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"Option2" The Nexus of Modularity, MEP, and BIM: Rethinking High-Rise Housing Developments

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1. INTRODUCTION

The construction industry is witnessing a transformative shift in integrating modular construction and Building Information Modeling (BIM) in high-rise buildings. Blending prefabricated modular units with advanced digital modeling promises enhanced efficiency, cost-effectiveness, and sustainability. Modular construction, characterized by the assembly of pre-engineered building sections, offers significant time and cost savings, while BIM facilitates precise design, integration, and management of Mechanical, Electrical, and Plumbing (MEP) systems. This study anchored in qualitative and quantitative analyses of existing literature to evaluate the feasibility and effectiveness of this integration, points out the importance of MEP system updates in the potential of modular high-rise housing from a selective criteria analysis.

2. SELECTIVE CRITERIA

In selecting research papers on construction methodologies, our criteria focus on BIM, Cost-Effectiveness, Time Efficiency, Sustainability, and MEP Systems' Adaptability. We assess financial benefits by comparing costs between traditional and modular methods. Time Efficiency scrutinizes project timeline reductions through prefabrication and digital modeling. Sustainability evaluates environmental impacts, such as reduced material use and energy consumption, facilitated by BIM planning. Finally, integrating MEP systems within prefabricated modules is examined for design and connectivity challenges. This framework ensures that chosen studies offer significant insights into construction methodology advancements. In the current study of 30 related papers, it has been discovered that, based on current technology and research, there has not yet emerged an efficient replacement solution for modular MEP systems, like the Nakagin Capsule Tower aging problem.

3. PRELIMINARY CONCLUSION

Integrating modular construction with BIM in high-rise buildings presents a transformative strategy, offering significant improvements in efficiency, sustainability, and construction quality. The aging of MEP systems underscores the limitations of traditional construction in maintaining and updating essential infrastructure. This deterioration leads to increased energy consumption and higher maintenance costs, potentially affecting the building's long-term sustainability and safety. Future research can aim at creating integrated solutions for modular MEP systems that boost energy efficiency, cut maintenance costs, and further sustainability. Researchers should investigate the use of efficient design and prefabrication technologies to simplify the MEP system upgrade and replacement process, alongside employing digital modeling (e.g., BIM) to enhance system performance and flexibility. The consideration of innovative materials and technologies to prolong MEP systems' life and adaptability to environmental shifts is also crucial. This method promises more resilient and sustainable MEP solutions for high-rise housing, thus improving overall building performance.