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Performance Evaluation of Mivan Aluform Formwork System in High-Rise Building Construction

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EXECUTIVE SUMMARY: *The construction industry thrives on efficiency, cost-effectiveness, and timely project delivery. Conventional construction methods often struggle to meet these demands, particularly for large-scale residential developments. Mivan formwork, an innovative aluminum-based system, addresses these challenges by enabling rapid, high-quality construction. Originally developed by a European company and later manufactured by Mivan Company Ltd., Malaysia, in 1990, this technology has transformed the way high-rise and mass housing projects are executed worldwide. Mivan formwork allows entire walls and slabs to be cast in a single pour, reducing construction cycles while ensuring precision and durability.*

I. OVERVIEW OF MIVAN FORMWORK TECHNOLOGY

A. Significance in Modern Construction:

Formwork is a critical component in any construction project, directly impacting speed, labor efficiency, and structural quality. As urban populations grow, there is increasing demand for fast, reliable housing solutions. Mivan formwork provides a modular, reusable solution that accelerates construction while maintaining high-quality standards, making it particularly suitable for large residential and commercial projects.

B. Evolution of Formwork Systems:

Traditionally, wooden plywood formwork was widely used in India and across the world. However, limitations such as low reusability, increased labor requirements, and longer construction cycles prompted the development of more advanced solutions. Aluminum formwork systems, like Mivan, emerged to overcome these challenges, offering lightweight, durable, and highly adaptable structures.

C. Global Adoption and Indian Scenario:

Mivan technology is extensively used in Europe, Asia, and the Gulf countries. In India, leading real estate developers have employed Mivan formwork for iconic high-rise towers, including Lodha One and Dosti Towers. This adoption highlights a shift towards faster, more cost-effective construction methods, though conventional systems still persist in some areas due to resistance to change.

D. Project Aim:

This project aims to explore Mivan formwork comprehensively, including its practical application at construction sites, understanding construction cycles, and evaluating its efficiency compared to traditional methods.

E. Project Objectives:

1) Review existing research and literature on Mivan formwork.
2) Study the fundamentals of formwork systems and modern construction techniques.
3) Conduct an on-site case study to observe practical implementation, workflow, and productivity.
4) Analyze the cost-effectiveness, efficiency, and sustainability of Mivan formwork.
5) Compare Mivan with conventional formwork systems in terms of speed, quality, and maintenance.
6) Identify challenges, limitations, and best practices in adopting Mivan technology for high-rise construction.

F. Scope of the Study:

Mivan technology is expected to gain wider acceptance in the future due to its clear advantages, including reduced construction time, lower labor costs, and enhanced quality. This study highlights its potential as a standard formwork system for high-rise and mass housing projects.

II. REVIEW OF EXISTING RESEARCH AND APPLICATIONS

A. Understanding Past Developments:

A thorough literature review provides insight into previous research, technologies, and best practices. It helps establish a foundation for the current study and guides the practical application of Mivan formwork.

B. Key Studies and Findings:

1) Efficiency in Residential Projects (Atul R. Kolhe et al., 2014): A case study of the 'Megapolis' project in Pune demonstrated how combining conventional substructure with Mivan formwork for upper floors enhances speed and productivity.
2) Comparative Cost Analysis (Ganar A. S. et al., 2015): Comparison of G+12 buildings using conventional and Mivan formwork showed considerable reduction in project duration and cost efficiency with Mivan systems.
3) Overcoming Technical Challenges (Kushal Patil et al., 2015): Addressed common defects such as segregation and honeycombing in shear walls, suggesting suitable admixtures to improve concrete quality.
4) Maximizing Productivity (Prathul U et al., 2015): Demonstrated that Mivan formwork significantly improves productivity in repetitive construction tasks, making it an economically viable alternative to conventional systems.
5) Structural Performance Analysis (Sajeet S. B. et al., 2015): Studied different Mivan wall configurations and their impact on lateral strength and stiffness, highlighting the system's suitability for high-rise construction.

C. Summary of Literature Review:

From the studies analyzed, it is evident that Mivan formwork offers substantial advantages in terms of speed, quality, and cost-efficiency. Its global adoption reflects its proven performance, and Indian projects are increasingly recognizing its potential for mass housing and high-rise structures.

