ADAPTING SOME SELECTED MOTIFS OF ZARIA WALL DECORATIONS FOR CERAMIC TILE DESIGNS AND PRODUCTION.

BY

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DECLARATION

I declare that the work in this thesis entitled "**ADAPTATION OF SOME SELECTED MOTIFS OF ZARIA WALL DECORATIVE SYMBOLS FOR CERAMIC TILEDESIGNAND PRODUCTION.**" has been carriedout by me in the Department of **Industrial Design under the supervision of Prof. A. Ahuwan and Prof.U.A Sullayman.**

The information derived from literature has been duly acknowledged in the text and a list of reference is provided. No part of this thesis was previously presented for another degree or diploma in any university.

_____ _____ _____

Name of Student **Signature** **Date**

CERTIFICATION

This thesis entitled **"ADAPTATION OF SOME SELECTED MOTIFS OF ZARIA WALL DECORATIVE SYMBOLS FOR CERAMIC TILES DESIGN AND PRODUCTION"** by RAKIYA MOHAMMEDSANI, meets the regulations governing the award of Master of Industrial Design Degree of Ahmadu Bello University, and is approved for its contribution to knowledge a literary presentation.

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DEDICATION

This research is dedicated to Almighty Allah the Manufacturer, Designer, the Fashioner and Creator of the universe,to my parents, my late husband, my present husband, my children and other members of my family.

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ABSTRACT

Modern and traditional Arts have established a developmental relationship in the history of creativity of art forms, with effect from the early man, in its quest for survival. The traditional arts are fading away but fewhave been translated into modern usage and the act of inculcating the concept from one generation to the other is diminishing. Some of the design experts, (lords or kings) of the traditional designs lacked that creativity of extending the art to other concept of contemporary modern designs. The focus of this study is to extract, experiment, incorporate integrate and adapt some selected Zaria traditional walldecorative motifs/symbols for the production of ceramic wall tiles. The study also embarked upon series of studio experiments at enhancing clay body that best fit into the production of the tiles on which the decorations were made. Again the study discusses the findings base on the results of the clay body experimented upon, plasticity test, shrinkage tests, glazing and firing,calculations for compressive strength and modulus of rupture of the tiles. The study concludes that tiles are used virtually everywhere. In homes, public places, schools, hospitals, etc all over the world and also tiles generally serve as a protection over dirty. The study finally made recommendation and suggestion for further research into the course of study.

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DEFINITION OF OPERATIONAL TERMS

BISCUIT: To fire ware unglazed in preparation for glazing; also the unglazed fired ware. Literally meaning baked twice.

BLUNGER: Used to mix materials and water thoroughly. Blunging is done in an octagonal or hexagonal tank with a central vertical shaft. On this shaft are fastened radial blades or paddles. These are set at an angle so that, when the shaft rotates, the blades force the slurry to run out of the tank by a tap at the bottom. It can be then be sieved, settled etc.

CALCINE: To purify by the action of heat, from the use of the word to describe the burning of lime (calx). The potter uses the term to describe the preparation of a material by heat, usually in the region of 700C (1292F).

COTTLE: Expandable wall of card, plastic or clay to contain poured plaster until it has set.

FLUX: An oxide which promotes ceramics fusion by interacting with other oxides. The oxides which are usually referred to as fluxes are the alkaline oxide because they interact with the glass – forming silica.

FELDSPAR: A group of minerals used in proportions of up to 25% as flux in bodies and up to 100% in glazes. They contain alkalis plus silica and aluminum oxide and are therefore natural frits or glazes.

KAOLIN: Synonymous with china clay in North America. The purest clay approximately closer to the idealized clay mineral. It contains very little iron impurity and is therefore white. It has therefore little plasticity but it is popular as a body constituent because of its whiteness. It is high in Aluminum oxide content and with few alkaline impurities.

POROSITY: The ability of fired clay to absorb water by capillary action.

QUARTZ: The popular name for the mineral rocks specifically called milky quartz and crystal quartz. They are used as sources of silica for glazes and bodies and are introduced as a powder or as quartz sand. Hence, for wall tiles quartz is employed as a thermal expansion regulator.

SLAB: They are formed ceramic form sheets of clay. The slabs (Sheets) are wire cut, beaten out or rolled out. They are then cut and used in soft state or stiffer to construct the projected piece. Slab bed objects tend to be more angular than those formed by pinching, coiling and throwing.

TRANSLUCENCE: The property of porcelain and china which allows light to be seen through the material.

GLOSSARY

S/No.	Local Term	Source	English Translation
1.	Kayan Kifi	Hausa	Fish Bone
2.	Bayan kadangere	"	Lizard`s back.
3.	Tafiyar maciji	"	Snake track.
4.	Kayar maciji	"	Snake bone.
5.	Katantanwa	"	Snail shell.
6.	Zanke	"	Tenet.
7.	Wutsiyarhawainiya	"	Chameleon`s tail.
8.	Kunya	"	Ridges
9.	Dagi	"	Northern knot
10.	Zane	"	Drawings

CHAPTER ONE

1.1 INTRODUCTION

The discourse of technological development always brings into centre stage the dichotomy that exists between two schools of thought: the *modernist* and the *traditionalist*.Adou, (1988) said that 'The modernist school of thought argues that the traditional technology is crude and archaic and cannot measure up to the current, fast and appealing technological advancement of the modern world. While the traditionalist argues that the modernist technological development is the intrusion of Western ideas that has made it problematic both for the advancement and appreciation of the traditional technology. However, a lot of critical contributions have been made on this discourse, which has also affected critical discourse in other subject matter, like history, sociology, architecture, etc.

In art, critical arguments have come into focus in the discourse of traditional and modern African art. While the traditionalist argues that African art is ritually conceived and forms the total way of life of the people (culture), and should be treated as such, the modernist argues that art is a form of entertainment, which is conceived and creatively done for the general appreciation of the people, Adou (Ibid). Meanwhile, this study is not to make a case for either of the two schools of thought but to appreciate the analytical perspective of both schools of thought as they will allow us to understand better the mechanism, genesis, and functions of both and their dialectical relationship with one another in the advancement of this study.

Much contemporary discussion on the nature and origin of art in Africa has its root on the historical paradigm of the early man. From Early Man's attempt in food gathering to attempt in

controlling forces of nature, man has unconsciously developed the art form. This form has eventually helped man to document his motivation for his early activities and means of survival.

In Africa, both the per formative and visual art-forms expression serves a particular function, the visual art for instance may satisfy an everyday household need, adorn the body, or use to fulfill religious or social obligation. These include; baskets, pottery, ceramics, carved headrests, and stools. Another aspect of the visual art also includes designs and decorations, which serves the functions of both decorative and communicative. There are also designs on cloths, body and walls of buildings, which may indicate an individual's prestige or a design to identify a person or a group social status. This till date has constantly reminds us of man's historical development. Agreeing to this fact, Janson (1973) acknowledged that "the first known pictures were done (on walls of caves) in the old stone age by people who lived in caves." While Gilbert and McCater (1988) posit that such pictures were done "to exert control over the forces of nature."

In recent times and with the coming of the Western *civilization*, there came a shift that today eventually brought about the recent discourse in modern and traditional art in Africa and indeed Nigeria. Fowowe (2004: 5) collaborate the assertion when he wrote that: "Western Education, Christian religion and, of course, cultural diffusion had brought a new dimension into artistic creation. With the advent of colonialism, the ubiquitous and revered art traditions whittled gradually and the 'half caste' of the Western and the Nigerian Art emerged in the guise of contemporary art".

The coming together of the modern art and traditional art-forms, according to Fowowe's (2004) observation, is very important at this juncture. Relying on this observation, one is therefore tempted further when he observed and concluded that indeed modern art-form did borrow from

traditional art-form. However, this author seems to move his argument further when he observed that "both traditional and modernity have very much in common."

Thus, it is important to make a fundamental observation and state that modern and traditional technology or art-forms have a lot in common and both can further enhance the development of the other. The argument that postulates that modern seems to be better than traditional and vis-à-vis is a form of nomenclature that threatens the appreciation of both. The most important conclusion to draw from here therefore is that whatever space that man creates it should be user friendly. Ajayi (2004) seems to put it succinctly when he stated that, "creation demands a creative and flexible response which can be meaningfully related to people's lives".

1.2 STATEMENT OF THE PROBLEM

Traditional designs in Africa and indeed Nigeria is rapidly fading out of existence. Many designs, especially those done on structures are being demolished due to modern technological development in architecture. While it is important to note that the modern technological development has its advantages, it is also very important to state that the development is unconsciously responsible for the 'death' of traditional designs. This development is not just a threat to the aesthetics of the African art-form but an attempt to erode the people's cultural heritage. This trend has not only made it almost impossible for the appreciation of the traditional African art, but has also made mockery of the art form and has continued to be problematic to the existence of the form. The problem of this study is therefore, the adaptation of some selected traditional motifs of Zaria wall decorative symbols for ceramic tile design and production.

Meanwhile, another angle to the problem instituted by the development is rooted in the attempt to make it impossible for indigenous African and indeed Nigerian traditional artist to be out of

creative activities. Apart from the gradual demise of the traditional African aesthetics, there is also the decline in its economic value due to less patronage thereby making it impossible for traditional artists to earn valued economic living for their creativity.“There could have been indigenously designed tiles that reflect our true identity as persons in our local market; it will enhance our technology and economy” Morakinyo (2012)

However, the economic angle of this problem as well as the ‘death’ of cultural heritage calls for urgent and immediate attention by stakeholders. It is therefore imperative that collective effort is made to revamp our great cultural and historical heritage that is gradually being phased-out by the modern development in both art and technology. This can be achieved by inter-relating modern and traditional art as well as technology. So the researcher intends to adapt traditional wall decorative motifs or symbols onto our modern ceramic wall tiles.

1.3 AIM AND OBJECTIVES OF THE STUDY

The main aim of the study is to adapt Zaria wall decorative motifs and symbols onto ceramic wall tiles, so as to use modern ceramics at projecting old cultural symbols into modern ceramic tiles. The specific objectives of this study therefore areto:

i. Merge Zaria wall decorative motifs and modern tiles to preserve Nigerian socio-cultural heritage;
ii. Experiment on how modernizing Zaria wall decorative motifs could help modern appreciation of Zaria traditional designs.

iiiIncorporate traditional motifs and prototype designs into the industries, in order to enhance aesthetically the decorative productions of ceramic wall tiles.

iii. Digitalizing Zaria traditional wall decorative designs for easy integration into modern machine production of tiles.

1.4 SIGNIFICANCE OF THE STUDY

The study is significant because it brought to lime light the creative ability of the local craft artists as well as the strength inherent in the exploration of the traditional design motifs and symbols for modern applications**.** Adapting Zaria motifs into ceramic wall tiles production can enhance the aesthetic and appreciation of the traditional motif. It can also serve as valuable documents of the traditional symbols to create awareness. It can help in selling Nigerian local material culture to the rest of the world. As opined also by Morakinyo, (2012). "This will in turn enhance our technology and the economy, and we would have been able to export and earn foreign exchange for our nation through this sector" Academically, this is a significant contribution to knowledge because from all literatures gathered, none has adapted Zaria motifs on tiles .Tiles have taken over rug carpets in homes and public places today, so the future generation can come up to see our diminishing traditional designs beautifully decorated on modern ceramic tiles. It can serve as reference materials to other researchers.It can also serve as source of womenempowerment, and at the same time, can boost the marketability of Nigerian ceramic tiles product in the international market as foreign expatriates are deeply in love with African cultures and traditions.

1.5 JUSTIFICATION OF THE STUDY

Several motifs and design styles exist among the various people of Zaria city of Kaduna state, Nigeria. In spite of the knowledge of these motifs, none has been adopted into tile designs. In addition, this study could serve as a stimulus for domestic production which will in turn expand both the knowledge and the economic base of ceramic practitioners.

1.6 LIMITATION OF THE STUDY

Most of the traditional artists do not understand English, which brought about communication barriers. The researcher had to employ an interpreter in the course of the field work.

The few literate heads of the household refused the researcher from taking a picture of the designs on the walls of their structure.Some will first seek for the researcher`s identity and at the end of it all still will not consent for the researcher to take a snapshot. Another limitation is the fact that there are no adequate equipment to carry out some important tests like, strength of the materials, modulus of rupture of the materials in the department, but had to go to other departments to use these machines.

Some of the motifs are temporal, because of climatic influences, environmental hazards and a times demolition of structure.

1.7 SCOPE/ DELIMITATION OF THE STUDY

This study is delimited to adapting wall decorative motifs and symbols of some selected Walls in Zaria city, Kaduna State, Nigeria for ceramic wall tile designs and production.

1.8 RESEARCH QUESTIONS

- What are the possibilities of exploring Zaria wall decorative motifs on modern ceramic wall tiles?
- What will be the outcome of merging traditional Zaria wall motifs onto modern ceramic tiles?
- Will the adaptation of Zaria wall decorative motifs on ceramic wall tiles help revive and retain the diminishing traditional designs?
- How valuable and meaningful will the design be in the international markets?
- Will digitalizing these motifs really bring out the actual features of the intended design?

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

This chapter carries a literary background as a foreground to the concept of adapting traditional wall decorative motifs for ceramic wall tile designs and production. To do this will means to go through the traditional route of tracing the historical development of ceramic/ceramic tiles vis-à-vis the impact of foreign influence on the traditional designs and styles, the types of tiles, characteristics and consequently its aesthetic value and functionality.

2.2HISTORICAL DEVELOPMENT OF CERAMIC TILES

Ceramics originated from the Greek word *Keramos,* meaning 'potter's clay', which was originally the art of making pottery. Ceramics is now a general terminology used to describe the science of manufacturing articles prepared from pliable, earthy materials that are made rigid by exposure to heat. The Latin word 'tegula' is derived from a French word 'tuile' which precisely means a roof tile of baked clay. While, the English 'tile' is less precise, and can in addition, be made of any kind of earthenware slab applied to any surface of a building (Encarta Encyclopedia 2006).

Historically, "man has desired to create living spaces whichare beautiful, durable, and user friendly, thus ceramic tiles have been made by man for 4000 years". Beautiful tile surfaces have been found in the oldest pyramids, the ruins of Babylon, and the ancient ruins of Greek cities. Decorative tile work was invented in the near east where it enjoyed popularity and assumed a greater variety of design than anywhere in the world. During the Islamic period all methods of

tile decoration were brought to perfection in Persia. In Europe decorated tiles did not come to general use outside Moorish Spain, until the second half of the twelfth century. The tile mosaics of Spain and Portugal, the Maiolica floor tiles of renaissance Italy and the faiences of Antwerp, the development of tile iconography in England and in the Netherlands and the ceramic tiles of Germany are all prominent land mark in the history of ceramic tiles.

In Africa, tile making has its root in the socio-cultural development of the Africa people. It dates back to the Egyptians in about 4000 BC, where the use of wall and floor tiles covering existed. (www.designboom.newsletter). It also goes back to the history of art in Africa as (Chanda J. 2007) notes that the history:

> …spans a vast period, beginning as early as 25,500 BC and continuing to the present. Among theearliest surviving examples of African art are images of animals painted on rock slabs found in caves in Namibia. Animal images painted on or cut into rocks and canyon walls in the Sahara date from 6000 to 4000 BC. Later Saharan rock art depicts ritual activities, herding, and food preparation. Many surviving examples of African art date from the 14th to the 17th century. However, most of the African art known today is relatively recent, from the 19th century or later. Very little earlier African art has survived, primarily because it was made largely of perishable materials such as wood, cloth, and plant fibers, and because it typically met with intensive use in ceremonies and in daily life.

