THE EFFECT OF RAIN AND WIND ON BUILDING STRUCTURES.

(A CASE STUDY OF KONTAGORA TOWN).

BY

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DEDICATION

This thesis is dedicated to my Parents, Wives and Children. Whose prayers guide me through the rigours of this programme, I love you all, May Allah Blessed you with Aljanah Firdausiya, Amin.

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CHAPTER ONE

INTRODUCTION

Nigeria lies between Longitude 30° and 15° East of Greenwich, and between Latitude 4° and 14° north of the equator. It is surrounded by French speaking West African Countries except in the South, where it is boarded by the Atlantic Ocean. The elongated Territory of Benin Republic lies to the west, the Niger Republic to the North and the Sub-equatorial Cameroon to the east.

Nigeria is located at the heart of the trade belt with "Summer" rains and winter drought. The countries position in relation to the land and sea around it makes it face in two directions towards the land in the North and Seawards in the South. This factor has a great influence on Nigeria's climate.

Nigeria enjoys a tropical climate with distinct wet and dry seasons. There is, how ever a steady decreases from the coast towards the hinterland. In the duration and intensity of the wet season. The wet and dry seasons are associated respectively with westerly monsoon from the Atlantic Ocean and the dry continental North easterly harmattan from the Sahara Desert. Rainy seasons last for about four and half month (March to November) in the North, for example and nine months (mid may to September) in the south.

Building have always had as one of their functions, that of protection and materials were selected according to the kind of protection required of it. Traditionally, again prot0ection was mainly against external elements of climates, rain, sun, wind, temperature

and humidity which had to be controlled in some degree, because of the adverse effect these climatic elements (i.e rain) played on most of our buildings in the country. However, since the form and construction of a building is dependent upon climate more than upon any other design factor. Thus it is the climate of an area together with the geological formation of that area, that controls the availability and type of building finishes, while the climate itself determine the degree and type of shelter required so as to have building that may last for along period of time with little or no effect of climatic change or rain on them.

Climatic element such as rain in Nigeria plays a major role in causing most of the building failures, this had been experienced over the past years which arises due to either bad design or the use of improper buildings materials for example, penetration of rain, wind or combination of rain and wind to find a way through a roof covering, which causes the final breakdown following a long period of slow deterioration. This could be seen as the roof is being ripped off, where light weight coverings and low pitched roofs are particularly prone. Instances have been recorded in the country of complete aluminum roofs being lifted off from the buildings and carried some distance in strong winds. Gradual deterioration brought about in all materials by the weather is the cause. which depends on the nature of the roofing materials. For example, sun light has an adverse effect on anything containing oils and therefore, leads to a breakdown of bituminous roofings.

The sun's heat causes significant thermal movement in metals and plastics leading to fatigue and eventual rupture wind can carry with it dust particles which will erode materials

subject to severe exposure. Rain can bring about the desalination of slates and tiles. Salts brought down from a polluted atmosphere by the rain change to weak acids and gradually corrode or dissolve a range of roof coverings.

To provide complete protection to the building it must be arranged not only that the roofing reflects there in from the interior but that deflected rain is safely collected and harmlessly disposed of. The equality of rain water to be handed is the product of the rain storm. Therefore, the use of gutter and down-pipes must significantly withstand the most severe conditions to be anticipated. However, the adverse effects, theses elements had on most of our buildings as a result of which, causes building failures, includes: moisture, condensation, dampness, mould growth, water penetration, frost damage, spelling, heave, thermal, moisture, structural movement. Occasional, structural collapse etc. should be looked into and possible measures taken by improving the building finishes; so as to withstand any prevailing climatic conditions in order to have buildings which could be suitable for inhabitants use for a long period with little or no maintenance.

1:1 AIMS AND OBJECTIVES

This dissertation is aimed at studying the effect of Rainfall and Wind on structures or buildings in Kontagora Town. So as to serve a long period with little or no maintenance.

1:2 OBJECTIVES

(1) To understand the working system of the climatic elements such as rain and wind and their effect on building structures.

(2) Analysis of all the elements of climate including rainfall, sunshine, temperature, wind pressure etc.

(3) To identify the effect of Wind force and Rain fall on the external face of the building that causes breakdown of plaster and paint finishes.

(4) To identify the problems of Wind on account of the structural load they impose on the structural finishes that causes failure in structures.

(5) And to recommend the best finishes suitable for the case study area (i.e Kontagora).

1:3 SCOPE OF STUDY AND LIMITATIONS.

For the purpose of this dissertation the scope of study will be limited to the prevailing climatic conditions and the adverse effects they had on building finishes of Kontagora in the Northern part of the country. To be specific the study will mainly concentrate on the effect of rain and wind on building structures.

CHAPTER TWO.

2:0 STUDY AREA

2:1 HISTORICAL BACKGROUND OF STUDY AREA

Kontagora Local Government is among the first seven local government created in Niger State on 3rd February, 1976 by Murtala Ramat Mohammed Regime.

Location:

Kontagora is located in mid-western part of the land area that make up Niger State along Lagos - Kano highway leading to Zuru (121 km) and Sokoto (430 km).

