An Attempt of Construction Time and Cost Analysis for Affordable Housing Projects using Microsoft Project Planner Software

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Abstract: After agriculture, the construction industry is India's second largest industry. Urbanization has become much messier as a result of the massive growth in refugees and urban slums, which is also resulting in the loss of natural resources. Housing is a fundamental need that must be met. The population of India is rapidly growing therefore the cost of living has risen as well resulting in an increase in the cost of housing which has become unaffordable. The idea of mass housing has been introduced to address this crisis. However, both the development and selling of mass housing gradually became prohibitively costly. The owners, contractors, and engineers are also developing new ideas to cut costs and boost efficiency. According to census data from 2001 and 2011, the number of immigrants from rural areas increased by 20% in seven metro cities. As a result, the urbanization has become even dirtier. On the other hand Housing is regarded as one of the most basic requirements. With the rapid growth in population, the cost of living has risen, making housing in cities unaffordable. To address this situation, policymakers developed MASS HOUSING national strategies.

Keywords: Mass Housing, Resources, EWS, Affordable Housing, Monolithic Technology

INTRODUCTION

Housing is a basic human need in developing countries like India, which is experiencing rapid urbanization. It has been a problem for the government to provide housing for refugees and EWS AND LIP people. They have developed an affordable mass housing concept, but due to a number of factors such as unwelcome policy changes and abrupt political changes, the project has been delayed or halted, as well as cost overruns. Many countries have successfully implemented the lean principle of construction over the years. We will examine the differences between conventional and advanced concept constructions, including cost and delay overruns, in this report.

OBJECTIVES:

1. To investigate the viability of a methodology for a large-scale affordable housing project.
2. To examine the suitability and acceptability of monolithic construction practises.
3. To get acquainted tool of Microsoft Project Management Software in affordable housing project.
4. To perform Earned Value Analysis for One Particular Type of Building for Aluform Technology.

LITERATURE REVIEW

The focus of this research is on Indian policies and practices relating to mass housing. It is about India's policies on mass housing and how they are enforced in the country. According to these writers, affordable mass housing is a global issue that many countries are addressing. The demands of an increasing population are outpacing the population's growth. People are looking for more space to suit their changing lifestyles. In the long run, settlement is unquestionably one of the most essential conditions for any company or organization. In this article, I will address the criteria for elevated structures, their appeal, and the construction procedures that used refined technologies and green ideas to improve tenants' quality of life, well-being, and flourishing, giving the structures stability and solidarity.

High-rise structures are complex structures that require extensive review, pre-planning, pre-construction work, final layout and plan, development, and execution. Quality assurance is another part of this approach that should not be ignored. The essence of the work done, the materials used, and the labor standard must be preserved on the job site during the construction process.

The most recent innovations are in use, although others are still being studied. People are unable to follow their interests due to a shortage of land in light of the rapidly increasing population, and high-rise buildings are being built to meet their needs. People with better offices have better living quarters as a result of these high-rise buildings. Technology and structure are the two most closely related callings for the tall structure plan. High-rise buildings are also constructed of strong block stonework until the end of the last century.

Comprehensive Analysis of Construction Time and Cost for Mass Housing Projects under Affordable Housing- Review Paper, Santosh A Gunnal, Abjijit N Bhirud (2021)

There are no affordable housing construction guidelines in India, which is a policy gap that must be filled immediately. A radical design and planning approach is required to ensure the long-term viability of upcoming affordable housing projects. In this report, the authors used an architectural and site-based research approach to conduct a cross-sectional assessment of Affordable housing layouts. The authors hypothesise that improved natural ventilation in living spaces, a feature of the housing layout, would result in a better indoor climate in affordable housing. Minimizing project time and expense at the same time is critical in construction planning and management. To maximize the overall benefit of a construction project, tradeoff optimization between these two variables is required. Early decisions on a building project have a significant impact on the project, and different situations should be considered depending on the owner's specifications when making decisions. At the start of a construction project, the knowledge available is generally limited and ambiguous. As a result, planning and managing the project is difficult (especially cost planning). As a result, a cost model that could be tailored to the needs of the owner was created.[1]

Forecasting the construction cost by using unit based estimation model K.S.V.S. Pujitha, K. Venkatesh (2020)

Construction projects, in general, take a long time to complete. Predicting price increases and forecasting construction costs are critical measures for project estimators, contractors, and owners in this context. Due to variations in construction elements, pricing is a difficult task, and this pattern is expected to continue in the long run. Many forecasting techniques, such as Earned Value Management (EVM), have been developed in recent years to handle the difficulty of prediction problems, while the current work describes an approach to forecasting the overall cost of a construction project using data from a simple project cost framework, i.e., to-date cost data. These figures are gathered and estimated on a regular or weekly basis for each account, and added together for the entire project In the case study project (Hostel Building with G + 14) the basic construction elements like column, beams and slab are considered as products and find the unit production cost based on the Estimated at Completion (EAC) data and then used to forecast to Estimate to Complete (ETC).[2]

Real-time resource tracking for analyzing value-adding time in construction Janiya Zhao, Olli , Bonham Badihib, Hylton Olivieric (2019)

