MIVAN Formworks Technology in Modern Construction

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***Abstract*—Mivan construction is an advanced building technology that uses a specially designed aluminum formwork system for casting walls, slabs, columns, beams, and staircases in a single concrete pour. Developed by the Mivan Company Ltd., Malaysia, this method enables the rapid construction of high-rise and mass housing projects with superior dimensional accuracy and structural strength.**

Unlike conventional brick-and-column construction, Mivan technology creates a monolithic reinforced concrete structure, reducing construction time, labor requirements, and material wastage while improving overall quality and durability also in analysis and design of mivan construction we need to calculate the slab thickness, beam thickness, and also the grade of concrete.

The implementation of Mivan construction is widely seen in large-scale residential apartments, affordable housing schemes, commercial buildings, and infrastructure projects. The aluminum formwork panels are fabricated according to the building design and can be reused multiple times, making the system economical for repetitive construction layouts. The process involves assembling the formwork, placing reinforcement, pouring concrete, and removing the panels after the concrete gain's sufficient strength.

This technology has been extensively adopted in modern urban developments due to its ability to achieve faster project completion, better surface finishes, and improved seismic performance. by calculating the analysis and design of mivan construction we can build smoothly and know if the building is safe in shear or not and also know the slab thickness and also beam thickness.

***Index Terms*—Mivan Construction, analysis, design, Aluminum Formwork, Monolithic Concrete Structure, Rapid Construction, High-Rise Buildings, Sustainable Construction, Quality Control, Housing Projects.**

I. LITERATURE REVIEW

A. Chaitanya Sambhaji Gaikwad et al:

Gaikwad et al. documented transformative findings regarding construction cycle times. They found that Mivan technology effectively reduces the floor-to-floor cycle from a conventional 15-20 days down to a predictable 7-8 days. This acceleration is primarily due to the integrated casting of walls and slabs. Furthermore, the study highlighted a drastic reduction in material wastage and dependency on heavily skilled masonry labor. From a structural standpoint, the monolithic pouring inherently enhances the building's rigidity and seismic resistance, minimizing dimensional discrepancies and eliminating the need for thick interior and exterior plastering. The research conducted by Chaitanya Sambhaji Gaikwad and colleague's stands as a foundational comparative study in the field of modern construction management. The primary objective of this research was to establish a rigorous, parameter-based comparison between traditional beam-and-column (conventional) building systems and the monolithic approach of Mivan Construction Technology. Recognizing the rapid urbanization and the consequent demand for expedited infrastructure, the authors targeted the operational bottlenecks of conventional shuttering.

B. Aaqib Majid Khan & Chitranjan Kumar (2015):

Aaqib Majid Khan and Chitranjan Kumar published a foundational paper in 2015 that provided a holistic evaluation of Mivan technology. Their research sought to intertwine granular financial cost analysis with rigorous structural performance metrics, providing a comprehensive guide for developers considering the transition to monolithic construction.

The structural tests yielded impressive results. Concrete poured monolithically using Mivan formwork reached a compressive strength of 453 kN within a seven-day testing period. In identical conditions, conventional casting peaked at only 414 kN in the same timeframe. This early and superior strength gain is critical because it allows for the safe and rapid removal of the formwork, thereby accelerating the entire construction cycle. Financially, the model proved that the faster turnaround time reduced the interest burden on construction loans significantly.

C. What Is Mivan Technology:

Mivan construction is a modern building method utilizing prefabricated, high-strength aluminum formwork panels to cast walls, floor slabs, columns, and staircases as a single monolithic reinforced concrete unit in one continuous pour. Mivan construction was developed by a European construction company and later manufactured and popularized by Mivan Company Ltd., a firm based in Malaysia starting in 1990.

D. Components of Mivan Formwork:

Mivan construction (aluminum formwork) components documented in civil engineering journals and textbooks are divided into wall components, deck components, beam components, and general joining accessories as follows:

- Wall Components: Wall Panels, Rockers, Kickers, and Stub Pins.
- Beam Components: Beam Side Panels, Prop Heads, and Soffit Panels.
- Deck (Slab) Components: Deck Panels, Deck Props, and Soffit Lengths.

