

## PERSPECTIVES ON EFFECTIVENESS OF GYPSUM BOARD OVER SANDCRETE BLOCK AS WALLING MATERIAL

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### ABSTRACT

Alternative material for construction of walls is gradually coming to stay in view of the scarce nature of traditional concrete material that is often being used. In the choice of suitable alternative walling material such as Gypsum board presented in this study, parameter such as cost, durability, shelf live among others need to be considered. It is based on this premises that perspectives on effectiveness of Gypsum board over sandcrete blocks as walling material. The analysis of the primary data received through the administered questionnaires was done using the Statistical Package for Social Sciences (SPSS), a software package developed for data analysis. Ninety-five (95) questionnaires were distributed to various construction organizations. The data was analyzed using the Mean Index Score (MIS) method of ranking. the research showed that the use of gypsum wallboard will be beneficial in terms of time, ease of construction and handling; it is not yet manufactured in Nigeria and will require some special training for manufacture and installation by local technicians or artisans. the research showed that the board is durable especially for construction of non-load bearing walls as it is not subjected to too much stress so it can last for very long periods.

Nine, the research proved that the effect of the Nigerian weather on the board is minimal. The board panels are used for internal walling and are not affected by the sun or rain or extreme temperatures and therefore are not damaged easily. The board however is affected by the foundation on which it stands, therefore, if the foundation is stable, failure free and water free, the gypsum panel wall also remains stable and damage free.

**KEYWORDS:** Gypsum, Effectiveness, Wall, Sandcrete, Board

### INTRODUCTION

Building construction has passed through a revolution in Nigeria. In the early stages of development in Nigeria, empires like Benin, Kano and the like were best known for their prestigious structures, most made from basic materials; mud, bamboo, wood, metal and other natural materials available at their disposal. These materials, though common at the time were not durable, as most could not withstand the effects of natural elements (flooding, heavy rainfall and such), this made the acceptance of western building materials much easier during the colonial era.

In the early days of the settlement, the laterite was used in its "raw", unmolded form, as opposed to the present-day trend of making it first into bricks. An area of land was set apart as a "borrow-pit", and the laterite was dug up by communal effort. This was normally done during the rainy season, when there would be plenty of water available for the treading (and general conditioning) process, which would follow the digging. The laterite was then well-moistened

with water and trodden under dozens of unshod feet. This treatment was repeated about thrice (in the course of about a fortnight), till the laterite was soft and fine in texture. It was then finally heaped up on the site (called atebo), and covered with large plantain/ banana leaves, to prevent it hardening quickly. And using the laterite just like that, was popular till early in the 1970s, when a number of innovations were made. (Source: Cordelia O. Osasona, *Traditional Building Forms & Techniques*, Ijebu-Ode, Nigeria). With further development, the use of laterite in its raw form was soon phased out as it became easier to use it in the brick and block form. The laterite was molded in the shape of a block and was easier to transport and use. This innovation made the Sandcrete block readily accepted in the country. 'Sandcrete block is now the main material used in construction of wall units in building construction in Nigeria and Ghana for load bearing and non-load bearing walls' (Anosike and Oyebade, 2011).

## **GYPSUM EXPLAINED**

Gypsum is a naturally occurring mineral resource found in many areas in the world and is mined just like any other mineral. According to Wikipedia, it is a soft sulfate material chemically made up of Calcium Sulphatedihydrate (Chemical Formula:  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ). in their publication in the *Journal of Fire Sciences* (Vol. 9), Kontogergerous, Mandilaras & Founti described gypsum as a crystalline mineral of calcium sulphate with chemically bound water which aids its resistance to fire. It has a hardness definition of 2 on the Mohs scale of mineral hardness. The word Gypsum was formed from the Greek word "gypsos" which means "chalk" or "plaster", and since large amounts of gypsum obtained from the quarries in the Montmartre district in Paris were dehydrated and used for many different purposes, it quickly became widely known as Plaster of Paris as it is still called today.

