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"Examining Aluminum Formwork (MIVAN) with Conventional Formwork and Investigating Precast Methods: A ComprehensiveStudy"

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Abstract: Aluminum shuttering, particularly the MIVAN aluminum shuttering system, has gained popularity in the construction industry for its lightweight characteristics and versatility in building structural components like walls. Originating from a European construction company, MIVAN shutters were first produced in Malaysia in 1990 by MIVAN Company Ltd. Currently, MIVAN Business Ltd. utilizes over 30,000 sqm of shuttering globally, with widespread adoption in India, especially by companies like Xrbia, aiming to provide affordable housing using MIVAN technology.

Renowned for its cost-effectiveness and suitability for diverse construction climates, MIVAN shuttering is widely utilized in the Middle East and Asia. The MIVAN method enables the construction of individual rooms, facilitating the rapid construction of multiple houses. This monolithic system involves continuous concrete pouring for floors, walls, staircases, and beams. Employing techniques such as hot air drying accelerates the construction process by allowing early removal of forms. Precision-engineered and lightweight, MIVAN shuttering panels are used for windows, doors, and service ducts before concrete pouring.

One of the distinctive features of MIVAN technology is its monolithic approach, ensuring dimension uniformity and eliminating the need for additional plastering due to the high-quality final surface with minimal tolerance and verticality. This study undertakes a comprehensive comparison between MIVAN technology and traditional building methods. The analysis covers fundamental principles, features, benefits, cost-effectiveness, and construction speed.

Through an extensive literature review, the study emphasizes the innovative aspects of MIVAN's aluminum formwork system. Key advantages include enhanced durability, reduced labor requirements, improved quality control, and accelerated construction timelines. Financial implications are thoroughly examined, considering various cost parameters to assess the overall cost-effectiveness of MIVAN technology.

Furthermore, the study explores construction schedules and productivity, highlighting MIVAN's benefits in terms of assembly simplicity, reduced construction time, improved site coordination, and faster project completion. The findings aim to provide valuable insights for construction professionals and decision-makers, advocating for the widespread adoption of MIVAN technology as a sustainable, efficient, and cost-effective solution in the construction industry.

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Keywords— Real State, Material price, Government Policies, precast, Conventional, Construction management, time and cost analysis,quality and productivity

INTRODUCTION

Formwork is a vital part of construction. Formwork is a mould or matrix design into which fresh concrete is poured and cured. It comes in two forms: horizontal and vertical. Formwork transports dead and live loads. Formwork is a temporary construction that provides a structure its shape and size. Vertical support is called shuttering and horizontal support is called centering. Staging includes bellies, props, and jacks to support vertical and horizontal supports.

Formwork Technology Inventions

Previously, only wood formworks were utilized in construction, but new materials are being introduced to create new formwork technologies. Newly developed formwork technologies include:

1. Table formwork
2. Aluminum formwork
3. MS formwork
4. Slip form tech.
5. Plastic molds
6. FRP formwork

This type of formwork technology is produced by firms such as PERI and DOKA.

The aluminium formwork technology allows for the simultaneous pouring of walls and slabs in RCC load bearing or RCC framed multi-story constructions. This improves efficiency and delivers a robust structure with a great concrete finish. Floor after floor, the machined metal formwork components provide uniform concrete shapes and finishes. This permits prefabricated plumbing and electrical fittings to be assembled with confidence.

The producers describe a low-cost housing system using aluminum formwork. Aluminium formwork technology is used to form cast in place concrete structures. It also controls other building trends like steel reinforcement, concrete placement, and mechanical and electrical conduits.

To improve and speed up construction, the entire conventional construction process must be restructured to allow interaction between design and production planning.

The traditional method of building individual houses, with weight bearing walls and a roof above, or RC framed structures with infill masonry walls, would be absolutely insufficient for mass housing development. Even contractors with great resources and experience often fail to control quality in such structures.

"Innovative technologies that can offer high quality, long-lasting structures at low cost are required to undertake mass housing projects."

Formwork is a temporary structure used to shape concrete and retain it until it hardens enough to withstand the imposed stresses. Formwork is vital in the building industry since it is a simple approach to avoid any misalignments or misplacements of the concrete structure. Proper formwork and work planning can assist minimize building costs and speed up construction. Construction

accidents can occur if the right formwork is not employed and care is not given during assembly and stripping. Choosing the right formwork is critical during construction.
Formworks are classified by material, size, shape, and location. Formworks include standard wood, reusable (plastic, aluminum), table (flying) form, leap form, slip form, and permanent insulated. The first two systems are standard and utilized for smaller projects. Large projects will be delayed if it is used. The table form technique is utilized for big pre-assembled formwork where a repeat of the complete bay is required. It is commonly used in hotels, schools, and homes. Jump form system usually operates by constructing its own structures. It supports the new construction over the completed formwork structure.
Used to build vertical members such as core walls, shear walls, and lift shafts. The leap form construction is staged.

Conventional Formwork

Formwork is one of the oldest styles of construction. For two to three story buildings, this formwork is made of wood, bamboo, masonry and carpentry. This sort of formwork is still used for tiny two-to-three-story buildings.
But this formwork isn't ideal for high rise constructions. Figure 1 shows some conventional beam, slab, and column formwork systems**.**

Formwork in steel

This steel formwork is utilized in construction where a lot of repetition is required.
It is faster than the other two. It's made of thin steel plates with rounded corners.
The panels can be made in any shape and size needed for construction. This formwork is ideal for curving constructions. It is typically employed in big projects. Unlike traditional and plywood formwork, this does not absorb water from concrete. This is deemed better. Some of the disadvantages of this formwork are that it requires adequate care and is heavy. Figure 1 depicts the steel formwork utilized on the building site.