Chanda's observation points out to one fact that every work of art in pre-Western Africa is tied to socio-cultural activities of the people. By stressing further, she again noted that:African art, unlike most European art, generally serves a function. The art may satisfy an everyday household need, adorn the body, or fulfill a social or religious role. These objects of use also have artistic value because skilled artisans had designed and created them with a strong concern for visual beauty and symbolic meaning. Many African art objects serve to indicate the

status of an individual, family, or other group. Objects such as weapons, staffs, and crowns act as symbols of rank, wealth, or position in the community.

Thus, Chanda (Ibid) arguments clearly show that African arts have its symbolic meaning in everyday usage. However, studies have shown that surviving African art is daily being affected by Western civilization which has great impacts on the traditional buildings. Most traditional buildings or structures today are greatly influenced by Western building styles and designs.Williet (1975) in Ogunduyile,(1985) noted that, traditional African Art loses more of its characteristic features as a result of civilization and that, civilization seems to be taking much of Art without putting it in a position to draw on mythical element of traditional Art for new artistic purposes. This trend is gradually putting traditional wall decorative designs out of existence since modern architecture is also not interested in the preservation of the traditional designs and styles.

Agreeing with the above, Okin (1988) stated that most of the new buildings in Nigeria today have no traditional wall decorations. To further add to the impact of the Western civilization to the near demise of the once flourished African art is also the coming of foreign religion – Islam and Christianity – as Bentu (1979) observed that "…some Christians and Muslims faithful have done a lot to destroy indigenous art forms and cultural images in the name of religion." While Olaosebikan (1982) attributes this problem to the effect of globalization and observed that availability of industrially manufactured and foreign crafts is seriously affecting the demand of local crafts in Africa. This trend, many analysts observed may lead to the total demise of the traditional wall motifs as Fatuyi (1972) in his contributions wrote that, "traditional wall decorations were still found in many parts of Northern States in Nigeria (especially Zaria) , but

also remarked that “the future of such design is not certain” Schwerdtfeger (2005) also opined that the upper class in Hausa society have discarded mud as a building material and with it the associated decorations, despite improved mud technology, and replaced both with a permanent method of construction, and that even the poorer section of the society of the community was looking again for a cheap and improved building materials. Schwerdtfeger (Ibid) in his write up “The Hausa Urban Art” asked if wall decoration will return back from its demise and feared that the skill have being lost forever. Toward the tail end of his write up, he stated and confirmed that an “ art form may no longer be fashionable or even disappear altogether, but the idea will survive in the splendor of hand embroidered gown or in the adornment of items of everyday use. Today tiles are part of building materials that are irresistible by anyone building a house or houses; the tiles could be wall, floor, or ceiling tiles. This study is on the track of adopting the motifs onto our ever flouring wall tiles.

Although the impact of westernization is seriously affecting the usage of traditional crafts, Chafe (2000) observed that “there are varieties of decorative motifs and crafts that are in use in both sub Saharan Africa and the Islamic cultures”. He opined that such crafts could be source of good inspiration to an artist. Ajayi (2007) also noted that traditional design forms and motifs are highly cherished and acceptable worldwide. He went further to say that there is need to incorporate this design concept and methods on products in order to meet international standard.Schwerdtfeger, (2007) also stated that,“Islam found a very rich and varied cultural tradition in Hausa land with a variety of patterns being used for house decoration, tools, all kinds of implements and dresses.”

To further compound the impact of foreign influence on traditional wall decoration in the Northern part of the country is the problem associated with apprenticeship. It is believed that,

apart from wall decoration the people of Zaria city for instance are also engaged in other crafts works like calabash carving, calligraphy, Koranic decoration, embroidery, leather work, pottery metal work, weaving etc. Thus, there is a great shift from artist willing to carry on with the tradition of wall decoration owning to the fact that economically the form no longer attract patronage like other crafts; coupled with the fact that age is also no longer on the side of the artists worse still many young artists are unwilling to take up and follow the tradition of wall decoration.

Meanwhile, it is also important to note that the impact of the Western influence on the traditional designs can be viewed from another angle, just as Newman (1979) pointed out that "African art is fast responding to new influences and that new needs and functions emerge making new forms evitable"Again,Okpe (2003); in Alkali (2009) also opined that Modern ceramics practice must be seen as a selective borrowing from ones tradition and culture rather than copyright of techniques that further accentuate conventional practice of modern pottery. That, modern ceramics should speak about myths, beliefs and ideas representing a wide range of human activities. Furthermore, Ida (1986) observed that "traditional decorations on walls could be adopted as wall murals in modern public building." Working with Ida's opinion, one is tempted to note that the only way in preserving the traditional art form is by its adaptation into modern art forms, such as in the current topic of research by this study. This trend will not only help to preserve the much cherished motifs but will also bring about the preservation of the Nigerian traditional, cultural and historical heritage.

AbdulSalam Ibrahim of BBC Hausa version,(2008).reported on a festive activity that took place at Enugu titled "History and Tradition" where all parts of Nigeria met to celebrate their various traditions with the hope to revitalized, publicized, promotes, and fully bring back

Nigeriatradition and cultural heritage. “There seems to be a promotion of traditional aspects of ceramics more than the industrial ceramics.” Sullayman , (2008). Effort are been made in several ways to revive our traditions, cultures and our heritage.If we decide to disfavor our traditions, cultures and heritages, in the nearest future we will lost our histories. So, adapting traditional designs or motifs and other significant identity of ours, into/onto modern technologically influenced indoors and out door objects, tools, architectural materials, schools, hospitals, play grounds etc. These will revive and retain our traditions, cultures, heritages. It will improve and develop our industrial sectors and also boost our income.

According to Sheila S.B and Jonathan M.B, many contemporary doomed mosques refer to historical precedents, they said that the Jumeirah Mosque in Dubai is a modern interpretation of Qaitbay’s tomb in Cairo, and that Chinese-American architect I.M. Pei abstracted the Mamluk-era doomed fountain in Cairo’s Ibn Tulun mosque for his design of Doha’s new domed Museum of Islamic Art. They also opined that the architectural traditions of domes remain vibrant in Islamic culture today.

2.2.1 Ceramic tiles

It is safe to say that ceramic tile is one of the oldest forms of covering known to man. Discoveries of ancient ceramics, similar to modern ceramic have been found on the banks of the Nile River in Egypt (Concept carpet 2002).

Furthermore concept carpet (Ibid) states that Italy, being the world capital ceramic tiles, has elevated the industry to the highest form of art. This nation, which has given the world countless art and architectural master pieces, has added beauty, fashion and design to the ancient product of ceramic tiles.

Today, ceramic tiles are manufactured not only in Italy and Spain but also in Mexico, the United States and many other countries. Nigeria has similar ceramic Industries that are rarely functioning, for example the ceramic manufacturers industry in Kano at Challawa Industrial estate has gone bankrupt.Gukas (2003) also stated that ceramic manufacturers industry in Kano has been closed down since 1994.Structural clay product Industries, Jos Maiduguri, Kaduna and Kano, have all close down.Royal ceramics at Suleja,Eleganza Ceramic Industries,Lagos.Double Portion Ceramic Industries Abuja,West African Ceramics, Lokoja Kogi State.Scsceiling Nigeria Ltd Lagos are all functioning ceramic Industries.

Many scholars and local individuals(large or small scale Industries),involved in ceramic tiles production have defined ceramics in so many perspective but all still boil down to the same ideology. According to Manfridini and Pellacani (2009), states that ceramic tile includes all ceramic products used as wall and floor coverings,tiles and components for swimming pools, as well as relevant accessories. Ceramic tiles can also be referred to as a flat piece of baked clay, used for covering roofs, floors and walls. Again, the European standard approved in November 1981 specifies that "ceramic wall and floor tiles are building materials that are generally designed for use as floor and wall coverings, both indoor and outdoor, regardless of shape and size. Generally, ceramic tiles are accessories in almost all live endeavors that is used in draft games, used as panel for blood group agitating, as a re-circled medium for collage andmosaic.Encyclopedia Britannica (2009) in Morakinyo (2012), defines tile, as thin flat slab or block used structurally or decoratively in building or an open earth ware or concrete piece used in constructions. It is recorded that tiles are formed by extrusion, by pressing moist clay into a mold. It isalso used as nail polisher among children. Children pound and grind ceramic tiles into

powdered form and used it to rub/polish their nails,which afterward gives the nail a smooth glossy look.(as observed by the researcher 1998).

2.3 TYPES OF TILES

Tile is a manufactured piece of hard wearing material such as ceramic, stone, porcelain, metal or glass. They are generally used for covering roof, floors and walls or other objects such as table tops. Other categories include ceiling tiles, decorative tile work, and Islamic tile work etc. All this is classified as types of tiles found around our vicinity. They are discussed under the following headings:

2.3.1 Roof Tile **–**Theseare mainly designed to keep out rain, and are traditionally made from locally available materials such as clay or slate. Modern materials such as concrete and plastics are also used and some clay tiles have waterproof glazes.

2.3.2 Floor Tiles **–** These are commonly made of ceramics or stone.They may be painted or glazed. The tiles are typically set into mortar consisting of sand, cement and often a latex additive for extra strength. But traditionally mortar is used.

2.3.3 Ceiling Tile **–** They are light weight tiles used in the interior of buildings. They provide thermal insulation, sound absorption, enhance fire protection and improve indoor air quality. It is also known as ceiling panels or drop ceiling tiles.

2.3.4 Decorative Tile Work **–** It typically takes the form of mosaic upon the walls, floors or ceilings of buildings. Although decorative tile work was known and extensively practices in the ancient world (as evidenced in the magnificent mosaics of Pompeii and Herculaneum), it perhaps reached its greatest expression during the Islamic period. In the

1920s and 1930s, decorative tile work was in vogue and prominent among the ceilings found in southern California.Orjan,(1990).

2.3.5 Islamic Tile Work – Because of the tenets of Islamic Sharia law, which disown cultural icons and figurative images in favour of more abstract and universal representations of the divine, decorative tile work was more acceptable. During the Islamic period, palaces, public buildings, and mosques were heavily decorated with dense massive mosaics. As both the influence and extent of Islam spreads, the artistic tradition was carried along.

2.3.6. Wall Tiles – Wall tiles are mass- produced thin tiles with a porous body and a white or colored glossy or matte glaze. A wide variety of shapes and sizes are available and the great majority of tiles are squares or rectangular. Ceramic wall tiles are building materials that are generally designed for use as wall covering, both indoors and outdoors regardless of shape and size. The ceramic wall tiles are prepared from a mixture of ball clays, sand, fluxes, coloring agents and other mineral raw materials which undergo various processing such as milling, screening, pressing, extrusion, casting or other processes, normally at room temperature, and are subsequently fired at a high temperature. Wall tiles can be glazed, unglazed, polished, engobed or even hand painted.

Apart from the above types of tiles, there are the Italian, Spanish, China, Indian, and Nigerian tiles. Spanish and Italian tend to last longer than other tiles, as they stay for 15-20year and are reputed to last longer for floor tiles. Agbaje, (2012).

Wall tiles are used in our homes, schools and even our surroundings. Tiziano and Gian (2000) said: “Wall tiles are used in domestic and institutional kitchens, bathrooms, washrooms and swimming pools, as well as decorative works such as table tops and fireplace surrounding. The

aesthetic appeal is the most important feature for a wall tile product used for interior and exterior decorations.

2.4 CHARACTERISTICS OF TILES

Ceramic tiles are used almost everywhere; on walls, floors, ceilings, fireplaces, in murals and as an exterior cladding on buildings. It is defined as a product made from inorganic materials having non-metallic properties. They also have a number of outstanding properties which determine their usefulness.

Ceramic tiles are inorganic, non –metallic materials that have been subjected to heat treatment to harden for long lasting use. It's made out of clay that contains a large amount of silicates.Ceramic tiles have unique and outstanding characteristics. These include

i. Abrasion resistance
ii. Low water absorption
iii. Stain and dirt resistance
iv. Frost resistance
v. Colour permanence
vi. Hygiene

2.4.1 Abrasion Resistance **–** Ceramic tiles have the ability to withstand stains, it has the capability to resist moisture and all kinds of stains. Stains are easily cleaned off from a ceramic tile especially the glazed ones.

2.4.2Low water absorption **–** Ceramic tile is the best and an excellent choice for use in wet areas. The glazed tile resists water while the unglazed tiles have a specific percentage of water it absorbs (3%) of moisture.

***2.4.3Stain and dirt resistance* –** Ceramic tiles do not retain dust particles easily. They can be cleaned easily with common household materials and do not need polishing, buffing to maintain their finishing.

2.4.4Frost resistance – Ceramic tiles have no combustible composition which makes it completely fire proof.Ceramic tiles can withstand any kind of temperature. No matter the level of fire on ceramic tiles the surface does not alter, nor does it produce any toxic gases, smoke or fumes. Ceramic tile also serve as a protective measure to structural surfaces.

***2.4.5Colour permanence*-**Colour is permanently fired into the ceramic tile so, fading does not easily occur.

***2.4.6 Hygiene*-**Dirt is not easily absorbed by ceramic tiles. The surface of ceramic tiles does not retain antigens and allergens, nor do they absorb odors and smoke, etc.

These features enable good hygiene and make ceramic tiles suitable floor and wall materials for hygienically conscious environment.

2.5 WALL DECORATIONS

Wall decoration evolved into heavy ornamentation and related artistic design in the 19th Century, especially in the Northern Nigerian society. Traditionally it was an embellishment of both interior and exterior of houses with various design patterns. Joy, (2011) also noted and observed that 'The decorated walls are mostly at the exterior of the house with various designs found in relief, floral, geometric and few representational forms.' The earliest influence is said to be attributed to the builders' manner of plastering with mud using free hand and their imaginative ability.Schwerdtfeger, (2007) in Joy(2011) states that, the Hausa master craftsmen when creating wall decorationsuse their individual imaginations and inventiveness. Thus, free-hand

manipulation leaves a pattern on the walls after the mud is dried up, giving the walls a design pattern which might have inspired decorators to go into elaborate designs. This method can be said to be associated with fresco art which means a design done on a fresh plastered wall.Decorations of walls may consist of low relief ornamentation of painted designs. In all cases design patterns are created basically to decorate surfaces.

2.5.1 Historical Development of Wall Decoration

The history of decoration is as far back as the history of man. Decorative symbols and motifs have been used in the savannah region of West Africa since time immemorial. Today, decoration of all kinds can be found on a large number of items from clothes, embroidery and weaving, to dyed and printed items, and is also found on calabashes, clay pots, and tools as distinct as weapons, farm implements and musical instruments. Other decorated items include leather work, such as horse trappings, sandals and covers for the Qur'an; basketry, including all sizes of mats, woven trays, local fans; woodcarvings; calligraphy; body decorations, and both internal and external wall decorations. The various types of decoration have, no doubt, influenced each other but it is not possible to trace these changes over time with any certainty, mainly due to the antiquity of the decorations and the early, largely unknown, changes they have undergone. In spite of this, a number of old decorations have survived and some still carry a distinct meaning, known sometimes only to the craftsman and his customer and sometimes to society as a whole.

