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RESEARCH PAPER

BUILDING MATERIAL PREFERENCES IN WARM-HUMID AND HOT-DRY CLIMATES IN GHANA

R. A. Oppong[1] and E. Badu[2]
[1]*School of Architecture, University of Liverpool, Merseyside, Liverpool, L69 7ZN, UK*
[2]*Department of Building Technology, College of Architecture and Planning, KNUST, Kumasi, Ghana*

ABSTRACT
This paper explores building materials preferences in the warm-humid and hot-dry climates in Ghana. Using a combination of closed and open-ended questionnaires, a total of 1281 participants (473 adults and 808 youth) were recruited in Ghana in a two-month survey in Kumasi and Tamale representing the warm-humid and hot-dry climates respectively. Sampling was purposive. The sample elements were chosen because they typically represented the communities of our case studies. Through hypothesis testing, the Pearson Chi-square results indicate a significant positive association between aesthetics and study areas (χ^2 =155.65; df =4; N =1278; p < 0.05) with an asymptotic significance level of 0. 000 (p = 0. 0005). The findings indicate aesthetics generally appear to be major considerations instead of climatic considerations in the choice of building materials in Kumasi and Tamale. This paper concludes that, the preference for building materials in Ghana points to neglect of climatic considerations due to aesthetics influences and apparent lack of enforcement of building rules and regulations. This paper recommends a review of the National Building Regulations-Legislative Instruments 1630 to reflect current trends in architecture and building developments.

Keywords: *Aesthetics, Building materials, Preference, Tropical climates, Ghana*

INTRODUCTION

This paper brings to the fore that combinations of factors appear to have impacted building materials preferences and architectural practices in Ghana. For example, as a direct result of urbanization and its associated wealth-creation in large Ghanaian cities as well as enhanced macroeconomic conditions, there is more pressure on urban land for various uses over the entire cityscape of Kumasi and Tamale. A direct result of this is the changing land use patterns and an adaptation to these change patterns. Closely associated with this is a gradual process of adjustment and in some circumstances, change in manifested preference of building materials and architectural practices. The process of adaptation to these change patterns brings in its wake, changes in architectural taste including the following: more intensive and better utilization of land and enhanced configuration of spaces; introduction of new, and hitherto lesser known building materials;

modification and, or, refurbishment of existing buildings to attract high yielding rental values; a gradual change in the style and pattern of building roofs, facades etc; an appreciation and experimentation with wider range of colours; and an introduction and appreciation of the need for more exotic plants for landscaping on building sites.

In order to better appreciate and understand architectural happenings in Ghana, sight must not be lost of the contextual circumstances within the overall macro-economic conditions and the enhanced economic circumstances besides the prevailing building material and architectural practices as well as the on-going process of urbanisation in the world (Burdett and Kanai, 2006; Commission for Africa, 2005). Furthermore, the contextual circumstances in most Ghanaian cities, particularly the large and fast growing ones such as Kumasi and Tamale, must not be overlooked. Ghana is now rapidly urbanising as in many African countries. Many writers have explored the process of urbanisation in Ghana (Asiama, 2006; Ghana Statistical Services, 2005; and Obeng-Odoom, 2010). The conclusions of most studies on urbanisation have been its effects of harsh impacts on the built environments, health of individuals, and more specifically, the vulnerable populace in Ghana (Luginaah *et al*., 2010). Notably, the arguments for urbanisation are varied and complex. The development-side theory emphasises the need to recognise the potentials of urbanisation. It is argued that urbanisation is not necessarily a bad thing (Martínez-Zarzoso, 2008; Otiso and Owusu, 2008).

The other side of urbanisation emphasises the conflict between land as a resource for production and as a set of amenities to be consumed (Jenkins *et al*., 2007). It is estimated that over half the area of the African tropical rain forests have been converted into other land uses (Richards, 1990) with negative consequent effects showing largely in adverse economic and physical conditions. Ghana appears to have lost control of its urban development. As a result, problems such as haphazard urban growth, incongruous land uses and architectural/building practices, environmental pollution, as well as slums have become part and parcel of Ghanaian towns and cities.

