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## Building Houses with Locally Available Materials in Ghana: Benefits and Problems

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### ABSTRACT

The purpose of this paper was to empirically examine the major benefits and problems with houses constructed with local materials in a developing country. The study was a cross-sectional survey of fifty respondents using structured questionnaire. The study found promotion of cultural heritage, abundance of material in the locality, provision of cool room temperature and availability and affordability of local building materials as the major benefits of houses built with locally available materials in Ghana. However, low strength, frequent maintenance, requirement of increased labour work and easily wearing or erosion of the materials were found to be the major problems associated with houses built with locally available materials in Ghana. Recommendation for adoption and improvement of the locally available materials for building houses are made. This paper contributes to the body of knowledge in the area of building materials in developing country context.

**Keywords:** *Building Materials, Houses, Cost of Building, Construction Industry, Cool Room Temperature, Cultural Heritage*

### 1. INTRODUCTION

Sustainable construction requires a critical review of prevailing practices, techniques and sources for raw materials. The rising cost of building is a source of concern to most governments in the world, especially in the developing countries. One possible cause is the rising cost of building materials since greater percentage of the cost of buildings is incurred on the materials (Yalley & Kwan, 2008). In the case of Africa, for example, there is an acute lack of affordable houses which is largely due to the high cost of the conventionally processed construction materials such as steel and Portland cement. The desire generated for these materials has a negative impact, leading to reduced value and perceived inappropriateness of locally available materials. An impediment to the solution of the problem of housing is the scarcity and/or the high cost of building materials. Ideally, building materials for low-cost housing should be produced from locally available raw materials. Furthermore, it would be best if these raw materials were abundantly available or they should be renewable in nature (RICS, 2008). Over-reliance on foreign and imported building materials is not the only contributing factor of rising cost of buildings but also the transportation from urban areas to rural areas and vice versa.

The case of Ghana is not different, It doesn't seem clear, how Ghana can tackle its housing deficit which is said to be currently at 1.6 million. According to a Ghana News Agency publication of March 29, 2011, the country's housing deficit is likely to double within the next ten years citing a public data on shelter. The publication further said that though high demand for housing existed

in the country; it lagged behind in addressing the challenge. The State Housing Company (SHC) and the private sector combined are said to be delivering 25,000 new housing units onto the market each year but that looks like a drop in the ocean as calculations show that if there is a deficit of 1.6 million houses which need to be solved in the next decade, housing production must increase from 25,000 to 160,000 a year.

It is important to identify and use locally manufactured and available materials (sand, stones, grass, thatches, clay, timber, clay bricks and clay blocks) in providing houses especially in the developing countries in order to meet the housing demand of their people. By the researcher's observation there is lack of patronage of local building materials in Ghana although it is readily available and abundant in many parts of the country. There is therefore the need to conduct a study into the need for constructing houses with locally available materials in order to appreciate peoples' experience about the benefits and challenges of using local materials for building houses and again, to make recommendation for future studies to improve and make them preferable materials for building houses.

Professionals in the built environment have suggested to the government of Ghana to initiate research to promote the utilization of local content of construction materials to ensure durability and affordability in the industry (Tamakloe, 2012). They explained that "it is not in the national interest to import about 80 per cent of construction materials at the expense of local content". They also noted that the nation was endowed with local content suitable and sustainable to revamp the industry

and make it attractive for investment drive. Traditional Houses represent the heritage of a country and also reflects traditional norms and values, fundamental to the culture of the people of that country (Rumana, 2007).

There are many problems plaguing the construction industries in Africa and in other developing regions, in view of growing populations and demand for housing. The high cost of importing materials, and of producing high quality building materials domestically, are perhaps the major constraints to progress. In addition, local production of building materials in many areas cannot keep pace with demand, particularly in rural areas where there is limited access to urban factories and where transportation facilities are limited (Batcbelder et al. 1985).

In general, the use of local materials needs to be supported and reinforced to produce sufficient quantities of materials of adequate quality to withstand the effects of climatic conditions which range from humid rainy seasons to extremely hot dry seasons. Mud structures, mud and wattle buildings, and locally produced bricks and blocks do not endure for many of these seasons, and must be constantly patched and repaired (Batcbelder et al. 1985). There is therefore the need to conduct a research into benefits and problems associated with the use of locally available materials for constructing house in developing countries. The aim of the study is investigate the major benefits and problems associated with houses built with local materials.

In view of the above, the main question of this paper is: what are the major benefits and problems associated with houses built with locally available materials in Ghana? The purpose of this study, therefore, is to empirically examine and analyze major benefits and problems with houses constructed with local materials in the context of

Ghana's construction industry. The objectives of the study are:

1. To find out the major benefits associated with houses constructed with local materials in Ghana.
2. To find out the major problems associated with houses constructed with local materials in Ghana.