Researchers and lean building practitioners have been interested in improving the effectiveness of production control in recent years, using methods such as the Last Planner System (LPS) and Location-based Management System (LBMS). Data collection and interpretation, however, remain manual in these techniques. Remotely locating employees on the job has been proposed as a possible technology for gathering critical data for production management. The aim of this research is to see whether a real-time monitoring system can be used to collect data for production control in various types of construction projects. In three case projects, including residential, office building, and plumbing renovation, we used Bluetooth Low Energy (BLE) technology to monitor staff in real time. Based on the collected data, we compared different tracking device placement strategies and evaluated the share of employees who were present in work locations for an extended period of time. The findings indicate that the proposed system can gather both location-based and time-based information about staff in real time, but quality and coverage problems must be considered when defining the data collection strategy for each project. Rather than investing in more advanced monitoring technologies, heuristics in data processing can be used to address accuracy and coverage problems to a large extent. The result is that when such heuristics and installation protocols are followed, real-time monitoring technologies are ready for use. On a construction site, a real-time presence index can be calculated. These figures may be used to assess the effect of waste management measures on construction sites.[3]

Investigation on Elements and Their Fraction of Housing Construction Cost N.H.V.T.N. Nanayakkara, C.D. Udawattha and R.U. Halwatura (2017)

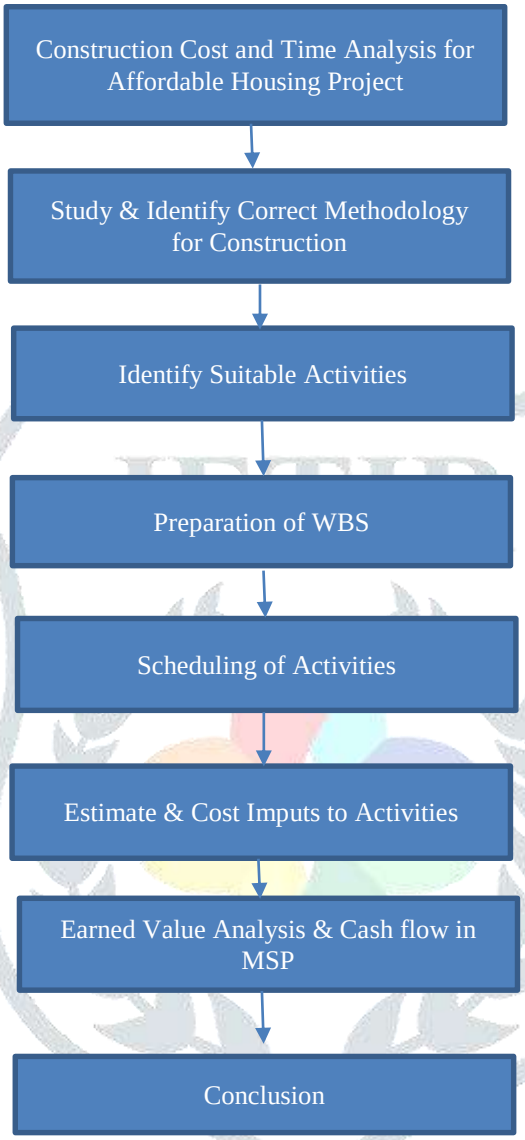
The construction industry is primarily dependent on estimated costs. The cost of a project is one of the most significant constraints in any construction project. The majority of the project's production costs are spent on construction. Despite this, every construction company fails to accurately estimate the actual construction cost prior to the start of the project. With minimal data, all stakeholders, including the customer, contractor, quantity surveyors, and engineers, attempt to estimate the construction expense. The aim of this study was to develop empirical relationships for each cost factor in the construction of two-story houses. The inquiry is focused on a bill of quantities for two-story houses that was previously prepared and gathered 45 bill of quantities for review. In this analysis, the house footprint is used as a variable parameter to sensitively measure the cost difference based on the type of house.[4]

Cost analysis for sustainable off-site construction based on a multiple- case study in China Chao Mao, Fangyun Xie, Lei Hou, Peng Wu, Jun Wang, Xiangyu Wang (2016)

In comparison to traditional cast-in-situ methods, off-site construction (OSC) methods such as prefabrication and modularization have been regarded as an efficient way to improve sustainability and productivity**.** In China, the multiple-case research approach is used to perform an in-depth review on the cost of implementing OSC versus traditional construction methods. The findings show that the overall cost of using OSC or semi-OSC techniques is significantly higher than the cost of using traditional building

methods. Processes including prefabricated part manufacturing, transportation, and design consultancy account for the majority of costs. In comparison to developed countries, China's expertise, skills, and consumer demand for OSC are woefully inadequate, increasing the cost of deploying OSC across the country. OSC, on the other hand, spends less on masonry, plastering, and measuring work. In addition, moving from on-site construction to factory-based indoor prefabrication reduces the number of employees required and the time it takes to complete a project, resulting in cost savings. To summarize, this study rationalizes the widespread adoption of OSC in the near future through detailed and rigorous cost analysis case studies from which Chinese stakeholders can consider the benefits and drawbacks of OSC and make informed decisions.[5]

