



Research Paper

## “Overcoming the Shortage of Skilled Labours for Plastering by Using Machineries in Construction” A case of TamilNadu.

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**ABSTRACT:** *This study is aimed at developing productivity models based on the combined usage of manpower and equipment resources in construction for Tall residential building projects in India. Construction projects are facing many problems from day to day in their business. Concreting, reinforcement, formwork, blockwork and plastering works are doing alternative method. The study found that improper planning of work, shortage of skilled labor, was the most important factor affecting the productivity in tall residential building projects. Technology plays vital role to improve construction efficiency and productivity, hence resulting in project time line reduction. This paper reports the results of a questionnaire survey of project managers, site engineers, supervisors and craftsmen, in India. The main methods for improvement have also been discovered; namely, more communication among team members, the appointment of a more experienced project manager and the assignment of more skilled workers. This paper tries to identify the various factors attributed to delay of high-rise building construction and effects of these.*

**KEYWORDS:** *Skilled Labours shortage, semi-automation, plastering machine.*

*Received 17 July, 2022; Revised 28 July, 2022; Accepted 31 July, 2022 © The author(s) 2022.  
Published with open access at [www.questjournals.org](http://www.questjournals.org)*

### I. INTRODUCTION

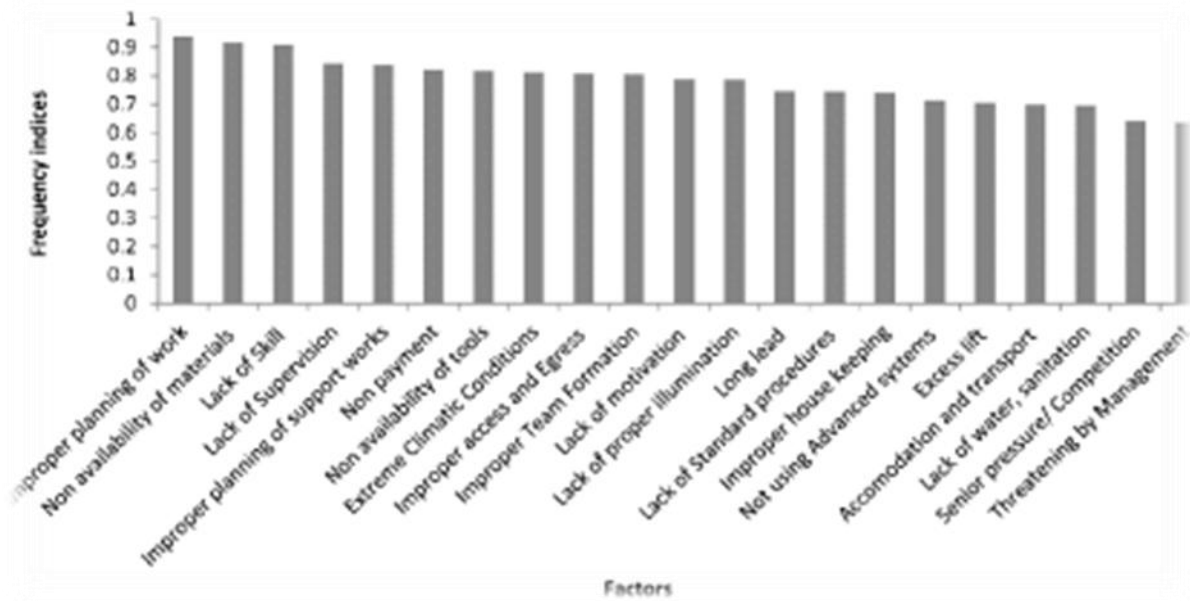
Improper planning of work, shortage of skilled labor, are the key factors affecting the productivity of construction. To overcome the inadequacy of skilled labour on construction site, which in turn highly impacts the quality and efficient productivity of construction, resulting in time and cost overrun. Construction Project delays are the major problems tackled by the construction sector owing to the associated complexity and uncertainty in the construction activities. The paper identifies and analysis the reasons for the inadequacy of skilled labour on site premises, strategies for overcoming Skilled Workers shortage, strategies for diminishing the wastage of mortar ruins on site premises, provide efficient analysis and comparative statistics to state semi-mechanized construction's efficiency over manpower and to take the edge of construction time and bring down the cost compared to conventional methods as a final output of study.

