

# THE EFFECT OF THE ENVIRONMENT ON BUILDING FINISHING MATERIALS IN LAGOS ISLAND RESIDENTIAL DISTRICT

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## Abstract

The environment has influence on the condition of finishing materials used in buildings over time, in terms of the building deterioration and aesthetics. This environmental influence can be climatic changes or human factor effects. Lagos Island is located at the coastal region of Nigeria, characterised by heavy rainfall, coastal sea breeze laden with high salt content, high temperature and humidity. What effects do these climatic conditions have on the finishing materials used in buildings located within Lagos Island residential districts? This study evaluates the present conditions of the building finishing materials used in Lagos Island residential district, with a view to know how the climatic changes and human factors have influence the finishing materials. Survey method was used, with structured questioners administered to 177 respondents randomly selected in the area. Observation schedule and photographic materials were also used. Data was analysed statistically. The result shows that 83.4% of the building have not been renovated in the last 10 years and many of the buildings finishing's were in deteriorating state, with low maintenance. The wall finishes have been affected by the climatic condition of the areas. The effect of the human factor was seen in the conversion of 65% of the buildings to mixed-used for both commercial activity and residential, which have affected the finishing materials used in the buildings. Recommendations were proffered, such as the repairs and renovations of the buildings. This is to assure the structural integrity and improve the aesthetics of the buildings.

**Keywords:** Climate, Environment, Lagos Island, Finishing materials, Human factor

## 1 INTRODUCTION

Human comfort and productivity in any environment, especially in residential and working environment is tied to how convenient the individual is, to be able to function effectively in such environment. The nature of an environment is determined (influenced) by the outlook (aesthetics) of buildings, the building types and the finishes of the buildings. The nature of the environment where a building is located can also influence the performance of such building. This environmental influences on building can be in the form of climatic changes, weathering or human factor effects. The environment that accommodates a building, plays a prominent role in the life cycle of the building (Oluwole and Ahmad, 2013). Also, one of the factors that necessitate regular maintenance of building exterior is the climate, as stated by Butt *et al.* (2010). Different geographical regions of the world have different and peculiar climate patterns. Studies such as Al-Hammad, Assaf and Al-Shihah (1997); Berdahl, Akbari, Levinson, and Miller (2008) had shown that climate and weathering affects different buildings finishing materials. Weather can be defined as reaction to changes in atmospheric pressure, which can alter air movement, temperature, and humidity. Some of these changes could be dramatic and can produce violent storms, while other changes are subtle and have little effect on the weather. This study looks at the effects of these climates changes and weathering on buildings finishing

materials in Lagos Island, Nigeria. Lagos Island, is located along the coastal region of Atlantic Ocean, having a weather characterised by heavy rainfall and the effects of coastal sea breeze laden with high salt content, high temperature and humidity. The effect of the climate and weathering condition on buildings located in Lagos Island was evaluated, identifying the climatic changes and human factors, which are some of the environmental influences on the changes that affect the finishing materials on the buildings in the study area.

## **2 LITERATURE REVIEW**

### **2.1 The Study Area and its Climatic Conditions**

Lagos Island is located in Lagos State, which is made up of Lagos Islands and Lagos Mainland. Lagos State is found in the South-western part of Nigeria, on the Atlantic coast. Having a total land area of 3,475.1/km<sup>2</sup> (1,341.7/sqm) and a population density of 2,593.7/km<sup>2</sup> (6,717.8/sqm). It is located at longitude 2°42'E and 3°42'E and between latitudes 6°22'N and 6°42'N, Figure 1. Shows the map of Lagos Island. Lagos State region is within the tropical rain forest belt and the eco-zones is characterised by wetlands and rain forest, the tropical swamp forest consisting of the freshwater and mangrove swamp forests. The wetland environment is characterized by rich alluvial and terrallitic red-yellow soil, on which is found dense luxuriant undergrowth, climbers, epiphytes and tropical hardwoods (Ojeh, Balogun and Okhimamhe, 2016). This materials were the building materials used by the earlier settlers on the Island in the 17<sup>th</sup>, 18<sup>th</sup> and 19<sup>th</sup> centuries. There are two seasons in the year, the wet season, which starts from April to October and a dry season, which is from November to March. This is facilitated by the interaction between the warm, humid maritime tropical air mass and the hot and dry continental air mass from the interior. Mean annual rain fall of Lagos in a year is around 1, 657 mm. Presence of very humid air throughout the year, with monthly average maximum temperatures ranging from 28.6°C in July/August to 33.7°C in February/March as shown in Figure 2 (Ojeh *et al.*, 2016). Also, maze of lagoons and Waterways, which constitute about 22% or 787 sq km of the state's total landmass characterised the drainage system. Irrespective of this, some of the landmass are about 200 meters away from the Atlantic Ocean, which makes many of the buildings external finishes to have direct effects of saline air from the Ocean.