Following the forgoing, the next (second) section discusses the general overview of architectural practices and recommendations of the warm-humid climate and hot-dry climates in Ghana; building materials and housing as well as building regulation reviews are also presented. The methodological description and appraisal as the third section set this paper's hypotheses for testing and discussions. The fourth section presents findings and discussions. Ultimately, conclusions are drawn to guide architectural and building development policy direction in Ghana and sub-Saharan Africa in general in the fifth section.

ARCHITECTURAL PRACTICES AND RECOMMENDATIONS FOR WARM-HUMID AND HOT-DRY CLIMATES IN GHANA

General Overview

The most prominent features of the hot-dry climates are very hot, dry air and dry ground. Day-time temperatures normally range between 27 and 49^{o}C (Koenigsberger *et al*., 1974). Humidity is continuously moderate to low. Outdoor conditions are so hostile in the hot-dry climate, that building interiors and exteriors are protected from solar radiation and the hot, dusty winds. Walls and roofs are constructed with heavy materials with large thermal capacity to absorb much of the heat entering through the outer surface of the wall during the day (Koenigsberger *et al*., 1974). On the other hand, the warm-humid climate is characterised by hot, sweaty and sticky conditions as well as continual presence of dampness. Air temperatures remain moderately high, between 21 and 32^{o}C, with little variation between day and night (Koenigsberger *et al*., 1974). Kumasi (warm-humid) is warmer than it was two decades ago due to decreasing humidity (Adarkwa and Poku-Boansi, 2011).

The most common materials used for building walls in the warm-humid regions are stones, and earth-based bricks. Sand-cement blocks are extensively used in the warm-humid regions in Ghana because they appeared fairly cheap and satisfactory to use as building material. Traditionally, earth-walled courtyard houses are typical with broad overhanging eaves to shade the exterior walls. Pitched roofs covered with various corrugated metallic sheets are common in the warm-humid climates in Ghana.

A bird's eye view of inhabited part of the warm -humid and hot-dry climatic regions of Ghana presents distinctions and similarities to some extent. For instance, the hot-dry climatic regions present a series of traditional circular and thatch-roofed houses built in variations of common pattern of houses/compounds and the warm-humid regions present rectangular and metallic-roofed houses in grid-iron pattern. The houses/family compounds commonly found in the hot-dry climatic regions are usually built of mud and decorated using local building materials. The walls of compounds are smoothened using stones and polished with varnish made from seed case of dawa-dawa tree to make the mud walls water resistant and also to reflect a large part of the incident solar radiation. Traditionally timber windows and door entrances are small in size and few in number. Windows are placed high on the walls to prevent admission of heat and dust into building interiors; however, windows in the warm-humid are large and fully openable. Fixed windows are not climatically preferable in the warm-humid climates (Koenigsberger *et al*., 1974).

Although, there is some use of mud-brick or sand-cement blocks as it predominates in the warm-humid regions, the circular compounds in the hot-dry climates are giving way to rectangular building forms. It is not uncommon, nowadays, to find thatched roofs replaced by metallic roofing sheets. Even though, thatched roofs provide insulation against heat and cold, the metallic roofs, for example, zinc and aluminium have the advantage of less maintenance. The choice and use of buildings materials are very important in the warm-humid and hot-dry-climates of Ghana since architectural style apparently reflects owners' personal taste and financial status (Drucker-Brown, 2001).

Housing stock and building materials

The distribution of population and housing stock is not uniform across the country but it is generally observed that more houses are built in urban areas than in other towns and villages in Ghana (Aryeetey *et al*., 2010). Though, there exists housing deficits (Baiden *et al.*, 2011), urban and rural housing stock saw increases between 1984 and 2000. It is claimed that the combined effect is that the increase in stock of houses (77.5%) was generally higher than the increase in population (53.9%) and households (49.2%), which imply improvement in housing development (Ghana Statistical Services, 2005). In 2000, the average number of households per house in Greater Accra (5.8) and Ashanti (4.1) was higher than the national average (3.6), implying some degree of overcrowding in these regions (Ghana Statistical Services, 2005). Housing stock in cities such as Tamale grew by less than 5% and 8.6% in Kumasi. The housing stock manifested lesser known and used building materials such as glass. Owusu and Tamakloe (1992) reported the use of plain sheet glass louvre blades in metal carriers in windows in low income urban housing in Kumasi.