III. MIVAN TECHNOLOGY

A. Overview

This section discusses the Mivan formwork system in detail—its applications, benefits, limitations, and distinctive features. Insights are derived from literature studies, site observations, and practical case studies. The technology has been increasingly adopted across India, especially in metropolitan cities like Mumbai, where several high-rise residential projects are being delivered using Mivan systems. Understanding the system thoroughly is crucial to appreciate its efficiency and long-term advantages in large-scale construction.

B. Benefits of Mivan Formwork:

Mivan technology is preferred due to its multiple advantages that address the limitations of conventional systems:

1) Requires comparatively less labor.
2) Enables faster floor cycle completion.
3) Fewer joints reduce leakage issues.
4) Provides a smooth surface finish for walls and slabs.
5) Offers better seismic resistance.
6) Maximizes carpet area due to thin structural elements.
7) Ensures consistent quality and accuracy.
8) Reduces construction duration significantly.
9) Eliminates the need for external plastering in most cases.

C. Limitations of Mivan Formwork:

Despite its strengths, Mivan technology has some constraints that must be considered during implementation:

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1) Skilled labor is required to ensure proper alignment.
2) Initial assembly and setup take considerable time.
3) Higher initial cost compared to traditional systems.
4) Most efficient only for repetitive floor layouts (typical floors).
5) Proper placement of construction joints is essential to avoid defects.
6) Susceptible to seepage and leakage if joints are not well maintained, especially during monsoons.

D. Applications of Mivan Formwork:

The primary uses of Mivan systems can be summarized as follows:

1) Quick and user-friendly operation, reducing construction time.
2) Adopts the 3S principle—Strength, Safety, and Speed.
3) Facilitates casting of slabs and walls in a single continuous process.
4) Supports fast assembly and dismantling of shuttering.
5) Simplifies beam and column formation.
6) Enables simultaneous construction of slabs and walls.

E. Key Characteristics of Mivan Formwork:

Some essential performance features of Mivan include:

1) Load Carrying Capacity – Panels are designed to withstand high loads during casting.
2) Striking Time – Panels can be removed earlier compared to conventional shuttering.
3) Durability – Made of high-strength aluminum alloy, ensuring long service life and repeated use.
4) Cycle Time – Supports a short construction cycle (commonly 7 days per floor), enhancing project efficiency.

F. Components of Mivan Formwork:

The Mivan system comprises multiple modular components manufactured using high-strength aluminum alloy. When assembled according to design drawings, they form an integrated mold for casting concrete. The main categories are:

1) Wall Components– Panels and Accessories For Wall Casting.
2) Beam Components– Panels and Supports For Beam Formation.
3) Deck Components– Slab Panels, Props, And Supports.
4) Miscellaneous Components– Accessories, Brackets, And Ties For Alignment And Stability.

IV. RESEARCH METHODOLOGY

A. Approach:

This section outlines the methods followed to gather information and analyseMivan technology. The study followed a two-phase methodology: theoretical research and practical case study analysis.

B. Theoretical Study:

The initial stage involved extensive desk research. A review of research papers, technical journals, and reference articles was undertaken to build a solid foundation of knowledge. More than 50 relevant publications were analyzed, enabling a comprehensive understanding of Mivan's concepts, advantages, challenges, and applications. This theoretical knowledge provided the basis for subsequent practical site investigations.

C. Practical Study:

The practical part of the research was conducted through a case study at a construction site employing Mivan technology. Key activities included:

- Observing the 7-day slab cycle process.
- Documenting step-by-step construction activities.
- Collecting data through discussions with site engineers and project managers.
- Recording photographic evidence of formwork assembly, reinforcement, concrete pouring, and panel striking.

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This combined theoretical and practical methodology provided both conceptual knowledge and real-time insights into the effectiveness of Mivan formwork technology.