The structure is completed much faster than the traditional formwork as a large amount of work can be completed in each daily work routine. There is no need for brick laying and plastering as all walls can be formed at the same time. The project can be completed in shorter time due to fast production methods which save onsite running, operating and financing cost. For the speedy construction Mivan technology is better than conventional technology. Initial cost of Mivan shuttering is high because aluminium formwork is more expensive than conventional formwork. But maintenance cost is negligible as the walls and ceiling are made up of high-quality concrete which do not require frequent repair work.

Precast Work using Mould

In India, where there's a substantial demand for residential buildings, the traditional cast-in-situ construction method prevails in most projects. However, the need for faster construction, especially in the residential sector, calls for more efficient approaches. Precast concrete construction emerges as a viable solution, offering several advantages over traditional methods. This research explores various aspects of precast engineering, including materials, design, calculations, economic benefits, and limitations. With its unique approach, precast construction has the potential to revolutionize the country's building industry, particularly in housing development. This study aims to shed light on the benefits and possibilities of precast construction, envisioning its leadership role in advancing construction practices in India.

By operating advance technology at construction project reduce cost and time in transporting of material and increase efficiency of work that ultimately reflect of time and cost.

From literature found that because of frequent change of project managers, Appointment of staffs in the site who are not experienced and also Non sequential progress of works and that Work was not followed as per procedure instead it was followed as per availability of resources caused delays in construction project on pandemic situation
Unavailability of adequately trained health workers and lack of experience in managing an unprecedented emergency; the pandemic and the confinement measures created a psychosocial burden for the population and, especially, the wellbeing of the health workforce.
The construction industry is the vehicle through which physical development is achieved, and this is truly the locomotive of the national economy. The more resources, engineering know-how, labor, materials, equipment, capital, and market exchange provided from within the national economy, the higher the extent of self-reliance. The increasing complexity of infrastructure projects and the environment, within which they are constructed, place greater demands on construction managers to deliver projects on time, within the planned budget and with high quality.

Therefore, improving construction efficiency by means of cost-effectiveness and timeliness would certainly contribute to cost savings for the country as a whole. Efforts directed to cost and time effectiveness were associated with managing time and cost.

It also aims to identify the main factors that lead to project delays and to suggest recommendations on how to overcome or mitigate effects of the problem. Data is gathered from responses from questionnaire survey and interviews with those involved in construction project

RESEARCH METHODOLOGY

Aim

Mivan formwork buildings are 20% less expensive. A 12-story Mivan-shutter building takes half the time to build. Mivan shuttering is cheap and good. We can build shear walls faster with Mivan shuttering. RCC walls have weather resistance, carpet area, and damp resistance.

Objectives

- To increase workability over long period for mass concreting work.
- To increase compressive strength of concrete.
- To reduce cracks due to shrinkage of concrete.
- To reduce segregation and honey-combing effect at joints where dense reinforcement is provided
- To compare the cost of building by using conventional formwork technique & by using MIVAN formwork technique.
- To compare the time & Cost of building by using conventional formwork technique & by using MIVAN formwork technique.
- To Analyze Comparative work on traditional and MIVAN and Precast work.

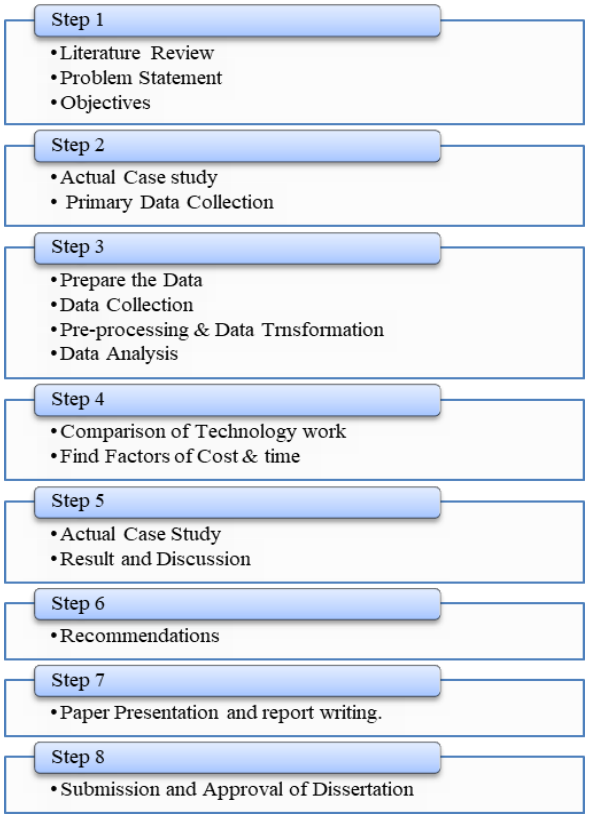


Figure: Methodology Work

Problem Statement

"Concrete shrinkage cracks are likely to occur. Honey-combing is a typical problem due to thin walls. Segregation develops due to complexity and dense reinforcement at corners also to compare the cost & time."

The following steps are undertaken in order to fulfill the work on thesis in order to achieve the above objectives:

- Literature Review, Problem Statement, Objectives
- Theoretical Content & Primary Data Collection
- Questionnaire Survey & Secondary data collection
- Data analysis
- Paper Presentation and report writing.
- Submission and Approval of Dissertation

