

## KNOWLEDGE AND POTENTIALS OF RECYCLED PAPER AS AFFORDABLE BUILDING MATERIAL IN IKORODU, LAGOS STATE

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### ABSTRACT

Paperboard or paper waste makes up about 26% of the solid waste disposed in landfills and since waste from paper producing factories pollutes the air, water and land; the need to put emphasis on the recycling paper factory products becomes indispensable. From the Architects point of view, affordable housing provision is undoubtedly a vital area that need ultimate intervention in developing cities and suburbs. The aim of this study was to investigate the knowledge and potential of recycled paper as an affordable building material in Ikorodu and its environ. The study adopted a Mixed Method of Research in carrying out the findings. Relevant literature was also reviewed and necessary data were collected through interviews granted to the selected licensed architects within the study area. Structured Questionnaires were administered to architects who are also lecturers in the two schools of architecture in Ikorodu. The selected respondent are either members of the Association of Architectural Educators, Nigerian Institute of Architects or registered with the Architects Registration Council of Nigeria. A total of 65 questionnaires were returned from the 69 administered. Findings revealed that architects have a huge role in building material specifications and that recycled paper exhibits promising attributes, such as lightweight, insulation properties, and thermal performance. It demonstrated satisfactory strength for non-structural applications and showcased potential as an eco-friendly alternative to traditional building materials. Furthermore, the environmental analysis indicated that recycled paper has the potential to contribute to sustainable construction practices, with reduced energy consumption and greenhouse gas emissions. This study contributes to the growing body of knowledge on sustainable construction materials and provides insights for architects allied professionals in the built environment in making informed decisions regarding material choices for environmentally conscious building practices.

**Keywords:** Affordable housing, Recycled Paper, Sustainable building material, Architecture

### INTRODUCTION

The economic necessity of reusing millions of tons of materials that have already been utilized in production is now acknowledged on a global scale. This also applies with regard to construction, as materials for buildings can be reused repeatedly. A key strategy for sustainable development and striking a balance between the advancement of the economy and environmental protection is the use of recycled resources Václav & Dana (2021). There is no doubt that Paper is an amazing material that we use every day in a range of products, such as tissues, paper towels etc. Due to its unique characteristics, relatively high compression strength and bending stiffness, low production costs, and ease of recycling, paper is becoming more and more popular across a variety of industries. In the broadest sense of the terms, that is, in construction projects of all sizes, mass-produced paper products such Recycled paper makes up the majority of paper and cardboard tubes. Paperboard, Kraft paper, and fiberboard are just a few examples of the raw materials that producers can use. Making paper tubes and cores is a process of paper conversion. It contains steps for paper web winding, paper web winding, and lamination bonding. Through a lamination process, the producers bind several paper webs or ribbons around a steel mandrel. The paper tube grows more rigid the more times the binding paper webs are turned around. The user's intended use for the product determines the dimensions that are utilized to make paper tubes. In 1976, Martin Pawley utilized paper-tubes for the first time to construct a house at Rensselaer Polytechnic Institute. Shigeru Ban, a Japanese architect who won the Pritzker Prize, then employed paper tubes as a building material to create frames, trusses, arches, vaults, domes, and towers. The paper-tube's strength may not be as great as that of other conventional building materials, but with clever optimization techniques, the use of geometry to streamline

types of forces, and combinations with other materials, paper-tubes can become a formidable option for a considerate, ecologically conscious, and effective building material.as special paper, paperboard, corrugated cardboard, honeycomb panels, tubes Latka (2017).

Housing continues to receive a great deal of attention and is a prevalent subject of discussion in both developed and developing countries due to its significance as a social benefit. Many cities and especially emerging Nigerian cities are experiencing a housing shortage with recent evidences attributed to the current inflated economic situation. This study investigates the knowledge and potentials of recycled paper product a residential building construction in Ikorodu and its environ. Nigeria. It examines architects' knowledge on the physical characteristics of recycled building material and its relevant potentials as an alternative building material for affordable housing provision.

### METHODS

The research methodology for this project involved a combination of bibliographic research and field investigations. It adopted a qualitative approach to gather and analyze data. The primary subjects of the study will be recycled paper and existing constructions that have utilized recycled paper as a building material. The research will involve data collection through literature review, case studies, and interviews with experts, and on-site observations. The collected data was analyzed using thematic analysis and comparative methods to draw meaningful conclusions regarding the properties, characteristics, and potential of recycled paper as a sustainable building material.