This Plaster of Paris was unique based on the fact that upon addition of water, it returns back to its original "gypsum" state and can be cut and set in different forms as desired (Source: Wikipedia). Gypsum is found in strata in different countries and regions in the world. It is deposited by water bodies (hot springs, lakes and sea water) and by volcanic vapour which means it can be mined anywhere in the world under the right circumstances, even in Nigeria. The gypsum board was first made by an American, Augustine Sackett in 1888. He wedged the plaster of paris between several layers of paper forming a thick board with a hardened exterior due to the compressive force used to hold the layers together. He called this board the "Sackett board", his own patent covered wallboard. It soon evolved quickly after that and even spread to other areas, mainly Britain. The hard exterior makes it even more useful as it can be finished in any way as desired with paint and other finishing agents. Gypsum board is manufactured in panels of standard lengths and widths. The thickness is determined by its function and gypsum core.

## **GRADES OF GYPSUM BOARD**

There are different grades of gypsum board, classified according to functions of structural stability, acoustic properties, fire resistance and the kind of material used for the surface. It is also classified according to size and shape of the edges that will be attached to the frames (this classification depends on the designs from the manufacturer). Some examples of the different edges available are rounded, tapered, beveled, square edge, and tongue and groove (V-edge).

## **RESEARCH METHODOLOGY**

The purpose of this research study was to create awareness of the use of gypsum board, determine the advantages and cost effectiveness and also to examine its usefulness in the Nigerian weather and climate. This study hoped to provide

empirical data to the advantages of using gypsum board as a solution to the high cost of Sandcrete block wall in the industry.

Research methodology as “The process used to collect information and data for the purpose of making business decisions” by the BusinessDictionary.com. In relation to this study, it is the process or methods involved in gathering data, analyzing such data and drawing relevant conclusions from the data collected in line with research that has already been carried out.

The bulk of data collected has been through review of relevant literature to the study obtained from related articles, journal publications, manufacturer’s website and records and well as other unpublished material.

## **RESEARCH DESIGN**

The research design most appropriate for this study is determined to be the Survey Research Design. The survey research design is concerned with the structuring of an investigation for the purpose of identifying the relevant variables and their relationships with one another (Ojo, 2005). The SSRIC (1998,) in a publication defined Survey research simply as a method of asking questions, either through face-to-face interviews or by sending and receiving mails. Survey research design can be further subdivided into descriptive, explanatory and exploratory research designs. For this study, two of these research designs were adopted. The first was the Exploratory research design, to collect data through review of literature, interaction and interviews with manufacturers, as well as studies of existing structures constructed with the gypsum board over time. The other research design applied is the Descriptive research design. The Descriptive research design was used to collect descriptive opinions, views and awareness of a certain group of professionals concerning the use of the gypsum board.

## **DATA COLLECTION**

To obtain this data, appropriate questionnaires were distributed to selected professionals in construction organizations in Lagos, Nigeria, about 100 professionals in total. The questionnaire was developed through an extensive review of literature, bearing in mind the aims and objectives of the study.

## **RESEARCH POPULATION**

The research population consists of professionals in the Nigerian construction industry with considerable years of experience in the industry across Lagos state, 10 different construction organizations will be visited. Clients who already have buildings partially or entirely constructed with gypsum board will also be included in the research as their satisfaction with the product, both cost wise and general structural soundness.

## **SAMPLE SIZE**

Determining a sample size is the process of choosing the number of observations for a study. A sample consists of selected elements, subjects or observations from a given population. In this research study, sample size determination is an important aspect to examine due to difficulty in studying the whole population, Ojo (2005). The analysis of the primary data received through the administered questionnaires was done using the Statistical Package for Social Sciences (SPSS), a software package developed for data analysis. The SPSS is a statistical package that provides powerful statistical analysis and data management system in a graphical environment and offers the analysis of different statistical features embodied in

a set of data which can be represented in various graphical forms,95 questionnaires were distributed to various construction organizations and 72 of them were returned.

**EFFECTIVENESS OF THE GYPSUM WALL BOARD ON CONSTRUCTION PROJECTS**

The effectiveness of the gypsum wallboard through the questionnaire was determined through a series of well-structured questions in this section. The questions asked were on the availability of the gypsum wallboard and the supporting accessories for purchase at the manufacturing company, there are other questions asked on the effects of Nigerian weather on the gypsum board. Questionnaires were also distributed to the specialists trained by the manufacturing company in assembling and construction of buildings using the drywall, project owners (Clients) responded based on their experience with the board since the completion of their projects.