Administrative Area:

At the creation of the Local Government Area Kontagora formally comprises of up Kontagora district Wushishi, Kotonkoro, Kumbashi, Mashagu and Zungero districts. It has the largest land mass area in the whole local government area in the state, before the creation of additional local government in 1991 and 1996 in which Wushishi, Mashegu and Mariga Local Government Area emerge. The local government council has elected Chairman, Secretary and 10 elected Councilors from 10 wards in local government areas.

Climate:

Kontagora local government experience hot and humid weather conditions in the dry season and heavy rainfall of six or more month. The hottest month in the year are March

and April. The mean daily maximum temperature of 32°C for most of the year. There is fall of temperature in the month of July - September.

Population:

According to 1991 census result Kontagora local government has population of 106,358 people.

The People:- Kontagora Local Government comprises of people from different Nigeria tribes. There are however Kambari, and Basewa but majority are Torroukwa immigrant from Sokoto, the people are friendly.

Humidity and Temperature:

The duration of sunshine per day with solar radiation intensity are two important parameters that determine the drying power of the ambient air under low recapture Humidity Values. (A. O. Ogunrinde 1999)

Niger State enjoys high sunshine hours of 8 - 9 hours per day in November. Hence daytime lengths are constant at about 8.5 hours or more for most of the dry season. The high evaporative power of between 16 and 20 milliliters of water in November also suggests a very high drying power. Extreme dryness is usually associated with values than 20ml when Relative Humidity (RH) is 40% or less (A.O Ogunrinde 1999).

Geology and Hydrology:

Three principal rock units generally under lie Niger State as follows;

(1) Crystalline Basement Complex

(2) Cetaceans Sediments

(3) Alluvial Deposits

The above rock units have different characteristics and water bearing potentials as will be discussed in the following:-

Crystalline Basement Complex:

About 60% of Niger State is under lain by crystalline basement complex rocks which are believed to be of pre-Cambrian age. The basement complex rocks occur in the northern and southern parts of the state in Chanchaga, Shiroro, Muyan, Paikoro, Suleja, Gurara, Bosso, Kontagora, which is the area of our concerned and some parts of Lapai, Magama Rijau and Mariga Local Government Areas ((A. O. Ogunrinde 1999).

Groundwater occurs under confined semi confined and unconfined conditions as drill log and pump testing in various parts of the formation have shown (Green field, 1998).

Estimation of Annual Rainfall During the Wet and Dry Season:

Rain fall during the wet and dry season implied rain fall sub-total for dry and wet were taken to be November to March (Five Months) while wet months are April to October (Seven Month).

The percentage contribution to total annual rainfall in Niger State in which Kontagora is part as depicted by the stations for the months of April to October (rainy season) and November to March (dry season) for each year and their long term mean for the stations were estimated. This is based on recent findings by Adefolalu (1993b) and Adeyemi et al (1991) which show that 80% or more of mean annual rainfall in Niger State is received

between (April - October) as an example was calculated. Using a graph in figure A and B attached (A. O. Ogunrinde 1999).

Rain Onset:

The onset of the rain for each year and the long term mean on set of the rains for the stations were estimated. The map of mean onset data of rains for Niger State was drawn using these long term mean values.

As earlier stated parameters is one of the parameters used to classify the state into climatological classes (mean onset date of rains o) the following classes as earlier used by Adefolalu (1983s and Adeyemi et al, 1991) were employed and the resulting climatic classification map is as follows:-

Class (i) Earliest Before April 10th

Class (ii) Early April 10th to April 30th

Class (iii) Late April 30th to May 10th

Class (iv) Latest After May 10th

(A. O. Ogunrinde, 1999)

Mean Annual Rainfall:

The Northern part of the State which includes the study areas and some other related areas local government closed to the study areas has the annual rainfall (mean) of less than 1000mm. In the Northern part of the state to be specific.

In the same study area it is recorded that about half of the Niger State, especially

some areas next to the Northern zone receives between 1000mm and 1200mm of mean annual rainfall. Thus covers Kontagora which is our study area and Lemu, Katcha, Bida, Agaie, Lapai and Mashegu, west of Borgu, North of Magama, South of Rijau, Western halft of Wushishi and Mokwa etc.

In summary therefore, the area of study is one of the areas that recorded the annual mean rainfall between the months of April 10th and April 30th. This is in all or some part of Kontagora in Niger State.

CHAPTER THREE.

3:1 LITERATURE REVIEW.

3:1:1 STRUCTURAL CONDITIONS OF HOUSES WITHIN NIGERIA METROPOLIS.

There are numerous existing housing stock within Northern metropolis. The number of houses almost represent 100% of the whole settlement. A physical survey on housing structural conditions was conducted to complement other survey and to determine the structural conditions of fall a the existing buildings.

Housing provision in this country varies from one place to another due to the difference in culture climate and socio economic characteristics of the population. Some of the houses within most of the northern metropolitan towns and old local government head quarters and old towns and cities like Kontagora. Some were structurally stable and can withstand prevailing climatic conditions, because most of the houses within most of the areas were constructed of the modern typed. Though, houses within Kontagora vary due to differences in ethnicity of the inhabitant and Kontagora being a rapidly growing town with people from all works of life some of the houses built are of the traditional local mud building.