E. Construction Process of Mivan Technology:

Step-1. Setting and Surveying:

- Line Marking: Surveyors mark precise layout lines on the floor using a total station.
- Kicker Casting: A small concrete guide wall (kicker) is cast to align the main wall panels.

Step-2. Wall Formwork Assembly:

- Panel Placement: Workers erect pre-engineered aluminum wall panels along the marked lines.
- Pin and Wedge Fastening: Panels are joined tightly using heavy-duty steel pins and wedges.
- Wall Ties: High-strength wall ties are inserted through panels to resist concrete pressure.

Step-3. Reinforcement and MEP Integration

- Steel Tying: Pre-fabricated steel reinforcement mesh is placed for walls and slabs.
- MEP Conduits: Electrical conduits, plumbing lines, and switch boxes are fixed inside the mesh.

Step-4. Deck and Beam Formwork Assembly:

- Prop Positioning: Vertical prop heads and deck runners are erected to support the ceiling.
- Soffit Panels: Beam soffits and deck panels are laid over the props to form the slab base.

Step-5. Alignment and Inspection:

- Plumb Checking: Workers use plumb bobs to verify the vertical alignment of all walls.
- Securing Panels: Tie rods and alignment chains are adjusted to prevent bulging during the pour.

Step-6. Concrete Pouring:

- Monolithic Pour: High-flow self-compacting concrete is poured into walls and slabs simultaneously.
- Compaction: Needle vibrators eliminate air pockets to ensure a smooth, honeycomb-free finish.

Step-7. Stripping and Curing:

- Vertical Stripping: Wall and column panels are removed after 12 to 24 hours.
- Deck Stripping: Slab panels are removed after 3 to 4 days, leaving the vertical props intact.
- Prop Removal: Supporting props are completely removed after 7 to 10 days of curing.

F. Advantages of MIVAN Technology:

- Monolithic Action: Casts walls and slabs together to form a robust box-type system that enhances earthquake (seismic) resistance.
- Superior Finish: Delivers smooth, uniform

concrete surfaces that eliminate the need for costly and time-consuming internal plastering.

- Panel Reusability: Allows aluminum alloy components to be reused up to 200–250 times, reducing long-term material waste and project costs.
- Low Maintenance: Minimizes structural joints and cracks, which significantly lowers water leakage risks and upkeep over the building's lifespan.

G. Flowchart for MIVAN construction process:

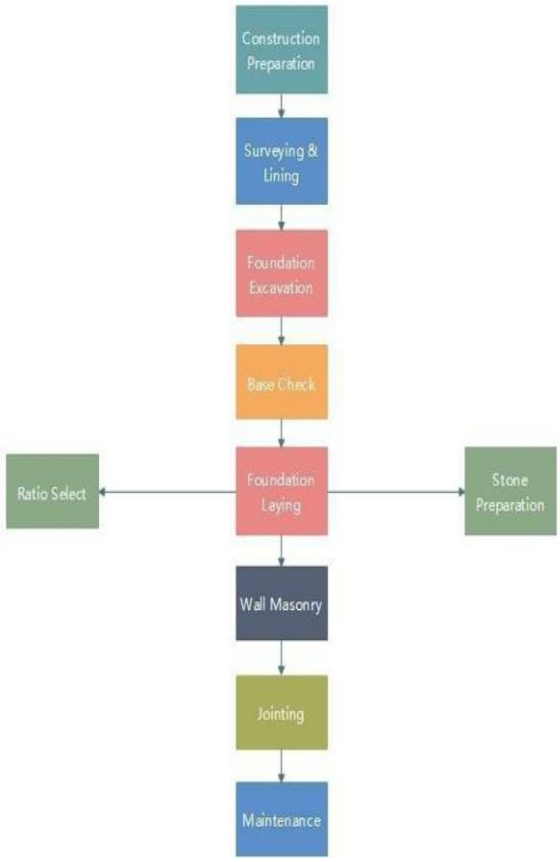


Figure 1. Flowchart showing Mivan Construction Process

II. RESULTS AND DISCUSSION ANALYSIS AND DESIGN FOR MIVAN TECHNOLOGY

1. Given data:
Room span: 4.0m*4.0m Slab thickness:120mm
Beam: 250mm*500mm Columns: 450mm*400mm
D.L: 0.45 L.L:0.20
Concrete: M25 Reinforcement:FE500 Clear cover: 20mm