RCC Building Plan

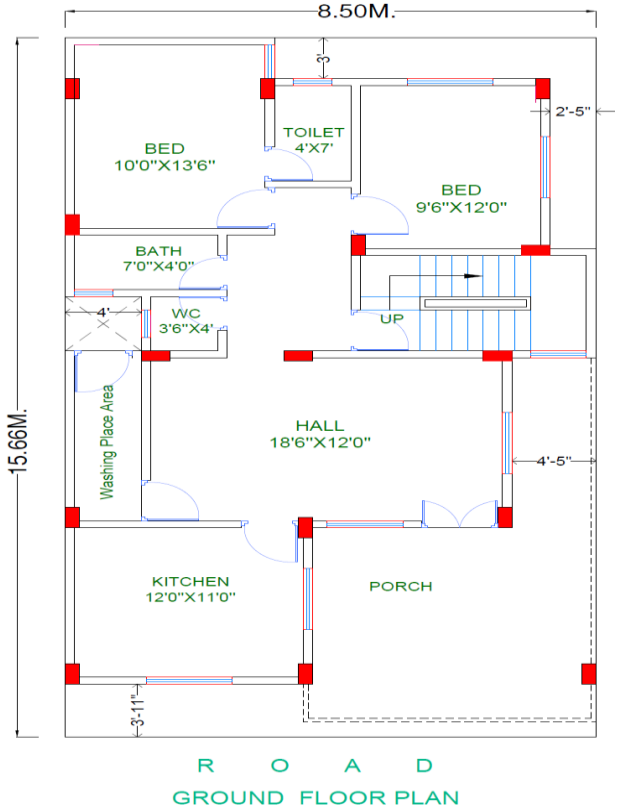


Figure: Plan of RCC Building Floor

Cost analysis of RCC work
Slab

We calculate cost of slab for a span of 15mx8m of total plan area by considering grade of concrete M40 & thickness of slab 150mm.
Grade of concreter M20 (1: 1.5: 3)
Volume of slab= 15x8x0.150m= 15cum (wet volume)
As we know, Dry volume is 54% more than wet volume.
Hence, Dry volume = 1.54x15= 23.1cum

- ✓ **Quantity of Cement:**

Cement = 1/5.5 x23.1= 4.2cum
To get quantity of cement in kg we multiply it by its density 1440kg/cum
Cement in kg =4.2x1440=6048 kg
Cement bags = 6048/50= 121 bags

- ✓ **Quantity of Sand:**

Sand quantity= 1.5/5.5 x23.1 = 6.3cum

- ✓ **Quantity of Aggregate:**

Aggregate quantity = 3/5.5x23.1=12.6cum

- ✓ **Quantity of Steel:**

Steel quantity = 1/100x15= 15cum
Steel in kg= 7850x0.15=1177.5kg

- ✓ **Quantity of Shuttering: 15x8= 120 Sqm**

Hence total cost in RCC work for making slab of area 15mx8m is RS 1, 76,165

Brickwork

We have our hall of size 5.48x3.65 (18ftx12ft) and wall thickness is 230mm, for calculation of brickwork we have to convert this into cubic meter.i. e,14 cum
Cement mortar 1:4 for 14cum (walls are 230mm)
Volume of 1 brick with mortar=0.200x0.100x0.100=0.002cum
No. of bricks with mortar in 14 cum =14/0.002=7000no.
V. of 7000 no. Of bricks (w.m) =7000x0.001539=10.773cum
V. of mortar for 14cum work=14-10.773=3.227cum
For dry v. of mortar = 1.33x3.227=5cum
Hence,
Quantity of CEMENT = 1/5x5= 1cum (1140 kg)
No. of bags = 30 bags
Quantity of SAND = 4/5x5= 4 cum

Plaster work

Plastering work is carried out on all the brickwork surfaces of our hall plastering work is in cement mortar (1:6).
Thickness of plaster is 12mm &area of wall is =60sqm.
Volume of plaster = area x thickness = 60x0.012=0.72cum
Dry volume of plaster = 1.33x0.72 = 0.96cum
Quantity of CEMENT = 1/7x0.96= 0.13cum
Weight if cement = 0.13x1440= 188kg
No. of bags = 4bags
Quantity of SAND = 6/7x0.4= 0.9cum

Table: Material Rate & Cost for Plasterwork

Material	Unit	Quantity	Rate Rs/Unit	Amount in Rs
Cement	Bag	4 Bags	380/Bag	1520.00
Sand	Cum	0.3 cum	1200/Cum	1080.00
Total				2600.00

Column

Column size: 230x450mm & floor to floor height is 3m
Total column cost = concrete cost+ steel cost + labour cost
We have M20 grade (1:1.5:3)
Total volume of 1 column = 0.23x0.45x3= 0.32 cum.

- ✓ Quantity of CEMENT = 1/5.5x0.50 = 0.10

Weight of cement = 0.10x1440 = 144kg
Hence no. of bags required for 1 column work = 3 bags

- ✓ Quantity of SAND = 1/5.5x0.50= 0.4 cum
- ✓ Quantity of AGGREGATE = 3/5.5x0.50= 0.3 cum
- ✓ Quantity of STEEL= (8 Bars of 16mm dia.)

Cutting length = 2900+225+225-(2x2(16))
= 3286mm

Type of construction	Slab	Brick work	Plastering	Column	Total Amount
RCC	17616	84250	2600	33500	296515

Hence for weight of steel = (16x16) x3.336/162.2 = 5.28kg
Hence for 8 no. its weight **= 48 kg**
Stirrups = 2 (130+350) +160-(2x8) x 5
= 1040mm
Hence for 20 stirrups = 0.666x20= **10kg**
Hence total amount of steel used in one column = 58kg

Table: Material Rate & Cost for Column

Material	Unit	Quantity	Rate Rs/Unit	Amount in Rs
Cement	Bag	3 bags	380/Bag	1140.00
Sand	Cum	0.4 cum	450/Cum	180.00
Aggregate	Cum	0.3 cum	550/Cum	165.00
Steel	Kg	58 kg	70/Kg	4060.00
Shuttering	Sqm	0.2 sqm	300/Sqm	60.00
Labor	No.	3 no.	350	1050.00
Total				6700.00

Hence cost of one column is Rs 6700
Hence total cost of 5 columns in our work = Rs 33500

Total cost of RCC work

Material	Unit	Quantity	Rate Rs/Unit	Amount in Rs
brick	No.	7000 Nos.	10/per no.	70000.00
Cement	Bag	30 Bags	380/Bag	11400.00
Sand	Cum	4 Cum	450/Cum	1800.00
Labor	No.	3 Nos.	350/day	1050.00
Total				84250.00