However, almost all different types of houses could be identified within Kontagora town and environs. Traditional type of houses represent about 50.8% of the total sample of houses and is the predominant house type within the town. Modern accounts for 36.9% detached houses 5.2% semi detached 4.2% while composite house type represent only 3.1%. This is shown below.

TYPE	% OF TOTAL TYPE
Traditional	50.8
Modern	31.9
Composite	3.1
Detached	5.2
Semi Detached	4.2
TOTAL	**100%**

Source Unpublished Thesis (Ahmed A. B. 1990)

3:2 BUILDING MATERIALS USED FOR CONSTRUCTION WITHIN NORTHERN METROPOLITAN TOWN.

Generally, four categories were identified, as the most widely used finishing materials used for structural (Building) constructions. The sample survey shows that about

50.5% of the houses at Kontagora, Minna, Kaduna, Kano and other cities, for examples, were built or constructed with mud, covered with corrugated zinc roofing sheets (source). Though, buildings along the modern areas such GRA in Kaduna, Minna and Kano and some part of Kontagora town were mostly constructed of the hollow sandcrete block, while the rest of the building were constructed of bricks or concrete (emphasis mine).

3:3 CLASSES OF BUILDING FINISHES MATERIALS USED FOR CONSTRUCTION WITHIN NORTHERN METROPOLITAN TOWNS.

Most of the houses survey around Kaduna, Minna, Kano and other cities revealed that they were constructed of the 1st class type of building finishes material which is made up of the following:-

Plastered Walls Comprises of different type of plaster finishes such as the ordinary plastering which is employed to most of the buildings around those areas for costing the internal premises and fronts of these buildings. This type of plaster finish could be seen to consists of a single or many layers. A single layer plaster, of up to 10mm thick, is applied in one operation upon flat brick, concrete or block walls of these buildings to prevent the rains falling directly in penetrating into the building fabric. (Arch I Buna 1989)

Some of the buildings observed to have decorative plaster finish which is employed to face fronts and interiors of most of the public buildings in most of our areas of GRA and modern settings purposely for architectural and decorative requirements. This type of plaster work which consists of a render coat, one or more floating coats, and one or several setting

coats is applied to provide a desired ornamental effect. (Arch I Bunu 1989)

To prevent the adverse effect of climate elements causing building failures, buildings at these areas are also being plastered with the special type of plaster finish intended for protecting the building fabric. Such special plasters comprising the building of damp proofing, sound absorption were applied to the surfaces of these building.

Damp proofing plaster which is made of ordinary cement said mortar of a composition 1:2 or 1:3 is mainly meant to applied on the surfaces of these building in order to prevent or protect the surfaces against the dampness caused by rainfall. However, sound absorption plaster up to 25mm thick, made by ordinary spraying of a cement sand mortar is applied to most of the buildings located at these areas to prevent the majority of the buildings at Kontagora for example were observed to be constructed of concrete swish or mud building finishes which have certain parts fallen, because of the rains falling directly on their surfaces. Though some of these buildings have their walls being plastered with either ordinary, decorative or the special type of plaster finish in order to prevent the fabric from effect of the climatic elements (N. El - Rufai, 1999).

Roofing materials of either aluminum or the corrugated zinc roofing sheets is used as covering material in most of the buildings in those areas, though most of the roofs were observed to have been seriously affected by climatic elements such as rainfall directly falling on them combined with the effect of isolation and temperature action that causes the roofing

materials to stained consequently resulted to heisting the amount of sound experienced in that from causing cracks of the wall finish.

Foundations of most of the buildings in that area in made up of concrete some of which are reinforced, so as to keep the building structure stable from the effect of wind. Majority of the buildings have aluminum, iron or asbestos roofing finishes materials, which is built of the following materials, roll roofing (ruberiod, asphalt felt, roofing felt, hydroizal, bitumen - polymer material, matalloizol), piece a materials based on asbestos cement or ceramics (asbestos cement commutated sheets, tiles, roof tiles), metallic roofing (roofing steel), wooden roofing (shingles, wood chips, this planks) roofs of these buildings protect the buildings against atmospheric precipitations, temperature action, insolation and other environmental climatic elements (A. B. Bashir, 1989).

However, most of the buildings have their roofs being seriously affected by rainfalls, as it could be been that the roofing materials were being stained as such, there ;is a need for sheradizing or galvanizing of the roofing materials.

3:4 TRADITIONAL BUILDING FINISHES IN SOME NORTHERN TOWNS.

Traditional buildings finishes in Nigeria however, shares two characteristics. It is constructed of locally available raw materials and it has limited durability, such that it requires frequent maintenance and replacement. Kontagora town is not an exception in this case. Some of the buildings were made up of the thatch green grass or palm leaves which is

the most common roofing materials, and in some cases it was brought so close to the ground so as to remove the need for any other wall. This was very serviceable protection for both rain and heat but required repair or replacement at intervals of about three to five years.