The study incorporates views from around 17 literature papers and 3 net case studies. And also has approached live constructions sites which go through the issues being addressed in the research paper. And the paper has tried to establish comparative results between manual methodology usage in plastering and semi-automation in plastering and puts forth the underrated values of the later.

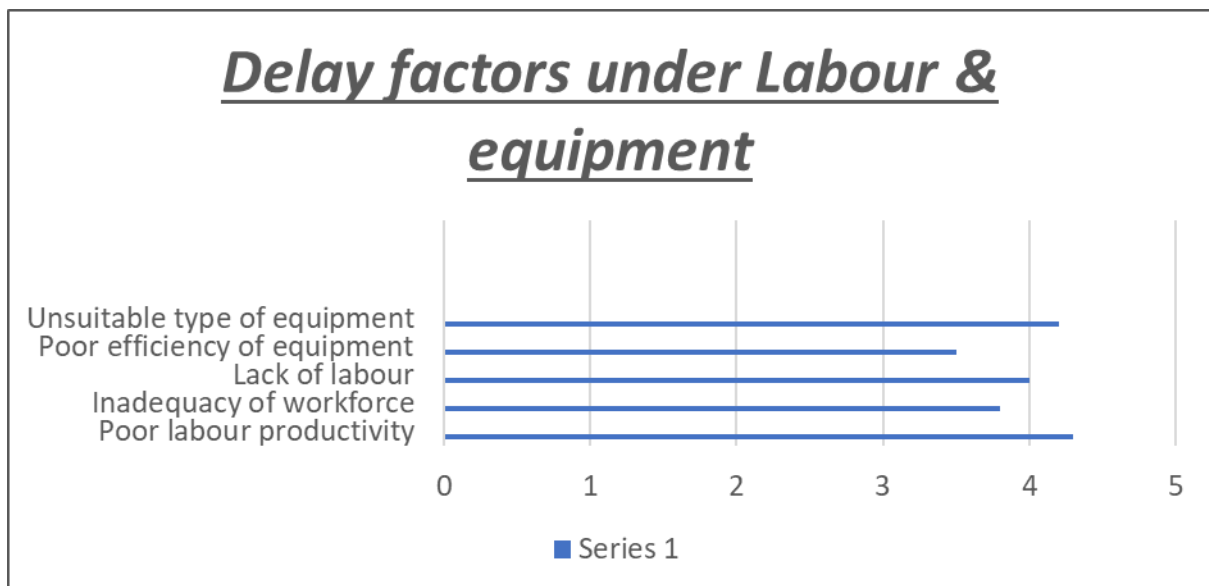
### II. ANALYSIS

#### 1.1 Factors affecting productivity:

The important factors affecting productivity highlighted in these studies are skill of labour, experience of labour, availability of materials, and labour supervision. Poor labour productivity, Inadequacy of workforce, Lack of labour, Poor efficiency of equipment, Unsuitable type of equipment.



Being one of the major contributors for the time and cost overrun, labour and equipment inadequacy factor leads to inefficient labour productivity.