### **2.2 History of Buildings in Lagos Island and its Evolution**

The building types that were originally found in Lagos Island were not dictated by climate of the Island, but by the materials that was available during that time. The choices was limited to smelly lagoon mud, palm leaves, poles, bamboo, decayed vegetables and clay. The type of houses built depended on the social condition and status of the individual. The building materials that were commonly used for the houses were made of mud, bamboo, placed and tied together in a row and in an upright position so as to serve as walls. The roofs were made of poles covered with palm leaves. This traditional styles, had walls about a foot thick in seven layers, each a foot high. The preceding layers were sundried before the next layer was added. Thatch obtained from leaves of the raffia palm was used for roofing while ribs of the raffia palm were used as lath to support the mud layers and later use of raffia palms was substituted for corrugated iron sheets. The houses were small and oblong in shape, some were without windows and had an opening for door, others had arched doorways and windows following after the Portuguese and Brazilian styles (Lagos State Bureau of Statistics, 2013).

However, recently in the last five decades most of the earlier traditional buildings on Lagos Island have evolved into modern structures, which was influenced by the evolution of global housing lifestyle and being accepted by more and more people (Devaux, 2011). Housing in

these area had began as dwellings with simple materials such as mud and it had evolved over time due to several factors, such as the advancement in technology and modern building materials and growth in population, as noted by Ekhaese, Adeyemi and Atamewan, (2014), new ideas in housing evolves with growth, development, religion, education, social, economic and cultural influences in urban areas. Preferences in housing types and factors, such as choice of materials are responsible for the evolution of housing types in traditional African communities such as Lagos Island. These are also due to the composition and socio-cultural norms of the area, religions and beliefs, privacy and comfort, size of households, tastes and preferences in planning and design, which influences the choice of building materials used in building.



Figure 1: Map of Lagos Island  
 Source: Source: [www.google.com](http://www.google.com) (accessed June, 2018)

### 2.3 The Environment, Climates, Weather and Building Materials

There are different types of environment, which varies from cities to cities, countries to countries and climatic condition differs across the world. The various geographical regions of the world have prevailing weather patterns that are typical for each specific region, as presented in Jegede *et al.* (2016) showing the climatic regions of the world with varied thermal characteristics, which would in turn have effect on the peoples way of life, the environment and buildings found in each region. Table 1.

Table 1: Climatic condition of global regions.

Climate	Countries	Thermal characteristic	
Arctic and Subarctic	Parts of America, Canada and Island	Winter	Intense, continuous cold, little solar light or heat, high wind
		summer	Modern temperatures, intense solar radiation
Continental steppe	Eastern Europe, Russia and Central Asia	Winter	Intense, continuous cold, negligible solar heat, high winds
		summer	Long, warm days, cold nights
Desert	Middle eastern countries, parts of North Africa	Little or no seasonal variation, hot day, cold night, intense solar light and heat, very low humidity and little rain	
Tropical rain forest	West Africa and central Africa, India	No seasonal variation, hot day, warm nights, intense solar radiation, high humidity, heavy rainfall	

Source: Jegede *et al.* (2016)

Also, some studies had highlighted the effects of climate and weathering on different building materials. Alshebani and Wedawatta (2014) explained that weather conditions affect the design, construction, and performance of buildings and further stated that the effects are on such materials as concrete, bricks, paints, masonry mortar, seals and sealants. Which are mostly affected by the condition of the climate.

#### **2.4 The Effects of Salty and Heavy Rainfall on Building Materials**

Studies such as Delgado *et al.* (2016) analysed the damages that salt action can cause on building materials, this includes dampness and deterioration of the materials. Besides other degradation mechanisms such as temperature changes, mechanical erosive actions of wind and water or water phase changes, salt-induced damage may have both chemical and physical damages (Delgado *et al.*, 2016). Furthermore, the study stated that the effect of salts in the deterioration of historical buildings and modern constructions, which usually do not have horizontal waterproofing, has long been known and it is recognized worldwide. Soluble salts can penetrate into buildings easily with the assistance of moisture which can further transport them and these buildings are affected from the attack of salt solutions. It has been found that different pollutants behave differently on bricks, stones, mortars, and also wood, which seems to react differently to the damaging action of salts and pollutants (Delgado *et al.*, 2016).