The tall and strong stems of sorghum are useful in traditional buildings. They may be used to reinforce thatching and are also woven into mats which are placed vertically and are widely used as a shelter round a compound instead of a wall, as a partition or as a temporary fence.

Buildings of thatch timber and unbacked clay require constant maintenance and frequent rebuilding. In the long run, the preservation of such buildings rather than their replacement presents considerable difficulty rather than conserving existing structures.

3:6 MODERN BUILDING FINISHES IN THE STUDY AREA.

Modern buildings finishes in Kontagora like any other place, shares two characteristics, it is constructed of sand concrete block or brick, and plastered with either ordinary, decorative or special type of plaster finish and its durability is unlimited, such that it does not need frequent maintenance and replacement for many years from the adverse effect of climatic elements such as rainfall, humidity, insolation and temperature action.

Most of the roofings of these modern buildings were constructed of the modern roofing materials made up of aluminum, iron or asbestos, that can withstand as a protection for both rain and heat and does require repair or replacement for many years.

Doors and windows of the majority of the modern buildings within the study area i.e Kontagora were glazed with various types of glazing materials. Wall finished were made up of stucco terrasite plaster finish mainly for protection and for architectural requirements.

3:7 SEASONS AND CLIMATIC REGIONS OF NIGERIA.

Nigeria enjoy a tropical climate with distinct wet and dry seasons. There is how ever a steady decrease from the coast towards the hinterland in the duration and intensity of the wet season.

The wet and dry seasons are associated with the prevalence of the moist maritime south westerly moon soon from north easterly harmattan from the Sahara Desert respectively. Climatic regions of Nigeria falls under four needing which includes the following sub equatorial south, tropical hinter lands high plateaux and the tropical continental north as shown the map below:-

Fig. 3.1:MAP NIGERIA SHOWING SEASONS AND CLIMATIC REGIONS OF THE COUNTRY.

3:8 FACTORS AFFECTING CLIMATE

The factors affecting climate that causes building failures arises due to the following conditions. Moisture condensation, dampness, would growth, water penetration frost damage spelling leaves thermal moisture, structural collapse wind. These conditions have adverse effect on most buildings that lead to deterioration of materials and even directly affect the structure which causes structural failure at the long run.

3:9 SPECIAL PLASTERS.

Special plasters are intended for protecting structures, promises and reservoirs against attack by external media, the most frequent varieties being damp proofing, sound - absorption and X - ray protection plasters.

3:9:1 DAMP PROOFING PLASTERS.

Is made of ordinary cement - sand mortar of a composition 1:2 or 1:3, which is applied on the damproofed surface by a cement gun (guniting), or of a cement - sand mortar with binder additives (soluble glass, ceresite, sodium aluminate, bitumen and latex emulsions and others).

3:9:2 SOUND ABSORPTION PLASTER.

Up to 25mm thick is made by ordinary spraying of a cement - sand mortar. The aggregate for the mortar is pumice, slag (cinder) or other varieties of lightweight sand with grains up to 5mm across.

3:9:3 X - RAY PROTECTION PLASTER

Is a substitute for a costly lead protective coat and is made with a barite aggregate. Barite (heavy spar) is required to carry not less than 85% barium sulfate.

3:9:4 ACID - RESISTANT PLASTER

Is employed for finishing premises of chemical plants. The resistance of the plaster to attack by various agents is obtained through the use of an acid - resistant cement binder

and ground quartzite aggregate.

3:10 FACING WORK

Facing is the most durable and decorative kind of finishing for buildings and installations. Facing is intended for: protecting buildings and installations against attack by atmospheric precipitations, water, acids, alkalis, gases and others, and thus it performs a technical (engineering) function; keeping faced surfaces clean, a sanitary and hygienic function; making surfaces attractive in appearance (single colour, mult colour, pattered, ornament, etc) - a decorative function.

Facing may be internal or external. Facing is applied to outside of basement walls, fronts of buildings, in kitchens, toilet, bath and laundry facilities, public catering enterprises, commercial enterprises, chemical plants, operating rooms of hospitals and clinics, under - ground pedestrian crossings, underground railway stations and others.

3:10:1 MATERIALS FOR FACING WORK.

Facing work is performed with such material as slab and tiles of natural stone, ceramic, glass, cement - sand, polymer coat cement - sand tiles, as bestos cement tiles, polystyrene and aminoplast tiles, wood chip and wood fibre slabs or panels, paper and wood - laminate plastics, glass - fibre plastic and other materials.

Slabs of natural stone (marble, granite sand - stone, limestone and others) are employed mainly for external facing. They may be sawn in thickness of, 50 - 60mm and hewn to thickness of 100 - 150mm.

3:10:2 PREPARING SURFACES FOR FACING.

Prior to facing, surfaces are cleaned of grease and bitumen stains, dust and dirt, sagged mortar, etc. When tiles are set in mortar, surfaces involved are scratched to produce a "ribbed" bed. Irregularities more than 15mm deep and overall deviations from the vertical of more than 15mm are levelled with a cement - sand mortar. Rough surfaces should be plastered with render and floating coast only. The floating coat is smoothed and scratched.

Where tiles are glued with mastic, surfaces being faced should present no irregularities and deviations from the vertical exceeding the thickness of the mastic coat.