V. CASE STUDY

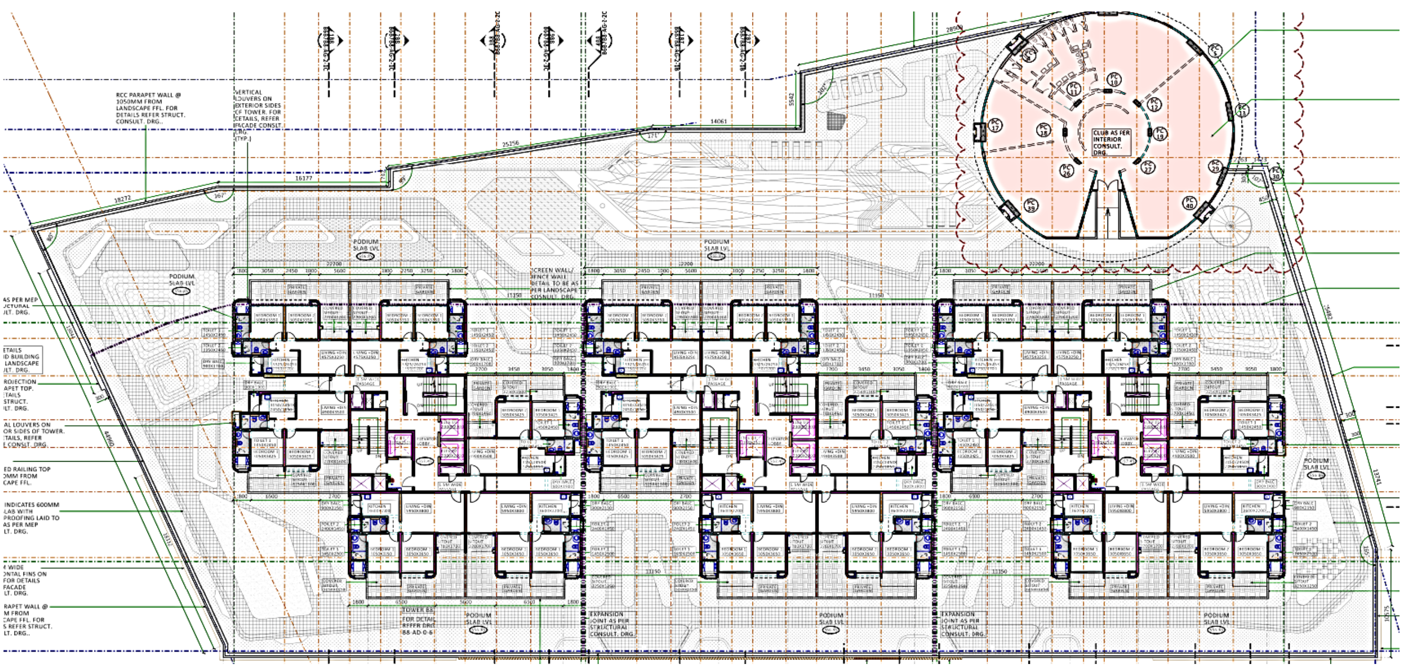
A. Introduction:

Our project is primarily practical in nature, and therefore it was essential to include a case study. A case study helps in understanding the technical aspects of construction on site and provides an opportunity to verify the theoretical knowledge gained during academics. After exploring different options, we selected a site that was well-equipped with *Mivan shuttering technology*, which provided us with everything required for our learning.

Generally, a case study can be presented in the form of an essay or a report. In this project, we have described the case in different sections so that each aspect can be studied clearly. This case study is mainly descriptive in nature.

B. Site Details:

- Project Name: Riverdale, Pune
- Developer: Duville Estate
- Design Architect: KIPA Architects
- Consultant: JW Consultants LLP
- Construction Contractor: MGPL
- Project Type: Residential project
- Project Area Builtup:25,00,00,000 SF
- Environmental Exposure Condition: Moderate
- Timeline of Case Study: July 2025 – September 2025
- Project Background: Project is the Construction of a mixed-use development of Residential & Commercial spaces with Built up area of 25 MN Sq. Ft. including Basement with various sizes.The development consists of 8 Residential towers with Commercial space on ground floor. The configuration are as follows:
  G+27 for 4 towers with Commercial development, a mini mall on Ground Floor, G+24 for 3 towers & G+9 for one tower with commercial shops on Ground Floor.
  Club House With Indoor Amenities.
  Spiral Staircase Leading ToThe Multipurpose Court OnThe Roof OfThe Clubhouse.
- Site Photo:



C. Location of Case Study Site:

The site of the project is located atKharadi, Pune, Maharashtra-411014. The site is well connected with major roadways, which ensures smooth transportation of materials and accessibility for the workforce.

D. Methodology of Case Study:

The case study was carried out using a structured process. The first step was the selection of an appropriate site, which matched the requirements of our project in terms of construction technology and scale. After finalizing the site, a questionnaire was prepared to guide the data collection process.

