International Journal of Latest Research in Engineering and Technology (IJLRET)
ISSN: 2454-5031
www.ijlret.com || Volume 08 - Issue 03 || March 2022 || PP. 20-25

Prospects of Utilization of Alucobond as Wall Finish in Mercantile Buildings in Tropical Climate

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Abstract: Finishing is one of the most paramount aspects of every building construction because it is the final construction stage of every building, hence needs adequate technical attention. The use of alucobond as wall cladding in modern building construction shows an acceptable advancement in wall finishing. This research work assessed the merit, demerit, and relevances of the utilization of alucobond as a wall finish in mercantile buildings in Tropical climates using Imo State as a case study. The research was pursued using a structured questionnaire administered to the registered professional builders in Imo state, Nigeria. A total of sixty-four (64) of the questionnaires were distributed administered with fifty-five (55) returned properly completed giving a percentage response of 86%. . Data from the respondents were analyzed using SPSSversion 19.0. and presented using mean and Relative Importance Index (RII) to establish the order of severity. The result revealed among others that; alucobond is a preferred wall finish as it offers better aesthetic value, is fire resistant, and is economical in terms of maintenance as opined by these professionals. Also, It largely contributes to the energy performance of buildings by rendering no harm (pollution and gas emission) to the immediate environment Therefore it is recommended that alucobond be used as both internal and external wall finish in mercantile buildings.
Keywords: alucobond, wall finishing, mercantile buildings

Introduction

Alucobond is campsite material consisting of two aluminum cver sheets and a core containing a a non-combustible mineral filling comprising of a minimum of 70% and it is characterized by its light weight nature Vamja et al(2013). This simple but extremely versatile product concept has been developed to provide a facade material with a host of distinct advantages for architects. It is stable yet flexible, has a smooth durable surface, and is available in several standard or individual colors. It is weather-resistant, unbreakable, shock-resistant, vibration absorbent, and easy to install.

It is a sandwich structured flat panel that consists of two thin aluminum sheets bonded to a non-aluminum core. The core is a low-density polyethylene or a mix of low-density polyethylene which exhibits fire-retardant properties. Vamja and Tejani (2013) noted that Sandwich structured composites are a special class of composite materials that have become very popular due to high specific strength and bending stiffness.

The use of alucobond is gradually becoming popular in the construction industry because of it widrspread structural aplicatioon in both commercial and residential buildings. Alucubong faces s are commonly made of steel and the core material may be polyurethane, polyisocyanurate, expanded polystyrene, extruded polystyrene,

phenolic resin, or mineral wool. This Material gained acceptance because it offers a series of merits it offers: light weight, cost-effective and durable (Gocgeldi et al., 2011). Until recently, alucobond or sandwich panel have been increasingly used in building structures, particularly as roof and wall cladding systems . they are also being used significantly as internal walls and ceilings(Vamja & Tejani, 2013).

Further, they possess many other advantages such as long-spanning capacity, mass capacity, mass productivity, transportability, fast electability, prefabricatability, durability, and reusability. These characteristics render such panels very useful even in an environment subject to extreme temperatures, in places where erection time and labor need to be minimized, and in many other difficult situations (Byrne, Davies &Robinson, 2013).

Aluminum composite panel gives a significant advantage over other conventional wall finishes in terms of reduced cost, decrease installation time, weathering resistance, lightweight, and minimal maintenance requirement. (Byrne *et al*, 2013)

Due to the deterioration of building components (especially walls) as a result of cracking of rendered Portland cement walls, consistent re-painting of building wall. Advancement in building construction materials and wall finishing techniques that conforms to standards. We were motivated to embark on this study to identify the positive effect of the installation of alucobond as wall cladding in mercantile buildings, in Owerri, Imo State Nigeria. Considering cost, quality, and time as a driven tool. Consequently, this paper assesses the effect of utilization of alucobond as wall finish in mercantile buildings, Owerri, Imo state Nigeria.