3:10:3 FACING OF INTERIOR SURFACES

Ceramic glazed tiles are set on a cement - sand mortar. The thickness of the mortar coat should not be less than 7mm and not more than 15mm. The prepared surface is wetted with water prior to facing. Walls may be faced using lines or templates.

Facing to lines is performed in the following manner. The top and the bottom boundaries of the facing are established, then horizontal and vertical courses are marked. The condition of the surface is checked, and grounds are placed at the facing corners at a distance from wall corners equal to one width of tile or angel - shaped item. Facing is conducted from bottom upwards in horizontal courses. Lateral (extreme) tiles are set first, in each course. A horizontal line is stretched over these tiles (ground being employed for the top and the bottom courses) to ensure that tiles courses remain horizontal and tiles are placed in the same plane.

3:11 PAINTING.

Painting in buildings and structure is a finishing operation intended for protective, sanitary, hygienic and decorative purposes.

In its protective function, painting safeguards structures against attack by surrounding media (moisturing, attack by acids, alkalis e.t.c). In some instances, paints are also required to be air and gaslight. By the kind of painting compositions (colours, paints), painting may fall into lime, glue, casein, silicate, emulsion, oil, enamel and other varieties. By degree of complication and quality, painting may be plain, improved and extra quality. Plain painting is employed for finishing some industrial buildings, auxiliary, storage and other ancillary premises; improved painting - for residential, public and industrial buildings; extra - quality - for finishing large public buildings (clubs, palaces, theaters, stations administrative buildings and others).

3:11:1 PAINTING MATERIALS.

Painting is done with the use of puttying paster, filling colours, primers, painting compositions are binders (film - forming substances), pigments, extenders, solvents and various additives (emulsifiers, stabilizers, plasticizers, siccatives, antiseptics e.t.c).

Binders for water compositions are lime, cement, soluble glass, animal glue, vegetable glue, artificial glue and water - soluble emulsions of polymer resins.

Binders for non - water compositions are natural, Semi - natural and artificial or synthetic drying oil and also of polymer resins.

3:11:2 PREPARING SURFACES FOR PAINTING.

Preparation and painting of various surfaces consist of successively performed processes and operations which generally comprises. Smooth the surfaces, cutting out the cracks, cutting out the knots and recessions Spots, cleaning, puttying, filling (stopping), grinding, priming and painting the surfaces. The required operations and priority depend on the dinned of surfaces involved the type and the quality of required finishes.

Prior to painting, surfaces should be dried. The moisture content of plaster and concrete should not be higher than 8%, and that of wood structures to be 12% except for surfaces to be painted with lime which may carry a greater amount of moisture.

3:11:3 INTERNAL PAINTING.

Depending on the height of premises or kind of work to be performed, operations are performed from floors, ladders, painting tables or scaffolding.

3:11:4 LIME WHITE PAINTING.

Is the cheapest and poorest kind of finishing only alkali - resistant pigments are suitable for lime water compositions.

3:11:5 GLUE PAINTING.

Is a common kind of internal finishing Glue water colours are mixed first with water only, and glue is added after a required colour has been obtained. Water colours are applied upon surfaces with a brush, a felt roller or a paint blower.

3:11:6 CASEIN PAINTS.

Are the most durable ones of water colours, but they admit of akli - resistant pigments only, thus restricting their colour range. Casein paints should not be used for kitchens equipped with gas cookers, as gas combustion products cause their rapid deterioration.

3:11:7 SILICATE PAINTS

Similarly to casein ones, can be prepared with alkali - resistant pigments only and are unsuitable for kitchen fired with gas cookers.

3:11:8 WATER EMULSION PAINTS

Find an ever greater application in painting work. They are diluted with water to working consistency and are intended for coating ceilings and walls. Films the emulsion paints form are air - light, elastic and washable. They are not suitable for window openings, doors, plastic item and surfaces primed with Vitriol compounds.

3:11:9 OIL, ENAMEL PAINTS (AND OTHER NO - WATER COMPOSITIONS)

Are employed for painting wood, plaster work, concrete, metal and other surfaces. These paints form a strong, plastic and air - light film which is resistant to repeated moisturing and washable. The paints are applied upon a primed (dry colour), surface by brushes, rollers or spray guns in two or more coats.

3:12 FLOOR FINISHES

Generally, it is considered that structural elements of a floor are as follows: a floor covering (a floor paper) which takes up service loads; an intermediate layer connecting the covering to underlying elements; a Screed provided for leveling up the surface, giving the latter a slope and robust crust on non - rigid elements; thermal and sound insulation; and a sub floor bed which distributes service load upon bearing base.

The type of a floor is determined by its covering which may be composed of piece materials, of roll materials and of tiles based on Polymer resins or of site cast materials. Composite floor coverings are built of boards, glued wooden planets, chip boards, parquet boards and panels, unit wood blocks, Ceramic and artificial stone tiles, slabs of natural stones and other materials.

3:13 FLOOR COVERINGS OF PIECE MATERIALS.

