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Comparative Study on Design of RCC Structure Using Mivan Technology

Bhagyashree Satpute [1], Prof. Raju Bondre [2]

[1] Research Scholar (M.Tech in Structural Engineering), Department of Civil Engineering, Guru Nanak Institute of Technology, Dahegaon, Kalmeshwar Road, Nagpur
[2] Assistant Professor, Department of Civil Engineering, Guru Nanak Institute of Technology, Dahegaon, Kalmeshwar Road, Nagpur

Abstract: - The rapid growth of urban population in India has created an urgent demand for fast, economical, and high-quality housing construction. Conventional Reinforced Cement Concrete (RCC) framed construction, though widely practiced, often suffers from longer construction durations, higher labor dependency, and variability in quality. In this context, MIVAN technology, an aluminium formwork-based system enabling monolithic RCC wall–slab construction, has emerged as a promising alternative. This review paper presents a comparative assessment of RCC structures constructed using conventional methods and MIVAN technology by critically analyzing ten previously published research works. The review focuses on structural performance, seismic behavior, construction speed, cost efficiency, quality control, and suitability for mass housing projects. Based on the literature, key research gaps are identified, particularly concerning optimization of structural design parameters, long-term performance, sustainability aspects, and adaptability of MIVAN technology under diverse Indian conditions. The paper aims to provide a consolidated understanding of the current research status and to highlight directions for future studies in the design and analysis of RCC structures using MIVAN technology.

Keywords: - MIVAN Technology, Aluminium Formwork System, Conventional RCC Construction, Monolithic RCC Structures, Seismic Performance, Structural Analysis, ETABS

I. INTRODUCTION

The Indian construction industry is presently undergoing a profound and transformative phase, largely driven by rapid urbanization, exponential population growth, migration from rural to urban areas, and an ever-increasing demand for affordable, durable, and high-quality housing infrastructure. For several decades, conventional reinforced cement concrete (RCC) framed construction with brick masonry infill walls has remained the most widely adopted building practice across the country due to its relative simplicity, availability of materials, well-established design codes, and widespread familiarity among engineers, contractors, and construction workers. Despite its long-standing acceptance, this traditional construction methodology is increasingly being challenged by multiple limitations, including longer construction durations, heavy dependence on skilled and semi-skilled labour, variability in workmanship quality, excessive material wastage, and escalating construction costs. These issues are further intensified in large-scale housing projects where delays, cost overruns, and quality inconsistencies can significantly impact project viability and delivery timelines. In response to these challenges, the Indian construction sector is steadily shifting towards modern and industrialized construction technologies that emphasize speed of execution, quality assurance, cost efficiency, and standardization. Among these emerging technologies, MIVAN formwork technology has gained significant attention and acceptance, particularly in mass housing and high-rise residential developments. Originally developed in Europe and subsequently adapted to suit Indian construction practices and climatic conditions, MIVAN is a modular aluminium formwork system that enables the monolithic casting of structural elements such as walls, slabs, beams, staircases, and other components in a single continuous pour. This integrated construction approach not only accelerates project execution but also ensures superior dimensional accuracy, better surface finish, and enhanced quality control when compared to conventional formwork systems. From a structural engineering standpoint, buildings constructed using MIVAN technology exhibit fundamentally different structural behavior when compared to conventional RCC framed structures.