Literature Review

An Overview On Alucobond

The evolution of aluminum composite material is gradually replacing most of the conventional materials of construction in building (Davies, 2012). According to (Ji, Faver, lin, Gillick & Hakkani-Tur, 2013) alucobond has been widely successful in hundreds of applications where there was a need for high-strength materials. Alucobond or Sandwich panel has been in existence since 1969. It is made of a composite material; the term composite material signifies that two or more materials are combined on a macroscopic scale to form a useful third material. According to (Vamja, Dipak, & Tejani, 2013) Sandwich structured composites are a special class of composite materials that have become very popular due to high specific strength and bending stiffness Davies j.m. (2001). The high strength to weight ratio of these materials makes them suitable for use in buildings. Aluminum Composite Panel is made of three layers; a low-density non-toxic polyethylene core (thermoplastic) material inserted in between two relatively thin skin non-combustible layers (aluminum; 0.3mm to 0.5mm), available in 3mm, 4mm, and 6mm thicknesses after finishing and can be curved and bent to form corners. Aluminum sheets can be coated with polyvinylidene fluoride (PVDF), fluoropolymer resins (FEVE), or polyester paint. It can be painted with any kind of color and pattern that imitates other materials, such as wood or marble. The material structure helps to achieve excellent mechanical performance at minimal weight. The combination of materials to utilize their favorable properties is the basic idea of composite engineering. With a monolithic material, a thickness increase leads to an increase in both the weight and material cost of a panel. The very high rigidity of the Aluminum Composite Panel has been achieved thanks to the interaction of its components under flexural load applied to the panel; the inner core takes the shear loads and creates a distance between the skins which takes the in-plane stresses, one skin in tension, the other in compression.

Applications Of Aluminum Composite Panel

Aluminum Composite Panel is used where high structural rigidity and low weight are required (Kabir, Vodenitcharova, & Hoffman, 2014). A typical example of the use of an Aluminum Composite Panel is in aircraft, satellites, high-speed trains, and fast ferries, where mechanical performance and weight saving are essential. Other application includes packaging (e.g. machine coverings and container construction), automobiles as well as buildings, and other forms of construction. Aluminum Composite Panel is now frequently used in buildings for external and internal cladding, facade, partition, insulation and signage, false ceilings, etc.; be it a residential building, a public building, a corporate headquarters and offices, trading or industrial complex, corporate designs for petrol stations, car showroom, banks and supermarkets The excellent ratio of strength/rigidity to the weight of Aluminum Composite Panel is superior to solid aluminum and steel, having lightweight yet extremely rigid and flat ((Kabir, Vodenitcharova, & Hoffman, 2014). Given the same bending resistance, the weight is approximately 40% less than a solid aluminum sheet and yet the form is structurally more stable, making fabrication and installation easy. This feature reduces the dead weight of the building. Being very light and strong, it weighs less than $1/10^{th}$ of conventional cladding materials such as marble, granite, tile, etc

Maintenance Of Aluminum Composite Panel

Maintenance of Aluminum Composite Panel can be divided into pre-installation and post-installation. Pre-installation maintenance entails proper storage and handling. Aluminum Composite Panel pallets should be protected during storage against rain, penetration of moisture, and condensation. Only pallets of identical sizes should be stacked, with a minimum of 6 pallets stacked on top of each other and nothing should be placed in between them to prevent marks on the panels. Post-installation maintenance requires immediate removal of the protective foil after installation, as weathering for a long period could make the foil difficult to remove, and also avoid residuals of glue sticking on the surface of the panel due to UV radiation (Kazemahvazi, & Zenkert, 2009). Routine cleaning of the panel is recommended. The frequency of cleaning the Aluminum Composite Panel depends on the design and the degree of soiling. Cleaning is carried out by using water or a combination of water and mild detergent (isopropyl alcohol) and must be followed by a clean water rinse to ensure the removal of all remnants of the cleaning detergent. A final wipe down using a sponge, leather, or wiper is necessary to avoid water stain. In addition, sun-heated surfaces should not be cleaned to avoid rapid drying which may lead to stain formation. Strong solvents such as MEK (methyl Ethyl Ketone), MIBK (Methyl iso-butyl Ketone), Triclene and paint thinner should not be used because paints might swell or remove (Zhao, Liu, Jiang, & Ren, 2017) No maintenance is required. Annual cleaning with mild detergent is enough to keep the surface shinning as ever. Apart from routine cleaning for aesthetic reasons, neither bare nor painted aluminum requires any Maintenance, which translates into a major cost and ecological advantage over the lifetime of a product

Methodology

Research Method

A well-structured Questionnaire was adopted in this research. Secondary data sources for this study were journals, published articles, and the internet on related studies. A well-structured questionnaire was designed and administered to respective building professionals in the Nigeria institute of building (NIOB) Imo state chapter to assess their respective opinions. A total of sixty-four (64) of the questionnaires were distributed out of which fifty-five (55) representing 86% were properly completed and returned.

Target Population

The target population was restricted to building professionals in the Nigeria institute of building (NIOB) Imo state chapter.

Sampling Technique

For this study, a systematic random sampling technique was used in the distribution of the questionnaire to the concerned respondents.

Sampling Size

The sample size that represents the targeted known population was determined by following the equation formula used below.

$$n = \frac{N}{1 + N(\mathrm{d})}2$$

Where;
n = the targeted/desired sample size
N= targeted population size
d^2 = degree of accuracy corresponding to the confidence level selected.