**Potentials of recycled paper products**

Recycled paper or cardboard has shown characteristic that has justified its use in the building industry, it has been used extensively by pritzler prize winner shigeru ban. Below are the potentials of recycled paper products as stated by (faggal, 2012)

- i. Flexibility: Corrugated cardboard is an extremely versatile material that can be cut and folded into an infinite number of sizes and forms. Prefabricated cardboard buildings will provide design flexibility, allowing users to adapt by altering the space to their needs. Attaching cardboard modules to the space allows it to be readily expanded.
- ii. Cost efficiency: Cardboard is a reasonably affordable raw material. Cost efficiency, on the other hand, can be accomplished through mass production of repetitive and standardized shapes.
- iii. Construction efficiency: Prefabricated cardboard building pieces enable quick, simple, and low-cost fabrication while also reducing time spent on the construction site.  
  
By reducing the number of building materials used, efficiency is improved, as cardboard may fulfill all of the tasks of a structure's outside skin. The removal of multi-layering reduces expenses and simplifies the construction process.
- iv. Durability: Experiments show that corrugated cardboard has a high level of strength, stability, and stiffness when compared to other conventional building materials; it can withstand enormous structural loads. The presence of wood fibers in its composition increases its strength and resilience. Cardboard is resistant to punctures and tears readily. The internal fluting's arched design: increases its endurance, allowing it to withstand more external stress. Weight Cardboard is lightweight, making it easy to transport, assemble, and disassemble.
- v. Recyclability: Cardboard is made from virgin cellulose fibers that comprise 43% recycled fibers. Cardboard can be recycled or reused once it has served its purpose. The Cardboard School Project in the United Kingdom has demonstrated that 90 percent of corrugated cardboard is recyclable, and the fibers can be recycled up to seven times before losing their resilience.
- vi. Environmental impact: Cardboard has a low environmental impact throughout the

manufacturing process since it uses less energy than other materials. As a result, fewer emissions are projected. Furthermore, it is made from a renewable resource that helps to mitigate the depletion of nonrenewable resources. All of the materials used in the production of cardboard are natural and non-toxic. Prefabrication, pre-assembly, and mass customization maximize resource utilization while reducing worksite waste and labor. Furthermore, lightweight cardboard components and panels reduce transportation costs.

**Limitations of the use of recycled paper products**

Recycled paper has certain restrictions that can influence its performance if not treated correctly; some of these limitations are listed below.

- i. Durability: When compared to typical building materials such as concrete, steel, or wood, recycled paper products have inferior structural strength. This restricts its employment to non-structural or lightweight structural components in load-bearing applications. Recycle paper has been used by architect shigeru ban who has test the possibilities of recycled paper as a structural member in different forms and the result was a success. Paper is a cellulose substance that must be insect-proofed. This can also be addressed by using additives during the manufacturing process.
- ii. Fire resistant: Paper reacts to fire in a similar way to how wood does; if handled improperly, it can catch fire. Fortunately, cardboard possesses a small amount of chalk-like substance, a good fire retardant, due to the ink traces left after recycling, which somewhat increases its fire resistance. Furthermore, (boric) salts can be used to treat cardboard with further protection. The ability of the material to be recycled is unaffected by the inclusion of these components.
- iii. Moisture resistant: When cardboard is exposed to moisture or direct water, the connections between the paper fibers may become destroyed. During the pulp production process, chemical additives can be used to increase cardboard's water resistance. These chemical treatments' only drawback is that they lessen recycling. Another strategy is to cover the cardboard with a thin coating of PET that has been recycled. These coatings shield cardboard from chemical and moisture risks. Additionally, even a flat roof has a slope, thus the roof should have one.

**Architects' Response to the use of Recyled Paper**

**Table 1: Assessing architect's agreement with the viability of material.**

Variable	Frequency	Percentage	
Viability of material	Strongly disagree	4	6.15%
	Disagree	6	9.23%
	Neutral	8	12.3%
	Agree	38	58.46%
	Strongly agree	9	13.84%
<b>Total</b>	<b>65</b>	<b>100%</b>	

Table 1 above shows the distribution of the respondents assessing the viability of recycled paper. 4 respondents which constitutes 6.15% of the respondents strongly disagree that recycled paper are viable for construction purposes; 6 respondents which constitutes 9.23% of the respondents disagree that that recycled paper are viable for construction purposes; 8 respondent which constitutes 12.3% of the respondents is neutral; 38 respondents which constitutes 58.46% of the respondents agree that recycled paper are viable for construction purposes while 9 respondents which constitutes 13.84% strongly agree that that recycled paper are viable for construction purposes. However, results from this study shows that recycled paper are viable for construction purposes.