## 2. METHODOLOGY

By design, this sub-study which is part of a larger study was a cross-sectional survey that sought the opinion of people who have lived in houses built with both local and conversional materials before about the benefits and problems with houses built with local materials. The target population was adults in Dorongo community (about 5 km from Bolgatanga, the capital of Upper East Region, Ghana) who have had the opportunity and experience in residing in houses built with local and conversional materials before and can therefore compare and tell the good and problematic aspects of such houses. This community was selected for the study due to the fact that, it is a small community with presence of houses built with both local and conversional materials (see Figure 1). A snowball sampling technique was adopted to identify people who have lived in such houses to seek their opinion. This is because according to Ofori and Dampson (2011, p. 22) with this approach to sampling, the researcher makes initial contact with a small group of people who are relevant to the research topic and uses these to establish contact with others.

Self-administered structured questionnaire was used. The items for identifying the benefits of houses built with local materials are presented in Table 2 while that for the problems associated with houses built with local materials are presented in Table 3.



Figure 1: Houses built with local and conversional materials in Dorongo, Upper East Region

The respondents were asked to rate their disagreement or agreement of the benefits and problems with houses built with local materials on a five-point Likert scale. The scale ranged from: strongly disagree (1) to strongly agree (5). It had three items for respondents' demographics. Content validity was established by a panel of two construction experts; construct validity was ensured by critically developing it within established theoretical framework. Cronbach alpha reliability tests for both constructs were above the recommended 0.70 (Straub, et al., 2004), and a composite reliability of all the 11 measurement items yielded a composite value of 0.793. Therefore the scales could be considered reliable. The questionnaire was pre-tested using a sample of 10 people who live near Dorongo community to identify any ambiguous items for refinement. Finally it was administered to the respondents through personal contact with the assistance of trained research assistants.

A total of 50 respondents returned their questionnaire out of 65 sent out representing 76.9% response rate. The data was analyzed using descriptive statistics to determine the major benefits and problems associated with houses built with local materials. The mean rating of both constructs for each item were computed with SPSS Version 16.0. Thereafter, the computed mean ratings were compared

with the theoretical mean rating (assuming normal distribution of responses above neutral) of 4.0 to determine the major benefits and problems of houses built with local materials. Any computed mean of an item relating to the benefits and problems of houses built with local materials equal or exceeding 4.0 indicated expression of benefits or problems of houses built with local materials, while values below 4.0 indicated expression of minor benefits and problems of houses built with local materials.

### 3. RESULTS AND DISCUSSION

The results obtained are presented and discussed under the following subheadings: respondents' demographics, benefits of building houses with locally available materials and problems associated with houses built with locally available materials, in order to address the research questions.

#### 3.1 Respondents' Demographics

The characteristics of the respondents are presented in Table 1.

**Table 1: Demographic profile of respondents (n = 50)**

Category	Number of respondents	Percentage (%)
<i>Gender</i>		
Male	35	70.0
Female	15	30.0
<i>Age</i>		
< 30 years	5	10.0
30 – 39 years	9	18.0
40 – 49 years	17	34.0
50 – 59 years	12	24.0
≥ 60 years	7	14.0
<i>Preference for Local Material</i>		
Soil / Earth	31	62.0
Agricultural waste	11	22.0
Industrial waste	8	16.0

For the characteristics of the respondents, in terms of gender, 70% of the respondents were males and 30% were females, implying that majority of the respondents were males. 10% of the respondents were below 30 years, 18% were between the ages of 30 and 39 years, 34% were between 40 and 49 years, 24% were between 50 and 59 while 14% were 60 years and above. This implies that majority (72%) of the respondents were 40 years and beyond. In terms of preference for locally available material for building houses, 62% preferred soil/earth, 22% preferred agricultural waste while 16% preferred

industrial waste. This means that most of the respondents preferred the use of soil/earth as a local material for building house.

#### 3.2 Benefits Associated with Houses Built with Local Materials

In addressing the first objective, respondents were asked to rate their agreement or disagreement to the items in the Table 2. The results obtained are presented in Table 2.

