International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 02 | Feb - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

Buildings as Material Banks: Reversible Architecture for Multi-Life Building Systems

Vinayak Soni[1], Ar. Shefali Soni[2]

[1]Student, School of Architecture, RGPV, Bhopal
[2]Asst. Professor, School of Architecture, RGPV, Bhopal

Abstract – Traditional construction follows a linear model. Buildings are built, used, and then torn down, which creates a lot of waste and resource loss. The idea of Buildings as Material Banks suggests a circular approach. In this model, buildings are designed as reusable systems of components. With reversible architecture and modular construction, we can recover materials and use them across multiple life cycles. This study looks at how reversible design allows for adaptable buildings that can have multiple lives. It also focuses on improving environmental performance and urban sustainability.

Keywords: Buildings as Material Banks, Reversible Architecture, Circular Construction, Multi-Life Buildings, Design for Disassembly, Urban Sustainability

1. Introduction

Rapid urbanization has raised the demand for construction and created more demolition waste. Permanent building methods restrict adaptability and material recovery.

Buildings as Material Banks suggest designing structures for disassembly and reuse, based on reversible architecture principles. This approach helps buildings change over time while saving resources.

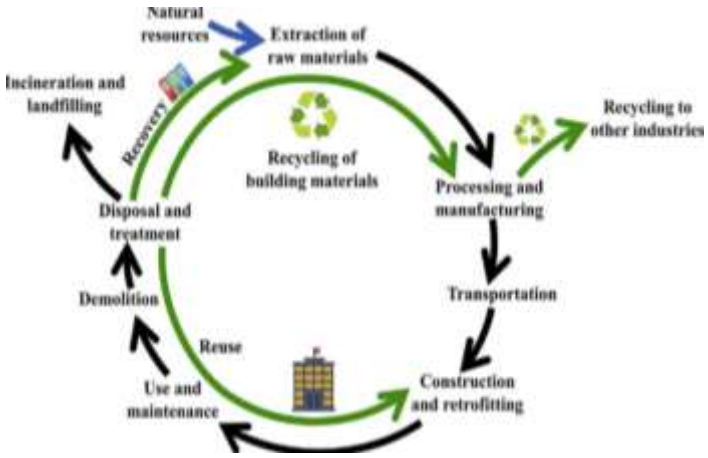

Figure 1 Showing Life-cycle of Building Material

2. Research Gap

Although reversible architecture and circular construction are common topics, there is little research on buildings as integrated material banks that can support multiple life cycles. There is not enough comparison between traditional and reversible building systems. Practical architectural design strategies for adaptability and disassembly in urban settings are also not thoroughly explored.

2. Research Methodology

This study takes a qualitative and comparative approach, which includes:

- Reviewing existing literature on reversible architecture and circular construction
- Analyzing adaptable building systems and modular construction methods
- Comparing conventional buildings with multi-life reversible systems

Key evaluation criteria included material reuse potential, environmental impact, adaptability, and lifecycle efficiency

Figure 2 Showing Conceptual diagram of Buildings as Material Banks

3. Reversible Architecture Principles

Reversible buildings include:

- Modular standardized parts.
- Mechanical connections instead of permanent ones.

- Layered building systems that allow for easy upgrades.
- Accessible joints for maintenance and disassembly.

These features allow for functional changes and material recovery.

4. Multi-Life Building Systems

Multi-life buildings are made for long-term flexibility. They let you change the use and layout without needing to tear anything