**1.2 Manual plastering downside:**

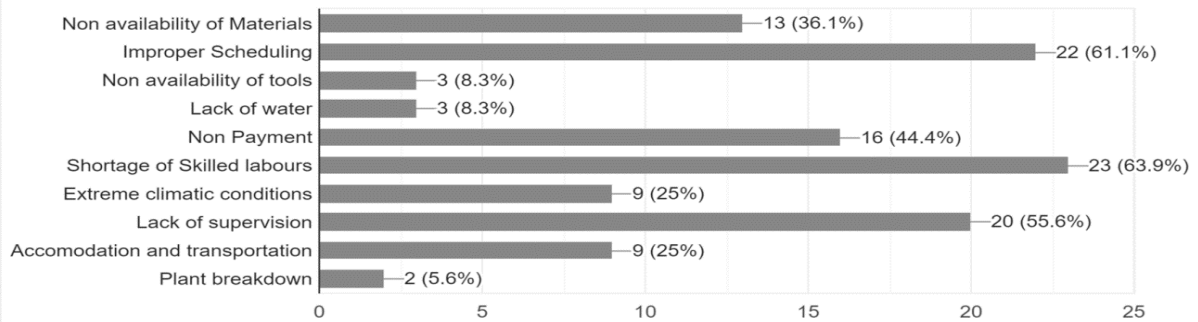
This monotonous work needs more time hence the mixture is made in small quantities to ensure it doesn't dry. Hence it increases application time. Uneven application and limitations on overall application at a single stretch. In a construction project, time and cost overrun is a common issue and categorized as a world-wide Crisis (Murray and Seif, 2013). In the study of Pai and Bharath (2013), leisurely performance of works where activities were not stopping completely, was considered as time overrun. This time overrun often results in disruption of work, low productivity, delayed projects, the cost will increase, claims of third parties, and termination of the contract. It also results in consuming long construction period (Kikwasi, 2012). This is affecting the construction cost and time. In the near future the skilled labour shortage might rise. As a result, on time project completion and quality of the project might be in chaos. Hence a study putting forward the need to allow existing machineries in construction to play vital roles instead of just employing traditional methodologies & labour usage is necessary.

**1.3 Labour shortage corroboration:**

Statistics from NSDC – (National skill development corporation). Survey statistics from FICCI – (Federation of Indian Chambers of Commerce & Industry)

8. which are these factors that majorly affects the manpower management?

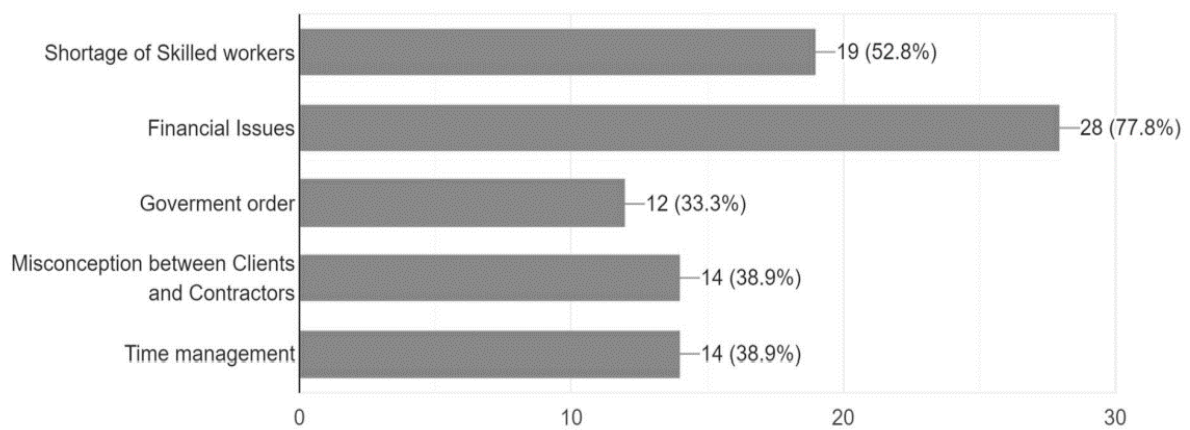
36 responses



In many places Stalled construction projects are due to lack of skilled Labours and shortage of Labours and payment delay.