Unlike traditional systems that rely on discrete beams and columns with masonry infill walls, MIVAN buildings predominantly consist of continuous reinforced concrete shear walls that act as the primary load-resisting elements. This monolithic wall-slab system significantly alters key structural parameters such as lateral stiffness, load distribution mechanisms, natural time period, energy dissipation capacity, and overall seismic performance. The presence of continuous RC shear walls enhances the building's ability to resist lateral loads arising from earthquakes and wind, resulting in reduced storey displacements and inter-storey drifts, thereby improving structural stability and occupant safety, especially in seismic-prone regions. Furthermore, the monolithic nature of MIVAN construction minimizes the number of structural joints, which are often the weakest points in conventional RCC frames, leading to improved durability and reduced susceptibility to damage during extreme loading events. However, despite its numerous advantages, the adoption of MIVAN technology also raises important questions related to design optimization, material consumption, cost–benefit considerations, architectural flexibility, long-term performance, and sustainability, particularly under diverse Indian soil and seismic conditions. Therefore, a detailed comparative study of RCC structures designed using MIVAN technology and conventional construction methods becomes essential to comprehensively understand its technical feasibility, structural efficiency, economic viability, and practical limitations. In this context, the present review paper critically synthesizes the findings of ten major research studies reported in the literature that focus on the comparative performance of MIVAN and conventional RCC construction systems. By examining aspects such as structural behavior under seismic loading, construction speed, cost efficiency, quality control, and suitability for mass housing, the review aims to establish the current state of research in this domain. Additionally, the paper identifies key research gaps related to optimization of design parameters, long-term durability, sustainability assessment, and adaptability of MIVAN technology, thereby providing a strong foundation for future research and development in modern RCC construction practices.

II. LITERATURE REVIEW

[1] M. Ganga Jamuna and Dr. P. Anuradha (2024) conducted a Comparative Study of Conventional Structure and Mivan Structure Using ETABS- The study was undertaken to evaluate and compare the structural performance of conventional RCC construction and MIVAN technology–based structures under seismic loading conditions, with particular emphasis on understanding the influence of wall thickness and configuration on overall seismic response. For this purpose, the authors developed detailed analytical models using ETABS software and carried out Response Spectrum Analysis, which is widely recognized as an effective method for assessing the dynamic behavior of buildings subjected to earthquake forces. Both conventional RCC framed structures and MIVAN structures were analyzed under identical loading conditions, with the MIVAN models incorporating reinforced concrete shear walls of varying thicknesses to examine their effect on seismic performance. The comparative results clearly demonstrated that MIVAN structures with a wall thickness of 300 mm arranged in an I-shaped configuration exhibited markedly lower storey displacements, reduced inter-storey drifts, and shorter fundamental time periods when compared to conventional RCC systems. Furthermore, the increased wall thickness and monolithic construction in the MIVAN system resulted in higher storey shear capacity and significantly enhanced structural stiffness, indicating a superior ability to resist lateral seismic forces. These improvements in stiffness and load-resisting capacity contribute to reduced deformation demand and improved overall stability during earthquake events. Based on the analytical findings, the study conclusively established that adoption of MIVAN technology, particularly with a 300 mm thick shear wall configuration, provides enhanced seismic resilience, improved structural performance, and greater stability, making it a highly effective and reliable construction method for tall buildings located in seismic-prone regions.

[2] Abhijit V. Bidare and Deepali Bhagaje (2021) in their study Comparative Analysis of Conventional Technology and Mivan Technology- The study examined the differences in cost, construction time, and quality between conventional RCC construction practices and MIVAN technology, with specific reference to the evolving needs of the Indian construction industry. The authors emphasized that rapid urbanization, increasing population, and large-scale housing requirements have compelled the industry to shift towards industrialized and modular construction methods capable of delivering projects within stringent timelines while maintaining consistent quality standards. Through a detailed comparative analysis, the study assessed key parameters such as formwork cycle time, labour dependency, material utilization, construction speed, and quality of finish for both conventional and MIVAN construction systems. The findings revealed that MIVAN technology, based on precision-engineered aluminium formwork, enables significantly faster construction due to rapid assembly, efficient repetition cycles, and the ability to cast multiple structural elements monolithically in a single pour.