**Table 2: Benefits of building houses with locally available materials**

Items	Mean	Std. Deviation	Ranking
Promotion of cultural heritage	4.760	0.476	1 <sup>st</sup>
Abundance of material in the locality	4.340	1.154	2 <sup>nd</sup>
Provision of cool room temperature	4.220	1.016	3 <sup>rd</sup>
Local building materials are affordable and cheap	4.200	1.069	4 <sup>th</sup>
Local building materials provide less environmental effect	2.720	1.107	5 <sup>th</sup>
Local building materials have fire resistance characteristics	2.420	1.089	6 <sup>th</sup>

With reference to Table 2, the respondents ranked promotion of cultural heritage at first (1<sup>st</sup>) position as the major benefits of houses built with locally available materials with mean rating of 4.760 and standard deviation of 0.476, followed by abundance of material in the locality which was ranked second (2<sup>nd</sup>) position with mean rating of 4.340 and standard deviation of 1.154. Provision of cool room temperature was ranked third (3<sup>rd</sup>) with mean rating of 4.220 and standard deviation of 1.016, and at the fourth (4<sup>th</sup>) ranked position was local building materials are affordable and cheap with mean rating of 4.200 and standard deviation of 1.069. These were the major benefits of houses built with locally available materials.

However, local building materials provide less environmental effect was ranked fifth (5<sup>th</sup>) as a minor benefit of building houses with locally available materials with mean rating of 2.720 and standard deviation of 1.107, which was followed by local building materials have fire resistance characteristics at sixth (6<sup>th</sup>) position with mean rating of 2.420 and standard deviation of 1.089. These items were rated by the respondents as minor benefits of houses built with locally available materials.

The highest ranked benefit of houses built with locally available material according to the respondents responses was promotion of cultural heritage. This is probably due to the fact that the traditional people are able to incorporate into the design of the houses built with locally available materials their cherished cultural patterns as well as the symbols of their beliefs and values. In so doing they are able to preserve and also promote their cultural heritage. This result is in line with Rumana (2007) assertion that traditional house reflects cultural heritage of peoples and also encapsulate traditional norms values. Additionally, Steele (1988) explained that the practice of drawing on traditional architecture to inform

contemporary design has been promoted by many theorists and distinguished architects.

The respondent ranked abundance of material in the locality as the next benefit of houses built with locally available materials because the people always use the materials that are not only available but also abundant in their area. The reason might be that they get access to the materials in their locality and also in the quantity that they need for building their houses. This finding is parallel with the view of Sarkar (2006) that mud is a material available everywhere in abundance free of cost and is being used as building material from centuries.

Provision of cool room temperature was also found as a major benefit of houses built with locally available material. It is an undeniable fact (especially in warm climate areas) that houses built with local materials have cool room temperature particularly with houses built with soil or earth and thatches. Earth as a material is such that it does not easily allow heat to pass through. This characteristic of earth makes it possible to prevent heat at the external part of any building from reaching the internal part of the building. As expressed by Sarkar (2006) that mud houses are most effective since they are environmental friendly, cool in summer and warm in winter. Laterite makes an excellent material for walling; it is easily obtained, cheap and gives a cool room temperature; especially in developing countries where the weather condition is normally warm (Heathcote, 1995). Houses built with earth tend to be naturally cool in the summer heat and warm in cold weather.

Finally, the last major benefit of houses built with local materials according to the respondents was that local building materials are affordable and cheap as also stated by Heathcote (1995). Furthermore, Arumala and Gondal (2007) explained that soil is one of the oldest building materials readily available, cheap, among others. Normally, the local building materials are not bought, the

cost incurred in obtaining them are for those who will fetch the materials, example hiring people to cut palm front, dig the earth and cut bamboo. This makes it cheap and affordable for obtaining local materials for building houses.

### 3.3 Problems Associated with Houses Built with Local Materials

The results obtained when the respondents were asked to rate their experiences on the problems associated with houses constructed with local materials are presented in Table 3.

**Table 3: Problems associated with houses built with locally available materials**

Items	Mean	Std. Deviation	Ranking
Houses built with local materials have low strength	4.600	0.728	1 <sup>st</sup>
Houses built with local materials require frequent maintenance	4.360	1.174	2 <sup>nd</sup>
Houses built with local materials require a lot of labour work	4.200	1.212	3 <sup>rd</sup>
Houses built with local materials ware or erode so easily	4.140	0.729	4 <sup>th</sup>
Houses built with local materials are easily attacked by rodents/pests	3.560	0.929	5 <sup>th</sup>

The result as presented in Table 2 indicates that houses built with local materials have low strength was ranked first (1<sup>st</sup>) as the major problem of houses built with locally available materials with mean rating of 4.600 and standard deviation of 0.728, followed by houses built with local materials require frequent maintenance which was ranked second (2<sup>nd</sup>) position with mean rating of 4.360 and standard deviation of 1.174. Houses built with local materials require a lot of labour work was ranked third (3<sup>rd</sup>) with mean rating of 4.200 with standard deviation of 1.212. At the fourth (4<sup>th</sup>) ranked position was houses built with local materials ware or erode so easily with mean rating of 4.140 and standard deviation of 0.729. These were the major problems of houses built with locally available materials.