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Data collection was done during site visits through direct observation, discussions with engineers, and inspection of ongoing work. The collected data was then analyzed and compared with theoretical knowledge and documented standards. Finally, based on the analysis, relevant conclusions were drawn regarding the effectiveness and challenges of the Mivan shuttering system.

E. MivanAluformShuttering and the 7Days Slab Cycle:

A key observation in this project was the application of the Mivan shuttering system, specifically the 7-day slab cycle. In practice, depending on site conditions, this cycle may extend to 9–12 days. However, with efficient planning and skilled manpower, it is possible to complete the cycle within 7 days. Some large construction companies even achieve a 5-6 day cycle by deploying additional workforce and night shifts if structure is not complicated.

The slab cycle is divided into day-wise activities. Each stage of the cycle involves specific tasks that must be completed systematically to ensure continuity in construction. For example:

- Day 1 - 2: Erection and alignment of vertical aluminium shuttering material.
- Day 2 – 3: Fixing of Desking Slab aluminium panels & shuttering
- Day 3 - 4: Placement of reinforcement steel and installation of services such as wall conduits, sleeves, and electric concealed piping work.
- Day 5: Technical &Quality checks from Engineering & Consultant staff and final preparation before concreting.
- Day 6: Casting of slab with concrete pouring.
- Day 7: Striking of side panels and shifting of shuttering material to the next floor.

By following this structured sequence, the construction process becomes faster and more efficient, which reduces project timelines and improves overall productivity.

F. Day Slab Cycle Activities in Mivan Shuttering:

1) Day 1 -

The first activity on Day 1 is the grid line marking work**.** The surveyor provides specific reference points as per the structural drawing, based on which grid lines are established along the X and Y axes. These grid lines remain constant throughout the construction process and act as a permanent reference to ensure dimensional accuracy. Engineers must always verify formwork alignment with respect to these grid lines. To transfer grid positions from one floor to another, a hole is left in the slab by placing sleeves, and then a plumb bob is used. By aligning it with the upper floor grid, the lower floor grid can be positioned accurately. This simple technique saves both time and cost, while providing accuracy comparable to surveyor markings.

The second activity involves Thesi work**.** This is done using wooden pattis of around 15–20 mm width and approximately 200 mm length. These pattis provide the support required to hang vertical panels, especially for column formwork. For example, if a column size is 300 mm, then two pattis are fixed at 310 mm spacing, leaving a 5 mm gap to accommodate panel thickness. Thesi are fastened with the help of concrete nails drilled into the slab, with at least two nails per piece for stability. To ensure safety, thesi should be placed at intervals of about 1 m, with more density at corners than at the center, since corners are structurally weaker and prone to collapse. This ensures correct alignment and safety during casting.

The third activity of Day 1 is column and non-structural wall reinforcement work. Reinforcement is placed strictly as per the structural drawing. Bars are cut, bent, and tied according to specifications, while maintaining the required cover blocks to prevent corrosion and ensure strength. After completing the fixing, reinforcement is checked thoroughly before proceeding further. This reinforcement provides additional strength to concrete and is a standard activity across all construction sites.

2) Day 2 -

On Day 2, the main task is column and wall panel erection**.** Wall panels are positioned over the kickers, which are already supported by the thesi fixed earlier. Before fixing, the panels are oiled on the side facing the concrete to avoid sticking and to achieve smooth finishing. Panels are then joined vertically using pins and wedges. Generally, pin pattis are fixed at 600 mm spacing, while at the bottom, where concrete pressure is higher, the spacing is reduced to 300 mm. Once wall panels are intact, work for beam bottoms can start.

Additionally, flat ties are used to resist lateral concrete pressure. Typically, one tie is placed at 200 mm from the bottom, and the remaining ties are fixed at 500 mm intervals. This ensures stability during concreting. After completing wall panel erection, preparations for deck panel work begin.

3) Day 3 -

Day 3 starts with deck panel work**.** This involves completing shuttering for the slab above so that reinforcement can be placed on the next day. Deck panels are supported by slab soffits, which are placed as per structural dimensions. This is entirely dependent on drawings, and panels are carefully adjusted to achieve the exact slab shape and size.