16. Stalled construction projects are due to

36 responses



Many surveys conducted throughout India were identified and provided as supporting argument for the skilled labour shortage. FICCI (Federation of Indian Chambers of Commerce & Industry) Survey on Labour / Skill Shortage for Industry. (2011)

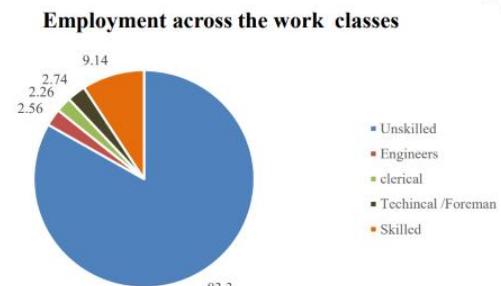
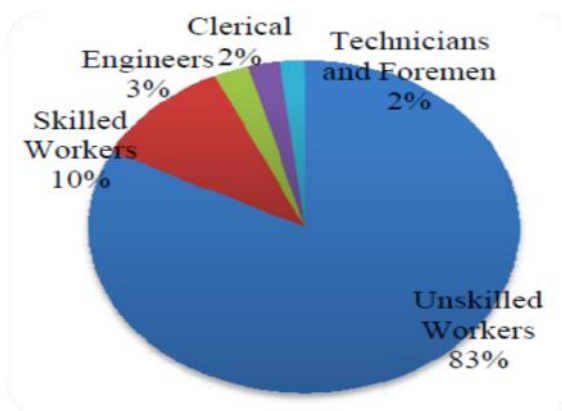


Figure 1 Percentage of skilled/Unskilled worker in the Indian construction sector

Source: (National skill development corporation, 2020)

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Figure 1 Percentage of skilled/Unskilled worker in the Indian construction sector

The state-wise scenario of construction workers from 2017-2019 can be Seen. It shows that there are 4.43 million construction workers in 2017-2018. And approx. half are registered – 2.79 million in 2017 and 2.83 million in 2019.

Most of these unskilled workers are seasonal, migrant workers from poorer agricultural states and they lack education and formal training and usually pick up skills on the job, informally from peers or supervisors, resulting in an inefficient performance on the job. Among the 10 per cent skilled construction workers, A projection identifying the Skilled labour shortage in the construction sector with supporting documents from

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## Skilled Labour shortage Data – Tamil Nadu



NSDC five year plan (2007-2012)  
- PLFS (2017-2018)

NSDC – National Skill development corporation, (Gov. org.) PLFS - Periodic Labour Force Survey (Gov. org.)  
The Indian construction sector is poised to relieve the economy after the COVID-19, but the input resources like shortage of skilled labor will be very challenging to match with the demand during the recovery period.

The factor like migrant labor, and health & safety factor has triggered the demand of the construction worker even more, and the positive impact of the COVID-19 is that has triggered the decade of digitalization & automation required in the construction sector within the past year.

The construction industry, because of its unique nature, requires high level skilled capacity to fulfil the requirements. The paper speaks with the statistics making it feasible to be considered for studying the skilled labour shortage impact analysis.



### 1.4 SEMI-AUTOMATED MACHINE USAGE FOR PLASTERING:

Plastering is the term used to describe the material spread over the surface of irregular and coarse textured wall, column, and ceiling to provide a smooth, hard and leveled finish which can be painted for good appearance. In actual „Plastering“ is an art, truly recognized for constructing the base. It refers to the construction done with plaster which includes a layer of plaster on an interior wall or plaster decorative moldings done on ceilings or walls. The process of creating plasterwork is called „Plastering“.

Site studied Plastering machine specifications:



**PLASTERING MACHINE Specifications:**

The machine provides:

- wide cover of - 2’-6”
- Heights covered -9’-0”, 10’-0”,11’-0”
- Plasters 200 sq.ft to 300 sq.ft area in 1 hour.
- Plastering thickness ranges from 5mm to 20mm.
- The machine requires 21 days time for production.