There are three major types of dwellings in Ghana: separate/detached (25.3%), semidetached (15.3%) and rooms in compound houses (44.5%) (Ghana Statistical Services, 2005). There is a higher proportion of compound houses in urban areas (51.6%) compared to rural areas (38.4%) while there is a higher proportion of separate/detached houses in rural areas (33.2%) compared with urban area (16.0%) (Ghana Statistical Services, 2005). Notably, the two main materials for outer wall construction are mud bricks/earth and cement

/concrete (Table1). Another material gradually gaining popularity but not captured in the Ghana Statistical Services data base is glass (Table 2). Even though glass is an ancient building material dating back more than 5,000 years; glass is believed to be a building material that originated around 3500-3000 BC in Egypt and eastern Mesopotamia (present-day Iraq) (Bell, 2006).

Building materials and regulations

Ghana is geographically divided into three main climatic zones: the warm-humid (e.g. Kumasi), the hot-dry (e.g. Tamale) and the coastal-hot savannah climatic zones (e.g. Accra). The Greater Accra regions constitute the Coastal-hot savannah climatic zone (Fig.1). Building materials and construction technology generally differ from one climatic zone to another in Ghana.

Regulation 32 (1) of the Legislative Instrument (L.I.) 1630 stipulates that mud or swish used in plastic state to erect an earthen wall or for swish walling (locally known as *atakpame)*; wattle and daub; pise or earth rammed between wooden or other formwork to make a wall in situ; unburnt earth bricks or blocks (adobe); stabilised earth products, bricks and blocks (or landcrete); burnt clay products; sandcrete, concrete, or reinforced concrete; thatched or leaves in roofing or otherwise; timber or bamboo products; asbestos-cement products; metal products; glass and synthetic materials; stone products; lime-based materials; and other approved building materials may be used in the construction of buildings so long as they conform to the provisions of the L.I. 1630 (The Republic of Ghana, 1996).

Notwithstanding the provisions regarding building materials under Regulation 32, designated planning authorities, having regard to the architectural values and general standard of development of any particular area, may reject any application for approval of a building, if it is viewed the building would detract from the general trend of development in a particular area (The Republic of Ghana, 1996). However, Ghana, like many other countries in sub-Saharan Africa has practical difficulties of enforcing the wide range of restrictive building regulations (Boamah *et al*., 2012). Ikejiofor (1999) argued that little modification to existing rigid building regulations and housing codes constituting serious barriers to shelter provision in sub-Saharan Africa, particularly regarding acceptable local building materials, can provide an alternative that is perhaps more appropriate to enhance urban housing. Accordingly, Ikejiofor (1999) assertion will be in line with United Nations Commission on Human Settlements (UNCHS)'s Enablement Strategy to housing where governments are to assume the role of providing housing through the concentration on reforming and managing the legal, regulatory and financial policy framework (Ogu and Ogbuozobe, 2001). Currently in Ghana, the Local Government Act, (Act 462), 1993 and the National Building Code, (L.I. 1630), 1996 are the main instruments used for the guidance of physical development throughout Ghana.

From a distance, one may be tempted to believe that there are no rules and regulations that guide physical development activities in Ghanaian cities and towns (Boamah *et al*., 2012). Building construction and the use of building materials appeared to be at odds with climatic considerations. This paper does not argue that building rules and regulations should be applied to limit peoples' taste and preferences of building materials because when regulations are made on building materials, it limits peoples' accessibility to explore for innovation but some degree of sustainable building should be adhered to as pertains in Singapore where the Building Control (Buildable Design) Regulations, introduced in 2001, require buildings to attain minimum buildability scores under the Buildable Design Appraisal System (BDAS) (Pheng and Chen, 2011).

Development controls are not enforced in Ghana due to ineffective mechanisms (Boamah

Table 1: Main wall construction materials by region/climatic zones in Ghana (2000)