RESEARCH METHODOLOGY:

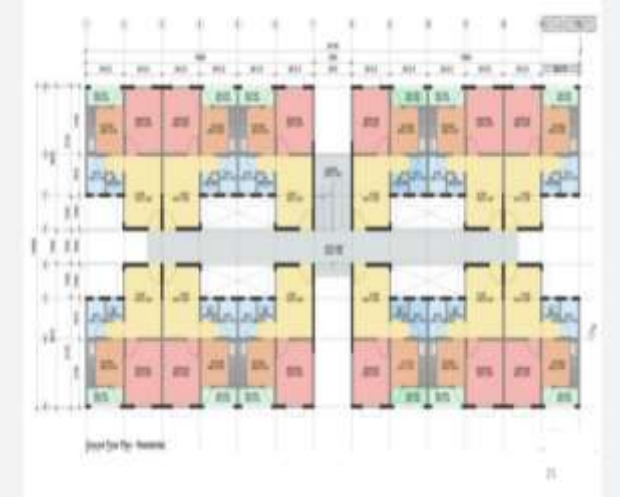


CASE STUDY:

RAY NAGAR-RAY OF HOPE, SOLAPUR.30000 HOUSES WITH INFRASTRUCTURE-WORLDS LARGEST AFFORDABLE HOUSING PROJECT ON PPP BASIS.

Ray Nagar Housing Project is a RERA registered project located in Kumbhari, Solapur. Vasant Vihar Realty Pvt Ltd is building the Ray Nagar Housing Project. Ray Nagar Housing Project's RERA number is P52600017938. According to RERA registration, the Ray Nagar Housing Project project began on date null and is scheduled to be completed on or before 2024-12-31. Ray Nagar Housing Project offers amenities such as RCC Road and Rain Water Harvesting. Land for 30000 houses has already been purchased, with a 25% beneficiary contribution and the remainder provided by the developer. The Woman of the House will be granted ownership.5 lakhs per house (27.94 sq. mt carpet area, including living, kitchen, bed, individual bathroom, and WC with water connection.2.5 lakhs in subsidies per house (1.5 lakhs in the centre + 1 lakh in the state).The cost of infrastructure per unit is one lakh rupees (State under various schemes).Rainwater harvesting, CC Roads, Storm water drains, Water supply, WTP, ESR/GSR, Sewerage, STP, external electrification, street lights, solid waste containers, and so on are examples of infrastructure.

TYPICAL FLOOR PLAN OF ONE BUILDING & DWELLING UNIT PLAN:



Total Carpet Area: 27.94 sq. mt.,

Living Room = 2.5m x 3.6m Bedroom = 2.5m x 2.975m,

Bath = 1.2m x 1.75m, Kitchen = 2.5m x 2.1m

Balcony = 2.5m x 0.925m WC = 1.2m x 0.9m

SITE PHOTOS:

METHODOLOGY:

ALUFORM TECHNOLOGY:

Formwork technology is used to address the issues of mega housing projects all over the world in a cost-effective and functional manner. On the whole, it wants to make the most of new building methods and equipment. This technology has a lot of potential in India for providing affordable housing to the country's growing population**.** Good construction will never cause a delay in the completion of a project, nor will it be uneconomical.

ERECTION OF FORMWORK:

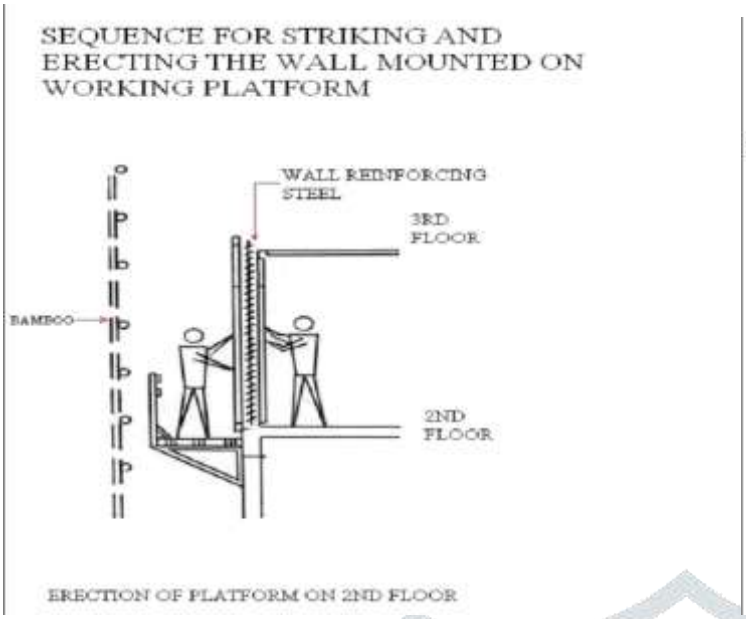


Fig.No.1-Erection of Platform

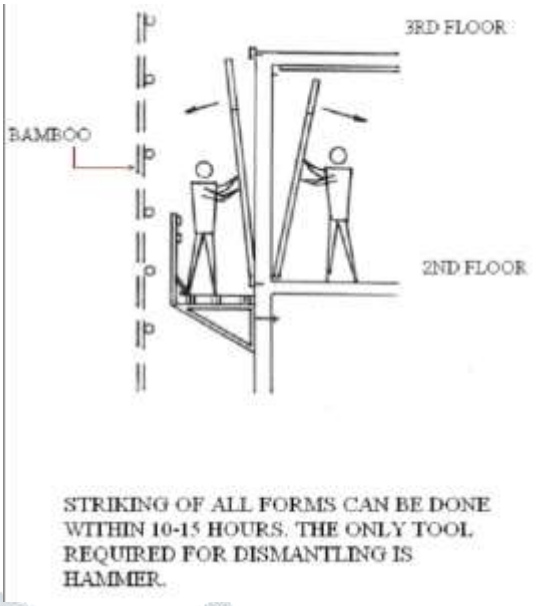


Fig.No.2-Striking of Alu Forms

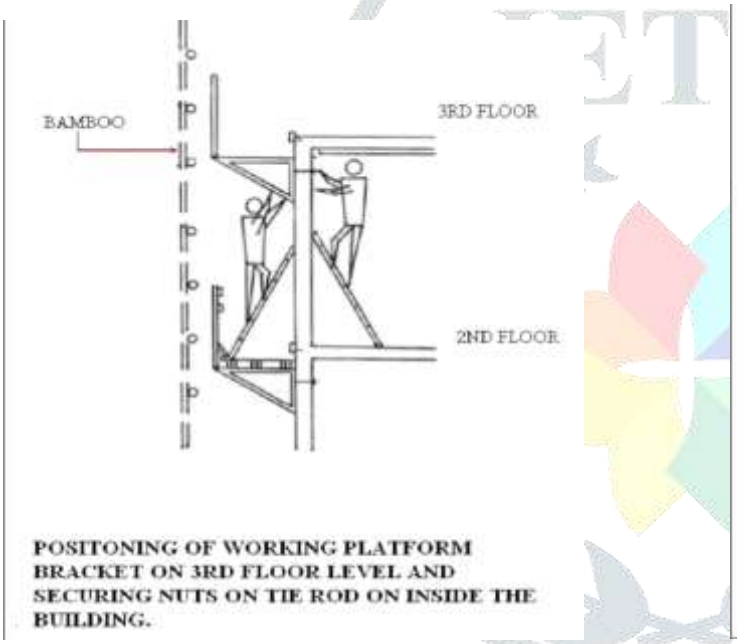


Fig.No.3-Positioning of Working Platform

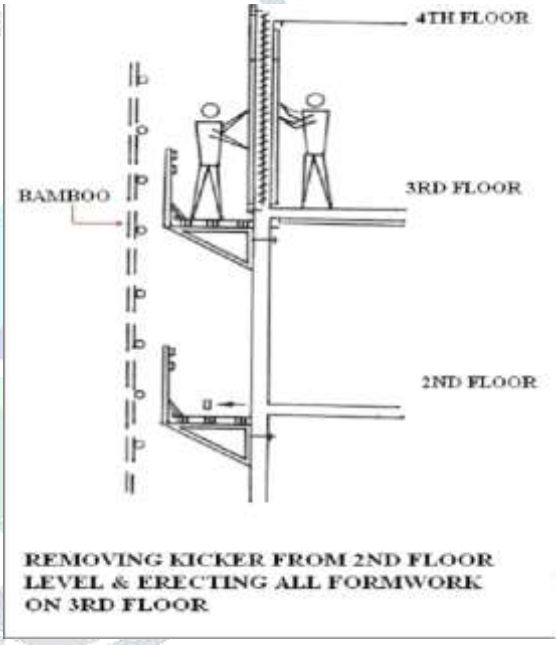


Fig.No.4-Removal of Kicker

- The formwork assembling at the site is a quick & easy process .All panels are clearly labeled to ensure that they are easily identifiable on site and can be smoothly fitted together using formwork modulation drawings.
- It usually follows ideal work cycle of 4-7 days.
- Day 1- Layout, Steel binding
- Day 2- Steel binding, Wall Shuttering
- Day 3- Wall Shuttering, Slab Shuttering
- Day 4- Slab Steel binding.
- Day 5- Slab steel binding, Concreting
- Day 6- Removing Vertical Formwork after 24Hrs

COMPARISON BETWEEN CONVENTIONAL AND ALUFORM TECHNOLOGY:

Sr. No	Description	Aluminium Formwork	Conventional Timber Formwork
1.	Quality of work	More	Less
2.	Time Taken for installation	Less	More
3.	Supervision required	Less	More
4.	Plastering	Not required	Required
5.	Initial Cost	More	Less
6.	Scrap Value	High	Less
7.	Finish of RCC Components	Smooth	Rough
8.	Monolithic Construction	Yes	No
9.	Slab Cycle	10 Days	21 Days

DATA COLLECTION:

Cost Component for Aluform Technology for proposed RAY Nagar Project as Follows:

Sr.No.	Items	Percentage	Cost of One Building	Cost of one DU
1	**STAGE-I**			
	A) UP TO PLINTH			
	i) UP TO FOOTING CONC.	4.27%	**1280055**	**21334**
	ii) UP TO FLOOR PCC	3.36%	**1008928**	**16815**
	B) RCC			
	a) Ground Floor	12.87%	**3860095**	**64335**
	b) First Floor	12.87%	**3860095**	**64335**
	c) Second Floor	12.87%	**3860095**	**64335**
	d) Third Floor	12.87%	**3860095**	**64335**
			17729362	**295489**
2	**STAGE-II A FINISHING**		**2999723**	**49995**
	A) FINISHING			
	RCC Door Frame Main door	3.70%	1111351	18523
	reinforced jalli	0.09%	26180	436
	Tandoor Flooring	0.64%	193081	3218
	Waterproofing for W/C & Bath	0.56%	168104	2802
	W/C Orissa pan	0.57%	170730	2846
	Other plumbing item	2.29%	686688	11445
	Electrification common area	2.15%	643590	10727
	B) FINISHING		**3100944**	**51682**
	P.V.C. door shutters w/c & bath	2.37%	711898	11865
	Solid core flush door	1.54%	461625	7694
	Aluminum window	3.14%	940520	15675
	apex ACE Exterior Paint	2.25%	675714	11262
	BB Coba Terrace Slab	1.04%	311186	5186
3	**STAGE-III FINISHING**		**6169971**	**102833**
	Ceramic tiles	7.46%	2239205	37320
	Kitchen otta with sink and fittings	5.32%	1596459	26608
	wall Putty	4.48%	1343041	22384
	OBD	1.03%	309333	5156
	Electrification Internal Du	2.27%	681933	11366
	Total:--	**100%**	**30000000**	**500000.00**

PROJECTED PHASEWISE SCHEDULE FOR 30000 HOUSES:

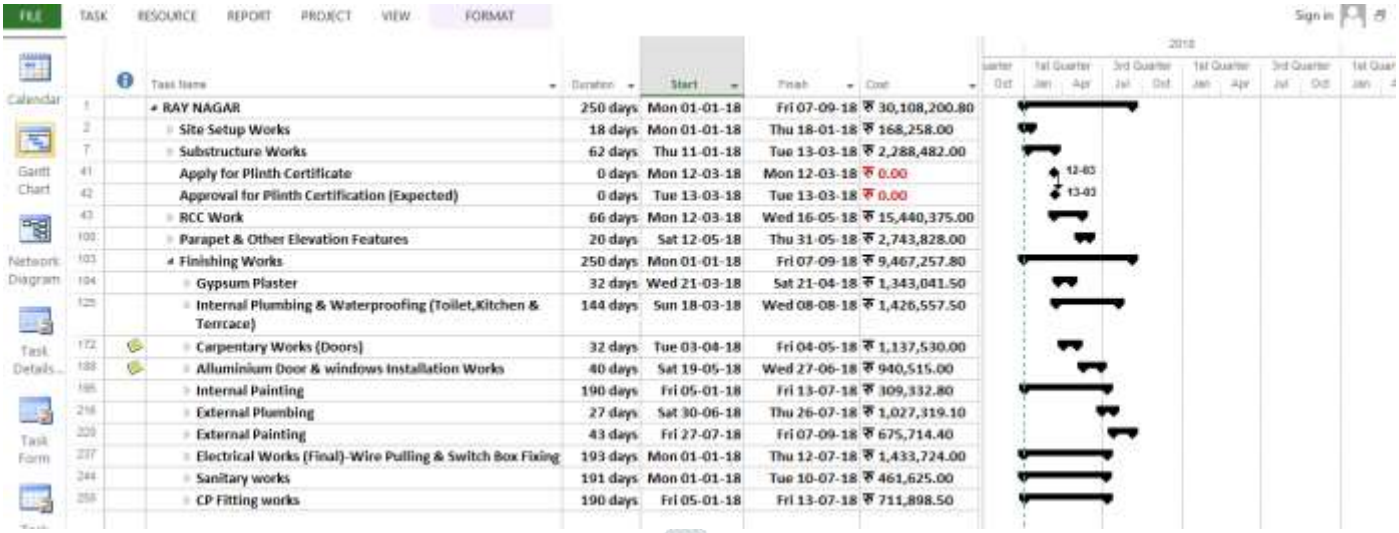
Sr.No.	Activity	NO of DUs	2018	2019	2020	2021	TOTAL
A	**Dwelling Unit**						
1	Work Up to Plinth	30000	7812	9072	9072	4044	30000
2	1)G.F.	10000	2100	2880	2880	2140	10000
3	2)F.F.	10000	2040	2880	2880	2200	10000
4	3)S.F.	10000	1920	2880	2880	2320	10000
5	Finishing I	30000	5220	8640	8640	7500	30000
6	Finishing II	30000	4500	8640	8640	8220	30000
7	Handing Over	30000	4500	8640	8640	8220	30000

REQUIREMENT OF ALUMFORM MATERIAL FOR EFFICIENT AND SMOOTH EXECUTION OF BUILDING:

SR.NO	DETAILS	AREA	UNIT
1	INTERNAL VERTICAL FORMWORK UNIT	1507.57	SQM
2	INTERNAL VERTICAL FORMWORK CORRIDOR	144.29	SQM
3	EXTERNAL VERTICAL FORMWORK	286.23	SQM
4	HORIZONTAL FORMWORK- SLAB UNIT	358.86	SQM
5	HORIZONTAL FORMWORK- SLAB CORRIDOR	46.07	SQM
6	KICKER FORMWORK- ONE SET	24.39	SQM
	TOTAL FORMWORK QUANTITY	2367.40	SQM
	Aluminum Shuttering for One Building	**7507.18805**	**SQM**

DATA ANALYSIS:

TIME ANALYSIS & COST ANALYSIS FOR PROJECT IN MSP WITH RESPECT TO ALUFORM TECHNOLOGY:



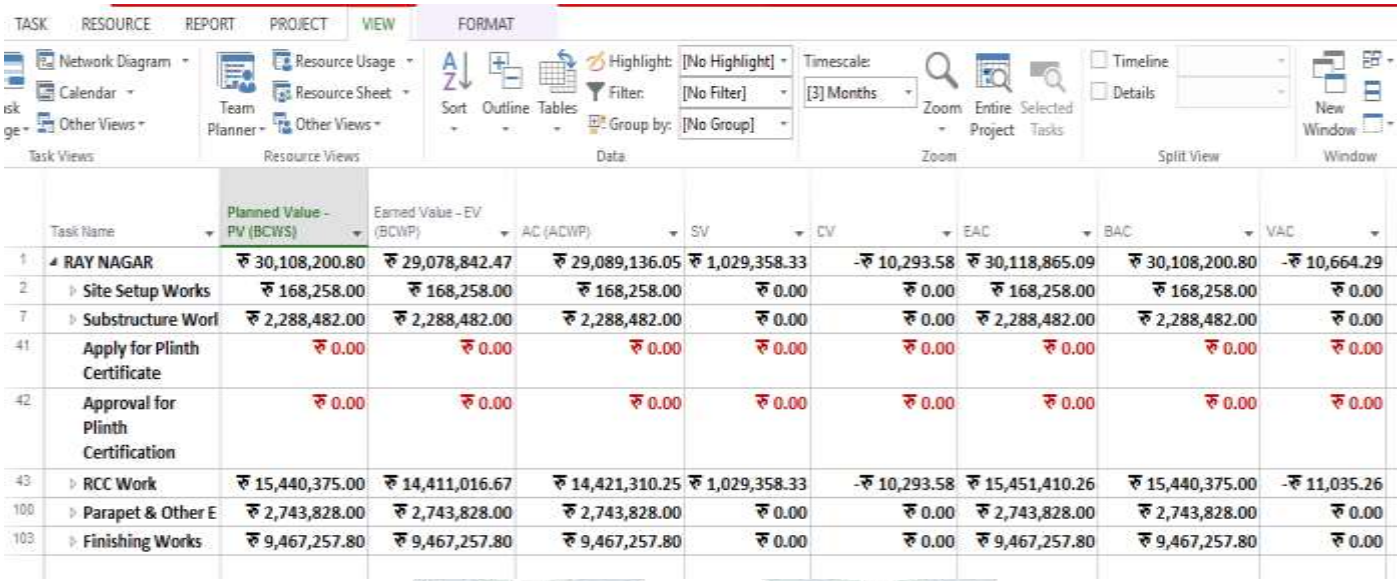
	Task Name	Duration	Start	Finish	Cost
1	RAY NAGAR	250 days	Mon 01-01-18	Fri 07-09-18	₹ 30,108,200.80
2	Site Setup Works	18 days	Mon 01-01-18	Thu 18-01-18	₹ 168,258.00
7	Substructure Works	62 days	Thu 11-01-18	Tue 13-03-18	₹ 2,288,482.00
41	Apply for Plinth Certificate	0 days	Mon 12-03-18	Mon 12-03-18	₹ 0.00
42	Approval for Plinth Certification (Expected)	0 days	Tue 13-03-18	Tue 13-03-18	₹ 0.00
43	RCC Work	66 days	Mon 12-03-18	Wed 16-05-18	₹ 15,440,375.00
100	Parapet & Other Elevation Features	20 days	Sat 12-05-18	Thu 31-05-18	₹ 2,743,828.00
103	Finishing Works	250 days	Mon 01-01-18	Fri 07-09-18	₹ 9,467,257.80
104	Gypsum Plaster	32 days	Wed 21-03-18	Sat 21-04-18	₹ 1,343,041.50
125	Internal Plumbing & Waterproofing (Toilet,Kitchen & Terrcace)	144 days	Sun 18-03-18	Wed 08-08-18	₹ 1,426,557.50
172	Carpentary Works (Doors)	32 days	Tue 03-04-18	Fri 04-05-18	₹ 1,137,530.00
188	Alluminium Door & windows Installation Works	40 days	Sat 19-05-18	Wed 27-06-18	₹ 940,515.00
196	Internal Painting	190 days	Fri 05-01-18	Fri 13-07-18	₹ 309,332.80
216	External Plumbing	27 days	Sat 30-06-18	Thu 26-07-18	₹ 1,027,319.10
220	External Painting	43 days	Fri 27-07-18	Fri 07-09-18	₹ 675,714.40
237	Electrical Works (Final)-Wire Pulling & Switch Box Fixing	193 days	Mon 01-01-18	Thu 12-07-18	₹ 1,433,724.00
244	Sanitary works	191 days	Mon 01-01-18	Tue 10-07-18	₹ 461,625.00
259	CP Fitting works	190 days	Fri 05-01-18	Fri 13-07-18	₹ 711,898.50