Once deck paneling is finished, internal checkingis carried out. At this stage, engineers verify whether the paneling and deck work have been executed properly. This is a crucial step because any error at this stage could lead to costly rework after concreting. Internal checking usually involves:

- Cross-verification of dimensions with drawings.
- Checking alignments using kayam line dori.
- Ensuring panels are fixed firmly without gaps.

By completing these checks internally, chances of structural defects or misalignments are minimized.

4) Day 4 -

Day 4 is focused on beam and slab reinforcement work. Reinforcement bars are cut and placed beam-wise, strictly as per the bar bending schedule. It is important that bars are free from rust, oil, or mud, since impurities affect bonding. Cutting should be precise to avoid improper end cover. Reinforcement is placed with cover blocks made of the same grade of concrete, ensuring they do not break or move during concreting. Engineers check reinforcement against drawings and seek approval from the structural consultant before pouring concrete.

The second activity on Day 4 is slab leveling. This can be done in two ways:

- Using Dumpy Level**:** The level is set on a tripod, calibrated with screws, and used with an E-staff to measure benchmark levels and calculate slab heights.
- Using TBM and Line Dori**:** Workers communicate through hammer signals—one strike indicates checking, two strikes indicate low slab, and three strikes indicate high slab. Accordingly, props are adjusted to achieve level.

- The final task of the day **is** external checking. This is carried out by engineers and Mivan specialists to verify overall alignment. Common checks include:
- Plumb bob check for verticality.
- Stair and lift alignment check.
- Right-angle check using diagonal measurement of the slab span.

These checks ensure that all structural members are properly aligned before concreting.

5) Day 5 -

Day 5 activities begin with electrical conduiting work**.** Electrical conduits, made of metal or plastic, are laid within the slab shuttering before concreting. This allows safe routing of wires after slab casting. Junction boxes, bends, and other accessories are fixed at their designated positions as per the electrical layout drawing. Care is taken to secure conduits firmly so that they do not shift during concrete pouring.

6) Day 6 -

On Day 6, a thorough grid line checking is performed to ensure that room dimensions are not affected due to misaligned panels. Supporting panels are tightened and secured to avoid collapse during casting.

Simultaneously, arrangements for casting are made. Since Mivan involves mass concreting, all preparations must be finalized a day prior. This includes:

- Fixing 125 mm diameter pipelines with pumps to deliver concrete to upper floors.
- Ensuring sufficient stock of materials to avoid stoppages.
- Checking plants, machinery, and walkways for smooth operations.

A critical part of Day 6 is the safety check. Workers are ensured to wear helmets, shoes, gloves, and vests. Safety nets (both horizontal and vertical) are checked, pipelines are tested for leakage, and adequate lighting is arranged for night concreting if required. Warning signs are also displayed from the site entrance to the casting area.

7) Day 7 -

Day 7 is the most crucial stage—the casting of slab. Unlike conventional construction, the entire floor is cast at once in Mivan technology, which eliminates contraction joints. The sequence generally starts with columns, followed by beams, and finally slab concreting. Concrete is poured through pipelines and spread according to the planned pathway.

To ensure compaction and void-free concrete, high-quality needle vibrators are used. Rubber hammers are also used by workers to strike panels during pouring, which helps eliminate air gaps. After pouring, power float machines are applied on the slab surface to achieve a smooth finish.

Once casting is completed, post-concreting activities such as curing, striking of panels, and preparation for the next cycle are undertaken. These activities are similar to conventional systems but carried out in a more systematic and faster manner due to Mivan formwork.

VI. COMPARISON OF ALUFORM SHUTTERING WITH CONVENSIONAL SHUTTERING

A. Introduction:

When comparing Mivan formwork with other traditional systems, several key differences become evident in terms of materials used, work cycles, speed of construction, quality of finishes, aesthetics, cost, and maintenance requirements. In India, the most widely used system is the conventional timber or plywood formwork, hence a direct comparison with Mivan is most meaningful. This comparison highlights not only the efficiency of Mivan but also its long-term advantages over conventional practices, especially in high-rise and mass-housing projects.

B. Quality Comparison:

Mivan formwork, being a modern technology, ensures superior quality in construction. The aluminum panels provide precise dimensions, resulting in walls that are smooth and free from surface irregularities. Voids or honeycombs in concrete are minimized because of the tight joints and accurate alignment of panels. The smooth finish achieved eliminates the need for extensive plastering.