Decoration on ceramic wares refers to the act of putting ornaments or making wares more beautiful by placing adornment on or in them. Decorations could take the forms of patterns derived from simple linear design to complex design motifs and sometimes are combined. Decoration is also an act of creating textures on or in ceramic wares.

Wall decoration, accordingto Olaosebikan, (Ibid) have been traced to as far back as the cave age when man used earth and vegetable dyes to paint on cave rocks. Olaosebikan (1982) and Jefferson (1974) said that African artists use their free hands spontaneously following their creative inspirations, as was done in the rock paintings of pre-historic times. Not taking into consideration the form the decoration takes, Walter (1975) said it might range from crude, simple geometric or symbolic scratching on walls as in Egypt, to highly sophisticated and deciphered use of decorations; often accompanied by a patterned dressing of the wall surfaces itself, as in Hausa land and the Lower Nubia.

Heathcote (1976) wrote about the earliest Hausa wall decoration and how it might have originated from restrained and rather geometrical work that arose in an almost unpredicted fashion from established technique used for building with mud. The Hausa mud building design are produced using free hand in the application of mud plaster which then leaves a pattern of parallel, curve lines on the building. Afuwape (1984) says, the plastic mud used by builders is also used for coating and decorating the surface walls.

Sa'ad (1985) wrote that the second area where the traditional margins excel is in the use of the plasticity of mud to create sculptural relief for both interior and exterior surfaces of buildings. This is enhanced by the use of traditional colors to create beautiful effect that leave many tourists and students of African art bewildered. Also Fagg (1971) in his write up on housing in Zaria stated that: "One of the most striking features of Hausa architecture is the external decoration of buildings, which usually surrounds doors, but which may cover old building walls facing the street".

Lawal (1963), stated that decorations in general has served as writing to record the thinking, ways of life, myths, history and culture of the people. He also noted that some old decorations still exist but they are very few and far from surviving. Most of the traditional decorations are no more available because of land tenure problem which is very complicated. He opined that some decorations which were carried out about a century ago may not be as meaningful and inspiring to the present generation as they were forty years ago.



Plate I

A house belonging to a Malam decorated in the early 1930s Source:Schwerdtfeger Retrieved (2012)

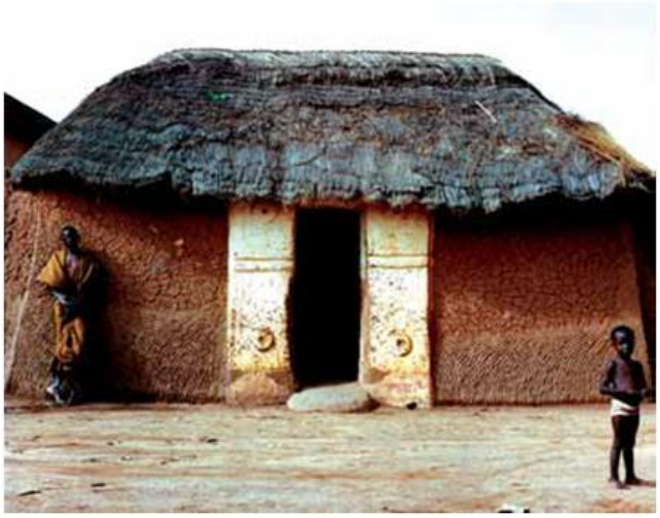


Plate II

House Decoration dating back to the late 19th or early 20th century Source:Schwerdtfeger Retrieved (2012)



Plate III

The same house was repaired and decorated in the late 1980s Source: Schwerdtfeger Retrieved (2012)



Plate IV

The Emir's palace in Zaria in 1963 Source: Schwerdtfeger Retrieved (2012)

2.5.2 Types of Decorations

2.5.2.1 Incised or Low Relief Decoration*:* This is a technique whereby metal or other tools are used to create deliberate impressions on ceramic wares, mostly at leather-hard stage. Relief decoration in Zaria accordingtoSchwerdtfeger (2005) has progressed from a combination of a few simple motifs in the 1840s, to more complicated and luxurious wall decoration using ever smaller motifs. He also noted that, the explicit meanings of the more recently introduced relief motifs have almost completely been lost. This development is partly due to a change in the perception of relief decoration by customers and craftsmen alike. But above all, it is the result of the gradual replacement of old indigenous status symbols with new imported ones which renders wall decoration partly obsolete.

2.5.2.2 Impressed Decoration:The technique allows physical touch of hands that gives value as well. It is achieved by way of creating impressions on wares at the leather-hard stage. The impressions that are created at this stage are achieved by stamping selected design motifs or patterns in the soft clay body. The stamp is usually of a selected motif that could be repeated over and over on the ware to form a desired pattern. This technique produces impressions that are either in low or high relief or in a combination of both.

2.5.2.3Appliqué Decoration:this technique of decoration is achieved by way of creating high relief on wares by way of using additional clay to create desired patterns or motifs on a piece of ceramic ware.

Other forms of decoration are made using the stimulated textures, they include

a. Engobe or Slip Decorations
b. Underglaze Decorations

c. Overglaze Decorations

d. Painting as a source of decoration

2.6MOTIFS AND DESIGN CONCEPT

Motif is a unit design used to generate a pattern for decoration.It is also believed to be a distinctive and recurring form, shape, figure found on wall paper, textiles, painting, tiles etc, while design is defined as the general arrangement of different parts of something that is made. Albert, (1985)in Ajayi (2007) defined design as the act of product conception itself. He further stated that it is to integrate all the determining parameters such as, the nature and characteristics of materials, clients/marketing, cultural environment, process of production, function of the end product etc. Oguntona, (1986) also in Ajayi (2007) defines design as the creation of new forms, which is preceded by conceptualization and followed by what was conceived in a visual expression. Design means different things to different people or professionals. Most people however see design as the process of conceiving anything in the mind. In essence, Ogunwole, (2010) stated that, design is a field that is capable of almost limitless extension. That it is the unification, relationship and arrangement of contrasting elements whose goal is to fulfill a purpose.Olaosebikon,(1963) confirmed that, in the northern parts of Nigeria, traditional buildings exist in family groups(unified) that is surrounded by high walls with beautifully decorated gates.Heathcole, (1976) observed that, the elaborate ornamentation of exterior walls with representational motifs of Lorries, bicycles, guns, umbrella, etc, was where he drew some of his inspirational motifs from. Some of the motifs were the 19thcentury Zaria Fridaymosque interior design/ decoration. Some of these decorations are executed mainly on the walls of the entrance to the main building facing the street.

However, in Nigeria modern pottery (ceramics) was introduced in 1904. According to Gukas(2003) and Moses;(2004) they both traced the history of ceramics in Nigeria to "Mr. Roberts, as the person who introduced modern ceramics to the rural community in Ibadan". Meanwhile, "the technology of modern ceramics was not accepted among the Yoruba's up till 1912 when Robert finally left the country. Following the departure of Roberts, "Michael Cardew's experiment at Abuja (Suleja) brought a tremendous change into the modern and contemporary ceramics." Michael Cardew introduced the Gbaji Potters to some students at Government Day Secondary School, Kwali. Among these students is the famous and one of the first modern ceramists in Nigeria, Professor AbbashiyaMagajiAhuwan, of lndustrial Design, Ahmadu Bello University, Zaria, Kaduna state, Nigeria.

By 960 AD, decorative tiles had become widely used in Syria and Turkey. However, as transport and communication developed, tile usage increased but were mainly used to decorate the floors of Cathedrals and Churches, and by the end of 12th Century, manufactured ceramic tiles had spread across Italy, Spain and into the rest of Europe.

This chapter however, reviews literature and works of early researchers with the view to noting the extent to which this problem under study has been handled before. Studying our new generation building, we found out that urbanization and western civilization have great impacts on our traditional building and designs. Most of our building or structures today are greatly influenced by western styles. Traditional wall decorative designs are almost out of existence since our modern architects are also not interested in the traditional features and styles. Okin (1988) stated that most of the new buildings in Nigeria today have no traditional wall decorations.

Fatuyi (1972) wrote that “traditional wall decorations are still found in many parts of northern Nigeria, but also remarked that the future of such design is not certain. He went further, drawing analytical link between modern technological development and traditional art as well.

The fact remains that both tradition and modernity have very much in common. In her writing on contemporary orients, Nadia (2008), stated that “a new generation of designers is emerging which mixes tradition and modernity to produce objects and spaces with fresh appeal to both local and international appeals”.

Countries like France, Lebanon, Britain, U.A.E, Turkey, Saudi Arabia, China, Nigeria etc, all theplaces found around these areas like the restaurants, hotels, offices and homes are all embracing a globalized, “contemporary” design images. Berrads (2008) cautioned that the term“contemporary” does not necessarily mean “western” but could also mean “oriental”. He further stated that contemporary does not belong to only one culture. Gureli,(Ibid) said our creations are inspired by our traditions. We take them to any part of the world by using the universal language – modernity. We belong to two cultures, the traditional and the modern.So we take our inspiration from both cultures, explains Berrad,(Ibid).

In Indonesia and Morocco, the traditional artisans are increasingly taking inspirations from modern creations, and in response to the new demand for contemporary design turning out new products. The fact remains that both tradition and modernity have much in common. While Nadia (2008) in her writing also argues that “ By merging the best of both of these worlds, this style offers tangible evidence that modernity and tradition are not contradictory, rather they are the seeds of our future wherever we live.

CHAPTER THREE

3.0 METHODOLOGY

Introduction

This chapter explains the procedures used in this study. The procedures or stages of discussions are the processes of mould making, template making techniques, source of raw materials used, and method of procurement, the formulation of various clay bodies, and procedures of production, which deals with the sourcing of information from primary and secondary data and testing the strength of the product with a compressive machine. To the best of the researcher's knowledge Zaria wall motifs in Kaduna state have not been studied mainly for the purpose of producing ceramic wall tiles. The study seeks to explore and experiment withthe Zaria wall motifsfor ceramic tiles design and production**.** A number of procedures for data collection such as interview and analyses have been adopted by various investigators to facilitate the conduct of their research, but the major concern of every researcher is the quality and validity of the research design adopted to suit a particular research appropriately.According to Russell (2006),exploratory design is flexible and often used when the topic or issue is new. This study is exploring on the use of local motif that can be experimentally applied as a decorative medium on ceramic tiles.

According to Adetoro(1997) in Anyaoha (2010), the researcher must examine various procedures and techniques used in some previous studies. He further stated that the thoroughness of investigators, sample selection, analyses and adequacy of reporting the findings and the validity of the procedure employed add a lot of quality to any research.Again, Sullayman, (1991) defines research design as the arrangement of conditions for the collection and analysis of data in

a manner that aims at providing both external and internal validity to the findings of the investigation, while Osuala (2006) says research is simply the process of arriving at a dependable solutions to problems through the planned and systematic collection, analysis and interpretation of data.This chapter reveals how the entire study was conducted in order to accomplish the stated objectives of the study.

3.1RESEARCH DESIGN

In order to achieve the desired objectives of this study, the study adopted the experimental/ exploratory research design which is used for the sourcing of the materials (population) for the study. This design method includes the following:-

- Pilot study – (Preliminary study).This involves the visits to sites of the motifs and the draught men of the Zaria wall decorative motifs.
- Field work- This involves collections and gathering of wall decorative motif or design in Zaria city (which involves the primary and secondary sources).
- Exploratory/experimental work-This involves the studying, arrangement of the single motifs from Zaria city to its compositional value as well as to create some patterns for the ceramic tiles through to its production stage.

In the light of this, Asika (2001) emphasized that research design is "an outline or a scheme that serves as a useful guide to the researcher in his effort to generate data for his study". The design was found suitable by the researcher because it was designed to satisfy a desire for better understanding on the exploration of traditional Zaria wall decorative motifs for ceramic tiles designs and production. Dakyes, (2006) reported that exploratory study is aimed at exploring the nature of a given phenomenon at an initial stage so that the outcome of the exploration could

guide subsequent usage and further studies. Dingba (2010) in her work, "Exploring the Aesthetic possibilities of Anthill patterns in Painting", used this method to make a non-representational and representational structure of ant hill forms. And again, Dakyes (2006) used the exploratory research design to investigate graphic design problems found in billboard designs in Nigeria.

3.2 POPULATION

The population of the study could be small or large. Nevertheless, what is important is that all members of the population must have at least one characteristic in common. Dakyes,(Ibid)saysit can be a geographical area or inhabitation of a place, country that constitutes a given area. Against this background, Mbahi (2001) states that "population denotes the whole of the large group from which the members of a sample are selected". In this case, the purposive sampling technique was used to select the population.Wimmer and Dominick(2007) inAndrew(2012) pointed out that purposive sampling include subjects selected on the basis of specific characteristics or qualities.Omosili (1996) also observed that 'purposive sampling is another technique of selecting a research sample purely on the basic of the special characteristics that particular elements in a population possess and which may be directly relevant for testing the hypothesis.' Again Adetoro (1986), states that in order for the researcher to collect information needed he/she must specify the entire group that contains the source of information. This group comprises many parts that have things in common. In this research, "Adaptation of some selected motifs of Zaria wall decorative symbols which include, dagi, zane, floral, abstracted dagi, geometric floral, katantanwa, yankangishiri, kayarmaciji, tafiyamaciji, kayankifi, Banyan kadangere, Zanke and several othermotifs for ceramic tile designs and production" constitutes the population of the study, and the entire Zaria wall decorative motifs that are assessable to the public.

3.2.1 Sample

The method of drawing samples is called sampling. Precisely, sampling is a subgroup drawn from population which is generally large. In other words, sampling is representative of population and is expected to have similar characteristics of the actual population. The purposive sampling technique was used to select twenty (20) motifs from two hundred (200) motifs found on walls in Zaria city. Some of these motifs were earlier on adapted on regalia embroidery and cap embroidery. The sampling was used to gather the specific number required for this study. The main reasons for using the purposive sampling is to enable the researcher obtain possible accurate data that exhibits the characteristics of the entire population. In view of this, a small sample size that could be properly managed so as to arrive at a conclusion that would have internal and external validity was adopted. As such, a total of twenty(20) Zaria wall motifs were selected,ten (10) were explored and five (5) executed and produced to ensure adequate control.

3.2.2 Primary Source

Primary Sourceis the source that contains direct account or information of an event or phenomenon given by someone who actually observed the event or phenomenon,(Sullayman, 2009).Therefore the primary source of data for this study consists of the photographed pictures of the motifs found in Zaria city (wall), snapped by the researcher and others found on regalia and cap embroideries.

