

Reimagining Interiors: Design Applications Of Corrugated Cardboard As A Sustainable Material

Dr. Surbhi Chitkara

Former Assistant Professor & Independent Researcher,
Lady Irwin College, Delhi University

Dr. Sushma Goel

Former Professor & Vice-Principal, Lady Irwin College,
Delhi University

Abstract: The increasing demand for environmentally responsible design solutions has encouraged designers and researchers to explore alternatives to conventional interior materials. Corrugated cardboard, traditionally associated with packaging and transportation, has emerged as a lightweight, recyclable, economical, and versatile material with growing potential in interior design applications. This paper investigates the role of corrugated cardboard as a sustainable material for furniture, decorative elements, exhibition systems, partitions, and temporary interior installations. The study adopts a qualitative and exploratory research approach supported by literature review to evaluate the environmental, functional, and aesthetic potential of corrugated cardboard in interior spaces. The findings indicate that the material offers significant opportunities for low-impact, modular, and innovative design solutions due to its adaptability, affordability, and recyclability. However, challenges related to moisture resistance, fire safety, durability, and consumer perception continue to limit its wider adoption in permanent interiors. The study concludes that corrugated cardboard has the potential to redefine sustainable interior practices by encouraging recyclable, flexible, and resource-efficient design approaches for future-oriented interior environments.

Keywords: Sustainability, corrugated cardboard, interior design, recyclable materials, circular economy, eco-friendly interiors.

I. INTRODUCTION

Sustainability has become a central focus in interior design as industries seek to reduce environmental impact caused by waste generation, industrial emissions, and excessive resource consumption. Consequently, designers are increasingly exploring alternative materials that are both functional and environmentally responsible (Becchio et al., 2012). Conventional interior materials such as plastic laminates, synthetic boards, and non-recyclable composites contribute significantly to environmental pollution and landfill accumulation (Papanek, 1995). This has created a growing need for renewable, recyclable, and low-impact materials that support sustainable development and circular design principles.

Among emerging sustainable materials, corrugated cardboard has gained considerable attention due to its

lightweight structure, affordability, recyclability, and environmental benefits. Traditionally used for packaging and transportation, the material is now being transformed into furniture, exhibition displays, partitions, lighting fixtures, wall treatments, and temporary interior installations. Its versatility and ease of fabrication allow designers to experiment with creative and functional interior solutions while promoting environmentally conscious design practices (Sangree et al., 2018).

The creative possibilities of cardboard gained global recognition through the experimental works of Frank Gehry, who developed sculptural cardboard furniture using layered construction techniques, and Shigeru Ban, whose paper-based architecture demonstrated the structural strength and adaptability of recyclable materials (Fiell & Fiell, 2005). Inspired by similar sustainable approaches, companies such as

IKEA have also adopted paper-based innovations and eco-friendly packaging systems to reduce environmental impact.

Recent studies have further investigated the use of cardboard in adaptive and sustainable architectural systems. Sapienza et al. (2022) explored innovative cardboard-based micro-architectural structures designed for flexible and multifunctional use. Their research emphasized the material's lightweight properties, modularity, recyclability, and ease of construction, highlighting its potential for temporary structures and sustainable spatial applications. These findings reinforce the growing importance of corrugated cardboard in environmentally conscious interior and architectural design practices.

Corrugated cardboard combines strength, flexibility, and lightweight properties, making it suitable for diverse interior applications. Its fluted layered structure provides structural stability, while its flexibility allows easy cutting, folding, shaping, and assembly into modular forms. Furthermore, its recyclable nature supports environmentally responsible production and waste management systems (Kaya & Akyuz, 2015). In countries such as India, where affordable and sustainable solutions are increasingly important, cardboard-based interiors present opportunities for low-cost, portable, and temporary design applications.

Despite these advantages, corrugated cardboard continues to face limitations related to moisture sensitivity, fire resistance, long-term durability, and consumer perception. Many users still associate cardboard with temporary or disposable products rather than durable interior materials. Therefore, there is a growing need to critically examine the practical, environmental, and aesthetic potential of corrugated cardboard within contemporary interior design practices.

Although previous studies have explored cardboard in furniture and packaging applications, limited research has focused specifically on its broader role within sustainable interior design practices, particularly in the Indian context. This study attempts to address this gap by examining corrugated cardboard as both a sustainable and design-oriented material for contemporary interiors.

A. RESEARCH OBJECTIVES

Aim: To explore the design applications and sustainability potential of corrugated cardboard in interior design.

Objectives:

- ✓ To study the sustainable properties of corrugated cardboard.
- ✓ To identify contemporary interior applications of corrugated cardboard.
- ✓ To analyze the environmental and aesthetic benefits of cardboard-based interiors.
- ✓ To evaluate the limitations and challenges associated with the material.
- ✓ To examine future opportunities for corrugated cardboard in sustainable interior design practices.