By contrast, conventional systems often rely on timber or plywood, which can warp, absorb moisture, or deform over repeated usage. This results in uneven surfaces and requires extensive plastering to achieve acceptable finishes. In terms of durability**,** Mivan-based structures are stronger and more consistent than those built with conventional formwork systems**.**

C. Aesthetics Comparison:

In conventional construction, partition walls are typically made with masonry blocks, while beams and columns are cast separately. This creates visible joints and unevenness in the finished surface, reducing the overall aesthetics of the building.

In Mivan technology, however**,** walls, slabs, beams, and columns are cast together in a single pour**.** This monolithic casting ensures seamless junctions between structural elements, providing an elegant and uniform appearance. The absence of visible joints enhances architectural beauty and results in aesthetically superior buildings.

D. External Finishes Comparison:

In conventional systems, external finishes rely heavily on cement plastering, which is labor-intensive, prone to cracks, and requires frequent maintenance. Over time, these plastered surfaces deteriorate and need reapplication or repainting.

Mivan structures, on the other hand, provide smooth, concrete-finished external walls**,** which significantly reduce plastering requirements. Minimal finishing work is required, which not only reduces maintenance but also ensures long-term durability and cost savings in finishing works.

E. Maintenance Comparison:

Buildings constructed with conventional formwork generally require frequent maintenance. Issues such as plaster cracks, ceiling leaks, and water seepage in block walls increase long-term repair costs. The maintenance burden is particularly high in large projects.

Mivan construction minimizes these issues due to its monolithic concrete structure**,** which is less prone to cracks and leakages. The requirement for repair and rework is negligible compared to conventional systems, thereby reducing the life-cycle maintenance cost of the structure.

F. Cost Comparison:

At the initial stage, conventional formwork is cheaper since timber and plywood are easily available at lower cost. However, over the long term, Mivan proves to be more cost-effective due to its high repetition capacity (up to 250 slab cycles). This makes it especially viable for large-scale projects where economies of scale can be achieved.Its also help to reduce cost of construction work as surface is smooth & even so no need of plastering work is required.

The Costing for Mivan Shuttering with Conventional Plywood Shuttering Work

- Conventional Shuttering work – Rs. 700 Sqmtr
- Mivan Shuttering Work – Rs. 650 Sqmtr

Additionally, Mivan being aluminum-based has a high scrap value compared to conventional systems. The approximate scrap values are:

- Conventional timber formwork – 10%
- Steel formwork **–** 30%
- Aluminum formwork (Mivan) – 50%

Thus, although the initial investment in Mivan is higher, its long-term financial benefits, lower maintenance costs, and higher scrap value make it economically superior.

VII. RESULT AND ANALYSIS

India, being one of the fastest-growing construction markets in the world, demands rapid, efficient, and cost-effective building technologies**.** With increasing urbanization and a rising population, the need for mass housing projects is immense. Based on the case study and analysis, Mivan formwork emerges as a highly suitable technology for India.

It is particularly advantageous for high-rise structures and projects requiring speed without compromising on quality. However, its application must be carefully selected. Mivan may not be suitable for small-scale or irregular projects, as its economic benefits are realized only when there are enough repetitions of similar floor layouts**.**

Factors to be evaluated before selecting Mivan include:

- Availability of local construction resources.
- Required formwork cycle (fast vs. slow construction).
- Crane dependency and site logistics.
- Number of floor repetitions in the project.
- Specified construction period and deadlines.
- Environmental impact and sustainability goals.
- Building size, height, and layout.
- Symmetry of floor plans.
- Nature of architectural and structural design.

By assessing these factors, developers can make informed decisions about adopting Mivan or conventional systems, thereby avoiding financial and operational risks.

VIII. CONCLUSION

From the detailed study and case analysis, it can be concluded that **Mivan formwork has the potential to become a backbone of the Indian construction industry**. With India's rapid pace of urbanization and the pressing demand for affordable mass housing, adopting such innovative technologies is crucial.

Key conclusions include:

- Although shifting from traditional to modern systems is challenging, adopting Mivan is essential for improving efficiency in India's construction sector.
- The use of Mivan drastically reduces project duration and overall costs compared to conventional formwork. The standard floor-to-floor cycle of 7 days (sometimes reduced to 4–6 days) is significantly faster than the 20+ days required in conventional methods.
- Mivan is not only fast but also cost-efficient, making it highly suitable for township projects, affordable housing, and large-scale developments.
- Its indirect benefits, such as high scrap value, recyclability, and reduced environmental impact, add to its sustainability advantage.