From the above calculation of all the quantities we calculate all the quantities of RCC work including building materials and labour charges & found out the total cost required:

Cost analysis of Mivan Formwork work
Mivan Formwork slab

Total area covered for Mivan Formwork slab units
=13.71x7.61=104.47Sqm
(45ftx25ft= 1125sqft)

Rate of solid Mivan Formwork slab (125mm) per sqm = 1292/sqm (120rs/sqft)

For this construction project 10 Mivan Formwork slabs are used. Size of each Mivan formwork slab unit is 3.04mx3.65m (10ftx12ft)

Hence for 10 slab units 3.04mx3.65m i.e. for 11.152 sqm (10x12ft=120sqft)

11.152x10 =111.52 sqm

Rate per Sqm is Rs 1292

we can calculate cost required for this area is

111.52x1292 Rs = Rs 1, 44,038

(1200sqft*120Rs)

Table: Size of each Mivan Formwork Slab

Size of each Mivan Formwork slab	No. of units	Rate of each unit	Total
3.04m*3.65m (10*12ft)	10	Rs 1292 /unit	1,44,038

For this project 3 workers are working for 5 days to prepare slab units, rate of labour per day = 300/ day
Hence labour charges = 3x5x300= 4500rs
Transportation cost for 100 km (25Rs /km) = 100x25 =Rs 2500
Crane handling charges = 5hrsX1200= Rs 6000
Hence, **labour+ transportation + crane = Rs 13000**

Hence total cost for making Mivan Formwork slab is Rs 157038

Type of structure	Activities	Total cost of slab in Rs
RCC	Per unit + shuttering + labour	1,76,165.00
Mivan Formwork	Unit making + transportation + erection	1,57,038.00

Mivan Formwork hollow wall panels

For room size of area 5.48m x 3.65m
20 Mivan Formwork hollow wall panels are used of size 0.91m x 2.74m (3x9 ft) which accounts area 2.50 sqm. (27 sqft)
Rate of hollow Mivan Formwork wall per sqm is Rs 1076. Hence rate of one Mivan Formwork wall is Rs 2700.

For our room size total cost of all Mivan Formwork wall is Rs 54000

For this project 3 workers are working for 5 days to prepare wall units, rate of labour per day = 300/ day
Hence labour charges = 3x5x300= Rs 4500
Transportation cost for 100 km= 100x25 = Rs 2500
Crane handling charges = 5hrs x1200= Rs 6000
Hence, **labour+ transportation + crane = Rs 13000**
Hence total cost for Mivan Formwork walls is Rs 67000

Cost Differentiation

From above calculations of Mivan Formwork & RCC construction we find the cost differentiation in both of the system:

Activity differentiation

In this section, a few comparisons have been made with the traditional building method by observing the work being done on the site and analyzing the activities.

- The Mivan Formwork building approach is only based on the shear wall concept; as a result, a normal floor does not include any kind of columns, but in conventional architecture, columns are required to be constructed.
- Whereas in conventional construction, block work and curing take a significant amount of time to finish.
- The daily height of blocks that can be worked on is restricted to between one and one and a half meters for reasons of alignment whereas;
- Mivan Formwork elements are exempt from any and all of these requirements.
- In the conventional method, block work must continue with proper curing, and plastering also requires a curing period for sufficient hydration and to attain strength; however, in the Mivan Formwork method, no such intensive curing is required because the main and final curing is done at the casting yard only to achieve maximum strength.
- The conventional approach requires plastering work to be done, whereas the Mivan Formwork method doesn't call for any form of plastering work to be done.
- The usual approach requires extra time for the shuttering work and reinforcement works associated with slabs; however, using Mivan Formwork, slabs can also be made in the yard itself.
- The elements of Mivan Formwork cannot be used to fix all of a structure's components; in a few strategically placed spots, block work is required for Mivan Formwork construction as well.
- During building using Mivan Formwork, design changes are not feasible. On the other hand, traditional construction allows for any kind of design change to be done without any difficulty.
- When using Mivan Formwork for building, better quality control is achievable; when using a conventional system, however, it becomes increasingly difficult to maintain high standards of workmanship as the floor level rises.
- When compared to conventional methods, the Mivan Formwork construction technology uses roughly half the amount of total man power.

When compared to the usual method of construction, the Mivan Formwork method ensures more accurate alignment of the structural elements.

Mivan Formwork construction is also ideal for use on major construction projects, whereas the conventional approach can lead to a variety of issues and takes a significant amount of time to finish.

This research is based on a case study that covered the generation and composition of construction trash on site, in addition to its reuse and recycling. In terms of potential cost reductions, the case study also analysed the economic viability of waste minimization strategies such as reuse and recycling of waste materials from construction projects.

The project site of a recently built, G+15 residential complex was analysed for this study. Each level of the structure has almost 181 square meter of living area.

The construction site for the project can be found in Warje, close to Sinhgad College in Pune. The location of the project was chosen due to the fact that it included traditional building and construction operations.

The total costs of the project were 10,750,000. It was determined through a benefit–cost analysis (BCA) that the economic viability of reusing and recycling waste materials from construction projects may be demonstrated.