In addition to time efficiency, the study reported superior construction quality in MIVAN buildings, characterized by better dimensional accuracy, uniform surface finish, and reduced need for post-construction plastering and rework. Although the initial investment in aluminium formwork is relatively higher, the authors observed that MIVAN technology becomes highly cost-effective in large-scale and repetitive projects due to substantial savings in labour costs and shortened project durations. Based on the overall evaluation, the study conclusively established that MIVAN technology holds clear superiority over conventional RCC construction methods in terms of efficiency, economic viability, and construction quality, particularly in mass housing schemes and high-rise residential structures, where speed, uniformity, and reliability are critical success factors.

[3] Anmol Hinduja, Tarun Sankle, and Mahroof Ahmed (2025) in their paper Comparative Study of Mivan Technology and Conventional RCC Structures in High Seismic Zones- The study analysed the seismic and wind performance of a G+12 residential building constructed using both MIVAN technology and conventional RCC structural systems, with the objective of evaluating their comparative behavior under lateral loading conditions. Recognizing that high-rise residential buildings in seismic-prone regions are particularly vulnerable to earthquake and wind forces, the authors employed advanced structural analysis software to develop detailed analytical models of both construction systems. The evaluation focused on critical response parameters such as storey displacement, inter-storey drift, base shear, and natural time period, which are key indicators of lateral stability and seismic performance. The analytical results clearly revealed that MIVAN structures exhibited significantly lower displacement and inter-storey drift values when subjected to seismic and wind loads, primarily due to their monolithic, joint-free construction and the presence of continuous RC shear walls, which enhance stiffness and ensure efficient load transfer. In contrast, conventional RCC framed systems, characterized by multiple beam–column joints, showed comparatively higher lateral deformations. Beyond structural performance, the study also highlighted the practical advantages of MIVAN technology, including faster construction cycles, reduced dependence on skilled labour, and improved execution efficiency. These benefits were found to be particularly advantageous for high-rise mass housing projects, where both structural safety and timely project delivery are critical. Based on the combined assessment of structural and construction-related parameters, the study concluded that MIVAN formwork technology not only improves structural resilience under seismic and wind forces but also enhances overall project delivery timelines, thereby offering a well-balanced and effective solution for achieving safety, efficiency, and speed in high-rise residential developments located in earthquake-sensitive regions.

[4] Prof. Mrs. Poorva Ziradkar, Ajinkya Shinde, Momin Ayyaj Shamsuddhin, Shravan Pawar, and Momin Shayan Rashid (2025) in their study Use of Mivan Formwork in RCC G+12 Building- The study highlighted the critical significance of formwork technology in accelerating construction speed and enhancing economic efficiency within the building industry, particularly in the context of rapidly increasing population and the consequent surge in housing demand. The authors emphasized that traditional construction practices are often inadequate to meet the pressing requirements of large-scale and time-bound residential developments, thereby necessitating the adoption of rapid construction technologies such as MIVAN formwork systems. Through a detailed analytical assessment, the study demonstrated that MIVAN technology substantially reduces overall project duration by enabling faster formwork cycles, simultaneous casting of structural components, and efficient repetition of standardized building layouts. In addition to time savings, the precision-engineered aluminium formwork used in MIVAN construction was found to significantly enhance construction quality, ensuring high dimensional accuracy, superior surface finish, and consistency across floors, which in turn reduces the need for extensive plastering and rework. The authors specifically examined the applicability of MIVAN formwork in high-rise residential buildings such as G+12 structures, where speed, uniformity, and structural reliability are critical. The findings indicated that the monolithic wall–slab construction achieved through MIVAN technology improves overall structural performance while maintaining strict control over quality and workmanship. Based on the comprehensive evaluation, the study conclusively established that the adoption of MIVAN formwork offers substantial advantages in terms of time efficiency, cost reduction, and construction quality, making it an effective solution for addressing the urgent housing requirements of densely populated urban regions and supporting sustainable urban development.

[5] Amith B. N. and Akash T. N. (2023) in their paper Comparative Study of Mivan and Conventional Formwork Structures- The study examined the cost implications, time efficiency, and overall performance of MIVAN formwork systems in comparison with conventional formwork techniques, with particular emphasis on their impact on project economics and construction productivity. The authors highlighted that formwork alone contributes nearly 35–40% of the total cost of an RCC structural member, thereby making the selection, design, and optimization of formwork systems a critical factor in achieving cost-effective construction.