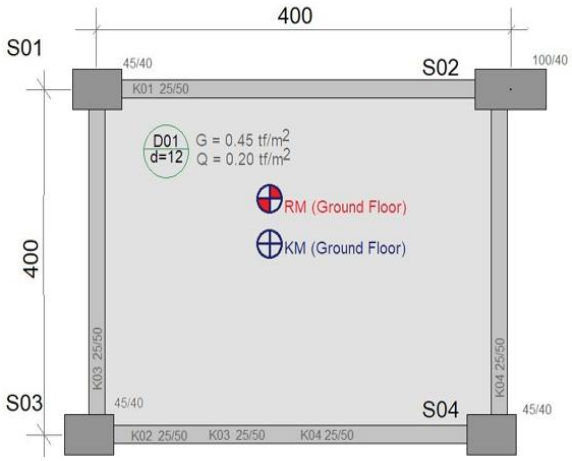


Figure 2. Room Plan (4m x 4m – specimen)

2. Load calculations:
convert LL and DL DL:0.45(9.81)=4.41 KN/m² LL=0.20(9.81)=1.962 KN/m²
LL + DL= 4.41+1.962=6.37KN/m² (Total service load)

Wu = 1.5 x (LL+DL) =
Wu = 1.5x 6.37 = 9.558 KN/m²

3. Slab thickness:
Effective depth:
d=D-cover- ϕ/2 = 120-20- 10/2 d=95mm
Analysis considering 1m width of the slab

$Mu=\alpha WuL^2$
$Mu =0.062*9.558*4^2 =9.49KN\text{-}m^2$

Req steel:
Ast Required = Mu /(0.87*fy*0.9d)
Ast Required=9.49*10/(0.87*500*0.9*95)
Ast Required =255mm² per m of slab (b)

Provide: 10mm dia @ 150mm top and 10mm dia 150mm @ bottom
Per 1000mm – 12 bars of 10mm Ast Provided = 942 mm2

Min reinforcement:
Ast min = 0.12% of b x d =0.12*1000*120
Ast min = 144mm² (< Ast Provided) .
Hence Safe.

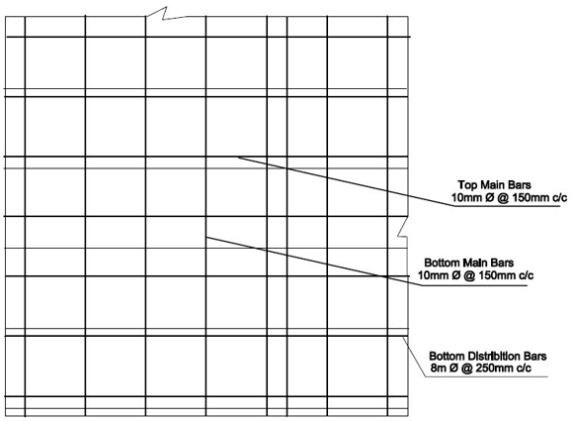


Figure 3. Slab Reinforcement (plan)

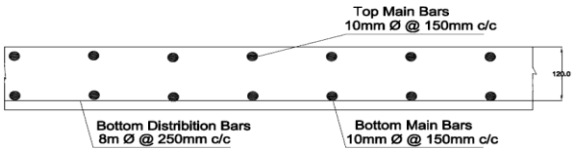


Figure 4. Slab Reinforcement (section)

4. Beam analysis:
b=250mm D=500mm d=500-20-16/2
d=472mm wslab=wu*L/4 wslab=9.565*4/4
wslab=9.565KN/m
beam self-weight wb=0.25*0.50*25 wb=3.125 KN/M
max bending moment Mu=wL²/8 Mu =12.69*4² /8
Mu =225.38 KN-m
max shear Vu=wl/2 = Vu =12.69*4/2 = 25.38KN
beam reinforcement: 0.85/b*d=Astmin/fy