**Machine Fitting & operation:**

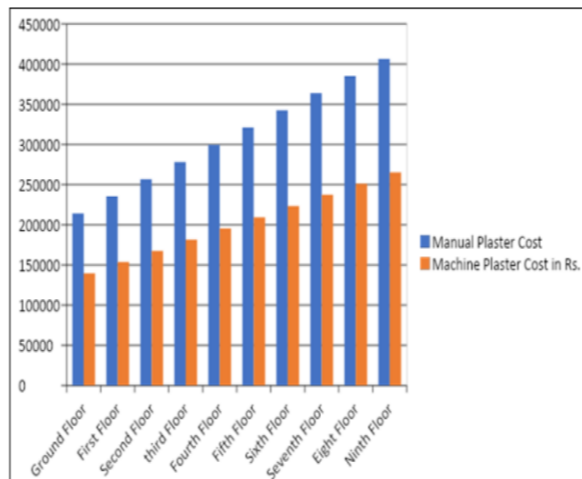
- The machine is mounted in between the floor height in order to have stability while the process takes place.
- For even distribution of plaster the machine generates vibration hence resulting in slightly high background Noise.
- Due to the accuracy resulted from mounted work process the finish is seamless providing 0 notice on joints.
- The machine is fixed at a 90’(degree( setting angle )
- The machine plastering process uses 2 SKILLED LABOUR & 2 UNSKILLED LABOUR.
- The machine can be transported using 4-5 members and requires clean premises to operate.

**Cost and maintenance:**

- The machine costs – 4,60,000 INR
- The machine rent is around 10 – 20 INR per sq.ft
- The machine uses a 1Hp DC motor.
- The machine uses only 3-5 Units of electricity per day.
- The everyday maintenance cost is around 20 INR.
- The machine is x4 times faster compared to the conventional plastering method.

**1.5 NET CASE STUDY – 1 - Plastering in Staff Quarter Residential Building. Staff Quarter Multi storey Residential Building (G+4) Building contains:**

Residential Multi story Building G+9	Manual Plaster Cost	Machine Plaster Cost in Rs.
Ground Floor	214015	139575
First Floor	235416.5	153532.5
Second Floor	256818	167490
third Floor	278219.5	181447.5
Fourth Floor	299621	195405
Fifth Floor	321022.5	209362.5
Sixth Floor	342424	223320
Seventh Floor	363825.5	237277.5
Eight Floor	385227	251235
Ninth Floor	406628.5	265192.5



**INFERENCE:**

The projected data in the above study clearly distinguishes the cost between manual plastering and semi-Automated machine plastering stating the cost of semi-automated robotic machinery usage to be nearly half of what manual plastering costs.

With calculation of various cost components for the plastering in both manual method and machine method the data has been projected for 9 floors of the building and clearly states the semi-automated machine plastering usage to be cost efficient.



### 1.6 NET CASE STUDY -2

comparative analysis of the technical and economic indicators of production technologies plastering works for A typical project of 12-storey brick-monolithic building was carried out.

Plastering work using manual way	Plastering work using the mechanized way
Main stages of the process of the manual plastering works (of walls and partitions, ceilings):	Main stages in the production process operations using plastering machines PFT (walls, partitions, ceilings)
Surface Preparation: Clean the surface, priming the surface, installing beacons for vertical surfaces, protective corners on the outer corners, windows and doorways.	Surface Preparation: Clean the surface, priming the surface, installing beacons for vertical surfaces, protective corners on the outer corners, windows and doorways.
Preparation of the mortar.	Preparing and applying plastering machines PFT: preparation of the machine to work, applying machine for cover surface using mixes.
Plastering of surfaces: application of the mortar, leveling, cutting irregularities.	Alignment of the mix and truncation of irregularities.
Preparation for finishing: surface structuring (if necessary), the grout of the surface, smoothing the surface, the second surface smoothing (for high quality coloring).	Preparation for finishing: surface structuring (if necessary), the grout of the surface, smoothing the surface, the second surface smoothing (for high quality coloring).

#### INFERENCE:

The Above study completely states the difference in cost and time percentage after comparatively analyzing both the method usage for a 12 storey building.