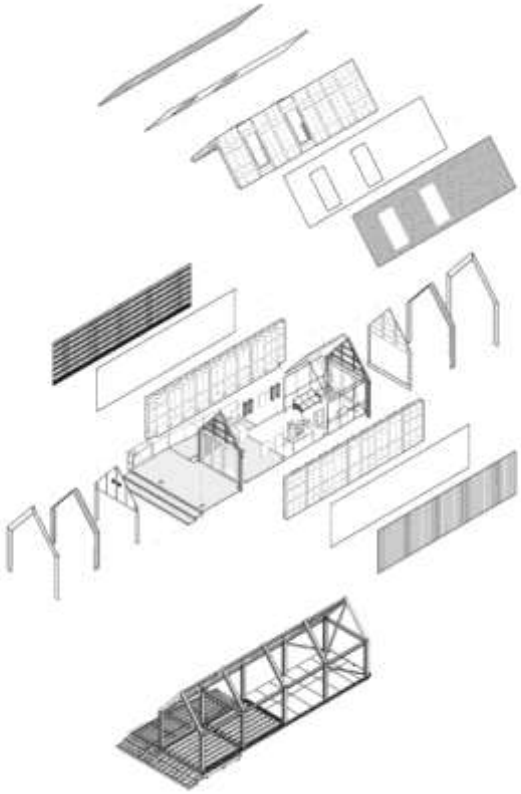

Figure 3 Exploded view showing a modular multi-life building system designed for adaptability and disassembly.

down. Components can be moved, reused, or put back together. This extends the life of materials and reduces the pressure of construction in urban areas.

5. Impact on the Urban Environment

Reversible multi-life buildings help cities in several ways:

- They reduce construction and demolition waste.
- They lower embodied carbon emissions.
- They decrease the demand for raw material extraction.
- They support compact, adaptable urban growth.
- They minimize disruption from frequent rebuilding.

This approach encourages cleaner, more resilient urban development.

6. Environmental and Economic Benefits

Benefits include:

- Significant waste reduction.
- Better resource efficiency.
- Lower long-term construction costs.
- Value of building components is retained.
- Reduced renovation and demolition costs.

While initial planning costs may be higher, overall lifecycle performance is better.

7. Challenges

Major barriers include regulatory limits, a lack of standard reusable parts, and resistance from the industry to new systems. Education and policy change are essential for broader adoption.

8. Recommendations

To promote Buildings as Material Banks:

- Integrate reversible design principles into building codes.
- Encourage modular and prefabricated construction.
- Develop digital material passport systems.
- Provide incentives for circular construction projects.
- Include reversible architecture in architectural education.

9. Conclusion

Buildings as Material Banks represent a change toward circular, flexible urban construction. With reversible architecture, buildings can go through multiple life cycles while cutting waste and environmental harm. This method provides a sustainable answer for fast-growing cities.

Acknowledgement

The author appreciates the guidance and support of academic mentors and faculty members. Their knowledge, helpful feedback, and encouragement played a key role in this research. Special thanks go to the research supervisor for continuous direction and valuable insights during the study.

The author also thanks architects, engineers, and researchers whose work on reversible architecture, circular construction, and design for disassembly provided a strong theoretical basis for this paper. Finally, the author is grateful to family members for their unwavering encouragement, patience, and support throughout the research process.

References

- **J. de Oliveira, D. Schreiber & V. D. Jahno (2024),** ***Circular Economy and Buildings as Material Banks***... — a systematic review of publications on *Buildings as Material Banks* and circular construction strategies, published in *Sustainability*. https://www.mdpi.com/2071-1050/16/12/5022

- **Ottenhaus et al. (2023),** ***Design for adaptability, disassembly and reuse – reversible timber connection systems*** — a literature review on adaptable and reversible building systems in construction. https://doi.org/10.1016/j.conbuildmat.2023.132823

- **European Commission —** ***Buildings as Material Banks: Integrating Materials Passports with Reversible Building Design*** — official project details from the *Horizon 2020* research program. https://cordis.europa.eu/project/id/642384

- **European Commission —** ***Buildings as Material Banks: Integrating Materials Passports with Reversible Building Design*** — official project details from the *Horizon 2020* research program. https://cordis.europa.eu/project/id/642384

- **BAMB Materials Passports Best Practice Guide** — insights into *materials passports* and reversible design strategies developed by the BAMB consortium. https://www.bamb2020.eu/wp-content/uploads/2019/02/BAMB_MaterialsPassports_BestPractice.pdf

- **BAMB Materials Passports Best Practice Guide** — insights into *materials passports* and reversible design strategies developed by the BAMB consortium. https://www.bamb2020.eu/wp-content/uploads/2019/02/BAMB_MaterialsPassports_BestPractice.pdf