Through a comprehensive comparative analysis of findings reported in various previous research works, the study systematically evaluated parameters such as formwork cycle time, labour requirement, durability, reliability, reusability, quality of finish, and overall construction efficiency for both MIVAN and conventional systems. The results clearly demonstrated that MIVAN technology offers significantly higher efficiency due to its modular aluminium formwork, which enables rapid assembly, precise alignment, and faster repetition cycles. In addition, the inherent durability and reusability of aluminium formwork were found to reduce long-term costs by minimizing formwork replacement and maintenance requirements. The study also observed that MIVAN construction substantially reduces dependence on skilled labour, thereby lowering labour costs and mitigating delays caused by workforce shortages. Furthermore, the superior surface finish and dimensional accuracy achieved through MIVAN formwork contribute to reduced plastering and finishing requirements, leading to additional time and cost savings. Based on the overall assessment, the authors conclusively established that MIVAN formwork is superior to conventional formwork techniques in terms of cost-effectiveness, speed of construction, reliability, and long-term performance, making it particularly well suited to modern construction demands, especially in large-scale, repetitive, and time-bound building projects.

[6] Sreenath V., B. Prakash Rao, Anup Wilfred Sebastian, and Chengappa K. K. (2018) in their paper Suitability of Modular Aluminium Formwork in RCC Framed Structures- The study assessed the applicability and performance of Modular Aluminium (MIVAN) formwork systems in large-scale residential and commercial construction projects in India, with particular emphasis on their suitability for high-rise RCC framed structures. To provide a practical and realistic evaluation, the authors adopted the Salarpuria Sattva Divinity project in Bangalore as a detailed case study, which enabled a direct comparison of construction quality, speed of execution, labour requirements, and overall cost implications among three different formwork systems, namely modular aluminium formwork, MIVAN formwork, and conventional timber or steel formwork. A comprehensive cost estimation was carried out for the construction of one typical floor using each formwork type, revealing that although the initial investment for modular aluminium and MIVAN formwork systems was comparable to that of conventional formwork, MIVAN technology demonstrated superior economic performance over the project life cycle due to its higher repetition capacity and faster formwork cycles. The study further highlighted that the monolithic construction approach inherent in MIVAN technology significantly enhances structural stability by ensuring continuity between walls, slabs, and other structural elements, thereby improving load transfer mechanisms and reducing construction-induced defects. In addition to economic benefits, the authors observed that MIVAN formwork facilitates superior surface finish, dimensional accuracy, and increased carpet area due to the elimination of conventional columns and beams in certain configurations. The markedly reduced construction time and lower labour dependency associated with MIVAN construction were identified as major advantages, particularly in high-rise projects where speed and consistency are critical. Based on these findings, the study conclusively established that MIVAN technology is highly suitable for large-scale and high-rise RCC framed structures, offering a balanced combination of long-term cost efficiency, enhanced structural performance, improved quality, and rapid execution, making it a preferred choice for modern residential and commercial developments in India.

[7] Prof. Manish Mata and Gauravi Anil Chaudhari (2021) in their paper Comparative Study of Various Construction Techniques- The study analysed the differences between MIVAN technology and conventional construction methods, with a primary focus on their applicability in large-scale infrastructure development. The authors emphasized that the construction industry plays a vital role in national economic growth and development, and therefore must continuously evolve by adopting efficient, innovative, and time-saving construction technologies to address the ever-increasing demand for infrastructure facilities. In this context, the comparative assessment highlighted the limitations of conventional construction practices, such as longer execution time, higher dependence on skilled labor, and variability in construction quality. The study systematically evaluated key parameters including construction speed, quality control, labor requirement, project execution efficiency, and overall performance of both construction techniques. The findings revealed that MIVAN technology offers substantial advantages over conventional systems, particularly due to its aluminium formwork-based monolithic construction, which ensures higher dimensional accuracy, superior surface finish, and consistency in quality. Additionally, the reduced dependence on skilled labor and faster formwork cycles associated with MIVAN construction were found to significantly enhance productivity and shorten project timelines. The authors further noted that the adoption of MIVAN technology contributes to improved planning and scheduling efficiency, which is crucial for timely project delivery in infrastructure projects.