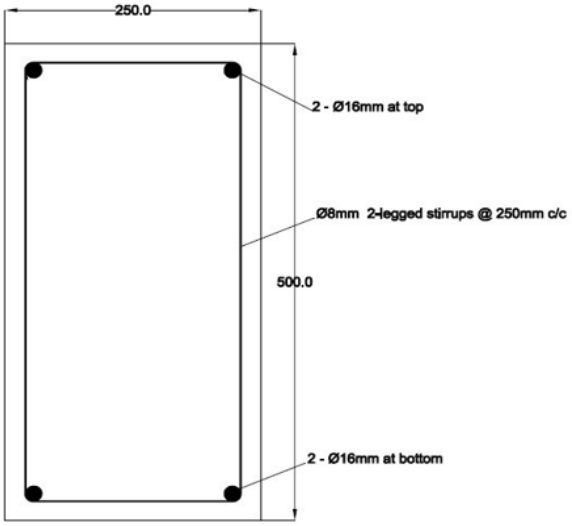


Figure 5. Beam Reinforcement

Astmin=0.85/500*250*452 = 193mm²
use 2-16mmϕ bottom
Ast Provided = 2*π/4*16² = 402mm² (> Astmin)
Hence safe provide 8mmϕ 2-legged striups @250mm c/c

5. Column analysis:
Size: w*d = 450*400 mm Ag=450*400=180000mm²
R=12.69*4/2 = 25.38KN P=2(25.38)
P=50.76KN
column self-weight Wc=0.45*0.40*3*25
Wc=13.5KN
column asial load Pu=50.76+13.5 Pu=64.3KN
Ascmin=0.8% of Ag=0.008*180000
Ascmin=1440mm²

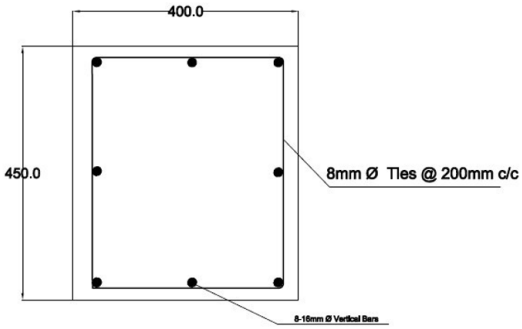


Figure 6. Column Reinforcement

use 8-16mmϕ 8* π/4*16² Asc=1608 (>1440)
So, provide 8-16mmϕ vertical bars & 8mmϕ ties @200mmc/c

Mivan Formwork as per the structural design:
System: Formwork is designed for columns, beams and slab.
Walls are considered as separately constructed from Masonry as per the architectural plans.

Column formwork:

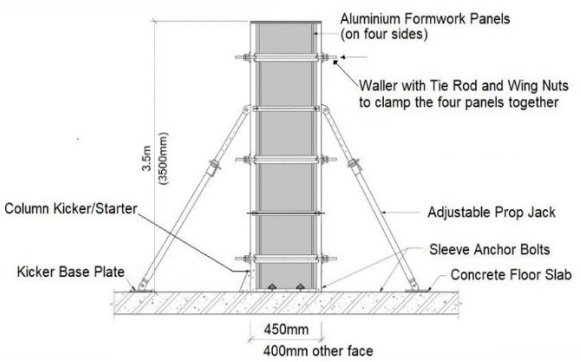


Figure 7. Column Shuttering

Beam & Slab Formwork

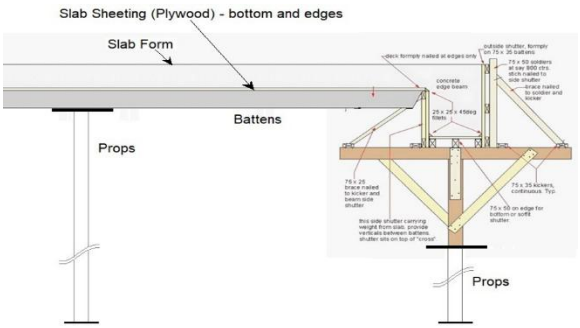


Figure 8. Beam & Slab Shuttering

Working principle and construction sequence: The process begins with setting out the building grid and checking dimensions, levels and alignment. Reinforcement for walls and slabs is then fixed according to the approved structural drawings. Aluminium panels are assembled and supported with pins, wedges, ties, props and other accessories. Openings for doors, windows and service routes are positioned before concreting. After the formwork is checked for line, level, plumb, tightness and cleanliness, concrete is placed and compacted carefully. The concrete is allowed to gain sufficient strength before panels are removed in accordance with the approved stripping schedule. The panels are cleaned, inspected and reused on the next cycle.