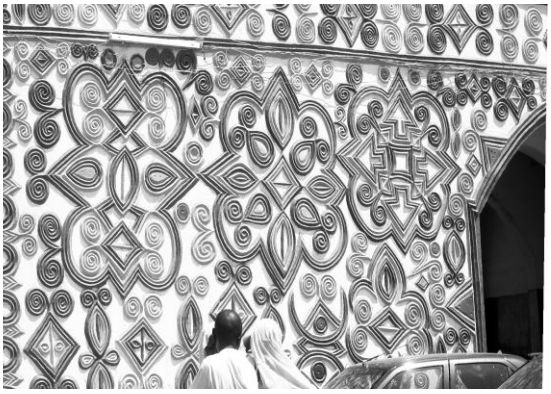


Plate V
of the Magina's House



*Plate VI*Combination of Dagi, Floral, Zane and Abstracted Zane Motif (wall)
Dagi motif found on the exterior walls of the Emir'sPalace, Zaria City



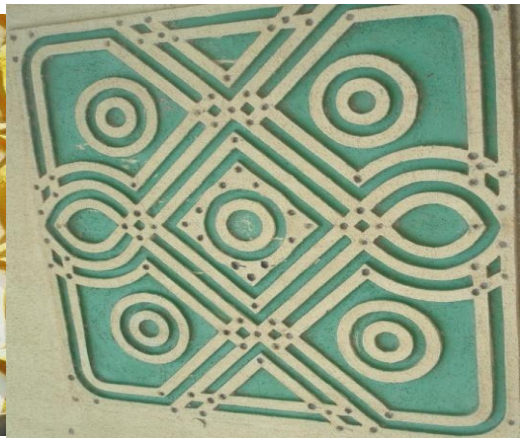


Plate VII
Dagi Motif found inside the Mini Entrance to the Emir's wife Compound

Plate VIII
Modern Dagidesign found in Kano (Emir's Guest House)





Plate IX
Dagi Motif on a Bag (Leather Works)

Plate X
Floral Motif on a the Wall of Emir's Palace





Plate XI Abstracted Dagi Motif

Plate XII Abstracted Dagi Motif with Curvilinear and Triangular patterns

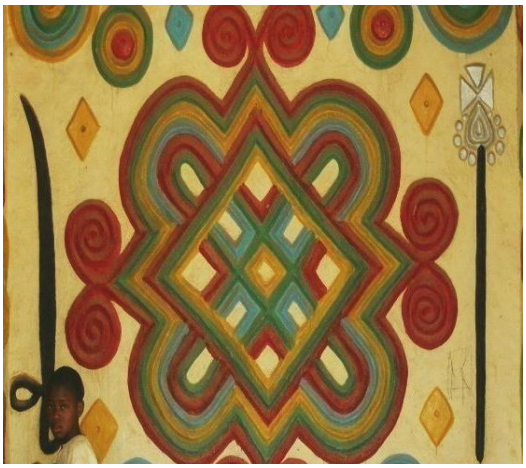


Plate XIII Dagi and Sword Motif

Entrance in the Emir's Sitting hall

3.2.3 Secondary Sources

These are materials that embody an account or information of an event or phenomenon by someone who did not actually go to the site or witness the event. Secondary sources collect and synthesize the primary materials. The secondary sources are data collected on designs (Zaria motifs) from magazines, journals and text books, seminar papers and visual electronic media (television) that have design related subjects

3.2.4 Area of the Study

The study is restricted to exploration of design motifs from Zaria city, with special interest on its traditional wall decorative motifs found and observed in homes (sitting rooms),Emir's palace (external and internal) decorations in the city.

3.3 METHODS OF DATA COLLECTION

The following instruments were used in gathering materials for this study. They include

i. Pilot study
ii. Photography
iii. Interviews
iv. Observation

3.3.1Pilot Study

A pilot study was carried out to the desired locations in order to observe and select the required traditional motifs of the Zaria wall decorative symbols. Subsequent visit were also made to obtain more relevant information like history of the design, the designers and its significance. The study noted that there were lords of wall decorators in Zaria city, and that a person is usually picked as king of the decorators, meaning that such a person is the overall lord of the decorators in Zaria wall decoration in Zaria city, see plate xiv.



Plate XIV
A cross section of interview with Malam Ja'afaru Garba (Magina of Zaria City) seated with a research assistant Mal. Bashir Umar. (2011)



Plate XV:
The Researcher (Mrs.Rakiya Mohammed) and the Respondent king of builders, (Mall. Jafaru Garba)
Photograph by Bashiru 2010 and recorded by Anyaoha N.J

3.3.2 Photographs - During the field trip, photographs of several wall decorative motifs were taken for closer observation and verification and as a basis for generating sketch diagrams for the study.

3.3.3Interview- Wall decorators were interviewed orally, using the face to face direct method of interview as suggested by Willet, (1971) and Ahuwan, (1976) that the use of direct interview is

better for a study that deals with material culture of a people. The direct interview method was successfully used by Ahuwan (Ibid) for the collection of data on Nigerian crafts. The interview of this study was documented in Hausa and was later transcribed into English for better understanding of the information.

3.4 PROCEDURES OF WORK

The work procedures are discussed under the following data collected and discussed under the following headings. They are exploration, developmental and production stages respectively. The three stages capture the systematic production of the work from the compositional unit motifs to its repetitive or rhythmical flow of the Zaria wall motif. These processes below will be discussed under the procedures of data collection as follows:-

- Preliminary preparations.
- Computer aided design
- Development of compositional motifs/ repetitive motifs.
- Processes of mould making.
- Template making techniques.
- Source of raw materials used and method of procurement.
- Formulation of various clay bodies and procedures of production.

The procedures are, the preliminary stages which include the sketches, the field work, snapshots redrawing and tracing of motif and computer aided designs (CAD). Generation of information from primary and secondary source all helped in the collection of the design data while the developmental stages include Exploring, experimenting and production of tiles in the studio.

3.4.1Preliminary Preparations

Preliminary studies in ink and pencil (black and white) were made on paper in order to pave way for the main work. Zaria wall motifs were carefully drawn ranging from a unit motif to compositional motifs to serve as a guide in the final design of the ceramic tiles. The motifs were photographed and transferred into sketches. The processes of the drawn Zaria wall motifs were developed from single composition to repetitive pattern composition in order to guide the final design of the tiles. Preparation of clay was done to ensure suitable claybody for the production of the adapted Zaria wall decorative motifs and symbols for ceramic tile design and production. See fig.1-20.



Fig.1

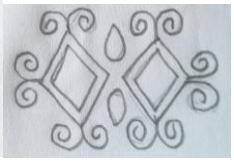


Fig. 2

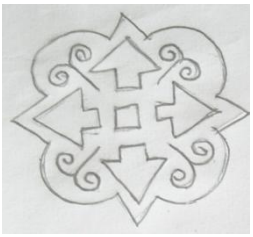


Fig. 3

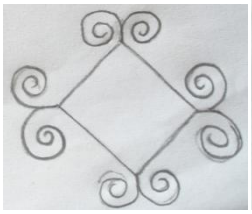


Fig. 4

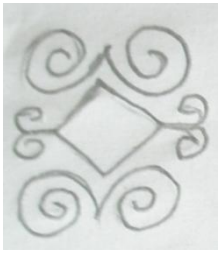


Fig. 5



Fig. 6Fig. 7

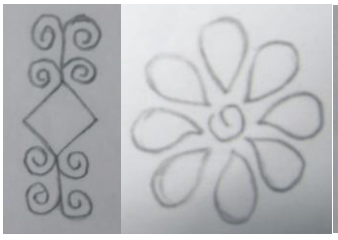


Fig. 8

Fig. 9

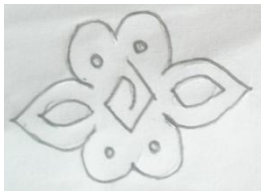


Fig. 10

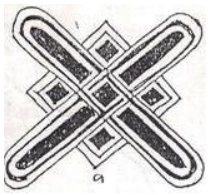


Fig. 11

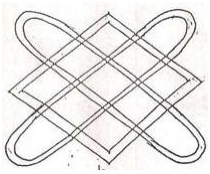


Fig. 12

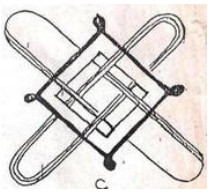


Fig. 13

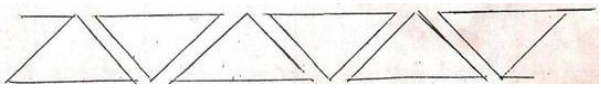




Fig.14Fig. 15

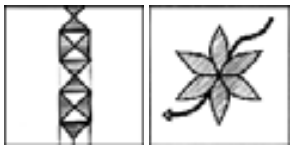


Fig. 16

Fig. 17



Fig. 18



Fig. 19

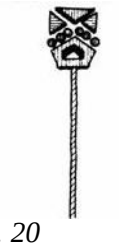


Fig. 20

Source: Fig. 1-10, researcher's drawings; Fig. 11-15, Rekwot (1998), Fig. 16-20, Schwerdtfeger (2005)

The above are pencil sketches of motifs extracted from Zaria wall design, and reference sketches collected from secondary materialsout of which five were selected for the research work. The selected ones are indicated above in Fig. 1,3,5,8 and 9 respectively.

3.4.2Computer Aided Design Process

Computer graphics are created using computer to generate, represent and manipulate images using two dimensional (2D) and three dimensional(3D) software packages to establish a design.

Today, computers and computer-generated images touch many aspects of daily life. Computer imagery is found on television, in newspapers and it is used as a medium to generate aesthetic visuals in all disciplines of academic pursuit e.g. industrial design (ceramics, textile, graphics,

glass),Education, Medicine, Geography etc.Bako (2006) used computer aided design to generate a textile design composition in his PhD Dissertation.

Improvement has been made so much in computer generated design. Most importantly, images are now made to look more realistic in colors just the way a real world look like and are called "realistic image synthesis".

Product design and mould making have been identified as areas where computer can be applied in ceramics. Beebhas and Renee (1995) making a very comprehensive description of computer assisted design and manufacturing of mold,Ajayi (2007) states the stages involved as product concept/model, product data base, process simulation, computer programmed evaluation, mold design and numerically controlled (NC) tool paths. The methodology of creating mould design via CAD/CAM technology differs from drawing the design in that the drawing is two dimensional while the mold is generally a three dimensional representation of the real parts without requiring additional views or supplementary information. This technology can be used to design prototypes for ceramics product.

Many software packages have been developed to generate visual imagery which can be categorized into types. They are: the 2D, 3D, 4D, 7D. Since the technological age, 3D computer graphics has become more commonly used, but 2D computer graphics are still widely used.

Here computer also plays an important role in the graphical presentation of the tiles, showing a two dimensional color variation on how it could be decorated and its placement in repeat and rhythmical patterns to help achieve better compositions during the final production. Some of the photographed and sketched motifs are graphically presented as can be seen in Fig. 17-20.

3.4.3Computer Tools (Icons) and Procedure used

i. PSC 2350 Series

ii. Standard Bar

iii. Origin/Snaps and Guide lines

iv. Pen Tool (tool bar)

v. Fill color

vi. Group

The computer design process was done using a software package (coral draw X 3 pack) the processes used is as follows:-

i. **PSC 2350 Series** – This package was used to scan the hand drawn motifs documented at the course of the pilot study. This was developed at the preliminary stage and was scanned into the computer.

ii. **Standard Bar** – An A4 sized paper was selected from the tool bar, which was served as a flat surface used in rendering the motif into two dimensional designs.

iii. **Origin/Snaps and Guide lines** – The origin of the design was generated in a snap and a guide line was used for enhancement, after which the scanned image was moved into Corel draw application in order to place it on an A4 sized paper.

iv. **Pen Tool (Tool Bar) -** This was used as a medium to trace out the motifs on the manual sketch.

v. **Fill color -** Ice blue colour was used to bring out the motif forward from its background.

vi. **Group** – Finally, all the design was grouped, and was power clipped into the container.

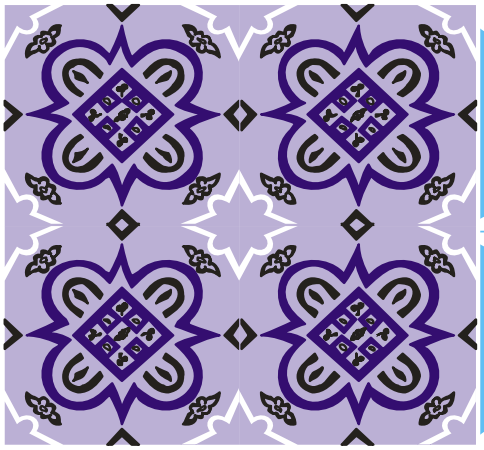


Fig. 21: Repeated Dagi Motif.

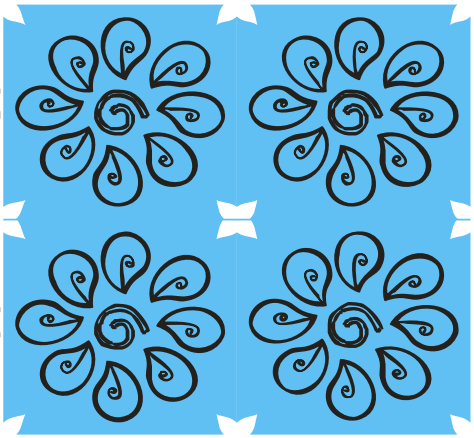


Fig.22: Repeated Floral Motif.

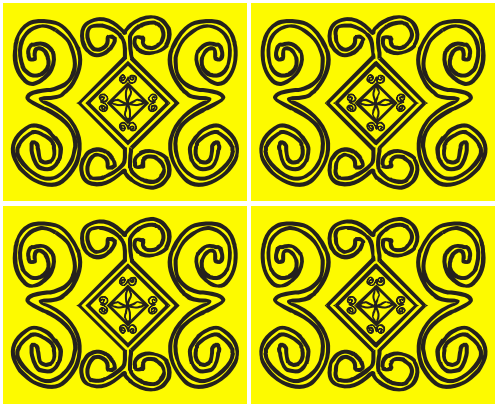


Fig. 23: Repeated Zane Motif.



Fig.24:Abstracted Dagi

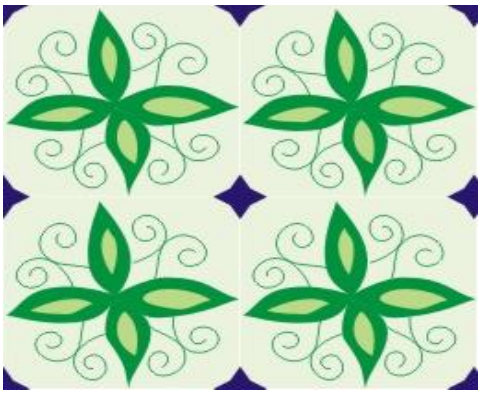


Fig. 25: Repeated Floral Geometric Motif

3.5 EXPLORATORY/DEVELOPMENTAL STAGE

This stage captures the compositional unit of motifs which were drawn on a tracing paper and afterward transferred onto a sized shaped clay slab through the process of tracing the designed motif and thereafter used theengraving method of design to achieve the finished designed models.