Based on the comparative results, the research concluded that the selection of appropriate construction technology, such as MIVAN, plays a decisive role in achieving improved project delivery timelines, enhanced structural and construction quality, and better overall project performance across critical sectors including housing, transportation, and public infrastructure, thereby reinforcing the relevance of MIVAN technology in modern infrastructure development.

[8] Darshankumar Patel, Shubham Pawar, Vishwadeep Pawar, Sagar Vasave, Prasad Bhamare, and Nikhil Patil (2023) in their paper A Review Paper on Comparative Analysis of MIVAN Formwork Technology and Conventional Formwork Technology- The study evaluated the economic viability and performance characteristics of MIVAN technology in comparison with conventional prefabrication and traditional construction methods, with a particular focus on the pressing needs of India's rapidly expanding construction sector. The authors emphasized that the growing demand for affordable housing, coupled with strict project timelines and quality expectations, has created an urgent necessity for rapid, cost-effective, and high-quality construction systems capable of delivering large-scale residential projects efficiently. Through a detailed comparative assessment, the study examined critical factors such as initial investment, repetition cycle benefits, labor dependency, construction speed, quality consistency, and overall cost efficiency associated with both MIVAN and conventional prefabrication techniques. The analysis revealed that although MIVAN formwork involves a relatively higher initial cost, this is effectively offset in mass housing projects due to its high reusability, reduced formwork cycle time, and significant savings in labor and project duration. Furthermore, the precision-engineered aluminium formwork used in MIVAN construction was found to enhance dimensional accuracy, surface finish, and structural reliability, thereby minimizing rework and quality-related issues commonly encountered in conventional systems. The results clearly indicated that MIVAN technology outperforms traditional prefabrication methods in terms of cost efficiency, reliability, and speed of construction, making it a highly favorable option for large-scale and repetitive housing developments. The study conclusively established that the monolithic construction approach inherent to MIVAN technology, combined with its rapid execution capability, provides a distinct advantage over conventional prefabrication techniques, particularly in projects demanding high output, uniformity, and accelerated project delivery, thereby reinforcing its suitability for modern mass housing applications.

[9] Nisarga K and Madhukaran (2022), in their paper Structural Performance of Mivan Structural System Over Conventional Structural System- The study investigated the structural behaviour of MIVAN structural systems in comparison with conventional RCC framed structures, with particular emphasis on addressing India's rapidly increasing housing demand resulting from accelerated urban population growth. The authors highlighted that conventional construction methods often struggle to meet the dual requirements of speed and structural efficiency, especially in large-scale residential developments. To evaluate the effectiveness of aluminium formwork–based MIVAN construction incorporating reinforced concrete shear wall systems, a detailed analytical investigation was carried out using ETABS software. The structural models were subjected to response spectrum analysis, enabling a realistic assessment of seismic behavior under dynamic loading conditions. Key structural response parameters, including storey displacement, inter-storey drift, base shear, fundamental time period, and natural frequencies, were systematically compared for both MIVAN and conventional RCC framed systems. The analytical results clearly demonstrated that MIVAN structures, owing to their monolithic RC shear wall configuration and continuity of load-resisting elements, exhibited significantly lower lateral displacements and inter-storey drifts when compared to conventional framed buildings. Additionally, the increased stiffness of the MIVAN system resulted in reduced time periods and improved overall stability under lateral loads such as earthquake forces. The study further observed that the efficient load transfer mechanism inherent in monolithic construction enhances seismic resistance and minimizes structural vulnerabilities associated with beam–column joints in conventional frames. Based on these findings, the research conclusively established that MIVAN technology offers superior structural performance along with substantial time efficiency, making it a highly suitable and practical solution for large-scale residential housing projects in densely populated urban regions where both rapid construction and enhanced seismic safety are critical requirements.