II. METHODOLOGY

This study adopts a qualitative and exploratory research approach to investigate the potential of corrugated cardboard as a sustainable material in interior design. The research combines literature review with comparative case study analysis to understand the material's environmental, functional, and aesthetic performance in interior applications.

The study was conducted in three stages. The first stage involved reviewing existing literature related to sustainable materials, circular economy practices, and the use of corrugated cardboard in furniture and interior applications. This helped in understanding the environmental, functional, and aesthetic potential of the material.

The second stage involved studying cardboard furniture, exhibition displays, temporary interiors, and paper-based architectural projects to understand the practical use of corrugated cardboard in design. The analysis helped evaluate the material's sustainability, functionality, aesthetic possibilities, and adaptability within contemporary interior spaces.

The final stage involved a comparative assessment between corrugated cardboard and commonly used interior materials such as plywood, MDF, and plastic. The comparison was carried out on the basis of recyclability, weight, affordability, fabrication ease, and environmental impact to identify the opportunities and limitations of cardboard in interior applications.

III. STUDY FINDINGS

A. MATERIAL VERSATILITY AND DESIGN ADAPTABILITY

The findings indicate that corrugated cardboard offers significant flexibility in interior applications due to its lightweight structure, ease of fabrication, and modular adaptability. Unlike conventional materials that often require energy-intensive manufacturing processes, cardboard can be easily cut, folded, layered, and assembled into diverse forms. This allows designers to create portable, customizable, and space-efficient interior solutions while minimizing material waste.

The cardboard's layered and fluted structure (as depicted in Figure 1) provides strength despite its lightweight nature, making it suitable for temporary furniture, shelving systems, partitions, and exhibition installations (Kaya & Akyuz, 2015). Designers are increasingly using cardboard to experiment with sculptural forms, geometric patterns, and modular systems that combine functionality with visual appeal. The findings of the study align with previous research emphasizing the growing role of recyclable and low-impact materials in sustainable interior practices (Papanek, 1995).



Figure 1: Cardboard's Layered and Fluted Structure
Adapted from Kaya & Akyuz (2015)

Beyond sustainability, corrugated cardboard also encourages experimental and innovative design thinking. Its foldability, texture, and modular potential allow designers to create sculptural forms, interactive installations, and space-saving interior solutions that may not be easily achievable with conventional rigid materials. This transforms cardboard from a temporary substitute into a material capable of driving creative and user-centered design innovation.

B. SUSTAINABILITY POTENTIAL IN INTERIOR DESIGN

The findings of the study highlight the strong sustainability potential of corrugated cardboard within contemporary interior practices. Since the material is recyclable, biodegradable, and often produced from recycled paper waste, it supports circular economy principles that encourage reuse and waste reduction (McDonough & Braungart, 2002; Gorgolewski, 2008). The circular lifecycle and reuse potential of corrugated cardboard within sustainable interior systems is illustrated in Figure 2.

Figure 2. Circular Lifecycle and Interior Applications of Corrugated Cardboard



Source: Adapted from McDonough & Braungart (2002) and Gorgolewski (2008).

Figure 2: Circular lifecycle and interior design applications of corrugated cardboard
Adapted from McDonough & Braungart (2002) and Gorgolewski (2008).

Unlike many conventional interior materials that contribute to long-term landfill waste, corrugated cardboard supports a circular lifecycle in which the material can be reused, recycled, and reintroduced into manufacturing systems after use. This lifecycle-oriented approach aligns with contemporary sustainable design strategies focused on reducing environmental burden throughout the material's usage cycle.

Compared to conventional materials such as plastic laminates and MDF, corrugated cardboard requires relatively lower production energy and generates less environmental impact (Becchio et al., 2012). Its lightweight nature also reduces transportation energy and installation costs. These characteristics make it an environmentally responsible alternative for sustainable interior applications.

Recent studies have also emphasized the importance of cardboard within circular economy frameworks and sustainable construction systems. Akinade et al. (2023) highlighted that recyclable paper-based materials can contribute significantly to reducing construction waste and promoting resource-efficient design strategies. Their findings support the role of corrugated cardboard as a low-impact material capable of aligning interior design practices with broader sustainability and waste-reduction goals.

Growing environmental awareness and increasing interest in eco-conscious lifestyles are encouraging designers and consumers to adopt materials that align with responsible design practices. As a result, corrugated cardboard is gradually becoming associated with innovative and sustainable interior solutions rather than merely packaging waste.