Wood Board Floors:- Are built, over bacteria, of planed tongued and grooved floorboards. All elements of planching (batters, floorboards, liners, plinths fillets) should be

prefabricated to specified dimensions at centralized works and delivered to construction sites in packages for a room or an apartment. Floors are laid of planed boards 74 to 124mm wide. Floors with normal service conditions are built of boards 29mm thick and those intended to take up dynamic loads (sports auditoria etc) - 37mm thick. Inside the rooms, boards are oriented in the direction of light, and in corridors and other premises - in the direction of predominant traffic. Floors can be laid by parquet and package techniques.

3:13:1 PARQUET COVERINGS OF FLOORS.

Made of parquet boards, panels and piece - assembled parquet. Parquet floor boards ranges form 150mm wide and 1.2, 1.8 and 3m long consist of a glued plank base of 19mm thick and a covering of parquet planks 6 to 8mm thick. The planks have smooth sides edges and are fastened to the base by means of a water - resistant glue. Parquet boards have tongues and grooves to facilitate their assembly. Coverings of parquet boards are laid over sleeper joints (batters) in the same manner as floorboards. Parquet boards (strip) are pressed together by hammering and fastened to batters by nails 60 - 70mm long.

Coverings of piece and prefabricated parquet are placed over a continuous boards base (subflooring), prefabricated large - size gypsum - concrete slabs, hardened and Semi - hardened cement - sand screed. Coverings of piece parquet are laid according to various patterns with a without border framing. "A herring bone" floor pattern is a simple and widely employed design.

3:13:2 FLOOR COVERINGS OF CERAMIC MOSAIC, CEMENT - SAND.

These types of floor coverings are laid over a cement - sand screed on an interlayer, 10 to 15mm thick, of ordinary cement - sand mortars or mortars resistant to chemicals. The Screed for the covering should be strong, rough and free from irregularities exceeding 10mm.

Tiles coverings may have a single colour without border, or a specified pattern with border. The interlayer should have a thickness margin of 3 - 5mm, since mortar is compacted and forced out of the joints when tiles are laid.

3:13:3 FLOORS OF LINOLEUM AND POLYMER TILES.

The base for a floor made of linoleum and polymer tiles should be adequately strong, rigid, heat insulated in some applications and free from roughness in excess of 2mm. The moisture content of stone based should not exceed 6%, and of the wooden ones - 8%, small irregularities and roughness of base surface are puttied over the priming and ground.

Linoleum floor coverings are glued with mastics or welded in continuous sheets and laid dry. In specialised workshops, linoleum is heated (during the cold Season) and unrolled then tailored into sheets of required length, re-rolled into coils, marked and sent to site. Linoleum is glued from the middle to the ends. This is done by unrolled linoleum sheets in a position with overlaps of 15 - 20mm and bending them back or rolling them in coils, either the face surface on the inside, and applying a mastic on the base.

Soft plastic tiles are glued onto the same bases and with the same mastics as linoleum. A floor may be given various patterns using tiles of various colours. Floors of tiles are easier to repair, as the procedure then boils down to a simple replacement of a loose or damaged tile. Tiles glued with raped - setting mastics are placed by moving forwards, whereas when slowly setting mastics are employed, a reverse procedure is used.

3:13:4 CAST - IN - PLACE FLOOR COVERINGS.

Cast - in place floor coverins are made up of the followings:- Concrete floor coverings; covering of cement covering; mosaic covering and xylolite coverings.

3:13:5 CONCRETE FLOOR COVERINGS.

Are employed for premises with increased static loads and moisture and are built in a single layer of 25 to 30mm thick from a concrete of not lower than grade 200 and its mobility should be from 0 to 2cm of cone slump.

A concrete covering can be laid directly over prefabricated floor slabs, over a concrete base or dampproofing. Concrete surfaces are cleansed, crosscut or scratched with metallic brushes, washed with water and ground - coated with laterite. Damp proofing coarses are cleaned, primed with a hot mastic and sprinkled with sand.

3:14 ROOF FINISHES.

Roofs protect buildings and installations against atmospheric precipitations, temperature action, insolation and other environmental agents. The material with which a roof is covered has one main purpose: the exclusion of all types of weather in the severest form likely to be encountered. Thus the roofing must withstand the conditions which occur in normal circumstances. Penetration of a roof covering arises due to either bad design, which allow a combination of rain and wind to find a way through, or a final breakdown following a long period of slow deterioration.

Generally, a combined roof consists of the following main elements: load - bearing structures, dampproofing, thermal insulation, leveling screeds and top water proofing which is termed roofing or roof covering. Roofing is built of the following materials: roll roofing (ruberiod, asphalt felt, roofing felt, hydroizal, bitumen - polymer material, matalloizol); piece materials based on asbestos cement or ceramics (asbestos - cement corrugated sheets, tiles, roof tiles); metallic roofing (roofing steel); wooden roofing (shingles, wood chips, thin planks).

3:14:1 ROOFING MATERIALS.

There are many different types of materials used for roofing or roof covering, some of the characteristics of the materials most commonly used are:- Built - up felt roofing. Single layer sheet roofing; sheet metal roofing; corrugated sheet roofing and slates and tiles.

3:14:2 BUILT - UP FELT ROOFING.