Material estimate Mivan construction building

Table: Material required for Footing

Work	Footing		
	Concrete quantity	Steel quantity	Shuttering
	Cum	Kgs	sqm
Up to plinth	102.68	3000	335.7
Total quantity	102.68	3000	335.7

Table: Material required for shear wall

Work	Shear wall		
	Concrete quantity	Steel quantity	Shuttering
	Cum	Kgs	sqm
Up to plinth	47.47	11000	531.133
Plinth to first slab	54.16	6272.63	
1st to 4 th	49.75	5196.14	
4th to 6th	49.75	4688.00	
6th to 7th	49.75	4195.60	
7th to 8th (terrace)	49.75	2893.50	
Total quantity	300.64	34245.87	531.13

Table: Material required for plinth beam and floor beam

Work	Plinth beam / floor beam		
	Concrete quantity	Steel quantity	Shuttering
	Cum	Kgs	sqm
Up to plinth	22.25	1800	285.57
Plinth to first slab	18.87	3246.60	
1st to 4th	15.92	2880.70	
4th to 6th	15.92	2880.70	
6th to 7th	15.92	2880.70	
7th to 8th (terrace)	16.03	2880.70	
Total quantity	104.92	16569.42	285.57

Table: Material required for nonstructural wall

Work	Nonstructural walls		
	Concrete quantity	Steel quantity	Shuttering
	Cum	Kgs	sqm
Up to plinth			
Plinth to first slab		1954.62	55.10
1st to 4th	57.54	3231.55	54.38
4th to 6th	57.54	3231.55	54.38
6th to 7th	57.54	3231.55	54.38
7th to 8th (terrace)	57.54	1389.02	56.16
Total quantity	230.16	13038.27	274.40

Table: Material required for Slab

Work	Slab		
	Concrete quantity	Steel quantity	Shuttering
	Cum	Kgs	sqm
Up to plinth			
Plinth to first slab	55.10	2345.05	1534.00
1st to 4th	54.38	2117.51	8100.00
4th to 6th	54.38	2117.51	5400.00
6th to 7th	54.38	2117.51	2700.00
7th to 8th (terrace)	56.16	211.51	2800.00
Total quantity	274.40	10815.07	20534.00

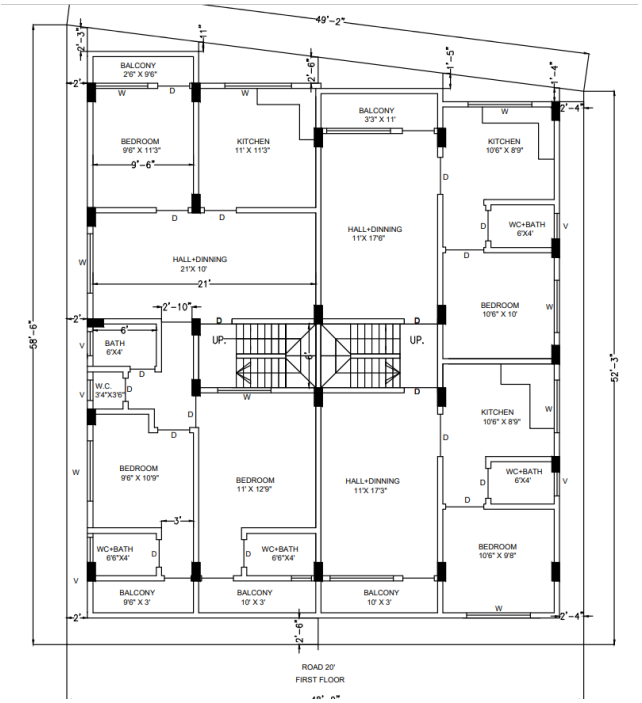
Table: Material required for staircase

Work	Staircase with side pardi		
	Concrete quantity	Steel quantity	Shuttering
	Cum	Kgs	sqm
Up to plinth			
Plinth to first slab	5.94	548.20	
1st to 4 th	5.72	441.39	
4th to 6th	5.94	436.98	
6th to 7th	5.72	436.98	
7th to 8th (terrace)	3.46	197.51	
Total quantity	26.78	2061.05	

Table: Material required for parapet

Work	Parapet		
	Concrete quantity	Steel quantity	Shuttering
	Cum	Kgs	sqm
7th to 8th (terrace)	5.37	120.50	
Total quantity	5.37	120.50	

Analysis of Case study work-MIVAN Formwork



Activity Schedule

Activity schedule

Execution	394 days	Fri 28-08-20	Tue 12-10-21
Site Clearing and Cleaning	3 days	Fri 28-08-20	Mon 31-08-20
Levelling	2 days	Mon 31-08-20	Wed 02-09-20
Marking on site as per drawings (Layout)	2 days	Wed 02-09-20	Fri 04-09-20
Temporary setup of construction needs on site	**2 days**	**Fri 04-09-20**	**Mon 07-09-20**
Electrical Supply	2 days	Fri 04-09-20	Mon 07-09-20
Water Supply	2 days	Fri 04-09-20	Mon 07-09-20
Temporary Site Toilets (Portable Sintex)	1 day	Fri 04-09-20	Sat 05-09-20
Portable Site Office	2 days	Fri 04-09-20	Mon 07-09-20
Earth Work	**5 days**	**Mon 07-09-20**	**Fri 11-09-20**
Excavation	3 days	Mon 07-09-20	Wed 09-09-20
Levelling of the	2 days	Wed 09-09-	Fri 11-09-20

remaining surface after excavation		20	
Spraying Anti-Termite Treatment (In the excavated area)	1 day	Wed 09-09-20	Thu 10-09-20
Foundation	**46 days**	**Thu 10-09-20**	**Wed 28-10-20**
Foundation work on excavated area (PCC, Main-bars, Distribution-bars)	4 days	Thu 10-09-20	Tue 15-09-20
Plinth (BEAM, COLUMN AND SLAB): [Reinforcement, shuttering, concrete work]	8 days	Wed 14-10-20	Thu 22-10-20
Back Filling	2 days	Mon 26-10-20	Wed 28-10-20