C. EMERGING APPLICATIONS IN CONTEMPORARY INTERIORS

The findings further reveal that corrugated cardboard is being increasingly used in a variety of contemporary interior applications. Retail displays, exhibition systems, pop-up stores, and temporary installations commonly utilize cardboard because of its affordability, portability, and ease of customization (Sangree et al., 2018). The material is particularly suitable for short-term installations where sustainability and cost-effectiveness are important considerations. Figure 3 highlights the diverse interior applications of corrugated cardboard identified through literature review and case study analysis.

Figure 3. Major Interior Design Applications of Corrugated Cardboard



Source: Adapted from Sangree et al. (2018), Kaya & Akyuz (2015), and Fiell & Fiell (2005).

Figure 3: Contemporary Interior Applications of Corrugated Cardboard
Adapted from Sangree et al. (2018), Kaya & Akyuz (2015), and Fiell & Fiell (2005).

In furniture design, corrugated cardboard is used for chairs, stools, tables, shelving systems, and modular seating arrangements. Layering techniques and honeycomb structures improve strength while maintaining lightweight characteristics (Ayrimis et al., 2010). Decorative applications such as wall panels, ceiling installations, lampshades, and sculptural

elements further demonstrate the aesthetic versatility of the material.

The material has also gained relevance in temporary and emergency architecture. Projects developed by Shigeru Ban demonstrate how paper-based materials can be used in humanitarian shelters and low-cost structures while maintaining structural functionality and sustainability (Fiell & Fiell, 2005). Figure 4 shows the Japanese Pavilion in Hannover, Germany which was Shigeru Ban's first design using paper tubing in very long dimensions (Bulut & Gurani, 2018).



Source: Bulut & Gurani, 2018

Figure 4: The Japanese Pavilion at Expo 2000

Recent research has further demonstrated the structural potential of corrugated cardboard in furniture design. Suarez et al. (2021) explored the development of thin-wall seating systems made from a single sheet of heavy-duty corrugated cardboard and concluded that carefully engineered folding and structural configurations can significantly improve load-bearing capacity and durability. Their findings reinforce the possibility of using cardboard not only for temporary furniture but also for functional and ergonomically efficient interior products.

The rapid growth of e-commerce industries and sustainable packaging movements has significantly increased the availability of corrugated cardboard waste, creating new opportunities for upcycling and circular material practices within interior design. This transition has encouraged designers to rethink packaging waste as a valuable resource for innovative and sustainable spatial applications.

D. CORRUGATED CARDBOARD IN THE INDIAN CONTEXT

Beyond global applications, the relevance of corrugated cardboard can also be examined within developing economies such as India. India generates significant amounts of packaging waste due to rapid urbanization, increasing consumerism, and the expansion of e-commerce industries. The reuse of corrugated cardboard in interior applications presents an opportunity to convert post-consumer waste into functional and affordable design solutions.

In urban Indian environments, cardboard-based interiors may be particularly suitable for exhibition spaces, temporary retail installations, student accommodations, compact apartments, and low-cost furniture systems. The material also aligns with the growing demand for sustainable and economical interior alternatives among environmentally conscious consumers.

Furthermore, the adaptability and affordability of cardboard make it suitable for small-scale design entrepreneurs and experimental interior practices within the Indian market. Its use in temporary and modular systems may help reduce material waste while encouraging sustainable consumption patterns. Table 1 presents a comparative assessment of corrugated cardboard and commonly used interior materials based on sustainability and functional parameters.

S. No.	Criteria	Corrugated Sheets	MDF	Plywood	Plastic
1.	Affordability	Economical	Moderate	Expensive	Moderate
2.	Ease of Handling	Easy	Difficult	Difficult	Easy
3.	Environmental Impact	High	Poor	Moderate	Poor
4.	Reuse / recycling Potential	Excellent	Limited	Limited	Average
5.	Fabrication ease	Highly suitable	Not ideal	Moderately suitable	Less suitable
6.	Resistance to Moisture	Weak	Moderate	Moderate	Strong

Table 1: Comparative Assessment of Interior Materials

The comparison indicates that corrugated cardboard performs strongly in terms of affordability, recyclability, and ease of fabrication. Although materials such as plywood offer greater long-term durability, cardboard provides significant environmental and economic advantages for temporary and modular interior applications.

E. LIMITATIONS AFFECTING WIDER ADOPTION

Despite its advantages, the study identifies several limitations that restrict the widespread use of corrugated cardboard in permanent interior applications. Moisture sensitivity remains one of the primary concerns, particularly in humid climatic conditions where exposure to water can weaken the material's structural integrity.

Fire resistance is another significant challenge, as untreated cardboard is highly flammable and requires protective coatings or fire-retardant treatments for safer use in interiors. Durability limitations also affect consumer confidence, especially when compared with traditional materials such as wood and metal.

In addition to technical challenges, consumer perception continues to influence the acceptance of cardboard-based interiors. Many users still perceive cardboard as a temporary or disposable material rather than a durable and aesthetically valuable design resource. This highlights the need for greater awareness, innovative treatments, and improved material presentation within the design industry.