		Warm-humid Regions							*Hot-dry Regions*		
Building Materials **Walls: Main Materials**	***Ghana* [%]**	***Western***	***Central***	***Greater Accra***	***Volta***	***Eastern***	***Ashanti***	***Brong Ahafo***	***Northern***	***Upper East***	***Upper West***
Mud	50	56.8	56.1	9.1	60.1	56.2	39.2	63.7	82.6	87.7	83.3
Wood	4	4.8	3	9.8	1.3	2.9	3.4	3.1	1	1.2	0.8
Metal Sheet/Slate	0.5	0.3	0.3	1.5	0.4	0.4	0.5	0.3	0.2	0.2	0.2
Stone	0.2	0.2	0.1	0.4	0.3	0.2	0.3	0.2	0.2	0.2	0.2
Burnt Brick	1.5	1.6	1	1.9	1.1	1.3	2.6	1.2	0.4	1	1.2
Cement Block/ Concrete	39.2	29.6	35.4	74.3	32.9	33.4	48.9	25.5	10.9	8.7	13
Sandcrete/landcrete	2.8	2.2	3.4	0.9	1.5	4.7	3.4	5.2	2.8	0.4	0.5
Packing cases/bamboo	0.2	0.3	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Palm leaf/thatch	0.8	2.1	0.3	0.3	2	0.4	0.3	0.5	1.6	0.3	0.5
Others	0.8	2.1	0.2	1.5	0.2	0.3	1.2	0.2	0.2	0.2	0.2
All Outer wall materials	100	100	100	100	100	100	100	100	100	100	100

(Source: Ghana Statistical Services, 2005)

Table 2: Main roof construction materials by region/climate zones in Ghana (2000)

				Warm-humid Regions					***Hot-dry regions***		
Building Materials	***Ghana***	***Western***	***Central***	***Greater Accra***	***Volta***	***Eastern***	***Ashanti***	***Brong Ahafo***	***Northern***	***Upper East***	***Upper West***
Roof: Main Materials (%)											
Thatch/palm leaf	18.6	22.4	10.7	3.7	31	12.6	7.9	25.3	60.3	43	16.1
Bamboo	2.1	8.1	3.4	0.2	0.4	1.4	2.4	1.7	0.4	0.5	0.4
Mud/Mud Bricks	1.9	0.2	0.3	0.3	0.2	0.2	0.3	0.3	4.6	17.9	30.9
Wood	0.9	0.8	0.3	0.7	0.2	0.3	1.4	0.9	0.7	2.7	3.6
Corrugated Metal Sheets	60.3	50.6	60.9	40.6	59.8	82.1	82.4	70.1	31.7	31.5	47
Slate/Asbestos	12.9	11.6	21.1	48.3	7.3	2.1	1.9	0.7	0.8	0.8	0.4
Cement/Concrete	2.4	5.4	2.4	4.4	0.7	0.8	3.1	0.7	0.3	0.4	0.4
Roofing Tiles	0.5	0.3	0.2	1.5	0.2	0.2	0.3	0.1	0.5	0.3	0.3
Others	0.5	0.6	0.6	0.4	0.2	0.2	0.3	0	0.7	2.8	1
All Roofing Materials	100	100	100	100	100	100	100	100	100	100	100

(Source: Ghana Statistical Services, 2005)

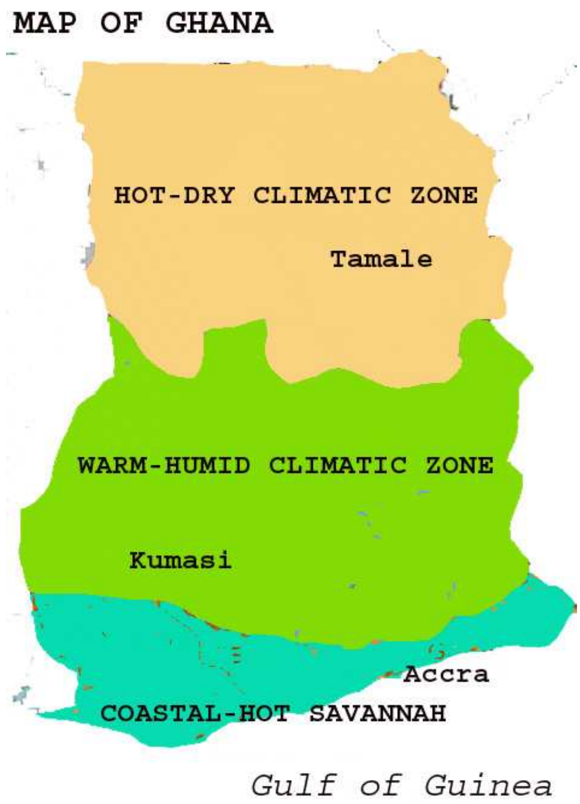

Fig. 1: Map of Ghana showing the three main climatic zones

et al., 2012). Development controls are violated in Ghana and that is largely attributed to colonialism (Boamah *et al.,* 2012). Available data generally indicate that northern region which has Tamale as its capital has about 83% and 11% of building walls in mud and cement blocks respectively (Table 1). But the situation is changing especially in Tamale as an urban centre; there is a noticeable trend of traditional but derelict building on urban prime land being converted into modern buildings of glazed walls, though there are examples of new technologies to construct modern buildings with the state-of-the-art facilities in local materials such as timber, mud, thatch, straw, bamboo etc. as pertains in some African countries such as Uganda, Zambia and Zimbabwe (Fig. 2 and 3).