3.5.1Modeldesign (exploring)

Models were explored and made for five different tile motifs, which included the model for dagi motif, Zane motif, Floral motif, Floral geometric motif and, the Abstracted dagi motif .The clay for the models of these five items were all properly picked, to free the clay from stones and other foreign bodies), kneaded, wedged and then spread and cut into slab forms with different sizes and shapes andneatly trimmed. After obtaining the sizes and shapes, the drawn motifs were transferred and traced onto the plain slab. Below in fig xiv and xv is a spread out slab of clay ready for cutting, sizing and designing of the five Zaria motifs models





Plate XVIPlate XVII
Spreading out clay slab (Ceramics Section 2009) Plain Clay Slab Ready for Sizing.

Ceramic Studio, Department of Industrial Design, ABU, Zaria





Plate XVIIIPlate XIXResearcher cutting out Clay slabs into sizes Working on Zane motif

Ceramics Section, A. B. U. Zaria (2009)

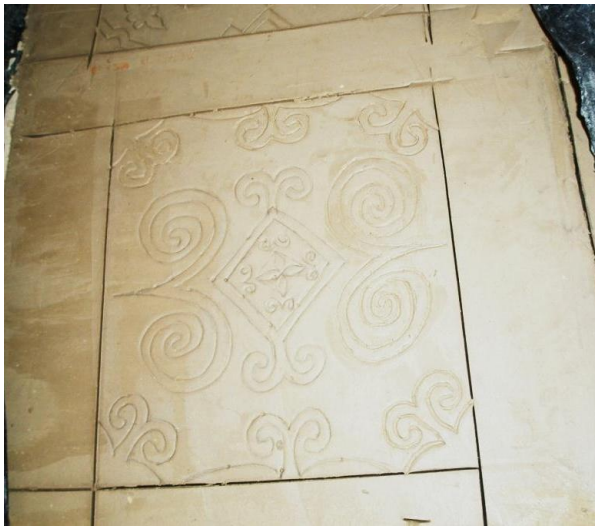


Plate XX
Traced Slab with Zane Motif, Ready to be Engraved
Ceramic Studio, Department of Industrial Design, ABU, Zaria

3.5.1Zane Model Making

In making the mold for the Zane motif, a model was first of all produced and the following procedures were undertaken;

A lump of clay was placed on a flat surface, rolled over and over to form a flat and appropriate shape for the Zane designed motif. The placement was accurate (Four sticks were used to create the frame in order to support the slab).

(a) The drawn motif was traced with the use of tracing paper onto the clay slab, in preparation for the Zane motif (model)

(b) The Zane motif was later engraved on the slab by subtracting the unwanted clay in order to bring out the Zane design.

(c) The outlined form was smoothened in a careful manner following the flow of the design outlines, bringing out an effect of the Zane design, as seen in plate xvi below.

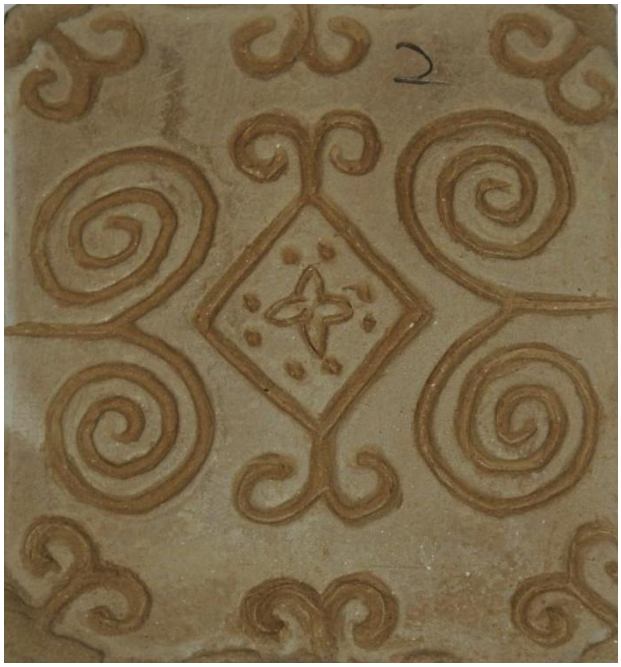


Plate XXI
Zane Motif in Engraved Tile (model)

3.5.2Dagi Abstracted model

The Dagi Abstracted model was designed and produced using the relief method. The motif was drawn on a plain clay slab,while clay lump was at the same time use to create the relief effect of the Dagi motif which thereafter displayed the characteristics of both relief and engraved method of making design. The same process was adopted in making models for Dagi, floral geometric, floral and abstracted Dagi 2. The dagi Abstracted are formed or redesigned with more geometrical shaped forms. These combinations helped and assisted in giving the design a rigid and flexible effect.



Plate XXII
Abstracted Dagi I in Engraved/relieved Tile
Ceramic Studio, Department of Industrial Design, ABU, Zaria

3.5.3 Floral butterfly model

The model made from the floral geometric motif was designed and obtained using the relief method of design. After tracing the design on the surface of a plain clay slab, small quantity of clay lump was then used to build up the designed outline.Modeling tools were then used to press smoothenthe relieved design to give it a neat and perfect finishing as indicated in plate xviii,



Plate XXIII
Floral butterfly motif in relief Tile design
Ceramic Studio, Department of Industrial Design, ABU, Zaria

3.5.5 Dagi Model

The procedures encountered in the Dagi model is also the same as the procedures in the Dagi abstracted model, the only model that had a different procedure or technique in making it, is the Zane motif which at the course of engraving, the motif was given deep impression on the slab and also deep projections to give it a different perspective and aesthetical look.



Plate XXIVDagi Motif
Ceramic Studio, Department of Industrial Design, ABU, Zaria

3.5.6 Floral Model

The method adopted for the making of floral model was the same as those used in making Dagi, floral geometric, abstracted Dagi 1 and 2 models. However the only difference is the cutting and smoothening of the motifs on the slab due to its rhythmical flow in order to bring out a complete relief projection for proper casting and creating of the templates.



PLATE XXV
Floral Model being worked on by the researcher.
Ceramic Studio, Department of Industrial Design, ABU, Zaria

After the above procedures, on the making of the Zane motif,Dagi, Abstracted dagi, Floral geometric and the floral motifs models, the following processes were used in producing a mould for the models. During the developmental stage after the exploratory stage, cast from the acquired model were made using the plaster of Paris (P.O.P) to achieve a strong and durable mould which was subsequently used to produce and reproduce as many tiles as possible.

3.6 PROCEDURES FOR MOULD MAKING

Step 1: Each Model was placed on a flat surface with the designed area facing upward, wad of clay, bricks and strong planks or board were all used as Cottles or retention wall built round the model to keep the liquid plaster of Paris in place until it sets and solidify upon the model.

Step 2: The measurement of plaster of Paris which was suggested by Singer and Singer(1963) Pottery craft catalogue(1989) and Kenny (1949) all in Sullayman(1991) suggested and agreed that the ratio of plaster to water is preferably 130;100. Based on this, this research used the ratio 130:100for the mixture of plaster of Parisand water formould making.

Step 3: After setting the model properly inside its retention wall, liquid soap was applied on the model to ensure easy removal of the model from the mold when the plaster became set.A reasonable amount of plaster was measured and poured into a container, containing the required amount of water based on the ratio stated earlier and was mixed harmoniously. The viscous plaster was poured in the retention wall allowing it to set onto the model.On setting, the Cottles were removed and the mould was lifted to face upward, left to set for about 15 to 20 minutes after which the mould was carefully and gently hit on a hard table to release and free the model from the castmould.

The mould then formed a replica of the model in its negative form. The mould was then taken outside and left under the sun for about four to five hours for proper drying. This same process was used in making all the other fivemoulds. In plate xxvi below, the researcher is building a retention wall round a model in preparation for casting, while plate xxvii shows model to be cast.



Plate XXVI



Plate XXVII

Preparing the Models for Casting (Retention Wall was built around the Model).
Ceramic Studio, Department of Industrial Design, ABU, Zaria





Plate XXVIIIPlate XXIX

Thorough mixing of Plaster of Paris in water and pouring itunto the Model.
Ceramic Studio, Department of Industrial Design, ABU, Zaria.



Plate XXX
Cast mould surrounded by Retention wall
Ceramic Studio, Department of Industrial Design, ABU, Zaria

A cast mould surrounded by a retention wallready to be detached from the wall.

Below are some of the cast moulds showing replica of the models produced in Ceramic Studio, Department of Industrial Design, ABU, Zaria.



Plate XXXI (Cast Zane Mould)



Plate XXXII (Cast Dagi Mould)



Plate XXXIII (Abstracted Dagi Motif)

3.7 SOURCESOF RAW MATERIALS USED AND METHOD OF PROCUREMENT

The raw materials used for this study were clay obtained from the Bomo clay deposits at the Department of Industrial Design,Ahmadu Bello University (A.B.U) Zaria, Kaduna state,Nigeria.Sharada clay, Feldspar and Quartz were obtained from Kano state, Kaolin from Katsina State, coloring oxide from Sabon-Gari market Zaria. Other materials used include, plaster of Paris and calcium bought from Kaduna central market. Biscuit fired clay and grog processing source, the location, procurement and selection of materials were guided by information from practicing ceramist in Nigeria.

3.7.1 Processing Selected Raw Materials (With useful effect)

The wall tile produced is a glazed body that is suitable for both interior and exterior uses only. It is non-vitreous and is not required to withstand excessive impact or be subjected to freezing and thawing conditions. It is suitable for residential walls. In processing the actual raw materials for the wall tiles with the motif designs laid on it, all raw materials used in this study were processed by the researcher except for the plaster of Paris and calcium that was bought.

Each of the clays was processed in a separate container. The following is the summary of the beneficiation:

3.7.1.1 Clay and Kaolin

i. Soaked for 24 hours

ii. Blunged for 4hours

iii. Sieved through fine mesh

iv. Dried for 15hours

v. Stored in a plastic container and kept in a dry place

3.7.1.2 Feldspar

i. The feldspar material was washed

ii. Calcined at biscuit temperature of 900-1000^{o}C

iii. Milled for 4hours

iv. Sieved through mesh 90

v. Dried and stored

3.7.1.3 Quartz

i. Washed

ii. Calcined at 900^{o}C

iii. Washed, dried and jaw crushed due to the setting of carbon monoxide upon the quartz during the calcining process in the kiln

iv. Milled for 4-5 hours, poured out of the miller

v. Sieved through mesh 90

vi. Dried and stored

All the solid minerals were grinded using the wet grinding methods. After the grinding, the powder was poured out of the ball mill, de-watered dried and kept in plastic drums to protect the materials from physical contact with foreign bodies.

3.8 TESTING OF MATERIALS

3.8.1 Plasticity Test: The different clay used, were tested for plasticity by cutting out of the prepared clay, rolled round the finger into ring shapes to study and observe if they show signs of crack and breakage.

3.8.2 Drying Shrinkage Test: The shrinkage test was obtained by preparing the clay into a workable consistency, rolled out into rectangular shaped slab. A ruler was then used to measure 10cm line across the slabs, the slab were then kept on a flat wooden bat to allow gradual drying in order to avoid warp age. The drying was left under room temperature. After drying the lines were re-measured again using the percentage linear shrinkage formula, as stated below;

% linear shrinkage = $\frac{Plastic\ \ lengt\ h - Dry\ \ lengt\ h}{Plastic\ \ lengt\ h} \times 100$

3.8.3 Determination of Percentage Shrinkage

Specimen 1:

Wet length (W-L) = 10cm

Dry fired length (DL) = 9.8cm

% Shrinkage $= \frac{10-9.8}{10} \times 100$

$= \frac{0.2}{10} \times 100 = 0.06 \times 100$

= 2%

Specimen 2:

Wet length (WH) = 10cm

Fired length (DL) = 9.4cm

% Shrinkage $= \frac{10-9.4}{10} \times 100$

= 6%

Specimen 3Specimen 4

Wet length (WL) = 10cm

Fired Length (DL) = 9.4cm

% Shrinkage $= \frac{10-9.4}{10} \times 100$

= 6%

Wet Length (WL) = 10cm

Dry Length (DL) = 9.8 cm

% Shrinkage $= \frac{10-9.8}{10} \times 100$

= 2 %

Specimen 5

Wet Length (WL) = 10cm

Dry Length (DL) = 9.8cm

% Shrinkage $= \frac{10-9.8}{10} \times 100$

$= 2\ \%$

3.9 FORMULATION OF VARIOUS CLAY BODIES

Ceramist refer to the particular types of clay they use as clay bodies, the clay body may consist of clay as it was found in its natural state. A clay body may be made up at the factory and packed either in dry bulk or damp in plastic bags. It may also be mixed from dry ingredients in the studio, in either case; it contains a variety of components that have specific functions in the clay body in this light. Zauro, (2007) stated that clay bodies usually consist of the combination of several ingredients which constitute kaolin, feldspar and quartz. An example of a clay body might be a white earthen ware mixed without iron oxide in order to produce a low- firing body that can take color well. Again Charlotte and John (2003), gave an example of porcelain which is a mixed body made up of high – firing components that will fire to the pure white, translucent ware so esteemed in china. The formulation of clay body used by this research includes the following: Quartz, kaolin, feldspar and calcium oxide. Each of the ingredients has an important role to play. Kaolin, a plastic material in the composition enhances refractoriness, workability and provides the white color in the body. Feldspar and quartz are the non-plastic components in the body. Feldspar gives translucency and decreases porosity, and as a flux, it lowers the fusion point of the body.Grema (2004),Morakinyo.et al.(2010),Britannica (2011) all in Morakinyo (2012), defined feldspar as a crystalline rock,composed of alumina silicates of potassium (K),

sodium (Na), and Calcium (Ca) (orthoclase), (albite), and anothite,That, it is the most important flux in bodies and glazes. On the other hand, quartz assists the body to resist shrinkage, provides strength and improves translucency of the body.

A preliminary test was conducted prior to the use of the actual blend of the listed clay bodies. The first stoneware body composition used was that of the ceramic section of the department of Industrial design, Ahmadu Bello University Zaria.The composition is as follows;

3.9.1 Clay body 'A' (Studio Clay from Ceramic section, A. B. U. Zaria)

Kankara kaolin = 50%

Bomo clay = 50%

Total = 100%

3.9.2 Clay body 'B'

3.9.2.1 (Studio experiment B1)

Kankara kaolin = 75%

Bomo clay = 25%

Total = 100%.

After experimenting with the first two clay bodies of which the first was studio working clay composition and the second one being an experiment carried out by the researcher, they were both successfully used to produce the tiles, fired at bisc and glost firing temperature respectively.

Other clay bodies were also experimented in the studio to obtain a body that can withstand a higher temperature range. Six different compositions were experimented upon during the study and they are as so stated in table3.0 above and table 3.1 below:-

3.9.2.2 Studio experiment B2,B3,B4,B5,B6 as seen below on Table 3.1

Table 3.1

Body composition	**Clay bodyB2**	**Clay body B3**	**Claybody B4**	**Clay body B5**	**Clay bodyB6**
Ball clay	200g	300g	200g	150g	250g
Kaolin	300g	300g	300g	350g	250g
Quartz	200g	200g	150g	200g	250g
Feldspar	200g	150g	200g	200g	200g
Calcuim Carbonate	100g	50g	150g	100g	50g
Total	1000g	1000g	1000g	1000g	1000g

Source: Studio Tests, 2010

In seeking for a clay body that can withstand the required temperature of firing, a seventh clay body was sourced from an international ceramic journal paper by S.L Correia, D Haofza and A.M Segadaes (2010).