The study was between three considerations of plastering manual type without lifts, manual using lifts and loader, using the full mechanization of PFT. And overall 44.25% shortening of time in walls and partitions work and 35.17% shortening of time in ceiling work.

Semi-Automated Machine Method	Conventional Method
<b>Work efficiency</b> – 600 Sq.m per day	Varying working efficiency depending on the worker
<b>Speed</b> – 1 machine = 16 Labours	Low to moderate depending upon the worker
<b>Operator</b> – 2 No’s	High human cost
<b>Efficiency</b> – High (4 sqm can be plastered in 1 min)	Less
<b>Finish</b> - Smooth	The finish is less smooth compared to machine.

### 1.7 NET CASE STUDY – 3

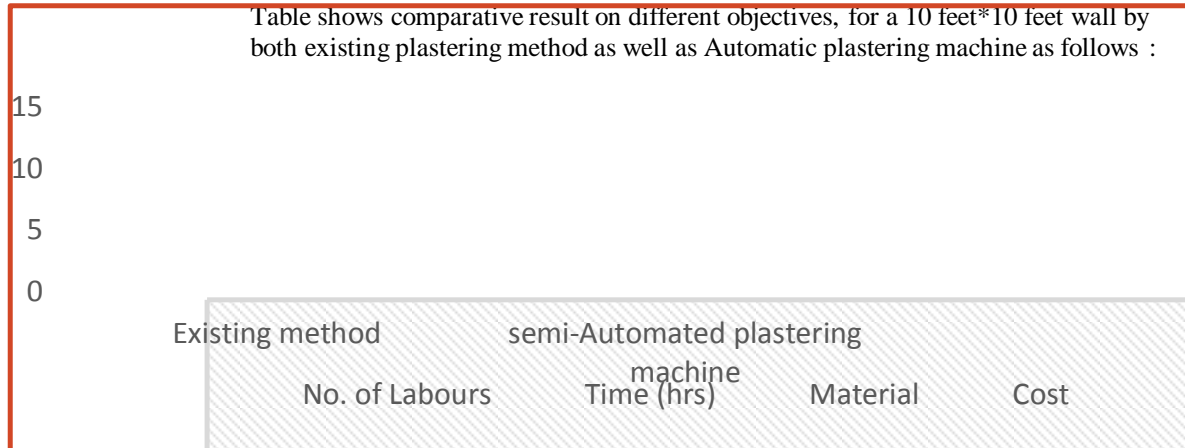
2018 - facade renovation of «Valteri - Centre for Learning and Consulting», Tehnolantie 15, Helsinki, Finland.

	Manual Labour Work completion	Machine Work completion
Time	6 months to complete renovation of façade.	½ Of Manual time consumption

Labours	3 sub-contractors working, scaffolding company (2-4 workers), demolition company (6 workers), plastering and printing company (6 workers), - IN TOTAL 16 construction workers	2 to 3 No’s
Efficiency	LESS COMPARED TO MACHINE WORK. The scaffolding team (2 people) could lift and install 1000 – 2500 kg of metal parts in eight hours shift, the demolition worker take away 100-250 m2 of old façade using a hammer-drilling tool, the plastering team (3 people) does 200-300 m2 of plaster per eight hours and spends 5000-6000 kg of mixture.	HIGH COMPARED TO CONVENTIONAL WORK. Robotics usage increase efficiency, productivity and quality of work on sites, as a result profits of construction industry are increasing.

*“Overcoming The Shortage of Skilled Labours for Plastering by Using Machineries in ..*