On the other hand, houses built with local materials are easily attacked by rodents and pests was ranked fifth (5<sup>th</sup>) as a minor problem of houses built with locally available materials with mean rating of 3.560 and standard deviation of 0.929. This implies that the respondents perceived attack by rodents and pests on building with local materials as not a serious problem.

The highest ranked problem of houses built with locally available materials was the low strength of the houses, implying that the locally available materials have strength that is below the expectation of the users. Probably, the respondents compared the strength of the houses built with local materials with that of the conventional materials such as cement, concrete, steel rods, among others. The strength of every house is important because it determines the durability and security of the house. This finding is consistent with the view of Venkatarama and Prasanna (2009) that one of the drawbacks for using earth alone as a material for construction is its durability which

is strongly related to its compressive strength. Riza et al. (2011) further explained that most soil in their natural condition lack the strength, dimensional stability and durability required for building construction. The above indicates that the local materials for building houses lack the desired strength and improvement of their strength properties would be beneficial to the users.

Frequent maintenance of houses built with local materials was the second ranked problem. This result is supported by Rumana (2007) that there is high maintenance requirement of earthen plinth and walls which are often plastered, especially during the wet season. This is due to the low strength of the materials that make it a requirement for the frequent maintenance in order to keep the building is good condition for use. If the houses built with local materials are not maintained regularly, they will deteriorate in some few years after their construction due to their vulnerability to weather such as rain and storm.

The next ranked problem with houses built with locally available materials was the requirement of intensive labour work. This result is confirmed by Harper (2011) that mud buildings require labour intensive work. Extensive labour work is required in constructing houses with locally available materials due to the fact that the activities involved in fetching and preparing the materials are considered part of the entire labour works of the project. However, the labour works from the acquisition of the raw materials and their manufacturing for houses built with conventional materials are not considered as part of the labour works required for the construction of such houses. Additionally, most of the building units such as earth brick, blocks, thatches, bamboo and sticks used for building houses are small in sizes and therefore

require a lot of labour works to construct such houses. Rumana (2007) further stated that there is high labour requirement for regular repair of earthen houses.

Finally, the last ranked major problem with houses built with local materials was that they wear or erode so easily. This result is parallel with that of Alexander (1992) that one of the effects of earthen buildings is the erosion of the soil caused by excessive runoff and the addition of significant weight to the running material due to the accumulation of large amounts of water in between houses. Soil or earth is a material whose constituents easily separate and allows for greater percolation when get in contact with water. This characteristic cause erosion to the materials and therefore makes it problematic for construction of houses.

#### 4. RECOMMENDATION

On the bases of the above results and discussion, the following recommendations are made:

1. Since the highest ranked benefit of houses built with locally available material was promotion of cultural heritage, governments of developing countries should encourage the use of locally available materials for building houses so as to promote their culture and attracts tourists in their country for economic growth.
2. Because the next benefit was abundance of material in the locality, real estate developers and governments of countries with high housing deficit should encourage the use of local materials in constructing houses in order to reduce the housing deficit and also produce affordable housing.
3. Provision of cool room temperature was also found as a major benefit of houses built with locally available material. It is therefore important for people living in hot weather like Sub-Sahara African to adopt the use of local materials for their housing in order to reduce the effect of heat from the hot weather on their health and the amount of energy required to fan and air-condition their rooms for comfort.
4. Since the highest ranked problem of houses built with locally available materials was the low strength of the houses and the last ranked major problem was easy erosion of the local materials, future researchers should consider researching into how to reinforce the mechanical and durability properties of the local materials with industrial and agricultural wastes or other conventional materials to ensure long lasting of the houses built with local materials.

5. Due to the finding that house built with local materials require intensive labour works, researchers and academicians should investigate and come out with better processes and methods of using the local materials for housing which will reduce the labour intensiveness with their use.

#### 5. CONCLUSION

The purpose of this study was to empirically examine and analyze the major benefits and problems with houses constructed with local materials in a developing country context. The study found promotion of cultural heritage, abundance of material in the locality, provision of cool room temperature and local building materials being affordable and cheap as the major benefits of houses built with locally available materials in Ghana. On the other hand, low strength, frequent maintenance, requirement of intensive labour work and easily wearing or erosion of the materials were found to be the major problems associated with houses built with locally available materials in Ghana. Recommendation for adoption and improvement of the locally available materials for building houses are made.

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