[10] Nikhil S. Thote and Aditi H. Deshmukh (2022), in their paper Comparative Analysis of Framed Structure Vs Mivan Structure- Carried out an in-depth analytical investigation to evaluate the structural performance of a G+9 residential building designed using two different construction methodologies, namely the conventional RCC framed system and the MIVAN (aluminium formwork) structural system. The study was motivated by the increasing demand for rapid, economical, and high-quality housing solutions in urban India, where traditional construction techniques often fail to meet stringent time and quality constraints.

The authors adopted ETABS 2016 as the primary structural analysis tool and performed a detailed comparative analysis in accordance with relevant Indian Standard codes, particularly IS 456:2000 for reinforced concrete design and IS 1893 (Part 1):2002 for seismic analysis, considering Seismic Zone III with medium soil conditions. Both structural models were subjected to identical loading conditions and load combinations to ensure a fair and consistent comparison. Critical seismic response parameters such as maximum storey displacement, inter-storey drift, storey shear, storey stiffness, and overall lateral stability were systematically evaluated. The results clearly demonstrated that the MIVAN structural system, owing to its monolithic wall–slab construction and significant reduction in beam–column joints, exhibited substantially higher stiffness and lower lateral displacements when compared to the conventional RCC framed structure. Furthermore, the continuous RC shear wall action in the MIVAN system contributed to enhanced resistance against lateral seismic forces, resulting in improved seismic performance and structural safety. The authors also highlighted that the reduced time period and improved load transfer mechanism in MIVAN buildings make them particularly suitable for earthquake-prone regions. Based on the analytical outcomes, the study conclusively established that MIVAN technology not only enhances structural performance but also supports faster construction, improved quality control, and cost efficiency, thereby making it a highly viable solution for large-scale and mass housing developments in modern urban environments.

III. RESEARCH GAP IDENTIFIED

From the detailed review of the above ten studies, the following research gaps have been identified:

1. Limited optimization studies on wall thickness, shear wall configuration, and reinforcement detailing in MIVAN structures for different seismic zones.
2. Insufficient comparative design-based studies focusing on load combinations, material consumption, and structural economy rather than only response parameters.
3. Lack of long-term performance evaluation, including durability, cracking behavior, and maintenance aspects of MIVAN structures under Indian environmental conditions.
4. Minimal sustainability assessment, particularly regarding embodied energy, carbon footprint, and recyclability of aluminium formwork systems.
5. Scarcity of soil–structure interaction and foundation behavior studies for MIVAN buildings compared to conventional RCC frames.
6. Limited focus on design adaptability, architectural flexibility, and challenges in retrofitting or future modifications of MIVAN buildings.

These gaps indicate the need for integrated analytical, experimental, and practical studies to fully establish the design efficiency and applicability of MIVAN technology in diverse construction scenarios.

CONCLUSION

This review paper presents a consolidated evaluation of ten significant studies comparing conventional RCC construction and MIVAN technology. The literature clearly establishes that MIVAN technology offers superior structural performance, enhanced seismic resistance, faster construction, improved quality, and better suitability for mass housing projects. The monolithic RCC wall–slab system significantly improves stiffness and reduces lateral displacements compared to conventional framed structures. However, despite its advantages, the review identifies critical gaps related to optimization, sustainability, long-term performance, and design flexibility. Addressing these gaps through future research will help in developing refined design guidelines and promoting wider adoption of MIVAN technology in India. Overall, MIVAN technology holds strong potential as a modern, efficient, and structurally robust alternative to conventional RCC construction.

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