	Since the work is done outside, the weather plays a huge role in efficiency. so that the progress of completing the tasks slows down..	
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Parameter	Net case study -1		Net case study – 2		Net case study - 3	
Project Title	Veeta Day Factory UPSIDC Barabanki, 2021		Study from the article – <u>Using plastering machines to improve the efficiency of finishing works</u>		facade renovation of «Valteri - Centre for Learning and Consulting», 2018	
Location	Uttar pradesh, India		USA		Helsinki, Finland	
Area covered	83,745 sq.ft (7780 Sq.m)		17,925 sq.ft (1665.3 Sq.m) Walls, partitions & ceilings		32,291 sq.ft (3000 Sq.m) Façade renovation	
	Manual method	Machine method	Manual method	Machine method	Manual method	Machine method
No. of Labours	6 to 8 No's	3 No's	6 to 8 No's	2 to 3 No's	6 No's	2 to 3 No's
Time consumed	6.9 Months	3 Months	21 Months	10 Months	6 months	Est. ½ of Manual method
Cost covered	31 Lakhs INR (31,03,217.5 Rs)	20 Lakhs INR (20,23,837.5 Rs)	461,321.4 USD (3 CRORE INR)	261,119.82 USD (1.9 CRORE INR)	125,000 Euros (1 Crore INR)	38016 Euros (31 Lakhs INR) Exc. Machine buy cost
Difference in cost	10 Lakhs (10,79,380.0)		200,201.58 USD (1 CRORE INR )		86,984 Euros (69 Lakhs INR)	
Machine Type	Spraying type		Slanding type		Spraying type / Slanding type	
Units consumed	-	3-5 Units/day	-	5-6 Units/day	-	5-6 Units/day
No of floors	9 STOREY		12 STOREY		5 STOREY	

**III. SITE STUDY & PROPOSAL**

Creating a Function M-File Using the above information, the following m.file can be created in MATLAB in which:

**SITE SELECTION:**

The site chosen for proposal for Individual villas and in house school in SPR city.

Location – (Binny Mills) Perambur, Chennai

Area of wall – More than 10,000 Sq.m

Total no of villas considered – 54 No's

**GROUND FLOOR DIMENSION:**

Size of SITOUT - 3.8M x 4.0M, Size of LIVING ROOM - 5.8M x 6.2M, Size of COURTYARD- 4.0M x 3.0M, Size of PUJA ROOM- 1.2M x 3.0M, Size of DINING ROOM - 5.8M x 4.0M, Size of KITCHEN- 4.5M x 4.1M, Size of UTILITY - 3.4M x 3.0M, Size of BEDROOM- 4.5M x 4.4M, Size of TOILET- 2.8M x 1.5M

Total area of plastering in ground floor excluding ceiling –  
 $[389.8 + 617 + 106 + 190.2 + 492.5 + 518.1 + 411.4 + 286.4 + 674.1 = 3685.5 \text{ sq.ft}]$

**FIRST FLOOR DIMENSIONS:**

Size of BALCONY- 1.7M x 6.7M, Size of COURTYARD - 4.0M x 3.0M, Size of Living Double height- 3.9M x 6.1M, Size of BEDROOM - 4.2M x 4.0M, Size of TOILET - 2.8M x 1.5M , Size of HOME THEATRE- 3.8M x 3.8M, Size of BEDROOM - 4.2M x 5.8M, Size of TOILET- 2.8M x 1.5M, Size of BEDROOM- 4.5M x 4.4M

Total area of plastering in ground floor -  
 $[389.8 + 617 + 106 + 190.2 + 492.5 + 518.1 + 411.4 + 286.4 + 674.1 = 3685 \text{ sq.ft}]$

