38		0.06		367.68	
	N22		4.39			0.01	367.67	
	N24		4.38		0.01		367.68	
	N26		4.42			0.04	367.64	
	N28		4.42			0.04	367.60	
	N30		4.42			0.04	367.56	
	N30W2		4.24		0.18		367.74	
	N28W2		4.30			0.06	367.68	
	N26W2		4.28		0.02		367.70	
	N24W2		4.26		0.02		367.72	
	N22W2		4.26		0.02		367.74	
	N20W2		4.28			0.02	367.72	
	N18W2		4.23		0.05		367.78	
	N16W2		4.36			0.13	367.65	
	N14W2		4.36			0.13	367.52	
	N12W2		4.34		0.02		367.54	
	N10W2		4.46			0.12	367.42	
	N8W2		4.37		0.09		367.51	
	N6W2		4.33		0.04		367.55	
	N4W2		4.31		0.02		367.57	

	N2W2		4.31		0.02		367.59	
	N0W2		4.36			0.05	367.54	
	S2W2		4.39			0.03	367.51	
	S2W4		4.20		0.19		367.70	
	S0W2		4.15		0.05		368.75	
	N2W4		4.06		0.09		368.84	
	N4W4		4.06		0.09		368.93	
	N6W4		4.12			0.06	368.87	
	N8W4		4.14			0.02	368.85	
	N10W4		4.08		0.06		368.91	
	N12W4		4.10			0.02	368.89	
	N14W4		4.07		0.03		368.92	
	N16W4		4.08			0.01	368.91	
	N18W4		4.00		0.08		368.99	
	N20W4		4.06			0.06	368.93	
	N22W4		4.08			0.02	368.91	
	N24W4		4.10			0.02	368.89	
	N26W4		4.09		0.01		368.90	
	N28W4		4.05		0.04		368.94	
	N30W4		4.10			0.05	368.89	
	N30W6		3.84		0.16		369.05	
	N28W6		3.75		0.09		369.14	
	N26W6		3.80			0.05	369.09	
	N24W6		3.70		0.01		369.10	
	N22W6		3.71			0.01	369.09	
	N20W6		3.64		0.07		369.16	
	N18W6		3.71			0.07	369.09	
	N16W6		3.66		0.05		369.14	
	N14W6		3.60		0.06		369.20	
	N12W6		3.83			0.23	368.97	
	N10W6		3.78		0.05		369.02	
	N8W6		3.82			0.04	368.98	
	N6W6		3.78		0.04		369.02	
	N4W6		3.74		0.04		369.06	
	N2W6		3.75			0.01	369.05	
	N0W6		3.84			0.09	368.96	
	S2W6		3.80		0.04		369.00	
	S2W8		3.06		0.74		369.74	
	S0W8		3.09			0.03	369.71	

	N2W8		3.07		0.02		369.73	
	N4W8		3.07		0.02		369.75	
	N6W8		2.98		0.09		369.84	
	N8W8		2.97		0.01		369.85	
	N10W8		3.03			0.06	369.79	
	N12W8		3.04			0.01	369.78	
	N14W8		3.10			0.06	369.72	
	N16W8		3.07		0.03		369.75	
	N20W8		3.03		0.04		369.79	
	N22W8		2.93		0.10		369.89	
	N24W8		3.07			0.14	369.75	
	N26W8		3.15			0.08	369.67	
	N28W8		3.28			0.13	369.54	
	N30W8		3.10		0.18		369.72	
	N30W10		2.32			0.78	368.94	
	N28W10		2.85			0.53	368.41	
	N26W10		2.54		0.31		368.72	
	N24W10		2.20		0.34		369.06	
	N22W10		2.09		0.11		369.17	
	N20W10		2.10			0.01	369.16	
	N18W10		2.20			0.10	369.06	
	N16W10		2.26			0.06	369.00	
	N14W10		2.40			0.14	368.86	
	N12W10		2.20		0.20		369.06	
	N10W10		2.03		0.17		369.23	
	N8W10		1.93		0.10		369.33	
	N6W10		1.88		0.05		369.38	
	N4W10		2.02			0.14	369.24	
	N2W10		2.14			0.12	369.12	