The data was analyzed using the Mean Index Score (MIS) method of ranking. The frequency of replies for each question was measured using the MIS formula and ranks from 1 to 7 were developed. The MIS formula used to determine the ranking of effectiveness of gypsum board is shown below:

$$\frac{5(S.A) + 4(A) + 3(S.D) + 2(D) + 1(U)}{5(S.A + A + S.D + D + U)}$$

Where S.A represents **Strongly Agree**<sup>[1]</sup> A represents **Agree**<sup>[2]</sup> U represents **Uncertain**<sup>[3]</sup>  
 D represents **Disagree**<sup>[4]</sup> S.D represents **Strongly Disagree**<sup>[5]</sup>

**Table 1: Ranked Responses to Questions in Section C**

Effectiveness of Gypsum Board	Strongly Agree	Agree	Strongly Disagree	Disagree	Uncertain	MIS	Rank
Accessories readily available for purchase	13	48	1	1	9	0.7528	1 <sup>st</sup>
Handling of Gypsum Panels	11	46	0	1	14	0.7083	2 <sup>nd</sup>
Gypsum panel readily available for purchase	12	44	0	3	14	0.7083	3 <sup>rd</sup>
Gypsum Board is structurally acceptable	19	22	12	5	14	0.6750	4 <sup>th</sup>
Gypsum Board will reduce construction cost.	5	31	0	7	21	0.6000	5 <sup>th</sup>
Specialists readily available to assemble panels	4	39	0	4	29	0.5806	6 <sup>th</sup>
Effects of Nigerian weather on gypsum board	5	23	6	9	29	0.5056	7 <sup>th</sup>

(Source: Field Survey 2014)

The Table 1 shows that the gypsum board, in terms of effectiveness is most effective in purchase of materials needed for installation with the mean index score of 0.752 meaning that the majority of respondents agree that it is readily available to purchase. The next 2 elements ranked on the list, both equally ranked with a ranking of 0.7083 are the purchase of gypsum board and the handling (transport, storage and use) of the board. It can be said that the boards are easy to buy, store and use without much loss or damage. The board was ranked 4<sup>th</sup> in terms of structural soundness, for internal non-load bearing walls as being effective. Ranked 5<sup>th</sup> is the fact that the use of gypsum board will reduce construction cost, as it is seen in the frequency of the items in Table 1 above, that most respondents agree that it will reduce costs while the

lesser majority are uncertain in that area. The availability of specialists to construct or install the drywall was ranked 6<sup>th</sup> in being effective while the 7<sup>th</sup> ranking was the effect of Nigerian weather on the gypsum board. From the ranking above it can be concluded that the gypsum board is most effective to purchase and construct.

**Table 2: Frequency Distribution of Respondents on Structural Stability of Gypsum Board**

Structural Stability and Acceptance	Frequency	Percentage
strongly agree	19	26.4
Agree	22	30.6
uncertain	14	19.4
disagree	5	6.9
strongly disagree	12	16.7
<b>Total</b>	<b>72</b>	<b>100.0</b>

(Source: Authors Field Survey 2014)

Table 2 above shows the frequency distribution of respondents about their opinion of the structural stability of the gypsum board. The majority of the populace agrees that it is structurally acceptable. 26 % strongly agree that the board is structurally sound, 30% also agree to that fact. 19% percent are uncertain about the structural stability of the panel while 6.9 merely disagreed.

**Table 3: Cost Reduction Effectiveness of Gypsum Board in Place of Sandcrete Blocks**

Construction Cost Reduction Using Gypsum	Frequency	Percent
strongly agree	5	6.9
agree	39	54.2
uncertain	21	29.2
disagree	7	9.7
<b>Total</b>	<b>72</b>	<b>100.0</b>

(Source: Authors Field Survey 2014)

Table 3 shows that 54% of the research population agrees that using gypsum board reduces construction cost in place of Sandcrete blocks. 29% are uncertain; the gypsum board might not necessarily reduce the cost of construction compared to using Sandcrete. About 9% of the populace disagree that using gypsum board will construction cost cheaper.