Majority of households in rural areas use earth/ mud bricks, which appear to have shorter life span due to poor treatment and building construction methods. Cement is increasingly used in the urban areas and the rural areas to some considerable extent. Corrugated metal sheets dominate as roof covering in the urban areas; whilst, the rural areas have a mixture of inorganic (metal) and organic (e.g. thatch) roof coverings (Hangen, 1974; Ghana Statistical Services, 2005). Three main materials are used in Ghana for roofing houses (Table 2): corrugated metal sheets (60.3%), thatch/palm leaf (18.6%), and slate/asbestos (12.9%). Socio-economic and cultural conditions seemingly dictate the use of these materials. In the northern part (Tamale) of the country, thatch/palm leaf and mud are more used for roofing than in the south.

In Southern Ghana especially Kumasi households depend more on corrugated metal sheets supported by timber for roofing (Afrane and Asamoah, (2011).

Baiden *et al*. (2005) asserted it is regrettable that even though Ghana has abundant timber resources; their use in the construction of buildings is limited to windows, doors and roof members. Between 1971 and 1972, the Department of Housing and Planning Research

Fig. 2: Thatch roofs and mud walls of the Tamale Chief's Palace are gradually changing into metallic roofs and sandcrete walls (Source: Authors')

Fig. 3: A fuel filling station in Livingstone, Zambia roofed with thatch (Source: Authors')

(DHPR) of the University of Science and Technology designed and constructed timber buildings to make timber competitive as concrete and sandcrete blocks (Nartey, 1974). But, elack of financial support curtailed the efforts of DHPR to benefit research, teaching and the development of the building industry in Ghana as a whole (Nartey, 1974).

In recent years, some buildings in the major cities are using metal trusses instead of wood for supporting roofing materials. Striking differences exist between the materials used for housing construction (wall, floor and roof) in the urban and rural areas in Ghana. People find cement a more durable and safe material for constructing floor. The preference for building material used by individuals and institutions seem to be driven by cost and availability of building materials. Ghana is a heterogeneous ethnic society with socio-cultural pluralism. Socio-economic circumstances including rural/ urban poverty; formal and informal economies; elitism and urban proletarianism characterise architecture and perhaps, the aforesaid features influence building material preferences.

METHODS

Methodological Orientation and Robustness

Using a combination of closed and open-ended questionnaire, this paper explored the connection between architecture and building material preference in Kumasi and Tamale as case study areas in Ghana. The questionnaire administration was undertaken between 7th June, 2008 and 18th August 2008. A total of 1281 participants (473 adults and 808 youth) were sampled in Kumasi and Tamale. The intention to use a large sample in this research was to help deal with the probabilities of both Type I and Type II Errors in hypothesis testing (Waters, 1997). Data collection was preceded by orientation of a research team on the tools and procedures for data collection in a two-day in house training session followed by a day of pre- testing the tools to minimise errors in data collection to enhance quality control as research experiences have shown in developing countries (Ward, 1983). The questionnaire administration took place in offices, schools and religious premises in order to obtain a large sample for our hypothesis testing. Sampling techniques in research were considered (Moses and Knutsen, 2007). A number of sampling was purposive rather than random due to time limitation. There were three levels of approaches to purposively sample/recruit the participants for the research. By way of stratification, the first level of sampling was through religious orientation ie either Christians or Muslims. The second was Political groups from the Metropolitan District Assemblies and the third group comprised the youth. The sample included city authorities, academics, building industry professionals, businessmen and women, the youth and public/ civil servants.