	N0W10		2.24			0.10	369.02	
	N0W12		1.72		0.52		369.54	
	N2W12		1.40		0.32		369.86	
	N4W12		1.49			0.09	369.75	
	N6W12		1.34		0.15		369.90	
	N8W12		1.74			0.40	369.50	
	N10W12		1,88			0.14	369.36	
	N12W12		2.00			0.12	369.24	
	N14W12		2.12			0.12	369.12	
	N16W12		2.02		0.10		369.22	
	N18W12		1.80		0.22		369.44	
	N20W12		1.54		0.26		369.70	
	N22W12		1.45		0.11		369.81	
	N24W12		1.87			0.24	369.57	
	N26W12		2.14			0.27	369.30	
	N28W12		2.50			0.36	368.94	
	N30W12		2.28		0.22		369.16	
	N30W14		2.02		0.26		369.42	
	N28W14		2.19			0.17	369.59	
	N26W14		1.78		0.41		370.00	
	N24W14		1.52		0.26		370.26	
	N22W14		1.20		0.32		370.58	
	N20W14		1.27			0.07	370.51	

	N18W14		1.57			0.30	370.21	
	N16W14		1.75			0.18	370.03	
	N14W14		1.76			0.01	370.02	
	N12W14		1.48		0.28		370.30	
	N8W14		1.20		0.28		370.58	
	N6W14		1.06		0.14		370.72	
	N4W14		1.26			0.20	370.52	
	N2W14		1.23		0.03		370.55	
	N0W14		1.69			0.46	370.09	
	N0W16		1.92			0.23	368.86	
	N2W16		1.64		0.28		370.14	
	N4W16		1.60		0.04		370.18	
	N6W16		1.46		0.14		370.32	
	N8W16		1.34		0.12		370.44	
	N10W16		1.54			0.20	370.24	
	N12W16		1.56			0.02	370.22	
	N14W16		1.65			0.09	370.13	
	N16W16		1.75			0.10	370.03	
	N18W16		1.62		0.13		370.16	
	N20W16		1.56		0.06		370.22	
	N22W16		1.58			0.02	370.20	
	N24W16		1.68			0.10	370.10	
	N26W16		1.78			0.10	370.00	
	N28W16		2.24			0.46	369.54	
	N30W16		2.30			0.06	369.48	

	N30W18		2.74			0.44	369.04	
	N28W18		2.70		0.04		369.08	
	N26W18		2.48		0.22		369.30	
	N24W18		2.30		0.18		369.48	
	N22W18		2.16		0.14		369.62	
	N20W18		2.10		0.06		369.68	
	N18W18		2.13			0.03	369.71	
	N16W18		2.24			0.11	369.82	
	N14W18		2.10		0.14		369.96	
	N12W18		2.18			0.08	369.88	
	N10W18		2.17		0.01		369.89	
	N8W18		2.15		0.02		369.91	
	N6W18		2.10		0.05		369.96	
	N4W18		1.94		0.16		370.12	
	N2W18		2.10			0.16	369.96	
	N0W18		2.10			0.16	369.80	
	N0W20		2.00		0.10		369.70	
	N2W20		2.14			0.14	369.84	
	N4W20		2.23			0.09	369.93	
	N6W20		2.30			0.07	369.86	
	N8W20		2.36			0.06	369.80	
	N10W20		2.40			0.04	369.76	
	N12W20		2.42			0.02	369.74	
	N14W20		2.42			0.02	369.72	
	N16W20		2.46			0.04	369.68	

	N18W20		2.52			0.06	369.62	
	N20W20		2.62			0.10	369.52	
	N22W20		2.62			0.10	369.42	
	N24W20		2.62			0.10	369.32	
	N26W20		2.70			0.08	369.24	
	N28W20		2.76			0.06	369.18	
	N30W20		2.84			0.08	369.10	
	N30W22		2.74		0.10		369.20	
	N28W22		2.76			0.02	369.18	
	N26W22		2.70		0.06		369.24	
	N24W22		2.64		0.06		369.30	
	N22W22		2.64		0.06		369.36	
	N20W22		2.64		0.06		369.42	
	N18W22		2.60		0.04		369.46	
	N16W22		2.55		0.05		369.51	
	N14W22		2.46		0.09		369.60	
	N12W22		2.42		0.04		369.64	
	N10W22		2.40		0.02		369.66	
	N8W22		2.33		0.07		369.73	
	N6W22		2.28		0.05		369.78	
	N4W22		2.17		0.11		369.88	
	N2W22		2.00		0.17		370.05	

	N0W22		1.78		0.22		370.27	
	N0W24		1.80			0.02	370.25	
	N2W24		1.96			0.16	370.09	
	N4W24		2.05			0.09	370.00	
	N6W24		2.20			0.15	369.85	
	N8W24		2.28			0.08	369.77	
	N10W24		2.35			0.07	370.70	
B	N12W24	1.60	2.50			0.15	370.55	
	N10W14		0.30		2.20		372.75	