**Table 4: Frequency Distribution for Handling of Gypsum Board in Nigeria**

Ease of Handling (Transport, Storage and Installation) of Gypsum Board	Frequency	Percentage	Cumulative Percent
strongly agree	12	16.7	16.7
agree	44	61.1	77.8
uncertain	13	18.1	95.8
disagree	3	4.2	100.0
<b>Total</b>	<b>72</b>	<b>100.0</b>	

(Source: Authors Field Survey 2014)

From the table above, it can be said that most respondents agree that the gypsum board is easy to transport, store and construct (install), 61% of the respondents agree to this and 16% more strongly agree. 18% of the research population is uncertain about the ease of handling while 3% disagree

**Table 5: Availability of Gypsum Board for Purchase**

Availability of Gypsum Board for Purchase	Frequency	Percent	Cumulative Percent
strongly agree	11	15.3	15.3
agree	46	63.9	79.2
uncertain	14	19.4	98.6
disagree	1	1.4	100.0
<b>Total</b>	<b>72</b>	<b>100.0</b>	

(Source: Authors Field Survey 2014)

Table 5 shows from that a large proportion of the population agrees that the gypsum panels are relatively easy to purchase and are readily available. About 19% are unsure about the availability of the gypsum panels while 1.4% did not agree that the gypsum panels are readily available.

**Table 6: Availability of Assembly Specialists**

Availability of Specially Trained Assembly (Installation) Specialists	Frequency	Percent	Cumulative Percent
strongly agree	4	5.6	5.6
agree	39	54.2	59.7
uncertain	25	34.7	94.4
disagree	4	5.6	100.0
<b>Total</b>	<b>72</b>	<b>100.0</b>	

(Source: Authors Field Survey 2014)

Table 6 above shows the frequency distribution of the respondents' opinion on the availability of installation specialists to construct the drywall. 54.2% of the respondents agree and 5.6% strongly agree that the specialists that build drywall are easy to find and are available for work, 34.7% were uncertain whether or not the specialists are available while 5.6% disagreed that the specialists were readily available.

**Table 7: Frequency Distribution for Cost Reduction Using Gypsum Board**

Construction Cost is Reduced When Gypsum Board as a Substitute for Sandcrete Block Wall	Frequency	Percent	Cumulative Percent
strongly agree	5	6.9	6.9
agree	39	54.2	61.1
uncertain	21	29.2	90.3
disagree	7	9.7	100.0
<b>Total</b>	<b>72</b>	<b>100.0</b>	

(Source: Field Survey 2014)

From Table 7 above submitted as follow: respondents that strongly agree that the gypsum board will reduce costs in wall construction is 54.2% and 6.9%. Also, 29.2% of the populace is uncertain whether or not the use of gypsum board in place of Sandcrete block will reduce construction cost, while the remaining 7% completely disagree.

**Table 8: Frequency Distribution on Effects of Nigerian Weather on Gypsum Board**

	Frequency	Percent	Cumulative Percent
strongly agree	5	6.9	6.9
agree	23	31.9	38.9

**Table 8: Contd.,**

uncertain	29	40.3	79.2
disagree	9	12.5	91.7
strongly disagree	6	8.3	100.0
<b>Total</b>	<b>72</b>	<b>100.0</b>	

(Source: Field Survey)

Table 8 shows the opinion frequency of respondents on the effects of Nigerian weather on the gypsum board. 6.9% of respondents strongly agree that the weather does not affect the gypsum board adversely, 31.9% also agree to this. A slightly percentage (40.3%) is uncertain of the effects of weather on the gypsum board. 12.5% disagree that the Nigerian weather does not affect the gypsum board: that means that the weather does in affect the gypsum board. Interactions with some of the respondents felt that the tropical weather (rain and heat) affect the gypsum board and it could start to crack or soften at the bottom where dampness is most likely to begin.

**GENERAL OPINION ON GYPSUM BOARD AND DRY CONSTRUCTION IN NIGERIA**

The opinion of the respondents on application of gypsum board and dry construction in construction of non-load bearing walls, and for construction of public housing units for citizens. The schedule is as presented in Table 9.