This is very widely used for flat roofs because it is the cheapest material for this purpose, it has a limited life of 15 to 20 years. When used on flat roofs the covering is built up from three layers of bituminous felt borded together with hot bitumen. For pitched roofs two layers can be used, the top layer being finished with mineral granules.

3:14:3 SINGLE LAYER SHEET ROOFING.

A number of proprietary products exist which are similar in their application to builts - uproofing but achieve their objective with a single layer. One such material is marketed under the trade name of Naralite and is a bitumen and mineral fibre roofing of laminar construction.

3:14:4 SHEET METAL ROOFING.

The metals used for this purpose are lead, copper, zinc and aluminum. Although lead is extremely durable and can be expected to last 100 years it is very expensive and very heavy, and consequently its use is limited to flashings where its high degree of malleability makes compshapes possible without jointing.

3:15 TILES.

Tiles differ from true slates, stone slates and stone slabs in that they are a manufactured product, made either from natural clay deposits (clay tiles), or from cement, colouring sand and agents (concrete tiles). These are two classes of both clay and concrete tiles, the first being the plain tile. Which is a comparatively flat unit and the second being the single - lap interlocking tile whose distinctive feature is its corrugated profile. Tiles may be classified into four categories: hand - made, machine made, machine - made sand - faced, and concrete.

CHAPTER FOUR.

4:0 METHODOLOGY AND DATA ANALYSIS.

The methodology can be explained in a chronological order thus:-

A. Research Topic

B. Statement of Problem

C. Aims and Objectives

D. Data Collection

E. Data Analysis Feed - Back

F. Decision Making

G. Data Evaluation

H. Implementation

I. Monitoring

4:1 DATA SOURCE.

All data contained in this thesis are acquired through verbal interviews and witnessed experience and the work of past researcher on related topics.

4:2 METHOD OF DATA COLLECTION AND PRESENTATION.

The collection of data in this project was through verbal interviews, eye witnessed and reconnaissance survey carried out in the field and some experienced gathered by the researched in the field as a citizen of the area of Study.

4:3: DATA COLLECTION TECHNIQUES.

To carry out this work, data required was being grouped into primary, and secondary Data and they are as follows.

4:3:1 Primary Data:-

Which is the first hand information collected from the inhabitants of the area and observations being carried out by me.

4:3: 2 Secondary Data.

This constituted information from the past works of other researchers a related topics, textbooks, journals, write - ups from libraries. This secondary data supplied us with the materials for literature reviews.

DATA ANALYSIS

4:4 CAUSES OF FAILURES ON BUILDING STRUCTURES

Due to Chemical Attack:-

In general terms, almost all materials for building may be subjected to chemical action of one kind or another during the life of a building. In Kontagora some of the buildings are liable to such problem but to a very limited degree but this is evident in buildings located around Kakuri area of Kaduna metropolis. Chemical attack is taken to

mean chemical actions which have deleterious effects on the materials used in the finishing work of that area. The range of what may be termed the sources of attack, together with the concentration of the chemicals involved and associated favourble conditions.

Prolonged wetting of building finishes materials in that area accounts for most of the failures. Furthermore, significant regard having been given to precautions necessary to exclude water, particularly by the correct use of damp proof courses. The materials most commonly affected in that area that causes failure by chemical attack include clay bricks, stones, cement based products (Concrete, plasters, renders, mortars, asbestos cement etc.) paint and timber.

4:5 DUE TO ACID ACTION.

The extent to which acids may have a deleterious effect on materials varies considerably. This is due not only to the variation in resistance which given materials may offer to attack, but also to the variability of the concentration, and as important, the sources of acids.

The acid action on building, around Kontagora from our findings is not much but this is also evidence in the building finishes materials at the industrial estate of Kakuri area in Kaduna. Because most of the buildings seen around those area were affected by atmosphere gasses. The building finishes materials so affected are stone, brick and cement - based products. These are given some consideration to the presence of certain acids which arises

out of industrial processes. Some of which are acid gases on stone work, and gases on bricks and acid on cement - based products.

4:6 DUE TO ALKALI ACTION.

Alkali action is mainly, though not entirely, associated with cement - based products and especially those containing Portland cement. Portland cement particularly (in some cases lime) is the sources of the Alkali.

As it could be seen in most of the building around Government Residential Areas in Kontagora. The action manifest itself in a number of different ways on most of the buildings around those areas depending on the finishes materials involved. Those included are as follows:-

- Expansion and cracking of concrete as a result of alkali - reactive aggregatives.
- The staining of block-work due to the action of iron compounds in blocks and alkali in the mortar and of lime leached from concrete.
- Effects of alkaline solutions on glasses of windows of buildings found around those areas.
- The saponification of certain paint films (that is the conversion of oil to soap when the external surfaces of these buildings were adversely affected by the excessive rains that falls on them).

4:7 DUE TO SULPHATE ATTACK

The term 'Sulphate Attack' is generally used to refer to the results of the chemical reaction (in many cases a series of reactions but more conveniently referred to here as 'reaction') that takes place between sulphates in solution and certain constituents of cement and hydraulic lime.