In all 808 (65.8%) youth and 438 (34.2%) of adults from Kumasi and Tamale were sampled respectively. 31% of the adults and 37.2% (youth) of the respondents came from warm humid climatic zone (Kumasi), compared with 28.6% (youth) and 3.1% (adults) from the hot dry climatic zone (Tamale). The age of respondents ranged between 15 and 80 years. The sampled elements were chosen because they satisfy our criteria for purposive or judgment sampling as deliberate choice of particular units of the universe on the basis that the sample so selected typically represented the communities of our case studies. With inferential statistics Hypothesis testing was performed on the whole sample. The data was mainly ordinal and non-parametric test c^2 (Chi-squared) was run to make intelligent inferences about the study's Hypothesis. Assumptions were checked and met after running the c^2 test for analysis. The chi-square indicated that the data met the condition of having an expected count of at least 5 in each cell (0 cells (.0%) have expected count less than 5) with the minimum expected count being 13.69 (Table 3).

The chi-square tests helped to determine whether or not there was a statistically significant association between variables. In undertaking the statistical test to confirm the statistical significance of manifested building materials preference through building/house types, statistical infallibility was acknowledged that even a good sample cannot accurately represent an entire population. Therefore, cognisance of the two types of errors (Table 4) associated with statistical tests was taken to guide our purpose of hypothesis testing. Variables were ordinal and the Symmetric Measures (Table 5) gave the same values for Phi and Cramer's *V*. That presented several statistical choices to make authors chose to use Cramer's *V* to measure the effect size to indicate the strength of association between variables. The Cramer's *V* was used because crosstabulations were larger than 2 x 2.

Research Hypothesis and Testing

It is widely acknowledged that architectural designs in the tropics such as Ghana and Nigeria paid attention to climatic conditions during the colonial era (Fry, 2011; Immerwahr, 2007). For example, buildings in the University of Ibadan combine higher blocks along one axis, which captures breezes, with lower buildings set at right angles to create courtyards (Le Roux, 2003). The climate-driven architecture initiated by British modernist architects like Maxwell Fry, Theo Crosby and Kenneth Scott in West African British colonies became accepted by Nehru in India and South American political leaders (Le Roux, 2003). Independent Ghana's leadership conformed to some colonial building programmes especially those that adapted local conditions and materials. Ghana's first president, Kwame Nkrumah, for instance, acknowledged progress in climatic design as means of emancipating Ghanaians who relied on electricity to keep buildings cool (Le Roux, 2003). President Nkrumah encouraged the use of local building forms and materials and promoted traditional architecture and the use of local building materials by building round huts as dormitories for students at the Bagabaga Training College, the Catering Rest House in Tamale and the Bolgatanga Public Library.

Notwithstanding the foregoing, the research found aesthetics (44%) to be the main drive for building material preference in the warm-humid and hot-dry climates in Ghana, climatic suitability (about 34%) came second in frequency even though it is asserted elsewhere that climate is one of the main considerations influencing architecture in the tropics (Le Roux, 2003). Therefore to ascertain the level of significance of aesthetics overriding climatic considerations, chi square under hypothesis testing was used. The hypothesis considered in this paper is stated as follows:

Aesthetics (attractiveness/beauty) generally appear to be a major influencing factor of building teardowns and manifested preference of glazing/glass buildings/houses in Ghana.

H_0: it appears that *Aesthetics* and *study areas (i.e. Tamale and Kumasi)* are independent of manifested building material preference and architectural practices in Ghana (any observed association has occurred by chance).

H_1: *Aesthetics* and *study areas (Tamale and Kumasi)* are dependent of manifested building material preference and architectural practices in Ghana (any observed Association has occurred by chance).

FINDINGS AND DISCUSSIONS

This paper's Hypothesis based on a Null Hypothesis (H_0) and an Alternate Hypothesis (H_1) is discussed under this section. Aesthetics generally appear to be a major consideration in the choice of building materials in Kumasi and Tamale as stated earlier on in this paper. Building materials such as sandcrete and glass were preferred to mud or earth-based material for aesthetic reasons. Amongst others 44% of the respondents indicated aesthetics (attractiveness/ beauty) as the main reason for preferring a particular building material within Kumasi and Tamale (Table 6).

Table 3: Chi-Square Tests

Test	Value	Degrees of freedom	Asymp. Sig. (2-sided)
Pearson Chi-Square	155.646[a]	4	.000
Likelihood Ratio	152.396	4	.000
Linear-by-Linear Association	118.055	1	.000
No. of Valid Cases	1278		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.69.