**Table 9: Dry Construction in Nigeria**

Dry Construction in Nigeria	Strongly Agree	Agree	Strongly Disagree	Disagree	Uncertain	MIS	Rank
Gypsum as a fully recognized substitute for Sandcrete in wall construction	21	34	0	2	13	0.7278	1 <sup>st</sup>
Gypsum as major material for public housing in Nigeria	11	33	2	20	6	0.6639	2 <sup>nd</sup>

The table above shows the ranking or responses from this section. Ranked first is the fact that the use of Gypsum wallboard should be encouraged in place of Sandcrete blocks in construction in the country. In second, with a ranking of 0.6639 was the respondents’ opinion on the use of gypsum board for public housing units in Nigeria. While most of the respondents agreed that it should be used for public housing, to provide more homes for citizens, a lesser majority do not agree with this concept, for various reasons.

**Table 10: Encouraging the use of Gypsum Board in Nigerian Construction Industry**

Gypsum Board Should be Encouraged in Nigerian Construction Industry	Frequency	Percentage (%)	Cumulative Percent
strongly agree	21	29.2	29.2
agree	34	47.2	76.4
uncertain	13	18.1	94.4
disagree	4	5.6	100.0
<b>Total</b>	<b>72</b>	<b>100.0</b>	

The Table 10 above shows that the majority of the research population agrees that the use of gypsum board should be encouraged in the Nigerian construction industry; 47.2% and 29.2% of the entire populace strongly agree. 18.1% of the populace for various reasons is unsure whether or not this should be while 5.6% clearly disagree.

**Table 11: Use of Gypsum Board for Public Housing in Nigeria**

	Frequency	Percentage (%)	Cumulative Percent
strongly agree	11	15.3	15.3
agree	33	45.8	61.1
uncertain	6	8.3	69.4
disagree	20	27.8	97.2
strongly disagree	2	2.8	100.0
<b>Total</b>	<b>72</b>	<b>100.0</b>	

When asked if the use of gypsum board should be encouraged in construction of public housing units, 15.3% of respondents strongly agreed, 45.8% merely agreed, 8.3% of the entire population were unsure while 27.8% disagreed that the board should be used for various reasons and 2.8% strongly disagreed. From personal interactions with a few of the respondents, it was deduced that the large number of disagreements resulted from the fact that they believe those that will be living in these public housing units will most likely cause damage to the board because they have very little knowledge in maintenance.

## DISCUSSIONS OF FINDINGS

From the table of ranking of responses to section c, it can be seen that the majority of respondents agree that the gypsum board is effective in all areas as questioned in that section. Table 5 showed that the gypsum board, in terms of effectiveness is most effective in purchase of accessories needed for installation with the mean index score of 0.752 meaning that the majority of respondents agree that it is readily available to purchase.

The next two (2) elements ranked on the list, both equally ranked with a ranking of 0.7083 are the purchase of gypsum board and the handling (transport, storage and use) of the board. It can be said that the boards are easy to buy, store and use without much loss or damage. The board was ranked 4<sup>th</sup> in terms of structural soundness, for internal non-load bearing walls as being effective. Ranked 5<sup>th</sup> is the fact that the use of gypsum board will reduce construction cost.

This shows that the gypsum board is effective to purchase and construct according to the opinion of the respondents. Personal interviews with some of the respondents revealed that the gypsum board is indeed effective also when considering labor, cost of construction and construction time. They attested to the fact that with the right tools and accessories and well trained drywall construction specialists, the drywall is quick to construct because of its lightweight nature and prefabricated edges for installation.

## SUMMARY OF RESULT ANALYSIS

The outcome of analysis is as summarized below

- The Table 5 shows that the gypsum board, in terms of effectiveness is most effective in purchase of materials needed for installation with the mean index score of 0.752 meaning that the majority of respondents agree that it is readily available to purchase. Other ranks, from 2nd to 7th of elements, prove that the gypsum board is effective in terms of cost from purchase to construction.
- Tables 6 through to 11 shows the frequency distribution of respondents answers to questions in Section C and confirms the effectiveness of the gypsum board.
- Table 11 shows the ranking of responses to questions in section D. Ranked first is the fact that the use of Gypsum

wallboard should be encouraged in place of Sandcrete blocks in construction in the country. In second, with a ranking of 0.6639 was the respondents' opinion on the use of gypsum board for public housing units in Nigeria. While most of the respondents agreed that it should be used for public housing, to provide more homes for citizens, a lesser majority do not agree with this concept, for various reasons. It can be concluded that the use of Gypsum board should be encouraged as a major substitute for Sandcrete block in construction of non-load bearing walls.