1. **Cost of project (A) =3, 01, 08,200.80 Rs.**
2. **No of Units (B)=60 Nos**
3. **Cost per DU= (A/B) =5, 01,803.34 Rs.**

EVM PERFORMANCE MEASURES

Project Management Questions	To Calculate	Formula
1) How are we doing time wise? - Schedule Analysis and Forecasting		
Are we ahead or behind schedule?	Schedule Variance (SV)	SV = EV – PV
How efficiently are we using time?	Schedule Performance Index (SPI)	SVI = EV / PV
2) How are we doing cost wise? - Cost Analysis and Forecasting		
Are we under or over budget?	Cost Variance (CV)	CV + EV – AC
How efficiently are we using resources?	Cost Performance Index (CPI)	CPI = EV / AC
What is project likely to cost?	Estimate at completion (EAC)	EAC = BAC / CPI
What are we under or over budget?	Variance at completion (VAC)	VAC = BAC – EAC
What will be the remaining work cost?	Estimate to Completion (ETC)	(BAC - EV) / CPI

EARNED VALUE ANALYSIS FOR RAYNAGAR FOR ALUFORM TECHNOLOGY



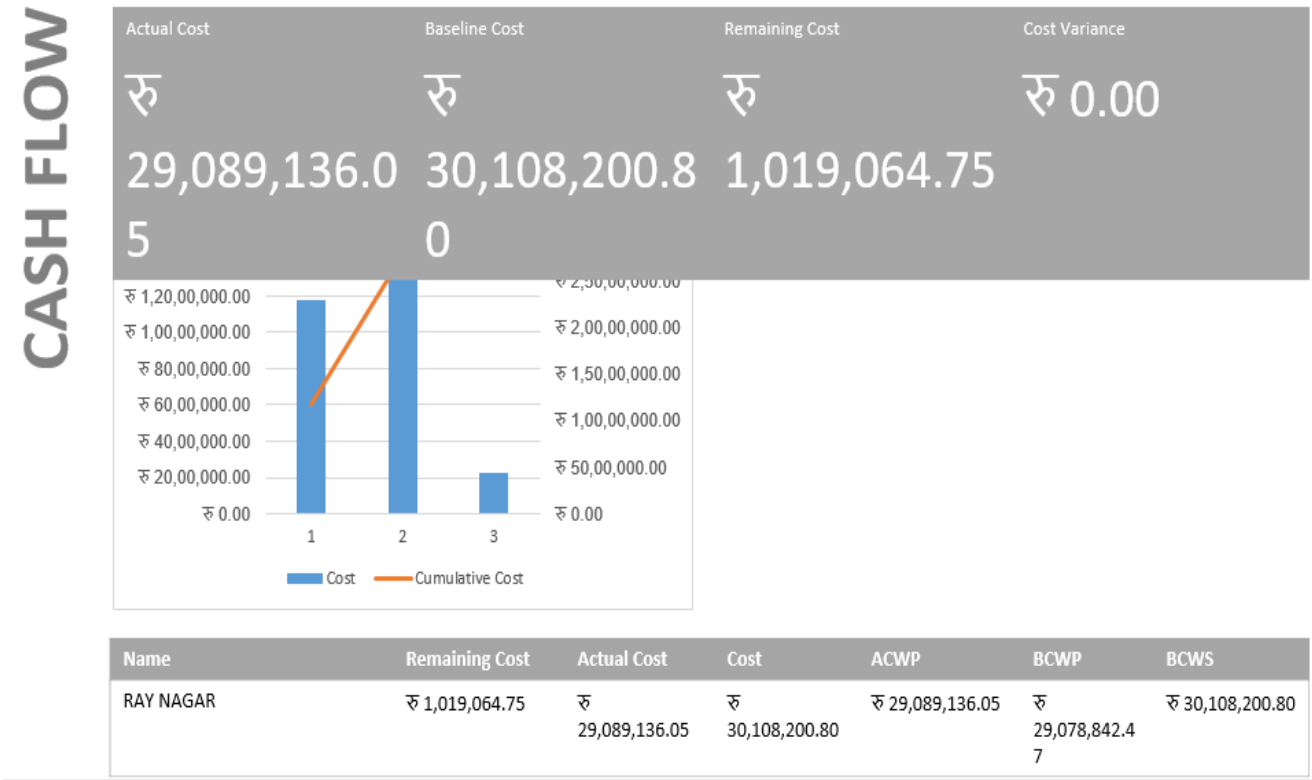
	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC
1	RAY NAGAR	₹ 30,108,200.80	₹ 29,078,842.47	₹ 29,089,136.05	₹ 1,029,358.33	-₹ 10,293.58	₹ 30,118,865.09	₹ 30,108,200.80	-₹ 10,664.29
2	Site Setup Works	₹ 168,258.00	₹ 168,258.00	₹ 168,258.00	₹ 0.00	₹ 0.00	₹ 168,258.00	₹ 168,258.00	₹ 0.00
7	Substructure Worl	₹ 2,288,482.00	₹ 2,288,482.00	₹ 2,288,482.00	₹ 0.00	₹ 0.00	₹ 2,288,482.00	₹ 2,288,482.00	₹ 0.00
41	Apply for Plinth Certificate	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
42	Approval for Plinth Certification	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00	₹ 0.00
43	RCC Work	₹ 15,440,375.00	₹ 14,411,016.67	₹ 14,421,310.25	₹ 1,029,358.33	-₹ 10,293.58	₹ 15,451,410.26	₹ 15,440,375.00	-₹ 11,035.26
100	Parapet & Other E	₹ 2,743,828.00	₹ 2,743,828.00	₹ 2,743,828.00	₹ 0.00	₹ 0.00	₹ 2,743,828.00	₹ 2,743,828.00	₹ 0.00
103	Finishing Works	₹ 9,467,257.80	₹ 9,467,257.80	₹ 9,467,257.80	₹ 0.00	₹ 0.00	₹ 9,467,257.80	₹ 9,467,257.80	₹ 0.00