Finally, the study then used a wall tile body composition sourced from the manual of practical potting by Charles F, Binns to produce the adapted motifs of Zaria wall decorative symbols for ceramic tile design and production which comprises of the following in table 3.2.

Table 3.2 Composition of Clay Body for Wall Tiles.

Black ball clay	15 lbs	22.5%
China clay	17lbs	25.5%
Flint	27lbs	40.5%
Stone	8lbs	12%
Total	140bs	100.5%

Source: The Manual of Practical Potting by Charles F. Binns. (2009)

3.10 CHARACTERIZATION AND PROPERTIES OF MATERIALS

Testing the behavior or nature of raw materials is very important in determining the properties of refractory products and their quality controls for repetitive production. (Sullayman, 2006).However, the mechanical strength of ceramics largely depends on factors such as the body composition,firing cycle, the design and the method of production whether coiled,thrown or press molded. (Gukas,2007). The XRF and XRD characterization of kankara clay, according to (Sullayman 2006 and 2011) are stated in table 3.3, while the chemical elements of Bomo clay are highlighted by Aluwong 1988 in Garkida1998 on table 3.4below;

Table 3.3CHARACTERIZATION OF KANKARA CLAY

Analyzed DI file: C:\IDENT\EXAMPLES\KANKARAC.DI
Sample identification: kankara clay
First database used: C:\IDENTDB
Second database used: C:\USERDB

Results:

	CARD ID	MATCH SCORE	REL M SCORE	I [%]	DISPL [μm]	FORMULA
1.	41-1316	48.96	0.29	1	17	Sl7.04Sel4.96
2.	41-1197	21.91	0.34	1	-84	PuAu3.64
3.	42-1818	26.30	0.28	2	-4	C5H7NaO3
4.	46-1973	17.59	0.32	1	-18	Cl6H19C1N20!C4H4O4
5.	09-0345	17.71	0.26	1	-75	Ca2P207
6.	38-1116	15.88	0.27	1	-18	Ba2CdCoA12F14
7.	15-0344	12.28	0.33	1	-43	Li4Al4B6O17
8.	29-1756	13.66	0.30	1	11	Cl2Hl3N3O2
9.	28-1327	11.55	0.35	1	-37	Tl3ScF6
10.	18-0720	14.47	0.28	1	-14	Li4B2O5
11.	42-0429	13.68	0.28	1	91	Fe4 (PO4) 3 (OH)3
12.	30-1346	12.02	0.32	1	70	Tl2HPO4
13.	19-0523	3.86	0.96	2	-4	AuNd
14.	38-0229	10.41	0.34	1	106	Cu2(OH) 2CrO4
15.	34-1786	10.33	0.33	1	-17	Cl8H38N2O
16.	43-0397	9.21	0.37	1	-18	Rb0.25CrF3
17.	42-1777	11.63	0.29	1	62	CllHl4O2
18	35-0864	12.65	0.26	1	-14	(NH3) 4Pt (TcO4)2
19	05-0406	10.20	0.32	1	-132	C8H6N4O2
20	40-1547	12.36	0.26	1	-97	Cl6H12Cl2N4O
21	26-1885	9.68	0.33	1	-22	C56.4Hl88Al54.7K35.9Nl8.8
22	43-1189	10.46	0.31	1	50	Re3Br9
23	32-0722	12.64	0.25	1	58	Pd2lSml0
24	32-1324	8.75	0.36	1	12	TlSc (MoO4)2
25	07-0269	6.99	0.44	1	-76	Bi I3
26	42-0602	10.32	0.29	1	-137	NaAl2 (Si3Al)O10(OH)2
27	03-0227	7.34	0.41	1	-4	SiO2
28	30-1421	4.86	0.61	2	-117	V0.76Cr0.16Mo0.0802
29	46-1977	9.35	0.31	1	8	Cl9H29NO!HCl
30	20-1767	7.00	0.41	1	-99	CH6ClN
31	21-0144	8.92	0.32	1	17	CaH2NO3PO4!H2O
32	43-1649	8.08	0.35	2	-24	(CH2CH2CH2O) n
33	24-1983	10.39	0.27	1	-99	C2H3N3
34	37-0719	9.52	0.28	1	36	C2o4co
35	46-0006	11.19	0.24	1	136	TlMgAsO4
36	12-0452	9.06	0.26	1	-64	Be4Si2O7 (OH) 2
37	03-0499	7.61	0.35	1	-142	(Na0.4Ca0.6)Al1.6Si2.4O8
38	35-1927	9.17	0.29	2	-46	C6Hl2O4
39	37-1501	6.65	0.35	2	8	C3H6O!UO2HPO4
40	16-0394	7.92	0.29	1	-29	Al203

Source: Sullayman (2006)

Table 3.4Neutron Activation Analysis of Bomo clay

Element	Conc.(ppm)	Element	Conc.(ppm)	Element	Conc.(ppm)
Na	3499	Cs	0.75	Cr	188
M	5059	Ba	75.4	Mn	336
Al	7.49	La	92.0	Fe	0.91
K	1.50	Ce	170	Co	4.29
Ca	39.32	Sm	15.1	Rb	6.07
Sc	15.5	Eu	1.64	Lu	9.07
Ti	3516	Dy	5.76	Ta	5.33
V	51.4	HF	9.07	Pa(th	21.2
U	10.3	Sb	0.03		

Source Aluwong 1988 in Garkida 1998

3.11 PRODUCTION STAGE

The production stages of tiles covers the following: tiles pressing, drying, biscuit firing, decorations, glazing, gloss firing and finally the arrangement of tiles in a repetitive compositional order.

3.11.1Materials and Tools

i. Clay

ii. Kaolin

iii. Feldspar

iv. Quartz

v. Liquid soap

vi. Plaster of Paris

vii. Water

viii. Ceramic modeling tools like: Knife, Cutting wire, Foam, Ruler, Polythenes

ix. Kerosene for firing

Materials used comprises of the natural materials like clay,quartz, feldspar etc. The working tools for engraving and smoothening, plaster of Paris (P.O.P) for casting of moulds, water for mixing P.O.P, groundnut oil, used engine oil or liquid soap to serve as separator between the clay model and the cast mould and also kerosene for firing finished wares (tiles).

3.11.2 Production of tiles

The adaptation of Zaria wall motifs on ceramic tiles is carefully produced through the process of design presentation and observation. This involves the use of the created moulds to produce the desired designed motif for the tile production.Clay lump was manually pressed into the mould with the hand pressure and sometime with a heavy metal to help improve compatibility of the clay properly into the mould. After filling the mould with enough clay, the cutting wire was used to trim off excess clay. Kenneth (2003) stated in his write up that clay can also be pressed and scraped level in a recess plaster mould, and should be given a little time to shrink, before it is removed and another tile is made thereafter.

At this stage, all the designed and cast motifs were produced and reproduced using the moulds. The output from the mould, i.e. tiles were gently removed from their moulds and placed on a flat polyethylene covered board with polyethylene wrap covering the top. These gave the ware a gradual drying process. At the leather hard dryness, the wares were worked on by scrapping the

unwanted edges and smoothening of the wares. This was successfully carried out at this stage after which the tile was left covered to continue the gradual drying process to the bone dry level

The bone dry stage of the production was simply the stage at which the wares were ready for its first firing called the biscuit firing. At this stage, the tiles were gently loaded into the kerosene fired kiln. It was pre-heated for about an hour to help for more dryness of the tiles, after which the firing proper commenced. This lasted for four hours at 900^{o}C. At the end of the firing, the kiln cooled down gradually before the samples were unpacked. Some were polished with vanish while some were glazed.



Plate XXXIV (Production Team) Plate XXXV (Researcher removing Tiles) Photo by Rakiya Mohammed. (2009). Photo by Tosin (2009), Ceramics Studio

After producing the explored Zaria wall decorative motifs and symbols for ceramic wall tile design, the tiles were sequentially arranged in order to come up with a specific proto-type which was finally used for the representation of the tile designs as can be seen in plate XXXIV, XXXV, XXXVI, XXXVII, XXXVIII.



Prototype Plate XXXVI:
Tile Produced from Floral Motif Mould
Ceramic Studio, Department of Industrial Design, ABU, Zaria

Fired Biscuit Tiles in simple repeat composition with Vanish Application produced in ceramic studio, department of Industrial Design, A. B. U. Zaria. (Unfinished productions)

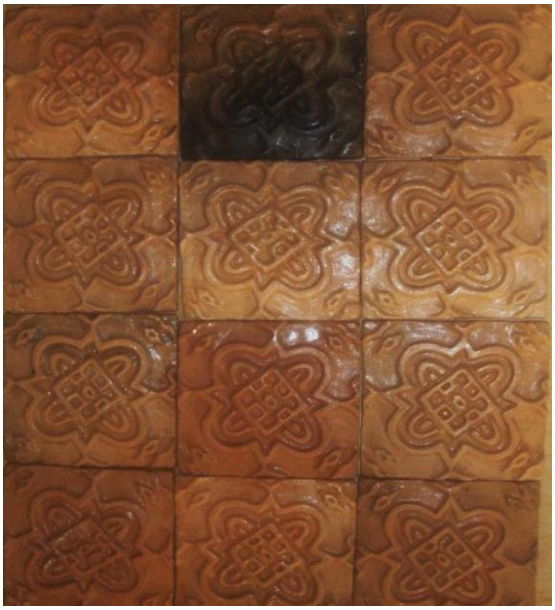


Plate XXXVII(Biscuit Dagi Motif)



Plate XXXVIII (Framed floral motif)





Plate XXXIX Plate XLFloral butterfly motif in simple repeat composition Composition of Dagi abstracted motif





Plate XLI Plate XLII

Back views of the tile, to help fuse the tiles unto the intended wall for permanence
Ceramic Studio, Department of Industrial Design, ABU, Zaria. Photo

3.11.3Glazing Recipes

The study used two types of glazes namely temoku and off white glaze. The recipes are as follows:

Table 3.5 Tenmoku Glaze Recipe

Feldspar	43%
Flint	19%
China clay	15%
Whiting	13%
Iron oxide	10%
Total	100%

Source; Studio Glaze (2011)

Table 3.6 Off-White Glaze Recipe

Feldspar	40%
Wood Ash	40%
Rice Husk Ash	20%
Bentonite	200g
Total	300%

Source; Studio Glaze (2012)

Glazes were tested on the samples by dipping. The glazes used for this study have different characteristics. Glaze one (temoku) was water based with brown effects, while the second glaze (off-white) was also a water based glaze with a white glossy color effect as demonstrated in plate xxxiv below.





Plate XLIII Plate XLIV**Dipping of Tiles into Glaze Mix** **Researcher loading the Kiln**Ceramic Studio, Department of Industrial Design, ABU, Zaria





Plate XLVPlate XLVI

Repeated Glost Floral Tiles (Finished Production)
Ceramic Studio, Department of Industrial Design, ABU, Zaria



Plate XLVII
Repeated Glost Zane Tiles (Finished Production)
Ceramic Studio, Department of Industrial Design, ABU, Zaria



Plate XLVIII
Repeated Glost Dagi Tiles (Finished Production)
Ceramic Studio, Department of Industrial Design, ABU, Zaria

3.11.4 Studio Experimentation

The studio was where the study tested various clay bodies that could be used for the production of tiles so as to arrive at the result, findings and Analyses of the study. Several activities were carried out in the studio, these activities include the preparations of the clay slab, tracing on the slab, scooping/engraving and establishing a mold for the designs. The production of the mould was achieved using the plaster of Paris (P.O.P). The moulds were used to produce the desired designs from selected traditional Zaria wall decorative symbols.

3.12 DETERMINATION OF CRUSHING STRENGTH OF TILES

Compressive strength is the capacity of a material or structure to withstand load tending to reduce size. It can be measured by plotting applied force against deformation in a testing machine. Compressive strength of tiles is one of the most important and useful properties of tiles. It is a maximum load a material can carry before it fails. It's thus computed as P/A, where P is the force applied to the material or object to be crushed and A is the area of the material to be crushed.Ceramics typically have a much higher compressive strength than tensile strength. The calculation from the result of the test is highlighted below while table 3.6 and 3.7 explained the details of the calculation of the crushing strength at gloss temperature of 900-9500c.The process of the procedure is shown in plates xxxvi to xxxix.

3.12.1Calculation of Crushing Strength for the Unglazed Tiles

1. Area of Sample A (Abstracted Dagi) = 19720mm^2

   Failure load of A = 270000 N

   Crushing Strength = P/A

   = $\frac{27000\ N}{19720\ mm^2}$ = 13.69 N/mm^2

2. Area of Sample B (Zane Design) = 15360mm^2

Failure load of B = 258000N

Crushing Strength = P/A

$= \frac{258000\ N}{15360\ mm^2}$

= 16.80 N/mm^2

3. Area of Sample C (Floral Design) = 10000mm^2

Failure load of C = 200000N

Crushing Strength = P/A

$= \frac{200000\ N}{10000\ mm^2}$

= 20 N/mm^2

4. Area of Sample D (Dagi Design) = 16900mm^2

Failure load of D = 290000N

Crushing Strength = P/A

$= \frac{290000\ N}{16900\ mm^2}$

= 17.16 N/mm^2

5. Area for Sample E (Abstracted Geometric) 22500mm^2

Failure load of E = 258000N

Crushing strength = P/A

$= \frac{258000\ N}{22500\ mm^2}$

= 11.47 N/mm^2

Table 3.7 Calculation of crushing strength for the unglazed tiles

Sample	Area of sample (mm^2)	Failure load of sample (kN)	Crushing strength (N/mm^2)
A	19720	270	13.69
B	15360	258	16.80
C	1000	200	20.00
D	16900	290	17.16
E	22500	258	11.47

3.12.2Calculation for Crushing Strength of Glazed Tiles

1. Area of Sample A (Abstracted Dagi) = $17350mm^2$

   Failure load of A = 280 kN

   Crushing Strength = P/A

   = $\frac{280\,kN \times 1000}{17350\ mm^2}$

   = $16.14\ N/mm^2$

2. Area of Sample B (Zane Design) = $13664mm^2$

   Failure load of B = 277kN

   Crushing Strength = P/A

   = $\frac{277\,kN \times 1000}{13664\ mm^2}$

   = $20.27\ N/mm^2$

3. Area of Sample C (Floral Design) = $9025mm^2$

   Failure load of C = 277kN

   Crushing Strength = P/A

   = $\frac{277\,kN \times 1000}{9025\ mm^2}$

   = $30.69\ N/mm^2$

4. Area of Sample D (Dagi Design) = 15376mm^2

Failure load of D = 320kN

Crushing Strength = P/A

$= \frac{320\,kN \times 1000}{15376\ mm^2}$

= 20.81N/mm^2

5. Area for Sample E (Abstracted Geometric) 20125mm^2

Failure load of E = 320kN

Crushing strength = P/A

$= \frac{320\,kN \times 1000}{20125\ mm^2}$

= 15.9 N/mm^2

Where P stands for force and A for area

Table 3.8 Calculation of crushing strength for gloss fired tiles

Sample	Area of sample (mm^2)	Failure load of sample (kN)	Crushing strength (N/mm^2)
A	17350	280	16.14
B	13664	277	20.27
C	9025	277	30.69
D	15376	320	20.81
E	20125	320	15.90

3.12.3Process of Crushing Tiles





Plate XLIX

PlateL**Sample in Concrete crushing Machine (Sample ready for Crushing**

(Concrete Laboratory, Department of Civil Engineering ABU. Zaria.