COMPLETION OF SUB-STRUCTURE	-	**Fri 20-11-20**	**Fri 20-11-20**
Super Structure	**228 days**	**Fri 20-11-20**	**Thu 15-07-21**
Column-Beam- Floor Slab (Level 1) [Reinforcement, Shuttering, Concreting,	7 days	Fri 20-11-20	Fri 27-11-20
Brick Masonry and Wall Concreting	11 days	Sat 26-12-20	Wed 06-01-21
Staircase (Conn. LVL1 & LVL2)	7 days	Sat 02-01-21	Sat 09-01-21
Construction of Elevator Area	5 days	Sat 26-12-20	Thu 31-12-20
Column-Beam- Floor Slab (Level 2) [Reinforcement, Shuttering, Concreting,	7 days	Sat 09-01-21	Sat 16-01-21
Brick Masonry and Wall Concreting	11 days	Tue 16-02-21	Sat 27-02-21
Staircase (Conn. LVL2 & LVL3)	7 days	Wed 24-02-21	Wed 03-03-21
Column-Beam- Floor Slab (Level 3) [Reinforcement, Shuttering, Concreting,	7 days	Wed 03-03-21	Wed 10-03-21
Brick Masonary and Wall Concreting	11 days	Thu 08-04-21	Tue 20-04-21
Staircase (Conn. LVL3 & LVL4)	7 days	Thu 15-04-21	Thu 22-04-21
Column-Beam- Floor Slab (Level 4) [Reinforcement, Shuttering, Concreting,	7 days	Thu 22-04-21	Thu 29-04-21
Brick Masonary and Wall Concreting	11 days	Fri 28-05-21	Wed 09-06-21
Staircase (Conn. LVL3 & ROOF)	7 days	Sat 05-06-21	Sat 12-06-21
ROOFING RCC (INCLUDING CURING)	32 days	Sat 12-06-21	Thu 15-07-21
COMPLETION OF CONCRETE WORK	**0 days**	**Thu 15-07-21**	**Thu 15-07-21**

ABC Aanalysis

This is the most common method of inventory control that adheres to the principles of Pareto's law. When only a few of something expensive is bought, a substantial amount of financial resources are used. For efficient inventory control in stores where a large number of materials need to be handled, the classification of those materials is necessary to take particular care of expensive items, which are less in number. This is because expensive items require eighty percent of the total cost of the materials that are purchased, but only twenty percent of the total cost is required for those materials. The ABC analysis is utilized frequently in the vast majority of firms today.

To organize the materials in accordance with the monetary value of their potential sales. As will be seen in the following section, this system divides all of the products sold in stores into three distinct categories labelled A, B, and C.

The sales value of an item can be calculated by multiplying the quantity of that item that is utilized annually by the price per unit that it sells for. Calculations and tabulations are performed on the total sales values of all of the goods.

The items, their sales values, and the quantity that was sold are tabulated in descending order, and the sales values are added up item by item before being displayed in the next column.

The sums of the sales prices and quantities of all of the items that are used on an annual basis are determined. It is determined how much of a percentage of sales each item makes up, as well as how much of a proportion of quantity each item makes up. The addition of these two columns demonstrates the proportion of total sales values for each item as well as the percentage of overall sales volume.

Items that account for seventy percent of the total sales value will be placed in category A. The percentage of its total quantity that is utilised is determined.

Roughly twenty percent of the merchandise's total sales value will be assigned to the B category. The percentage of its total quantity that is utilised is determined.

The items that make up about 10% of the total sales value will be placed in the C category. The remaining balance will be represented by its percentage quantity.

Characteristics of ABC Item:
A-Items

These items have a lower number but a higher sales value, ranging from 15% to 20% of the total. These are items in which the capital should not be restricted. You can place orders for them frequently, and you can devour them right away. The Director, who cares the most about the company's finances, will have final say on the purchase of these things. They only make up 10–15 percent of the total supply, therefore stores need to pay extra attention to them.

B-Items

They have the same quantity to purchase but a sales value of approximately 20 to 25 percent. Due to the fact that they are things of moderate worth, it is not essential to maintain a significant inventory of them. You are free to place orders for them on a regular basis, but the quantity you order should be sufficient enough that it will be cost effective to buy, and there should be no risk of a shortage occurring. They have a lower worth than things with an A grade, and the number ranges between 15 and 25 percent.

C-Items

They have the lowest sales costs in the industry, which is roughly 10%. They are required in a significant number, roughly between 50 and 60%. They can be purchased in large quantities to take advantage of significant price reductions and to spend less overall. This will help lower the costs associated with placing orders and

making purchases. They are available for purchase once or twice a year at most. They are the items with the lowest value.

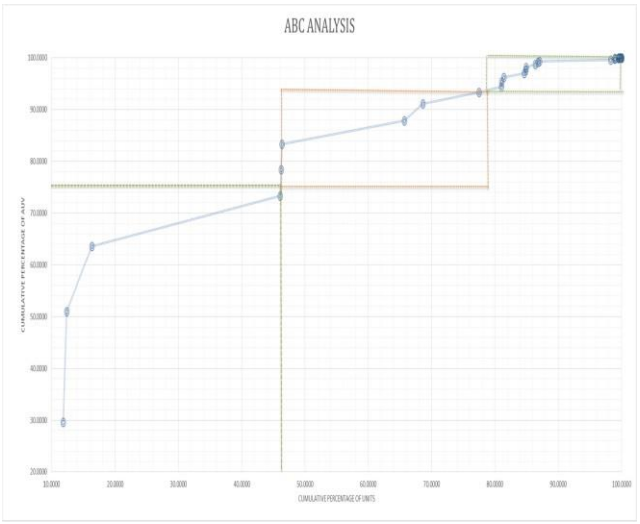
The Many Benefits of Using ABC Analysis I The inventory control of various groups of items will be improved if costly items are not kept for extended periods of time. This will also lower the amount of money spent on capital investment. (ii) The amounts of the many different kinds of goods are cost-effectively ordered and then stored according to demand. It eliminates the costs associated with placing orders and carrying stocks. (iii) It is now much simpler to make purchases from a wide variety of product categories, and substantial savings are available for making purchases from the C category in bulk. (iv) Improving the way records of individual product categories are kept contributes to effective inventory control.