Integration of walls and slabs: A major feature of the system is that reinforced-concrete walls and slabs can be cast together during the same pour, subject to the selected formwork design and construction sequence. This can reduce construction joints and help create a relatively uniform structural system. However, the reinforcement arrangement, wall thickness, slab thickness, openings and connections must be designed by a qualified structural engineer. The formwork itself is temporary equipment; it shapes and supports fresh concrete but does not replace the permanent reinforcement or structural design.

Speed of construction: Mivan technology is often selected for projects where the same floor plan is repeated many times. Once the formwork layout, reinforcement details, material supply and work teams are coordinated, a floor cycle can become predictable. Reusable panels reduce the need to build and dismantle timber formwork for every pour, and the integrated casting sequence can limit some separate masonry activities. The actual speed depends on the size and complexity of the building, crew experience, crane or lifting arrangements, concrete supply, curing requirements, inspection time and site logistics. Therefore, a fast cycle should be treated as a project target, not a guaranteed result.

Quality, accuracy and finish: Factory-made aluminium panels can provide consistent dimensions and a smooth concrete surface when they are assembled correctly and maintained in good condition. Accurate setting out and tight joints help reduce dimensional variation and leakage of cement slurry. This may reduce the thickness of plaster required in some locations, but a plaster-free finish should never be assumed automatically. Surface defects, misalignment, honeycombing and leakage can still occur if reinforcement is congested, concrete is not placed properly, joints are loose or compaction is inadequate. Inspection before, during and after the pour remains essential.

Labour, equipment and coordination: The system shifts a significant part of the work toward planned assembly, reinforcement fixing, concrete placement and systematic dismantling. Workers need training to identify each panel, install accessories safely and follow the correct sequence. Panels and accessories must be stored, transported and handled carefully to prevent damage. The method may require lifting equipment and close coordination between the formwork team, steel fixers, electricians, plumbers, concrete supplier and quality-control staff. Poor coordination can lead to rework, delays or openings and service routes being placed incorrectly

Cost estimation(conventional vs mivan)

Particulars	Conventional	Mivan
Area	172.22 sq. ft.	172.22 sq. ft.
Assumed rate	2, 000/sq. ft.	2, 200/sq. ft.
Estimated total	344440	378884
Cost difference	-	34, 444 higher
Percentage difference	Baseline	About 10% higher

IV. FUTURE SCOPE FOR STUDY

For present study the performance was evaluated for a 4.0m x 4.0m single room (16 sqm). It can be prolonged and extended to multi-storey buildings (G+10, G+20,

G+30) to find out detailed results on construction speed, cost and seismic performance. Present study can be further carried out by testing effect of different grades of concrete (M30, M40, M50) and self-compacting concrete (SCC) on durability and surface finish in Mivan construction.

In this work the cost and time analysis has been taken with low-rise exposure, it can be further taken as high-rise exposure with prolonged life cycle cost analysis

V. CONCLUSION

Mivan technology is a modern construction technique that uses aluminium formwork to construct reinforced cement concrete (RCC) walls, slabs, beams, and other structural components. It helps to complete construction work faster than conventional methods and provides good surface finish, dimensional accuracy, and uniform quality. The main advantages of Mivan technology are faster construction, reduced labour requirements, less material wastage, and the possibility of reusing aluminium formwork many times. It is especially suitable for large residential buildings, apartments, and projects where similar floor plans are repeated. However, the initial cost of aluminium formwork is high, and proper planning, skilled labour, and careful handling are required.

In our mini project we studied detail about mivan technology their importance, advantages, limitations and also, we studied about how to calculate the analysis and design of mivan technology where we took a single room plan and calculated its beam, colum, slab reinforcement

So, we can say that the topic of our mini project that is mivan technology was interesting to do and we studied about it in detail. There are a few limitations but there are various advantages in mivan technology where we created a case study , methodology, literature review for our detail study and in the end, we calculated the analysis and design of the mivan technology and got to know about it.

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