Plate LI

Crushing in progress

Plate LII

Crushed Sample

CHAPTER FOUR

4.0 RESULT AND FINDINGS

As the research was into the adaptation of some selected motifs of Zaria wall decorative symbols for ceramic tile design and production were carried out, several experiments were also carried out on the materials. Clay bodies were developed to ascertain the possibilities of usinga particular body that can be best suitable for wall tile making. A number of findings were made in the course of the experiment.

4.1 CLAY TREATMENT

Ball clay was soaked, blunged with kaolin, sieved and poured into moulds for considerable thicknessof workable mass. It yielded a good result for the slab making because it was smooth and slightly plastic for effective spread and easy cutting of slab into the various sizes.Kneading went a long way to help eliminate air bubbles in the clay mass and also gavehomogenously mixed clay.

4.2 RESULT OF MOULD – MAKING

Mould making for the purposes of the Dagi, Zane, Floral, Floral butterfly and abstracted Dagi motifs were made with the plaster to water ratio of130:100. The moulds were then exposed to direct sunlight for about 3 to 5hours;this helped the mould to dry properly. The dried mould was thereafter used to perfectly produce many tiles within the shortest time as the proper materials for production were all explored. In its progressive report, the plaster of Paris had a good setting time and gave a thick strong mould that appear in a three dimensional form.Despitethe pressure

of manually pressing clay into the mould, it was able to withstand the pressure and produce as many as 50 tiles in 3 hours.

4.3 RESULT OF SLAB TEST

The process of Slab making for models was effectively executed. The slabs evenly spread were cut into various sizes, designed with selected motifs, engraved in depth and also in relief form of decoration for all the five models which then represent each motif concept in the course of transferring the traced motif onto the sized clay slab. After the decoration, the slabs were covered with polythene bags and the designed slab (model tiles) were often turned upside down and vis-visa at certain interval to prevent warpage and cracks.

4.4 RESULT OF CLAY BODY TEST

4.4.1 Plasticity Result

Six different clay bodies were tested while three were existing clay bodies. The tiles produced with some of the body gave good outcome at green, biscuit and gloss firing stages respectively without cracks or warpage.The result of clays (Bomo, Sharada) were found to be plastic enough for the study, they both revealed no signs of cracks on the ringed or coiled clay rather it remained smooth and plastic.This method was recommended by (Opoku 2004) which was earlier recommended also by Cardew. All the other bodies also showed good characteristics of plasticity.Clay body B4 became highly vitrified and stronger as a result of much calcium carbonate in its body composition; body B4 will be very good for floor tiles which carry more load than the wall tiles. Secondary clays also serve as plasticizer in the preparation of the tile body composition.

4.5 RESULT OF SHRINKAGE LEVELS

4.5.1 Firing Shrinkage

The wet and dry length was all measured respectively before subjecting them to firing.Firing signifies the end of any pottery or ceramic production process. (Chioma2010). The production process could either be terminated at the bisc fired stage (pottery) or at the glazed fired stage (ceramics). The firing process is the stage when molecular water is drawn out of a clay product by the process of heating or firing it to a certain temperature to make the ware hardened. The same slabs used for the dry shrinkage test were measured and then subjected to bisc firing of about 900 to 950°c and calculated according to Rhodes (1957) methods in (Stephen, 2006) and (Chioma, 2010).

$$\text{Firing shrinkage} = \frac{\text{Dry length} - \text{Fired length} \times 100}{\text{Dry length}}$$

4.6 RESULTS OF TESTS ON PRODUCTION TECHNIQUE

Two techniques were adopted for the production of wall tiles and each of the technique had effects on the production. These techniques were: (1) Slab method (2) pressing method.The slab method is the very first method used for starting the production process where all motifs were traced on a sized and cut out slab. The transfer of the five selected motif designs of the Zaria city wallsonto the plain slab using a tracing paper yielded a perfect result as it makes in-

depthdrawings of the designed motif and engraving them was faster and easier for the study. Aside cut out slab for the model designs, there was alsocut out slabswhich were used for production by pressing the slab into molds,but in this case the researcher had to fill in more slabs into themold to have a good and well featured replica of the initial design.While the pressing method of clay lumps into themouldgavea better and more reliableoutcome as a strong wall tile was achieved with one lump of clay been pressed into the mould, The differences in this two methods was that, in the pressing method, one lump of clay was able to produce a tile after being pressed into the mould and excess clay trimmed off a cutting wire made from fish line or twine. Whereas in the slab method, more than one slab is pressed into a mould to achieve a tile with very little clay being trimmed off. Both were quite interesting to explore but the lump press yielded better as it gives a thicker, stronger and durable tile of Adapted Zaria wall decorative motifs and symbols for ceramic modern tile designs.

4.7 RESULTS ON CRUSHED TILES

Five each, of the glazed tiles were tested using compressive machine at civil engineering laboratory A.B.U Zaria, observation was made and noted as seen below.

From table 3.7 all the tiles were tested and some showed high degree of tolerance against rupture. In other words, all the tiles were very strong, and could only break at the following pressure points: stated in table 3.9 below.

Table 3.9Calculation of crushing strength for gloss fired tiles

Sample	Area of sample (mm^2)	Failure load of sample (kN)	Crushing strength (N/mm^2)
A	17350	280	16.14

B	13664	277	20.27
C	9025	277	30.69
D	15376	320	20.81
E	20125	320	15.90

Summarily, from the above table it was noted that the tiles with larger areas had lower crushing strength. While the smaller and thicker tiles, showed a higher and better level of crushing strength. As seen in the above, Sample C has a smaller size of 9025mm2 with a higher crushing strength of 30.69 N/mm2.While the largest with an area of 20125mm2 had the lowest crushing strength of 15.90N/mm2.

4.8 FINDINGS

Based on the support of the research experiments carried out, the following observations were made:

1. The plaster to water ratio of 130:100 by(Sullayman, 1998) classroom lectures and Sullayman, (1991-2006) was found to be ideal for making moulds meant for wall tiles production.
2. The clay bodies generated as reference to the Department of Industrial Design Ceramic section (Studio clay) i.e. 50% clay and 50% kaolin, was used to produce some of the tiles. The tiles werefired both at biscuit and gloss level and the tiles came out strong withoutany cracks nor warpage.
3. Secondly, clay body (B1)of 75% secondary clay to 25 % primary clay (Kaolin), was also experimented upon and used to produce strong and durable tiles as well. Clay body B2 to B6 were also experimented clay bodies andwere used to produce the adapted Zaria wall decorative motifs for modern ceramic wall tiles and fired up to glossfiring temperature

range of 1260^{0}C. This body wasfoundsuitable for wall tiles while body B4 can as well be used in producing floor tiles because it became vitrifiedand glossy in nature. The vitrified and glossy nature helps keep off dust and dirt from the surface of the tiles, as this is a characteristic of tile.

Clay body B2– ball clay 20%, kaolin 30%, quarze 20%, feldspar 20%, calcium 10%. While, Clay body B3-- was a composition of 30% ball clay and Kaolin 30%,quarzewas 20%, feldspar 10%, and calcium measured 10%.

Clay body B4- was a combination of ball clay 20%, Kaolin 30%, quarze 15%, feldspar 20%, and calcium 15%.

Clay body B5, was ball clay15%,kaolin35%, quarze 20%,feldspar 20%,and calcium 10%.

While the clay body B6 comprises of clay25%, Kaolin 25%,quarze25%,feldspar20%,Calcium 50%.The whole six clay body was prepared separately in different containers, poured into moulds to allow proper drying and to obtain a workable clay lump. All prepared and tested bodies were found suitable for wall tile production.

1. The laboratory test on crushing strength of tiles produced showed that tile three on table 3.7 have a highermodulus of ruptureof degree of crushing strength so it's recommended more for wall tileseven thus all the tiles produced are strong and durable. Tile B3 exhibited more characteristics of durability and strongest.

The wall tiles produced in this study can serve the same purpose locally as the Zaria wall decoration found in Zaria city when fired and can also be used in our modern homes as it is opened for every interested individual to make the designs as desired.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECONMMENDATION

5.1 Introduction

This chapter highlights the summary, conclusion and recommendations based on the objectives, findings from the tests and design production conducted.Based on the limitation of this study, Adaptation of some selected Zaria wall motif for ceramic tile design and production using the pressing technique,this chapter however, includes the observations made on the basis of various experiments carried out in the course of the study towards the achievement of the purpose of the study

5.2 SUMMARY

In the production of the Zaria wall motif for ceramic tiles using the pressing and slab technique methods for casting and production, an initially pilot study was done after which a preliminary studies was made.Several sketches (documenting designs) of the Zaria wall decorative motifs were made to show the possibilities of using Zaria wall decorative motifs on ceramic tiles designs.Incorporating the motifs into designs can enhance aesthetically the decorative productions of ceramic tiles in the industries.

Raw materials for body formulation,mould making, models making, were tested to determine their suitability and reliability on the provisions of the available literatures and the pilot studies conducted. Production processes were also tested based on the usefulness of the bodies formulated under various applications. These were necessary to determine the suitability of various materials and techniques with a view of making necessary recommendations.

The raw materials used such as calcium, kaolin, feldspar and quartz, ball clay was practicable on merging both the traditional and modern technological Arts to help preserve our social cultural heritage

5.3 CONCLUSION

Obviously, tiles have been used all over the world in so many ways for aesthetic reasons e.g. in the bathroom, kitchens, toilets, sitting rooms, churches e.t.c. Tiles can evidently serve as a product of protection against the wall from daily activities that produce dirt's, as well as a medium for decoration and also used for collage and mosaic in terms of recycling waste. Generally, this study made conclusions on the use of traditional (symbols) motifs as a medium of interaction towards the actualization of using indigenous motifs of the Zaria wall motifs found in Zaria, Kaduna State of Nigeria, which is focused on the objective,i.e to show that modernizing our traditional art will help encourage our present generation to value and appreciate our fore-parents creative ideas. Furthermore the data collected in the adaptation of some selected motifs of Zaria wall decorative symbols for ceramic tile design and productions, was shown, that not all clay body compositions that can withstand the high degreetemperature of firing and are equally good for wall tiles. Also a success was achieved in getting a suitable clay body that couldwithstand hightemperature firing. Conclusively also, clay lump pressing is seen as more effective when it comes to producing tiles manually. It was also noted that the bigger the size of a glazed tile, the lower the crutching strength and the failure load of the tile. This is as a result of tile thickness with various variation of heat been subjected to during the process offiring; this also affected the crutching strength and failure load of the tiles.

5.4 SPECIFIC RECOMMENDATIONS

1. Ceramists or potters should create awareness on traditional design to the public on the use of traditional motif for ceramic tiles.
2. The ball milling machine in the Ceramics section; Department of Industrial Design A.B.U Zaria has been in use for the past sixty eight years.New ones should be brought to replace this old facility.
3. A working space (studio) should be provided for postgraduate students of various levels, for effective workability because it has been a great challenge on most researchers conducted in the section.
4. Working wheel should be provided for the ceramics section to enable students work effectively.
5. A show room should be created for ceramics section to show case ceramic students talents.

5.5 GENERAL RECOMMENDATIONS

1. Our traditional heritage should be encouraged in our teaching and learning from primary to tertiary education.
2. A community development workshop can be organized for the builders in Zaria city on the possibilities of making tiles using their design motifs, and later transfer such ceramic tiles on the wall with adhesivewith the involvement of many designers instead of one designer standing all day long under the sun inscribing the motifs directly to the walls of their buildings.

3. Consultations should be made on research works done in the Nigerian universities by the Government for better development of our nation.
4. More Nigerian local artifact products should be researched into so as to upgrade them for industrialization, as in the case of the Chinese that transform old traditional works into modernity. It is said that the Chinese are the only one still currently using their tradition onto modern style all over the world. Aljazeera news 17th February 2011
5. Cultural bodies' like the centre for Art and Culture should endeavour to bring to lime light Nigerian cultural motifs on ceramic tiles for international recognition.
6. More documentation should be made on all motif found in Nigeria, for easy adaptation onto other ceramic tiles design.
7. Nigeria indigenous motifs can be internationalized.
8. Designers generally should be encouraged to work towards the upliftment of Nigeria indigenous designs in today's and the future designs

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APPENDIX 1

INTERVIEW CONDUCTED AT ZARIA CITY WITH SARKIN MAGINA (HEAD OF BUILDERS)

Interviewer - AssalamunAlaiku

Transcribe - Peace be unto you

Respondent - Amin,Wa'alaikumun Salam

Transcribe - Amen, and peace unto you too

Interviewer - SunanaMallamaRakiya Mohammed Sani dagajamiaharAhmadu Bello nan Zaria.

Transcribe - My name is Madam RakiyaMoh'd Sani from Ahmadu Bello University Zaria.

Respondent - Sanu da zuwa

Transcribe - Welcome

Interviewer - Nagode, Dalilinzuwawajen ka shine, Inna so in yimaka wasutambayoyi game da zannenjikin bongo.

Transcribe - Thank you, my reason for coming to you is that, I will like to ask you a fewquestions concerning the design on the walls.

Respondent – To, Allah yasa mu daje.

Transcribe – Okay,May God help us

Interviewer - Menenesunankamallam

Transcribe - What is your name sir

Respondent – Sunana MallamJafaruGarba

Transcribe - My name is MrJafaruGarba

Interviewer – MenenematsayinkaananGarin game da masuzanen bongo?

Transcribe - What is your position in this town concerning wall decorators.

Respondent – Nine SarkinmaginaananGarin

Transcribe - I am the king of builders in this town

Interviewer - Amatsayinkanasarkinmaginamenenezakaiyafadimin game da zaneko adonjikin bongo

Transcribe - In respect of your position, as the king of builders, what can you tell me about the drawings or designs made on the walls

Respondent – Wadannazanen da kukegani,asalinsudagaturkiya ne. Wanimaisuna baban gwani neyazodagaturkuya da wada nan zane. Amman,kafinzuwanBabbangwani,akwaizane.

Transcribe - These design you are seeing, originated from turkey. Somebody popularly known as BabanGwani (Abdulmaleeq) came from turkey with the designs. But before the coming of Babbangwani, we have our kinds of design.

Interviewer - Waceirinzanekukedasutunasali.

Transcribe - What type of designs do you people have originally.

Respondent - Muna da zane da kumaadonwandadaakanyiajikinbongo,kamar kwaliya da zanekokumaginar da zane a cikinginin.

Transcribe - We have designs that are made on walls (decorations) or built into the wall.

Interviewer - Wadananzanen da kakebatunsu, suna da watamahimanci a tsacinadinni, siyasa,rayuwakantakokumaharkar kasuwanci.

Transcribe - These design you are talking about, do they have any religious, political, social or economic significance?