Monthly Requirement Plan

SL No.	MATERIAL NAME		UNIT OF MEASUREMENT	SEPT-20	OCT-20	NOV-20	JAN-21	AUG-21	SEPT-21
				Planned quantity	Planned quantity	Planned quantity	Planned quantity	Planned quantity	Planned quantity
1	RCC	STEEL	KG	500		9375	2250	-	-
2		CEMENT	BRASS	-	286	1635	1050	-	-
3		AGGREGATE	BRASS	-	3	21	12.6	-	-
4		CRUSH SAND	BRASS	-	4.5	27	17.1	-	-
5		FLY ASH	BRASS	-	0.5	4.5	1.5	-	-
6		BINDING WIRE	KG	20	107.9	405	105	-	-
7	MASONARY	BRICKS	NO.	-	-	25500	67500	-	-
8		CEMENT	BRASS	-	-	6	12	-	-
9		CRUSH SAND	BAGS	-	-	225	750	-	-
10		FLY ASH	BAGS	-	-	3	9	-	-
11	PLASTER	CEMENT	BAG	-	-	-	-	1200	300
12		PLASTER SAND	BRASS	-	-	-	-	21	9
13	FLOORING & TILES	CEMENT	BAGS	-		-	-	150	213
14		SAND	BRASS	-	-	-	-	18	18
15		WHITE CEMENT	KG	-	-	-	-	60	-
16		KADAPPA	SQ.FT	-	-	-		180	420
17		DADO TILES	BOX	-	-	-		-	360
18		VITRIFIED TILES	BOX	-	-	-	-	90	210
19		ANTI SKID TILES	BOX	-	-	-	-	225	225
20		OOTA	NO.	-		-	-	600	1200
21	PAINTING	OIL PAINT	LIT	-	-	-	-	-	45
22		CEMENT PAINT	LIT	-	-	-	-	-	90
23		APEX	LIT	-	-	-	-	-	300
24		OBD	kg	-	-	-	-	-	450

A,B,C ANALYSIS OF MATERIALS

ITEM NO. (1)	MATERIAL DESCRIPTION (2)	UNIT OF MEASUREMENT(3)	UNIT COST(4)	NUMBER OFUNITS USED(5)	PERCENTAGE OF TOTAL UNITS USED. =(I5)/(I25)*100 (6)	CUMULATIVE PERCENTAGE OF UNITS (7)	ANNUAL USAGE VALUE (8)=(4)*(5)	PERCENTAGE OF AUV. =(8)/(I28)*100 (9)	CUMULATIVE PERCENTAGE OF AUV(10)	CLASSIFICATION OF MATERIALS
1	STEEL	KG	75.26	12125	11.8218	11.8218	151,18,411.71	29.6110	29.6110	A
2	CEMENT	BAGS	360	2971	0.5483	12.3701	100,19,123.86	21.3862	50.9972	A
3	VITRIFIED TILES	BOX	900	400	3.9523	16.3224	64,32,323.97	12.5984	63.5955	A
4	PLASTER SAND	BRASS	150	67	0.1515	46.2224	26,10,262.85	5.1125	78.3885	B
5	BRICKS	NO.s	10	93000	0.1430	46.3654	25,27,680.00	4.9507	83.3393	B
6	CRUSH SAND	BRASS	4000	1024	19.3360	65.7014	22,80,818.97	4.4848	87.8241	B
7	AGGREGATE	BRASS	2400	37	2.9035	68.6050	16,67,900.00	3.2668	91.0908	B
8	KADAPPA	SQ.FT	115	600	0.8890	77.4939	11,32,031.39	2.2172	93.3080	B
9	OOTA	NO.s	960	1800	3.5363	81.0303	5,54,728.71	1.0865	94.3945	B
10	FLY ASH	BRASS	176	12	0.0280	81.0583	5,21,120.08	1.0207	95.4152	B
11	DADO TILES	BOX	30	360	0.3493	81.4076	4,35,256.20	0.8525	96.2677	C
12	ANTI SKID TILES	BOX	41	450	3.2114	84.6190	3,60,440.32	0.7060	96.9737	C
13	APEX PAINT	LIT	200	300	0.2799	84.8990	3,18,260.55	0.6233	97.5970	C
14	OBD	KG	60	450	0.0137	84.9127	2,97,817.15	0.5833	98.1803	C
15	CEMENT PAINT)	LIT	429	90	1.4470	86.3597	2,70,470.72	0.5297	98.7101	C
16	OIL PAINT	LIT	1109	45	0.4277	86.7875	2,09,601.00	0.4105	99.1206	C
17	WHITE CEMENT)	KG	1015	60	0.2716	87.0590	1,21,800.00	0.2386	99.3591	C
18	BINDING WIRE	KG	35	637	11.2204	98.2794	1,18,992.00	0.2331	99.5922	C
			SUM	44,188		SUM	510,56,821			



From the ABC analysis following conclusions can be made,

Class A materials – 3 items (70% of AUV)
Class B materials – 7 items (25% of AUV)
Class C materials – 8 items (5% of AUV)
Class A materials constitute of Steel, Concrete and Vitrified tiles which impact 70% on project cost,
hence, they need to be ordered in small quantity frequently hence there is need of vendor analysis for
these materials so that material should be readily available when required at minimum cost.

Vendor analysis

Vendor analysis for steel

	VENDOR A	VENDOR B	VENDOR C
RATE PER KG	75.26	72.4	70.5
LEAD TIME	1 DAY	2 DAYS	4 DAYS

From above table we found that Vendor A delivers the material at earliest to the site but has very high
rate among all the vendors hence it is uneconomical, Vendor C has the lowest cost among all Vendors but
Vendor C takes lot of time to deliver the material which is not useful for our work, but Vendor B delivers
the material one day late than Vendor A & has low cost than Vendor A, hence Vendor B will be the right
choice for selecting vendor

Vendor analysis for Cement

	VENDOR A	VENDOR B	VENDOR C
RATE PER BAG	310	360	325
LEAD TIME	3 DAYS	SAME DAY	1 DAY

From above table we found that Vendor B delivers the material at earliest to the site but has very high
rate among all the vendors hence it is uneconomical, Vendor A has the lowest cost among all Vendors
but Vendor A takes lot of time to deliver the material which is not useful for our work, but Vendor C

Delivers the material one day late than Vendor B & has low cost than Vendor B, hence Vendor C will be
the right choice for selecting vendor.