However, changing consumer attitudes toward sustainability may gradually improve the acceptance of cardboard-based interiors. As environmentally conscious lifestyles become more mainstream, users are increasingly valuing recyclability, minimalism, and responsible consumption over conventional perceptions of luxury and permanence. While corrugated cardboard presents considerable environmental advantages, its long-term success in interior design depends on balancing sustainability with durability, functionality, and user acceptance.

IV. FUTURE SCOPE

Future research may focus on improving the durability, water resistance, and fire-retardant properties of corrugated cardboard through advanced material treatments and hybrid construction techniques. Further studies can also explore lifecycle assessment, consumer perception, and the integration of cardboard within smart, modular, and adaptive interior systems. Experimental research involving prototyping and structural testing may provide deeper insights into its long-term applicability in residential and commercial interiors.

IMPLICATIONS FOR DESIGNERS

The findings of this study may encourage interior designers, architects, and product developers to reconsider recyclable materials as viable components of contemporary interior practice. Corrugated cardboard demonstrates that sustainable materials can simultaneously support functionality, affordability, and creative experimentation within modern design environments.

V. CONCLUSION

The study demonstrates that corrugated cardboard possesses considerable potential as a sustainable material for contemporary interior design applications. Its lightweight nature, affordability, recyclability, and adaptability make it suitable for furniture, exhibition systems, decorative installations, and temporary interiors.

The research suggests that corrugated cardboard should not be viewed merely as a substitute material, but as a catalyst for rethinking sustainable interior practices. Its application encourages modular, lightweight, recyclable, and resource-efficient design approaches that align with contemporary environmental concerns and circular economy principles.

Within the Indian context, corrugated cardboard presents promising opportunities for affordable furniture systems, temporary retail spaces, student accommodations, and sustainable decorative products. However, achieving wider acceptance will require improvements in durability, moisture resistance, fire-retardant properties, and consumer perception.

Additionally, the increasing emphasis on sustainable development, startup-driven design innovation, and eco-conscious consumer markets in India may further encourage experimentation with recyclable materials in interior design. Corrugated cardboard could therefore emerge as a viable solution for low-cost, temporary, and adaptable interior environments within rapidly urbanizing cities.

The study concludes that corrugated cardboard has the potential to redefine sustainable interior practices by offering

recyclable, economical, and innovative design solutions for future-oriented interior environments. As sustainable design continues to evolve, corrugated cardboard may increasingly serve not only as an alternative material, but also as a medium for redefining environmentally conscious and adaptive interior environments.

REFERENCES

- [1] Akinade, O. O., Oyedele, L. O., Bilal, M., et al. (2023). Circular-economy-based approach to utilizing cardboard in sustainable building construction. *Buildings*, 13(1), 181.
- [2] Ayrlimis, N., Akbulut, T., & Dundar, T. (2010). Effect of waste paper on properties of lightweight panels for furniture applications. *Materials & Design*, 31(2), 1010–1014.
- [3] Becchio, C., Corgnati, S. P., & Kindinis, A. (2012). Improving environmental sustainability of interior materials. *Building and Environment*, 56, 180–188.
- [4] Bulut, D. M., & Gurani, F. Y. (2018). A study of Shigeru Ban's environmentally sensitive architectural design approach. *Gazi University Journal of Science Part B: Art Humanities Design and Planning*, 6(3), 147–157.
- [5] Fiell, C., & Fiell, P. (2005). *Design Now: Industrial Design*. Taschen.
- [6] Gorgolewski, M. (2008). Designing with reused building components. *Building Research & Information*, 36(2), 175–188.
- [7] Kaya, A., & Akyuz, K. C. (2015). Use of recycled corrugated cardboard in lightweight furniture panels. *BioResources*, 10(4), 7730–7741.
- [8] McDonough, W., & Braungart, M. (2002). *Cradle to Cradle: Remaking the Way We Make Things*. North Point Press.
- [9] Papanek, V. (1995). *The Green Imperative: Ecology and Ethics in Design*. Thames & Hudson.
- [10] Sangree, R. H., Widerman, E., & Grieser, J. M. (2018). Manufacturing and assessment of cardboard-based furniture systems. *Journal of Cleaner Production*, 187, 429–438.
- [11] Sapienza, V., Rodonò, G., Monteleone, A., & Calvagna, S. (2022). ICARO—Innovative cardboard architecture object: Sustainable building technology for multipurpose micro-architecture. *Sustainability*, 14(23), 16099.
- [12] Suarez, B., Muneta, L. M., Romero, G., & Sanz-Bobi, J. D. (2021). Efficient design of thin wall seating made of a single piece of heavy-duty corrugated cardboard. *Materials*, 14(21), 6645.