This attack is prevalent with the fair faced brickwork of buildings along Federal of College Education road and some of the buildings scattered around other areas in the Kontagora main town. The mortar affected generally has a whitish appearance, the mortar inclose contact with the bricks will often be whiter that in the centre of the joint. The ways in which the attack manifest itself in most of the buildings in those areas may be summarised as follows:-

- Expansion of the mortar, leading to deformation and cracking of the brick/blockwork.
- Spelling of the edges of the individual brick/blockwork.
- The mortar deteriorates, Generally the affected mortar cracks along the length of their joints (i.e their laminates) while it leads to their surfaces falling off.
- Wide horizontal and vertical cracks were seen to appear in the renderings, while there are also some outward curling of the rendering at the cracks in their joints.

4:8 DUE TO PLASTER AND MORTARS.

Manifestations of defects as a result of delayed hydration of quicklime which causes defect in an internal plaster finish are referred to as 'blowing' 'popping' and pitting, their effects causes conical holes in the finished work, especially as it could in existing buildings along Kontagora G.R.A which varies in diameter according to the position in which the material responsible for the defect occurs.

However, manifestations of defects in mortars due to hydrated quicklime in buildings in those areas, shows one or more of the following symptoms: small pits, with nodules of friable material at their bases, form in the mortar joint, strong pointing mortars are displaced, and pits develop in the weaken bedding - mortar, hence general expansion occurs, with deformation and consequent cracking of the blockwork, accompanied by disintegration of the mortar.

4:9 DUE TO FUNGAL ATTACK.

The rotting of timber, whether of the wet or dry rot type, is a form of chemical attack. Instead of conventional chemicals, such as those included in connection with the decay of bricks stone, lime and cement - based products, the decaying agencies are fungi.

Most timber used as fittings for windows doors and as fascia boards in most of the buildings at Unguwar Kanawa and other remote areas of Kontagora were adversely affected by this attack. The factors responsible for this fungal attack on these finishes materials could

be as a results of the followings:-

4:10 TEMPERATURE.

The temperature at which the majority of fungi are able to grow range from freezing point to a little below or above blood heat. Due to excessive rainfall that is experienced here in Kontagora and that which falls on the finishes materials, combine with the temperature at which the majority of fungi are able to grow would have adverse effect on these finishes material causing decay of timber, and subsequently lead to failure.

4:11 MOISTURE.

Moisture, is the most important factor to be considered in practice in connection with fungal attack that causes decay of timber, Kontagora being a town with a sufficient amount of raining season days, moisture content of 20 - 25 percent present in timber would enable the attack of the dry rot fungus and subsequently leads to deterioration and failure of the timber used as a finishing material.

4:12 AIR.

The present of air is one of the factor contributing to the growth of fungi. The amount of atmospheric air present within the Kontagora town completely saturate the cell spaces in the wood being used as finishing material in most of the buildings. This exposure of the face of a piece of otherwise saturated timber to air is sufficient to render it liable to

decay, which could as a result lead to failure.

4:13 DUE TO THERMAL MOVEMENT.

Buildings are continually exposed to changes in their thermal environment and so problems associated with thermal movements are perennials. This particular aspect is important when solutions for reducing the possibility of cracking are considered. Buildings around Kontagora and its environs are not and exception to the problem. The typical example of thermal movement was the one experienced in Barnawa Kaduna a disaster of 1983, during that period these occurred to a settlement which consequently lead to collapse of low cost storey buildings used by inhabitants in that area.

4:14 DUE TO MOISTURE MOVEMENT.

Moisture movement is by definition the dimensional change that is expansion or contraction which takes place in materials when there is a change in their moisture content - increases in moisture content result in expansion while decreases in contraction.

Moisture penetration in most of the building within Kontagora can only take place in those materials which are capable of absorbing or giving off moisture. It is confined, unlike thermal movements. Movement are dependent on the structure of the finishing material. In general high concentration of moisture penetration will increase the amount of movement.

CHAPTER FIVE.

5.0 CONCLUSIONS AND RECOMMENDATIONS.

This project is aimed at improving building finishes to withstand the effect of prevailing Climatic conditions of Kontagora town so as to serve a long period of time with little or no maintenance. Majority of the buildings surveyed revealed structurally Stable, though some recommendations had to be made to enhance their ability to withstand the various Climatic elements they were exposed to.

Some of the buildings around Fadama areas of Kontagora were liable to rising damp as it could be seen in the main walls, as such recommendations had to be made for proper injection of damp proof courses so as to prevent them from the settlement. The faces of many buildings in most of the areas in Kontagora town are soft and perishing due to adequate amount of rains falling on them as such best type of rendering such as Tyroleum finish should be applied in deterching this condition. Roofs of buildings around those area too were stained due to sufficient amount of rains falling on the roofing Material which is made up of corrugated zinc roofing sheets as such they should be sheradized or galvanised.

Most of the buildings located at G. R. A. areas and Federal Colleges of Education have their voids Unventilated and hence, condensation within the roof void will occur which will lead to timber decay and therefore it is Vital that some Ventilation be created by introducing air Vent at their eaves.

Finally, I recommend the best finishes material to the case study area.

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