- In Table 11 opinions on the use of gypsum board was encouraged in the Nigerian construction for public housing units, 15.3% of respondents strongly agreed, 45.8% merely agreed, 8.3% of the entire population was unsure while 27.8% disagreed that the board should be used for various reasons and 2.8% strongly disagreed.
- Interactions with some respondents showed that the large number of the respondents that disagreed resulted from the fact that they believe those that will be living in these public housing units will most likely cause damage to the board because they have very little knowledge in maintenance.
- The Table 11 showed that the majority of the research population agrees that the use of gypsum board should be encouraged in the Nigerian construction industry, 47.2% and 29.2% of the entire populace strongly agree. 18.1% of the populace for various reasons is unsure whether or not this should be while 5.6% clearly disagree. This shows that while most respondents agree that it would be helpful to encourage the use of gypsum board in Nigerian construction.
- Table 8 shows the opinion frequency of respondents on the effects of Nigerian weather on the gypsum board. 6.9% of respondents strongly agree that the weather does not affect the gypsum board adversely, 31.9% also agree to this. A percentage (40.3%) of respondents is uncertain of the effects of weather on the gypsum board. 12.5% disagree that the Nigerian weather does not affect the gypsum board: that means that the weather does in affect the gypsum board. This showed, and from interactions with respondents that the tropical climate of Nigeria will not affect the use of gypsum board.

## CONCLUSIONS

This study assessed the awareness and the cost effectiveness of using the gypsum board in Nigeria. The study carefully assessed the various factors involved in determining how effective it would be to encourage the use of gypsum board for non-load bearing walls for residential and other construction purposes in Nigerian construction. The result of the study was based on the analysis of data collected from a selected population, thus arriving at the following conclusions:

First, the study showed that the use of gypsum board has been in use since it was first developed in 1899 in the USA, though it is not commonly used in Nigeria, a large percentage of the Professionals in the construction industry are aware of its use. Second, the research showed that the use of gypsum wallboard will be beneficial in terms of time, ease of construction and handling; it is not yet manufactured in Nigeria and will require some special training for manufacture and installation by local technicians or artisans.

Third, there are no sources of production of the gypsum board in Nigeria; the board panels are imported from other countries where it is used and produced in bulk, then imported through Nigerite, which is a sister company to SINIAT.

Fourth, the research showed that the gypsum board panels are not produced in Nigeria, with the large amounts of gypsum deposits in Nigeria; it is possible for Nigeria to begin production in the nearest future.

Five, the research showed that the level of satisfaction of clients who have used the gypsum wallboard is very high. Six, from the opinion of the specialists who installed the gypsum board, the study showed that the use of gypsum board is relatively easy and stress free, requires little time and effort to install. Seven, the study showed that the use of gypsum board also encourages variation in design as it can be constructed with bends and turns that cannot easily be achieved using Sandcrete blocks. Eight, the research showed that the board is durable especially for construction of non-load bearing walls as it is not subjected to too much stress so it can last for very long periods. Nine, the research proved that the effect of the Nigerian weather on the board is minimal. The board panels are used for internal walling and are not affected by the sun or rain or extreme temperatures and therefore are not damaged easily. The board however is affected by the foundation on which it stands, therefore, if the foundation is stable, failure free and water free, the gypsum panel wall also remains stable and damage free.

## RECOMMENDATIONS

- Housing shortage for the population in the country calls for all tiers of the government, local, state and federal to be aware of the cost effectiveness of using the gypsum board in construction of public housing units for the citizens.
- The use of the board should be encouraged and made more popular in the construction industry amongst the professionals so that the obstacle areas, mostly the price of installation accessories can be settled in time, making the use of the gypsum board more effective.
- Project owners should be made aware of the cost benefits of using gypsum board.
- The manufacture of gypsum board from the availability will create employment for the largely unemployed citizenry and encourage economic development by generation of income for the country.
- More tests and research studies should be carried out on the effectiveness of using gypsum board in Nigeria in all other areas

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