Thus, Mivan emerges as the most suitable formwork system for large-scale Indian construction projects**. It** ensures quality, speed, cost-efficiency, and sustainability—parameters that align perfectly with the country's growing demand for urban infrastructure.

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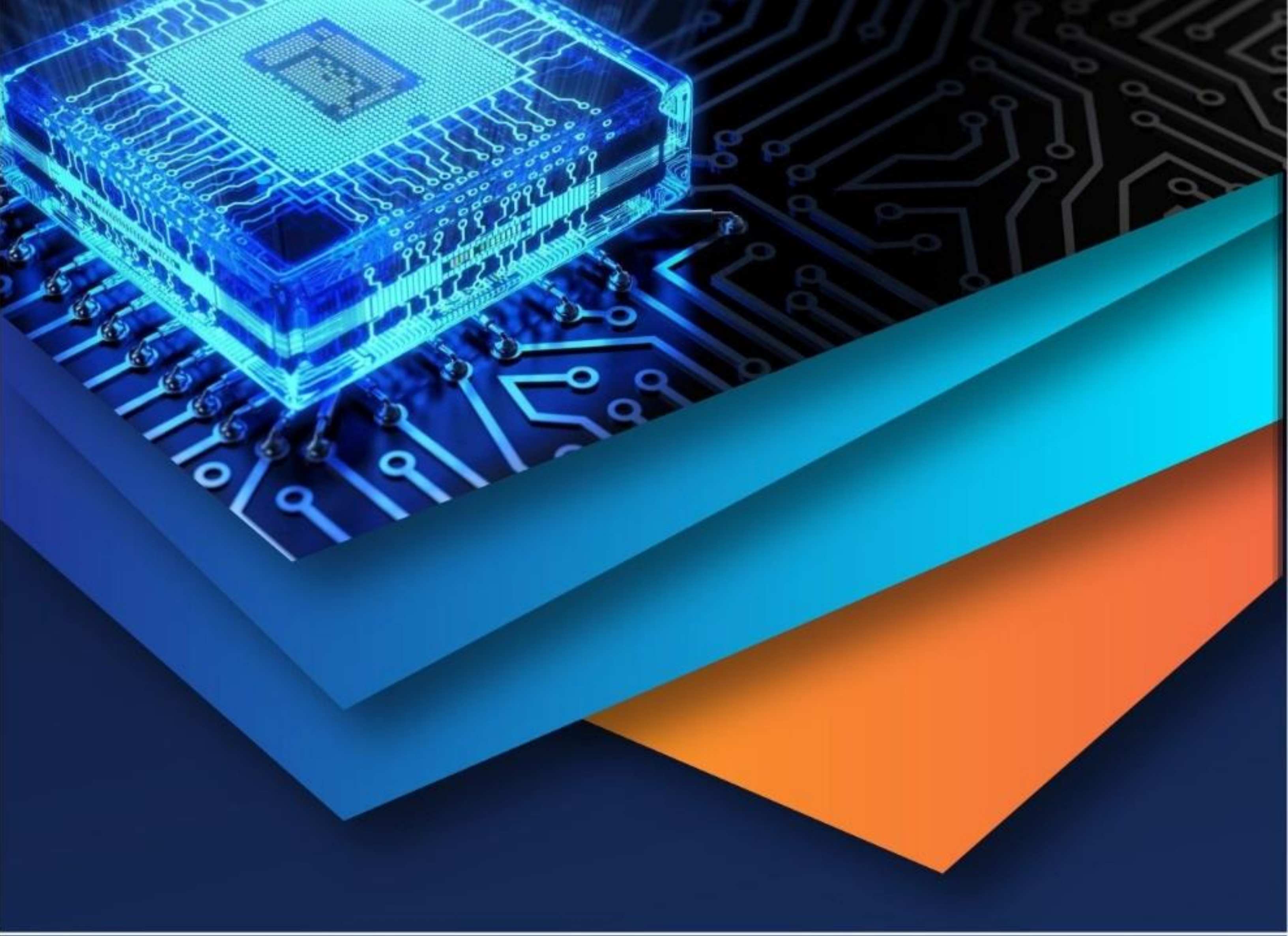

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