Respondent - Ai,to,akwai. Kin san nafarko,musulinciyaharamtazanensufanmutun kodabbah, A kasuwance, munasana'a da shi. Harkasarwajezanennaazuwa.Kinga,bandazanen bongo akwai shi a adonkwarya,surfani a riguna, huluna,takalma,jakakuna,kayan fata da robobi da sauranmakamaninsu.Asiyasancekumazancedankone.tambari ne nadukan Arewa.

Transcribe - Yes there is. Firstly, Islam prohibits human or animal (figure) drawings.

Economically these designs serve as source of income. These designs have gone as far as across the border. They are made on wears (regalia), bags, shoes, caps, plastics, leatherworks, calabashes etc. politically, these designs are binding tag for the northerners.

Interviewer - Itawannanzane, akwaiwandaakayimusumusamman ne. kokumaduk

wandake so, zaiiya yin su.

Transcribe - These designs, are they made for any particular kind of people or anybody

willing to have the designs.

Respondent – Adda,anawaattajirai,yansarauta da kumasaburwama'aurata.

Dukwandazayiaure a kangyaramasudakuna da waddananzane a zaman ado da kwalliyangida.Amman a yaudukwandayana da halizaiiyabadaayimaizane a gidansa

Transcribe – Formerly, the design is made for the wealthiest, royal lineages and newly

Married couple. For the newly wedded, their homes are always decorated with different types of motifs and symbols. Sometimes painted, engraved or built as reliefonto the wall. But today, any individual that is interested and have the financial capability is free to do the design.

Interviewer — Ni kuma da nake son in yiadonan kanshimfidan bongo nazamani,a

ganinka yadace,kumayayakakeganinkarbuwarsazaikasance a wajen al' umarArewa?

Transcribe — I have the interest of making these designs on wall tiles,what do you think,is it proper,and how will the Northerners see this new development.

Respondent - Akika,wannantunaninna da kyau.yan Arewazasu so wannansabuwar cigaba.

Transcribe - Quiet okay, this idea is good. The Northerners will like this new development.

Interviewer - MallamJafar,nagodekwarai da gaske da wadananamsocin da kabani game da tambaiyoyi na.

Transcribe — MallamJafar,thank you so much for all answers given to my questions. I appreciate.

APPENDIX II

PICTURES OF THE ZARIA WALL DECORATIVE MOTIF, ZARIA CITY



Plate LIII
Clay ceiling design in Zaria City (2010)
Photographed by: Moh'd Rakiya Sani



Plate LIV
Wooden Ceiling design in Zaria City (2010)
Photographed by: Moh'd Rakiya Sani



Plate LV
Zane Design engraved in the interior of
Mal. Jafaru's House in Zaria City (2010)
Photographed by: Moh'd Rakiya Sani



PlateLVI
An entrance into a main building with floral design
Photographed by: Moh'd Rakiya Sani



Plate LVII

An Engraved Wall Dagi Motif Alh. Jafaar's Brothers Sitting room



Plate LVIII

Engraved design in the interior



Plate LIX

Mud ceiling found in Mal. Isa's sitting room

Photographed by: Moh'd Rakiya Sani



Plate LXWall design from a Church in Turkey

Retrieved from Saudi Aramco (2011)

Photographed by: Moh'd Rakiya Sani

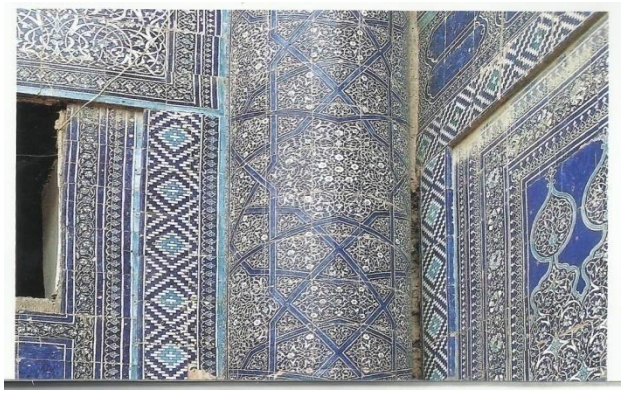


Plate LXIWall Design

Retrieved from Saudi Aramco (2011)

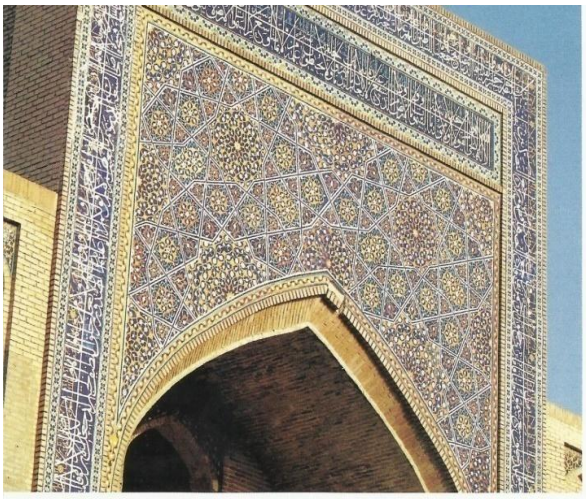


Plate LXII

Wall Design

Retrieved from Saudi Arabia (2011)

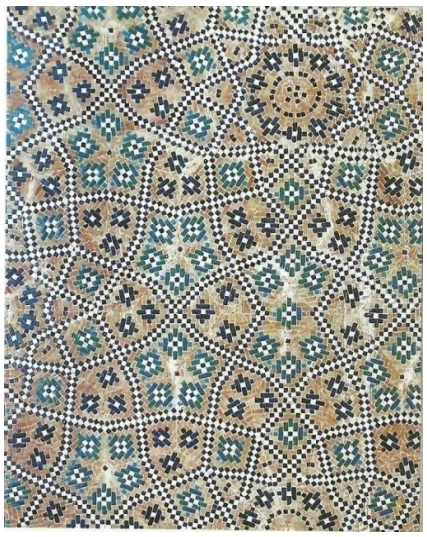


Plate LXIII

Wall design

Retrieved from Saudi Aramco (2011)

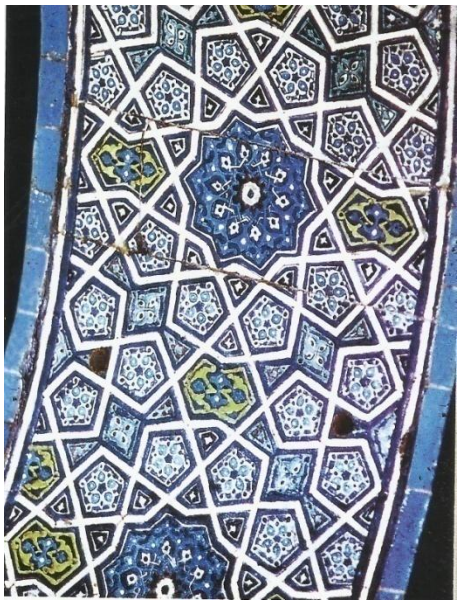


Plate LXIV

Wall design

Retrieved from Saudi Aramco (2011)

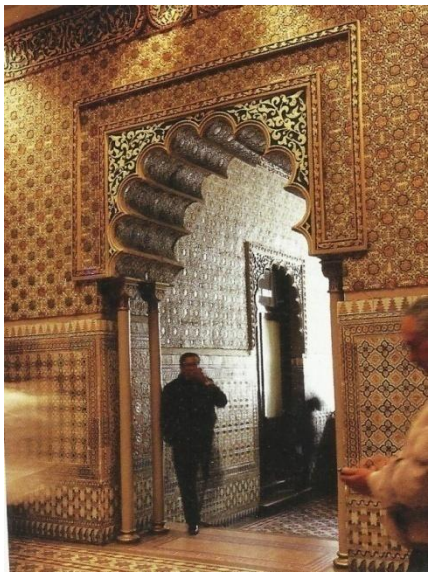


Plate LXV

Wall design

Retrieved from Saudi Aramco (2011)



Plate LXVI

Pouring of plaster of Paris onto the model by the researcher



Plate LXVII

Spreading out of the plaster of Paris evenly on a model. (Photographed by Bashir Umar, 2010)



Plate LXVIII

Engraving of a traced floral geometric motif by the researcher



Plate LXIX

Engraving and designing in progress



Plate LXX

Finished glost Zane motif



Plate LXXI
Finished glost Dagi motif



Plate LXXII

Finished glost floral motif



Plate LXXIII

Glost Dagi motif



Plate LXXIV

The researcher in the sitting room of the granddaughter of the emir of Zaria.

Emirs compound. Zaria city. (2010).



Plate LXXV

Entrance to the Magina's house (AlhajiJa'afaruGarba) Zaria city.(2011).



Plate LXXVI

A traditional and contemporary ceiling design, Zaria city

Photographed by Rakiya Muhammad. (2011).



Plate LXVII

A newly engraved design, Zaria city.

Photographed by Rakiya Mohammed. (2011).



Plate LXXII
Working on Design models (Ceramics Section 2009)



Plate LXXIII
Researcher and Assistant preparing Plaster of Paris (Ceramics Section 2009)

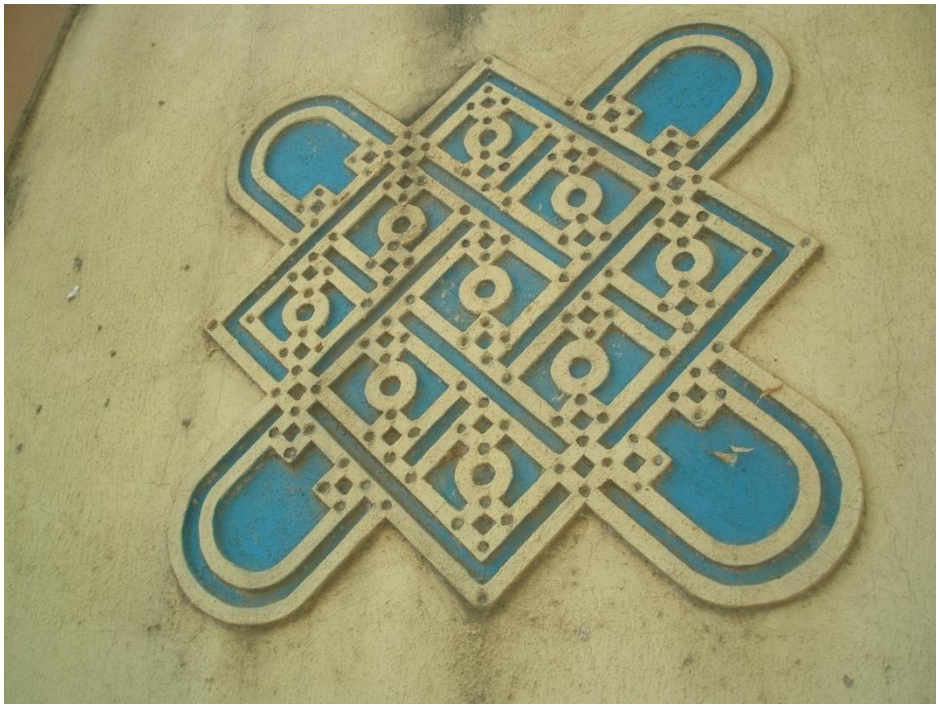
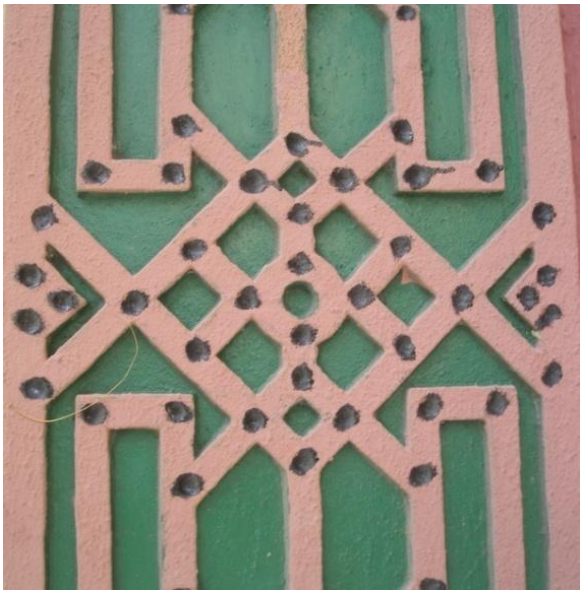


Plate LXXV
Modified Dagi Motif (Emir of Kano Guest House)



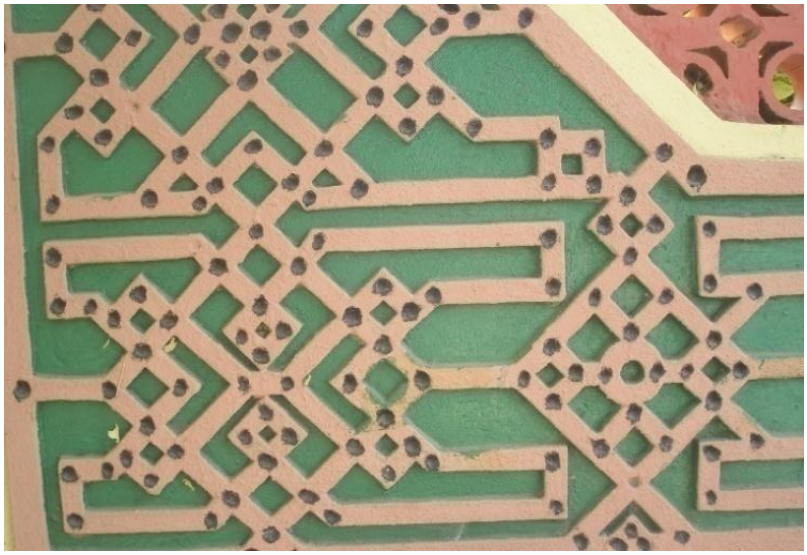


Plate LXXVI
Modified Dagi Motifs 2 (Emir of Kano Guest House)

File: KANKARAC.DI 19-Apr-2002 10:

a3 PC-APD, Diffraction softwa

Angle [°2θ]	d-value α1 [Å]	d-value α2 [Å]	Peak width [°2θ]	Peak int [counts]	Back. int [counts]	Rel. int [%]	Signif
38.005	2.3657	2.3715	0.200	320	67	1.4	1.5
38.710	2.3242	2.3300	0.320	676	66	2.9	6.8
39.555	2.2765	2.2821	0.120	369	64	1.6	1.6
41.460	2.1762	2.1816	0.240	76	66	0.3	0.9
42.780	2.1120	2.1173	0.280	56	62	0.2	1.5
45.590	1.9882	1.9931	0.400	237	69	1.0	3.5
47.085	1.9285	1.9332	0.320	76	76	0.3	1.0
50.375	1.8099	1.8144	0.060	114	66	0.5	1.0
51.295	1.7796	1.7840	0.400	135	59	0.6	3.1
55.245	1.6614	1.6655	0.480	253	58	1.1	3.3
57.095	1.6118	1.6159	0.200	130	56	0.6	1.0
58.610	1.5737	1.5777	0.800	37	55	0.2	0.9
60.205	1.5358	1.5396	0.120	139	53	0.6	0.8
62.570	1.4833	1.4870	0.320	392	52	1.7	7.2
64.170	1.4501	1.4537	0.480	77	50	0.3	2.1