3.5. Confident level and its corresponding z and d value

i. A 95% level of confidence has $\alpha = 0.05$ and critical value of $z_{\alpha/2} = 1.96$. For the purpose of this study, a confidence level of 95% was adopted owing to the fact that the questionnaire was geared towards achieving a reliable data. Consequently, the sample size is determined thus,

N = 76, $d^2 = 0.05$
n= $(76/1+76(0.05)^2 = 63.86$

In all, a total of sixty-four (64) of the questionnaires were distributed out of which fifty-five (55) representing 86% were properly completed and returned. The data collected was analyzed using random sampling and the Relative Importance Index (RII). Also, data on the relevance, merits, demerit, and effective

maintenance of alucobond as wall finish in mercantile buildings were collected from professionals (builders) using a structured questionnaire, and variables were measured on a five-point Linker-scale scored as follows:1=strongly agree,2=agree,3=Indecisive, 4=disagree and 5=strongly disagree.

Data Analysis Procedure:

Most of the questions here involve assessing some indices on a five (5) point Linker's scale. The data analysis, therefore, employed the following steps.

a. Computation of the mean using the formula

$$m = \sum \mathbf{FX} / \sum \mathbf{F}$$

Where m= mean

x = points on the Linker's scale (1, 2, 3, 4, and 5)

f = frequency of respondents' choice of each point on the scale

b. Computation of the relative importance index (RII) for each item of interest, using the formula RII = m / 5(highest linker scale)

Data Analysis, Findings, and Discussions

Data Analysis

This chapter critically analyses the findings from the questionnaires on the assessment of the effects of utilization of alucobond as wall finish in mercantile buildings.

Table 1 Percentage Response

	Categories	Frequency	Percentage (%)
Responses	**A**- Returned	55	86
	B- Not returned	9	14
Total		**64**	**100**

Source: field Survey, 2020

From Table 1, 55 questionnaires were appropriately filled and returned which is 86% of a total of 64 questionnaires distributed. 9 questionnaires were not returned by the respondents.

Table 2 professional's institute profile

Professional	category	Frequency	Percentage (%)
Builder	NIOB	55	100
TOTAL		**55**	**100**

Source: field Survey, 2020

Table.2 shows the professionals in the Nigeria Institute of the building that responded to this questionnaire comprised of 55 Builders.

4.4 Data Presentation and Analysis

Data from the professional's (builders) opinion are presented

Relevance of alucobond as wall finish in mercantile buildings

The Opinin of the respondent on the relevance of alucobond as an external wall finish for mercantile building was assess and the result is as presented in Table3. From the Table, the respondents ranked 'Aesthetics (RII=0.90) as the highest relevenace of the wall fnish. This was closely followed by 'Thermal Insulation' (RII=0.84), 'Projection of Building Image'(RII=0.81) which ranked second and third respectively. Details of the ranking of other relevance of the alucobonds is as presented in the Table.

Table 3 Relevance of alucobond as wall finish in mercantile buildings

S/N	RELEVANCE	1	2	3	4	5	∑F	∑FX	MEAN	RII	RANK
1	Projection of building image	0	6	9	17	23	55	222	4.03	0.81	3rd
2	Durability	2	8	8	18	19	55	209	3.80	0.76	4th
3	Aesthetics	0	0	3	22	30	55	247	4.50	0.90	1st
4	Fire resistant	5	7	18	10	15	55	188	3.42	0.68	5th
5	Thermal insulation	0	3	8	20	24	55	230	4.18	0.84	2nd

Source: Field Survey, 2020
Where 1- Strongly Disagree; 2- Disagree; 3- Indecisive; 4- Agree; 5- Strongly Agree.

Advantages of alucobond as wall finish in mercantile buildings.

The advanteges of the alucobond wall finish against other wall finish was assess and the result is as presented inTable 4. From the Table, it can be deduced the 'Long preservation of the building structure' (RII=0.88) was ranked as the highest advantage of the alucobond over other wall finish. Also, 'Long service life' (RII=0.80); 'Low maintenance cost' (RII=0.79) which ranked the secnd and third benefit of alucobond wall finish other as opined by the respondents. Deails of other advanctages of alucobod wall finish for mercantile buildings are as presented in the Table.