#### **2.5 Human Factor Effects on the Environment and Building Materials**

The concern of built environment experts about human factor is primarily on architectural design structures, such as residential, institutional, commercial, industrial buildings and the city spaces that these buildings are. This is the man-environment of human factor research and application. Rather than the man-machine of human factor which focuses on other aspect of human factor, which are the physiological process. Human factor can therefore be refer to as environmental, organizational and job factor, human and individual characteristics which influences behavior at work or in an environment, in a way which can affect health and safety. (Selleh and Sukadarin, 2018).

Furthermore, productivity in an environment is tied to the convenient level of the individual to be able to function effectively in such environment. The type of building in which any operation is taken place should consider the needs of the occupants for functionality and it should be the determination factors for the buildings' design type and the materials required for the building. Deterioration of building materials could reduce the expected convenience status of the occupants of the building. Especially deterioration by biological processes affecting building, causing ageing, damages and presence of excessive moisture to buildings materials by the appearance of mold growing on the materials (Viitanen *et al.*, 2010)

However, from the earlier definition of human factor conditions, it can be viewed from three aspects, which are the individual, Job (activities), the organization (environment) and how they impact on the people's (users of facilities) health, life and safety, which is the related behavior. This will help in developing products that maximize usability, easy maintenance, long lasting, favorable with the climatic conditions of the environment to improve occupants' safety, moral, and efficiency in the environment to perform to the standard that is expected of the building type.

### **3 METHODOLOGY**

This study was carried out using Survey method with structured questionnaires, used as the research instrument. The questionnaires were administered to 177 respondents randomly selected in the study area, Lagos Island. Also, observation schedule was used to assess the buildings and photographic materials were used to further investigate the conditions of the buildings and environment being studied. The study explored the factors that have influenced the change in the physical characteristics of housing in the residential district areas of Lagos Island. The questionnaires were self-administered in these areas namely, Tokunbo, Bamgbose, Mobolaji Bank Anthony, Campbell, Kakawa, Campos, Odunlami, Glover, Igbosere, Joseph and St Catholic Mission Streets. The data collected from the study were analysed statistically using statistical package for social sciences (SPSS).

### **4 FINDINGS AND DISCUSSION**

A total of eleven (11) streets were studied in the residential areas of Lagos Island. Table 2. Shows the surveyed building characteristics. 119 (67.2%) of the buildings surveyed were flats, 18 (10.2%) were Roomy, 8 (4.5%) were Self-contained why only 2 (1.1%) and 32 (18.0%) were shops and other types of building. This shows that majority of the building were purposely built buildings for residential, notwithstanding that some of the buildings have been combined for commercial purposes with 115 (65.0%) specifying the presence of shops attached to the buildings and 62 (35.0%) with none presence of shops and the numbers of the shops are between 1 to more than 6 shops having 104 (64.4%). Irrespective that 145 (81.9%) specifying that there has not been changes in the buildings being use for residential purposes in the last 10 years, as against 28 (15.8%) who said there had been a complete change in the use of the building form residential purposes.

Furthermore, many of these buildings were built over 10 years, between 11-15years, over 15 years having 56 (31.6%) and 64 (36.2%) respectively. This suggest that the condition of the building materials use for the building would have require replacements or renovation with regard to the salty moisture climatic conditions where this building are located, but this is not the case as majority of 147 (83.4%) specified that their building had not been renovated in the last 10 years as against 30 (16.9%) who specified contrary, shown in Table 3. The history of maintenance of the external finishing building materials of the buildings showed that many of these materials on the building had not been changed before, Table 3. Those that specified none changes in roofing material, entrance door and windows were 153 (86.4%), 155 (87.6%), 146 (82.5%) respectively and those that specified a form of renovation of these materials were very small with 24 (13.6%), 22 (12.4%), 30 (16.9%) respectively, which are small fraction of the building studied. Also, it was seen that many of the buildings external walls had been last painted in the last 6 years with 6-10 years having 69 (39.0%) and 11-15 years having 48 (27.1%). This suggested that many of the buildings are in a deplorable state as shown in Figures 2 and 3. Majority of the occupants had stayed long in these buildings between 6 to more than 15 years having 133 (74.1%), and many of them 96 (55.2%) stated good location as reason for staying long in the areas. A suggestion that this could be for the commercial activities within these residential areas. It was observed that many of the buildings were mixed-used building, both for residential and commercial uses, Figures 2 and 3. This has put pressure on the conditions of the building materials used for the external finishes of the building, even as these materials are exposed to the harsh

climatic conditions of the area, these are human factor effects on the condition of the finishing materials used in these buildings.