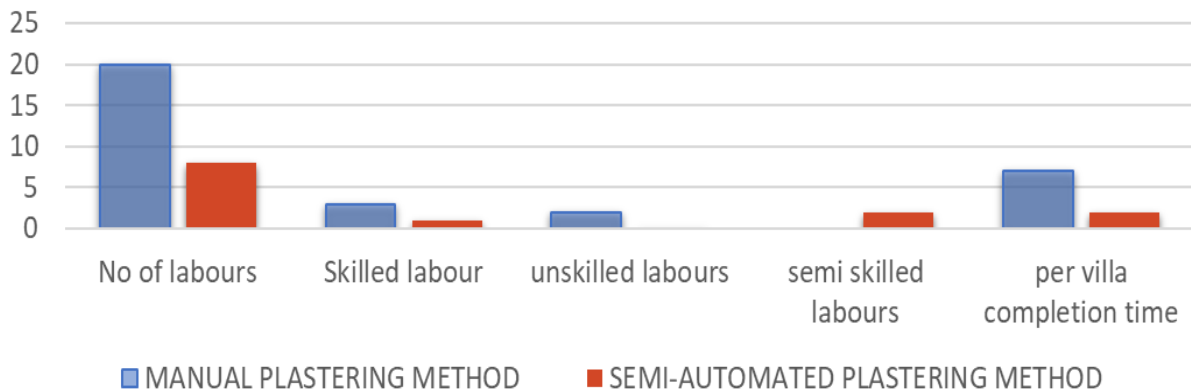
Total area of plastering in First floor -  
 $[246.9 + 390 + 504 + 673.1 + 286.4 + 504.1 + 728.4 + 286.4 + 674.1 + 286.4 = 4579 \text{ sq.ft}]$

Manual plastering method	Semi-Automated Machine plastering Method
No of Labours required in total : <u>20 No's</u> - 1 Team = 4 set - 1 Set = = 3 No's -- Skilled Labour = 2 No's -- Unskilled Labour	No of Labours required in total : <u>8 No's</u> - 1 Set = 4 Labours (x2 ) = 1 No -- Skilled Labour = 1 No -- Unskilled Labour = 2 No's -- Semi-skilled Labour
No of days required : <u>189 days</u> (7 days for a single villa using 2 sets of labours)	No of days required : <u>40 days</u> (1.5 days for a single villa )
Total cost for 54 villas : <u>52,92,000 Rs</u>	Total cost for 54 villas : <u>17,61,000 Rs</u>

**CONCLUSION:**

Difference arrived comparing both the methods; Labours – 12 No's less than manual plastering method requirement. Days – 149 days less than manual plastering method's consumption. Cost – 35,31,000 Rs less than manual plastering method cost.

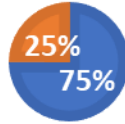
**Manual & semi-automated plastering methods comparison**





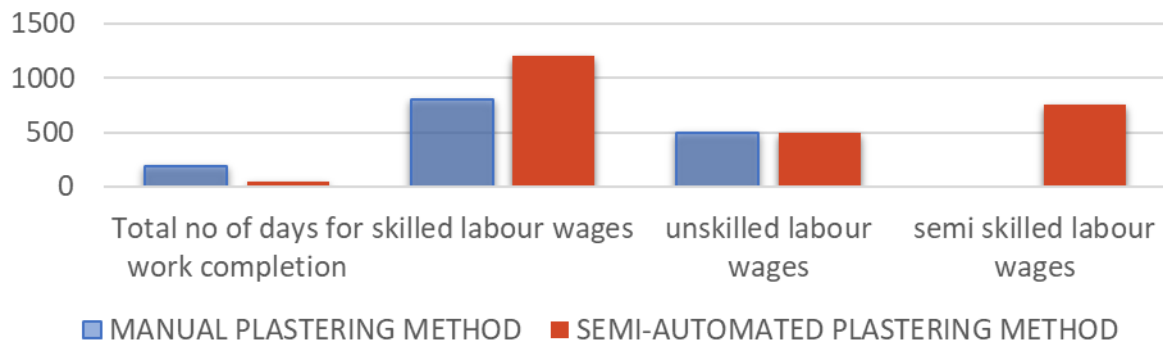
## COST

■ Manual cost in Rs    ■ Semi-automated cost in Rs



Manual cost	-52,92,000 Rs
Semi-automated cost	-17,61,000 Rs

### Manual & semi-automated plastering methods comparison



Stating Proposal of a device used for High Precision cement Moisture Analyzer. High Precision cement Moisture Analyzer - the PMS710 Digital Soil Moisture Meter 0-50% High Precision Soil Hygrometer to Test Cement (Sensor Tool) can be used for proper checks of moisture content and hence prove useful.

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