Table 4: Showing possible outcomes of Type I and Type II Errors

Decision	***Null Hypothesis is***	
	True	***False***
Not reject	Correct decision	Type II error
Reject	Type I error	Correct decision

Source: Waters (1997), p.495.

Table 5: Symmetric Measures

	Measure	Value	Approx. Sig.
Nominal by	Phi	.349	.000
	Cramer's V	.349	.000
No. of Valid Cases		1278	

Table 6: Main reasons for building material preferences and architectural practices in Tamale and Kumasi

	Reason	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Cost effectiveness	113	8.8	8.8	8.8
	Climate suitability	430	33.6	33.6	42.4
	An investment	43	3.4	3.4	45.9
	Aesthetics	560	43.7	43.8	89.7
	Modernity	132	10.3	10.3	100.0
	Total	1278	99.8	100.0	
Missing	System	3	.2		
Total		**1281**	**100.0**		

Anthony Atkinson, a liaison officer in the British colonial administration who worked in West Indies, Sudan, South Africa, Australia, Singapore and Ghana, found in 1950 that alternative building materials including 'swish' (earth stabilised with concrete) was rejected by Ghanaians though the material was tested by the Town and Country Planning Board Laboratory, Accra, and approved by many architects, including Maxwell Fry and Jane Drew (Atkinson, 1950). Atkinson' s finding is still valid today as this paper reveals that respondents in the hot dry climate apparently rejected buildings with traditional architecture of thatch, mud and timber. About 30% of respondents in the warm humid climate prefer timber buildings compared to only 1.6% in the hot dry climate. Respondents in the hot dry climate have preference for building/house types made of glass and glazing.

The Pearson Chi-square results from the hypothesis testing indicated a significant positive association between Aesthetics and study areas (χ^2 =155.65; *df* =4; *N* =1278; $p < 0.05$) with an asymptotic significance level of 0. 000 (p = 0. 0005) and therefore we reject the Null Hypothesis (Table 4). That means aesthetics are more likely than expected under the Null Hypothesis to drive the manifested building material preferences in Ghana. Crosstabulation cells did produce a pattern with significant result because adjusted residuals take the form of significant association. In total 10.3% of respondents indicated modernity as the main reason for building material preferences and architectural practices in the study areas as against aesthetics (44%). Perhaps, the reason being that, today many of the modern materials such as concrete/cement-based buildings materials have had problems such as "surfaces blackened and decaying" especially in the warm-humid climate (Le Roux, 2003).

Generally, this paper argues that there is a significant association between the individual preferences in warm-humid and hot-dry climatic zones and aesthetics towards manifested preference of building materials among the sample population. A respondent in Tamale (hot-dry climate) indicated 'an aesthetic view' in an open-ended question that "a glass/glazed building is preferred because it is beautiful and catchy and will do everything to have a building in glass, to have glass building means you are civilised". Between the warm-humid and hot dry study areas as variables, the **Cramer's *V*** of 0.35 indicates a typical (medium) association. Cohen (1988) argues that guidelines for describing effect sizes do not have absolute meaning; large, medium, and small are only relative to typical findings in the areas of behavioral sciences and education. Cohen suggests the use of "larger than" instead of large, "typical" instead of medium, and "smaller than typical" instead of small. He concludes these descriptions are field dependent (Cohen, 1988).

CONCLUSION

The hypothesis test in this paper revealed aesthetics as the main drive for building material preferences in the warm-humid and hot-dry climates over climatic considerations in Ghana. This paper finds that respondents in the warm humid climate prefer timber buildings compared to those in the hot dry climate on one hand. On the other hand, the respondents in the hot dry climate have preference for building/ house types made of glass and glazing as building materials. And, therefore, this paper argues that the criteria which define judgments on building material preferences and architectural practices remain difficult to explain. By inference from the literature review together with the results from the hypothesis testing, this paper concludes that buildings materials are used in the warm-humid and hot-dry climates in Ghana, disregarding statutory regulations of architectural values and general standard of development of any particular neighbourhood since the town planning authorities are not in position to reject any application for approval of a building, if it is viewed that the building would detract from the general trend of development in a particular area. As a matter of urgency, this paper recommends a thorough reing Regulation – Legislative Instruments 1630 to help guide building practices in Ghana as nations such as Singapore have been doing to enhance sustainable architecture and buildings.

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