Table 4 Advantages of alucobond as wall finish in mercantile buildings

S/N	ADVANTAGES	1	2	3	4	5	∑F	∑FX	MEAN	RII	RANK
1	Long service life	2	4	10	16	23	55	219	3.98	0.80	2nd
2	Design flexibility	5	5	8	18	19	55	206	3.75	0.75	4th
3	Low maintenance cost	1	7	6	20	21	55	218	3.96	0.79	3rd
4	High strength to weight ratio	5	7	18	10	15	55	188	3.42	0.68	5th
5	Long preservation of the building structure.	0	0	5	23	27	55	242	4.40	0.88	1st

Source: Field Survey, 2020
Where 1- Strongly Disagree; 2- Disagree; 3- Indecisive; 4- Agree; 5- Strongly Agree.

Disadvantages of alucobond as wall finish in mercantile buildings.

The demerit of the alucobond as wall finish was also identifieda nd ranked by the respndents and the details are as presented in Table5. From the Table. 'High Initial Cost of Installation' (RII=0.82) was identified as the major disadavantage in the utilization of alucobond. Other demerit ranked in their order of severity are as: 'inavailable in all building material market' (RII= 0.81) and 'Very expensive to install' (RII= 0.77) which is ranked secnd and third repectively.

Table 5 Disadvantages of alucobond as wall finish in mercantile buildings

S/N	DISADVANTAGES	1	2	3	4	5	∑F	∑FX	MEAN	RII	RANK
1	High initial cost	1	4	5	23	22	55	226	4.12	0.82	1st
2	Very expensive to install	2	4	12	18	19	55	213	3.87	0.77	3rd
3	Not readily available in all building material market.	0	4	8	22	21	55	225	4.09	0.81	2nd
4	A long time of installation compared to painting.	5	8	12	16	14	55	191	3.47	0.69	4th

Source: field Survey, 2016
Where 1- Strongly Disagree; 2- Disagree; 3- Indecisive; 4- Agree; 5- Strongly Agree.

Suggestions of effective maintenance of alucobond

The respondents also ranked suggestions on effective maintenance of alucobond and the result is as presented in Table 6. The respondents ranked 'the Use 5% solution of a commonly used industrial detergent for cleaning' (RII=0.87) as first and highest measure of maintenance while 'Cleaning done regularly on cloudy days' (RII= 0.82) was ranked seconds among the measures identified from literature for the maintenance of alucobond wall finishing.

Table 6 Suggestions of effective maintenance of alucobond.

S/N	SUGGESTIONS	1	2	3	4	5	∑F	∑FX	MEAN	RII	RANK
1	Routine cleaning for aesthetic reasons	5	5	8	18	19	55	206	3.75	0.75	3rd
2	Use 5% solution of a commonly used industrial detergent for cleaning.	0	0	8	21	26	55	238	4.33	0.87	1st
3	Cleaning should be done on a cloudy day	1	4	5	23	22	55	226	4.11	0.82	2nd

Source: Field Survey, 2020

Where 1- Strongly Disagree; 2- Disagree; 3- Indecisive; 4- Agree; 5- Strongly Agree.

Summary of Findings

The result of the study reveals that,

1. 'Aesthetics' (RII= 0.90), 'thermal insulation' (RII= 0.84), and 'projection of building image' (RII= 0.81) were found to be the most significant relevance of alucobond as a wall finish, followed by 'durability' (RII 0.76) and 'fire resistance' (RII= 0.68).
2. 'Long term preservation of the building structure' (RII= 0.88), 'low maintenance cost' (RII= 0.79), 'long service life' (RII= 0.80). Were found to be the most significant advantage of alucobond as wall finish while 'design flexibility (RII = 0.75), 'high strength to weight ratio' (RII=0.68). Ranked 4th and 5th respectively.
3. Recommendations on the best approach for effective maintenance show that the respondents collectively ranked. 'Use a 5% solution of a commonly used industrial detergent for cleaning' with a relative importance index of (RII= 0.87) as first, 'cleaning should be done on a cloudy day with a relative importance index of (RII= 0.82) as second and 'routine cleaning for aesthetic reasons' with (RII=0.75), as the third.

Conclusion and Recommendation

Conclusion

Alucobond plays a key role in the effective wall cladding of buildings owing to its performance and Properties. It largely contributes to the energy performance of buildings by rendering no harm (pollution and gas emission) to the immediate environment. Finally, an Aluminum composite panel is a preferred wall finish as it offers better aesthetic value, fire-resistant ability, and is economical in terms of maintenance as opined by the respondents.

Recommendations

Based on the findings of this research work, the following are the recommendations for effective utilization and maintenance of alucobond.

1. Alucobond be used as external wall cladding in buildings, especially in mercantile buildings to project the image of the building.
2. Routine cleaning should be done on the aluminum composite material for aesthetic reasons
3. Alucobond be used because of its ability to preserve the building structure for a long period.

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