Table 2: Buildings characteristics and factors influencing the characteristics of the buildings

<b>VARIABLE</b>	<b>CATEGORIES</b>	<b>FREQUENCY</b>	<b>PERCENTAGE</b>
<b>Building typology</b>	Flat	119	67.2
	Roomy house(Face me and Face you	18	10.2
	Self-contained	8	4.5
	Shops	2	1.1
	Others	30	16.9
<b>Number of rooms</b>	1-2 rooms	12	6.8
	3-4 rooms	15	8.5
	5-6 rooms	35	19.8
	Others	107	60.5
	No response	8	4.5
<b>Age of building</b>	1-5 Years	24	13.6
	6-10 Years	33	18.6
	11-15 Years	56	31.6
	Over 15 Years	64	36.2
<b>Length of Respondents stay in the house</b>	1-5 Years	44	24.9
	6-10 Years	65	36.7
	11-15 Years	49	27.7
	More than 15 years	19	10.7
<b>Reason for living in the house</b>	Good location	96	55.2
	Security	21	12.1
	Nearness to Family and friends	10	5.7
	others	47	27.0
	No response	3	1.7
<b>Complete change of the Use of building from residential in the last 10 years</b>	Yes	28	15.8
	No	145	81.9
	No response	4	1.8
<b>Presence of shop(s) attached to the building</b>	Yes	115	65.0
	No	62	35.0
<b>Number of shop(s) attached to the building</b>	None	63	35.6
	1-2	64	36.2
	3-4	8	4.5
	4-6	28	15.8
	More than 6	4	7.9

Table 3: History of the buildings external material maintenance

<b>VARIABLE</b>	<b>CATEGORIES</b>	<b>FREQUENCY</b>	<b>PERCENTAGE</b>
<b>Has the building been renovated in the last 10 years</b>	Yes	30	16.9
	No	147	83.1
<b>Has the roof of the building been changed before</b>	Yes	24	13.6
	No	153	86.4
<b>Has the entrance door of the building been changed before</b>	Yes	22	12.4
	No	155	87.6
<b>Has the windows of the building been changed before</b>	Yes	30	16.9
	No	146	82.5
<b>When last was the building painted</b>	Never	9	5.1
	1-5 Years	47	26.6



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6-10 Years	69	39.0
11-15 Years	48	27.1
Over 15 Years	4	2.3

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Figure 2: Buildings used for both commercial and residential purposes  
Source: Authors research.



Figure 3: The effect of the climate on the plastering material on the wall of the building  
Source: Authors research.

## 5 CONCLUSIONS AND RECOMMENDATIONS

This study evaluated the conditions of the building finishing materials used in Lagos Island residential district, the effect of the salty climatic nature of the area and the human factor effects was considered on the changes on the finishing materials. The exterior wall finishes were not good again, the finishes were beginning to wear out and get dirty obviously as a result of weather conditions. It could be concluded that the building materials used were affected by the salty and moisturized climatic condition of the area and lack of adequate or constant maintenance of these materials had translated to the appearances, poor aesthetic and structure of the buildings. Most of the building finishing materials had not been changed in the last ten (10) years. Also, Understanding human factor in design, building types, building environment, building materials can contribute a useful research in environmental design and to the practitioners of architectural designs. Having the ability to know how human factor deals with the environmental, organizational and job factors (commercial activities), human and individual characteristic. Being able to transfer this to architecture as it relates to our environment, design, and building construction. As seen in the mix-used of the buildings in this study, where the buildings were for both commercial and residential purposes, not minding the deterioration of the building from the effect of it use. It is recommended that constant repairs and renovations of the buildings should be enforced on building owners, to ensure the structural integrity and improve the aesthetics of the buildings. Regulations to check unapproved mix-use of the buildings should also be enforced to safe the buildings from being over used from it original design.

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