Vendor analysis for Vitrified tiles

	VENDOR A	VENDOR B	VENDOR C
RATE PER BOX	850	890	950
LEAD TIME	2 DAYS	2 DAYS	1 DAY

From above table we found that Vendor C delivers the material at earliest to the site but has very high
rate among all the vendors hence it is uneconomical, Vendor A & Vendor B deliver the material on same
day to the site but Vendor A has low cost of same material than Vendor B, Hence Vendor A will be the
right choice for vendor selection.

Stacking & Storage of materials

Types of physical storage system on site vary according to the space availability and company practices.
Industrial guidelines are also taken into consideration for the stacking and storage of particular materials.
Materials are most often classified as per the comfort level of working of the workers. Basic categories followed are civil, electrical, plumbing, finishes, construction chemicals, miscellaneous. The materials
are also often stacked as per the specification of the vendor or manufacturer.
Relevant IS Codes (IS: 4082: recommendations on stacking and storage of construction materials at site) specifications are also followed. E.g.: As per IS: 4082,
The materials should not be affected by impurities or atmospheric agencies.
Materials like cement should must be stored in covered sheds and stacked on timber raised platforms.
Reinforcing bars should be stacked yards away from moisture to prevent rusting and also away from oil and lubricants. Bars of different classification, sizes and lengths should be stored separately to facilitate issues.

RESULTS & DISCUSSION

A comprehensive case study on material management at worksite was done. Attempt has been made to improvise the inventory controlling measures, purchasing measures, by looking into the detailed report of previous organization hierarchy and their management.

The present work comprises the redesigning of the entire organization hierarchy without touching the core competency. Management was sub divided into sub system and further task work such as purchase manager, supervisor in charge. Under them further sub divides into supervisors and helpers. Effort is taken to improvise the existing hierarchy effectively, by improving purchasing department, financial department, material management department to merge with one and each
other.

Microscopically, dissections were done into the matters of purchasing, transportation and introduction of new possibilities, like, purchase requisition slip, tender quotation form, were initiated to help in achieving a better procurement control at the work site.

Analysis was done at the site based on cost input, such as ABC analysis. In ABC analysis, we categorize whole material into ABC type materials where Category consist of 10% of total material involved in construction but that cost 70% of the total cost.
Similarly Band B & C type material were also classified accordingly by this we mean that during construction the materials can be
released as per the above concept, so that, we can strengthen the financial control and proper scheduling and programming of the work can be achieved, there by graduating progress in work efficiently.

Further vendor analysis was done of type A material and similarly cost controlling efficiently was achieved, that is, if a contractor quotes a rate, and later on we calculate a similar quote for the same material for what the contractor has given. We can find that there is a change in the quotation Thus, enabling us to have a broad outlook on the financial control of the work. Thus, helping in proper release of the finance and preparation of the budget preparing process.

Cost analysis of precast work

Precast slab

Total area covered for precast slab units = 45ft*25ft= 1125sqft
Rate of solid precast slab (125mm) per sqft = 120rs/sqft
For this construction project 10 precast slabs are used. Size of each precast slab unit is 10ft*12ft.
Hence for 10 slab units (10*12ft=120sqft) i.e, for 1200 sqft area we can calculate cost required for this area is 1200sqft*120rs = 1,44,000rs

Size of each precast slab	No. of units	Rate of each unit	Total
10*12ft	10	120rs/unit	1,44,000.00

For this project 3 workers are working for 5 days to prepare slab units, rate of labour per day = 300/ day
Hence labour charges = 3*5*300= 4500rs
Transportation cost for 100 km(25rs/km) = 100*25 = 2500rs
Crane handling charges = 5hrs*1200= 6000rs
Hence, **labour+ transportation + crane = 13000rs**

Hence total cost for making precast slab is 158000rs

Type of structure	Activities	Total cost of slab
RCC	Per unit + shuttering + labour	1,78,000.00
Precast	Unit making + transportation + erection	1,58,000.00

Precast hollow wall panels

For room size of area 18*12ft ,20 precast hollow wall panels are used of size 3*9ft, which accounts area of 27sqft.
Rate of hollow precast wall per sqft is 100rs sqft. hence rate of one precast wall is 2700rs.

For our room size total cost of all precast wall is 54000rs.
For this project 3 workers are working for 5 days to prepare wall units, rate of labour per day = 300/ day
Hence labour charges = 3*5*300= 4500rs

Transportation cost for 100 km= 100*25 = 2500rs
Crane handling charges = 5hrs*1200=6000rs
Hence, **labour+ transportation + crane = 13000rs**

Hence total cost for precast walls is 67000rs

Cost differentiation

From above calculations of precast & RCC construction we find the cost differentiation in both of the system:

RCC work

Type of construction	Slab	Brickwork	column	Total
RCC	178000	84250	33500	298000.00

Precast work

Type of construction	Precast slab	Precast wall panels	Total
Precast	158000	67000	225000.00

Hence, we can find that for our construction the cost difference is found to be 68,000.00rs
Hence, we can say there is saving of

CONCLUSION

"Mivan formwork buildings demonstrate a cost advantage, being approximately 20% more economical compared to conventional formwork buildings. The utilization of Mivan shuttering significantly reduces construction time, achieving completion in half the duration required by traditional shuttering for a twelve-floor building. This not only enhances efficiency but also ensures a quality finished surface.

The Mivan shuttering technique allows for the construction of walls that serve as shear walls, contributing to a reduction in the building's response time during earthquake conditions. In comparison to brick walls, RCC walls offer superior resistance to weather conditions, enable increased carpet area, and effectively prevent dampness in the building. This highlights the economic and construction speed advantages of employing the Mivan shuttering technique, while also emphasizing the structural and functional benefits of RCC walls over traditional brick walls."

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