PERFORMANCE MEASURES AND COMPARISON

Performance Measures		Schedule		
		SV > 0 and SPI > 1	SV = 0 and SPI = 1	SV < 0 and SPI < 1
Cost	CV > 0 and CPI > 1	Ahead of schedule and under budget	On schedule and under budget	Behind schedule under budget
	CV = 0 and CPI = 1	Ahead of schedule and under budget	On schedule and on budget	Behind schedule on budget
	CV < 0 and CPI < 1	Ahead of schedule and over budget	On schedule and on budget	Behind schedule over budget

EARNED VALUE ANALYSIS FOR RAYNAGAR SUBJECT TO ALUFORM TECHNOLOGY

CASH FLOW ANALYSIS FOR RAYNAGAR SUBJECT TO ALUFORM TECHNOLOGY



Name	Remaining Cost	Actual Cost	Cost	ACWP	BCWP	BCWS
RAY NAGAR	₹ 1,019,064.75	₹ 29,089,136.05	₹ 30,108,200.80	₹ 29,089,136.05	₹ 29,078,842.47	₹ 30,108,200.80

REVIEW OF EARNED VALUE PARAMETERS

SR. NO.	EARNED VALUE PARAMETERS	MS PROJECT IN RS.
1	PLANNED VALUE	3,01,08,200.80
2	EARNED VALUE	2,90,78,842.47
3	ACTUATL COST	2,90,89,136.05
4	COST VARIANCE	-10293.58
5	SCHEDULE VARIANCE	10,29,358.33
6	CPI	0.99
7	SPI	0.97
8	BUDGET AT COMPLETRION	3,01,08,200.80
9	ESTIMATE AT COMPLETION	3,01,18,865.09
10	VARIANCE AT COMPLETION	-10664.29

EARNED VALUE PARAMETERS

EARNED VALUE PARAMETERS	FORMULA	VALUE	INTERPRETATION
1. Schedule Analysis And Forecasting- How Are We Doing Time Wise?			
Schedule Variance (SV)	SV = EV – PV	-1029358	**Behind Schedule**
Schedule Performance Index (SPI)	SPI= EV/PV	0.97	**Behind Schedule**
2. Cost Analysis And Forecasting- How Are			
Cost Variance (CV)	CV = EV – AV	-10229.5	**Over Budget**
Cost Performance Index (CPI)	CPI = EV/AV	0.99	**Over Budget**

CONCLUSION:

From above detailed study and analysis we can conclude that:

1. Aluform Technology is the Best Methodology for a large-scale affordable housing project due to following reasons :
   a. It Reduces Construction times as we can see in Bar Chart. Slab Cycle curtailed for 7 days from 21 days.
   b. Skilful Operation for Workmanship.
   c. Materials Carrying higher cost components can be reused for repetition of more than 150 times whereas for conventional practices we can't use it more than 10 times
   d. Even after complete use of materials it can be resale for its distress salvage value.
2. Suitability and Acceptability of monolithic construction practises is predominant as same type of structures to be built over years of time for 5 years as mentioned in Schedule of Case Study. For Conventional Method of practices it would be very difficult to manage in short period of time.
3. We have effectively used tool of Microsoft Project Planner to optimize Cost & Time for One Particular type of Building Using Earned Value Analysis. Results are shown in Variance & Cash flow.
4. Earned Value Analysis with Schedule Variance & Cost Variance are as mentioned.

ACKNOWLEDGMENT

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