**Table 2: Assessing architect’s agreement with the eco – friendly.**

Variable		Frequency	Percentage
Eco – friendly	Strongly disagree	1	1.54%
	Disagree	3	4.62%
	Neutral	14	21.54%
	Agree	29	44.62%
	Strongly agree	18	27.69%
<b>Total</b>		<b>65</b>	<b>100%</b>

Table 2 above shows the distribution of the respondents assessing whether the material is eco – friendly. 1 respondents which constitutes 1.54% of the respondents strongly disagree that recycled paper are eco - friendly; 3 respondents which constitutes 4.62% of the respondents disagree that that recycled paper are eco - friendly; 14 respondent which constitutes 21.54% of the respondents is neutral; 29 respondents which constitutes 44.62% of the respondents agree that recycled paper are eco - friendly while 18 respondents which constitutes 27.69% strongly agree that that recycled paper are eco - friendly. However, results from this study shows that recycled paper are eco – friendly.

**Table 3: Assessing architect’s agreement with the thermal performance.**

Variable		Frequency	Percentage
Thermal performance	Strongly disagree	19	29.23%
	Disagree	4	6.15%
	Neutral	23	35.38%
	Agree	17	26.15%
	Strongly agree	2	3.07%
<b>Total</b>		<b>65</b>	<b>100%</b>

Table 3 above shows the distribution of the respondents assessing the thermal performance of recycled paper. 19 respondents which constitutes 29.23% of the respondents strongly disagree that recycled paper has good thermal performance; 4 respondents which constitutes 6.15% of the respondents disagree that that recycled paper has good thermal performance; 23 respondent which constitutes 35.38% of the respondents is neutral; 17 respondents which constitutes 26.15% of the respondents agree that recycled paper has good thermal performance while 2 respondents which constitutes 3.07% strongly agree that that recycled paper has good thermal performance. However, results from this study shows that recycled paper are either or not has good thermal performance.

**Table 4: Assessing architect’s agreement with the weather resistance.**

Variable		Frequency	Percentage
Weather resistance	Strongly disagree	3	4.61%
	Disagree	7	10.77%
	Neutral	18	27.69%
	Agree	19	29.23%
	Strongly agree	18	27.69%
<b>Total</b>		<b>65</b>	<b>100%</b>

Table 4 above shows the distribution of the respondents assessing the viability of recycled paper. 3 respondents which constitutes 4.61% of the respondents strongly disagree that recycled paper has good weather resistance; 7 respondents which constitutes 10.77% of the respondents disagree that that recycled paper has good weather resistance; 18 respondent which constitutes 27.69% of the respondents is neutral; 19 respondents which constitutes 29.23% of the respondents agree that recycled paper has good weather resistance while 18 respondents which constitutes 27.69% strongly agree that that recycled paper has good weather resistance. However, results from this study shows that recycled paper has good weather resistance.

**Table 5: Assessing architect’s agreement with the fire resistance.**

Variable		Frequency	Percentage
Fire resistance	Strongly disagree	13	20%
	Disagree	6	9.23%
	Neutral	31	47.69%
	Agree	6	9.23%
	Strongly agree	9	13.85%
<b>Total</b>		<b>65</b>	<b>100%</b>

Table 5 above shows the distribution of the respondents assessing the fire resistance of recycled paper. 13 respondents which constitutes 20% of the respondents strongly disagree that recycled paper has good fire resistance; 6 respondents which constitutes 9.23% of the respondents disagree that recycled paper has good fire resistance; 31 respondent which constitutes 47.69% of the respondents is neutral; 6 respondents which constitutes 9.23% of the respondents agree that recycled paper has good fire resistance while 9 respondents which constitutes 13.85% strongly agree that that recycled paper are viable for construction purposes. However, results from this study shows that recycled paper either or not has good fire resistance

**CONCLUSION**

In conclusion, the investigation into the potential of recycled paper for residential building construction in Lagos State, Nigeria, reveals promising prospects for sustainable and eco-friendly building practices. The study demonstrates that recycled paper can be a viable alternative to traditional construction materials, offering environmental benefits such as reduced carbon footprint and waste management. However, successful implementation would require overcoming challenges related to Affordable housing. The findings underscore the importance of continued research, policy support, and public awareness to foster the adoption of recycled paper in residential construction, contributing to a more sustainable and resilient built environment in Lagos State and beyond.

This study concludes that recycled paper is viable for construction purposes, is eco – friendly and had good weather resistance; and either or not has good thermal performance and fire resistance.

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