# OPTIMIZAION OF RESOURCE USAGE AMONG PRECAST AND THE CONVENTIONAL CONSTRUCTION TECHNIQUES

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ABSTRACT – Different construction technique helps to complete the project earlier but it may be costlier and other construction technique the project can be completed with a reduced cost and increased time duration. The main aim is to evaluate precast and conventional construction techniques used in the recent construction industry based on the knowing the cost and time for the four different cases which is to be considered in the project. Time and Cost data are collected for the four different cases based the values got the data table is formed. From the data's collected the analysis is to be done by using the Earned value analysis method to find the earned value percentage for cost and time of the construction project for the different cases and sub-cases considered in the project. The mathematical equation is to be generated from the Earned Value percentage found for each case. By which the separate Equation for cost and time for different cases is generated. Graph is plotted from the equations generated. This will be helpful for each construction firm to know the cost and time of construction of residential building by constructing different components of the structure using precast construction technique. The suggestions are given for the use of precast construction technique in the construction of the residential building.

## INTRODUCTION:

Precast construction technique is one of the modern construction techniques which are being used widely now days in various parts of our country. It has its own advantages and disadvantages. The time of construction can be reduced, comfortable, safe, versatile, healthy, optimized and durable. Some of the disadvantages caused while using precast construction technique is its costlier when used for small projects, requires space, heavy equipment's, proper transportation. Now a days construction of the residential buildings for a large scale project are done using precast construction technique, mainly the government projects done by Slum clearance board, Housing boards etc. But precast construction technique is not preferred by most of the construction companies all around are country.

## OBJECTIVES:

1. To optimize the cost and time in the construction of building by using alternative construction technique.
2. To generate mathematical equation.
3. To suggest an optimum solution.

## LITERATURE REVIEW:

Different journals presented by different authors gave various opinions about the precast construction technique and the other optimizing techniques. The ongoing situation of the precast construction industry in India was studied by N.Dinesh kumar, P.Kathirvel(2015) . The effective cost for the single multi storey residential using precast construction technique was given in

comparison with cast in situ construction technique. The cost of double storey building which was constructed by precast construction technique was 13% higher than that of the same building constructed by conventional construction technique. Vice versa the duration of construction of the double storey building by precast construction technique 63 days lesser than the conventional construction technique.

The comparison is done between the precast and the conventional construction technique for the existing school building at Thanjavur, Tamilnadu by C.Sivapriya and S.Senthilkumar(2016). The total area of construction is 18880sq.m. Number of storey is G+7. The components considered in the project are 1.Wall panels, 2.Columns, 3.Beams, 4.Hallow slabs. Cost for the mold, erection and the finishing process is known and the final analysis is done. In this project the cost of the project is reduced to 20% by using precast construction technique than the conventional construction technique.

From this it is known that when the size of the project is less the cost increases while using precast construction technique which is reduced when the size of the project is greater but the duration remains the same. The duration of the project is less always whether the project is a small scale or the large scale project.

## METHODOLOGY:

The chapter will define the methods used to conduct the research. This chapter will include information about how the data were collected and how they are standardized for the hypothesis. In the addition data analysis procedures will be provided.
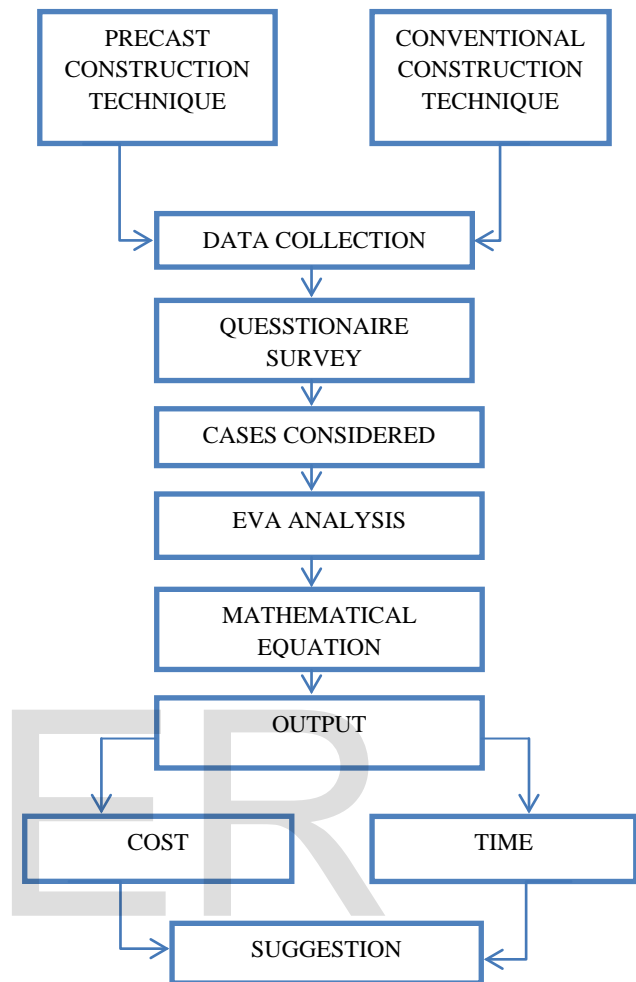


## DATA COLLECTION:

The cost and the duration details for the precast and the conventional construction technique are collected from the different construction firms. From the data's know the advantages and the disadvantages of both the construction technique are found out. Various difficulties faced while using conventional construction technique and how it is resolved by using precast construction technique are known.

## QUESSTIONAIRE SURVEY:

Further data's are collected using the questionnaire survey. The preferences from various expect about the precast and the conventional construction technique is known. Totally 30 samples were collected. From which some of the data are collected from the Theoretical experts and the other half of the ample are got from the Practical experts. Their opinions were greatly varied. The theoretical experts prefer precast construction technique while others prefer mainly conventional. But some are sure that the precast construction technique is the future upcoming technique which is going to be used all over the country.

Totally 19 questions were asked based on the factors considered in the precast construction technique, mainly the cost, time, aesthetics etc.

| No of Questions | Strongly Agree | Agree | Undecided | Disagree | StronglyDisagree | |
|---|---|---|---|---|---|---|
| | 100% | 75% | 50% | 25% | 0% | |
| 1 | 6 | 14 | 2 | 7 | 1 | 30 |
| 2 | 8 | 18 | | 4 | | 30 |
| 3 | 6 | 15 | 5 | 4 | | 30 |
| 4 | 2 | 14 | 3 | 11 | | 30 |
| 5 | 4 | 12 | 6 | 8 | | 30 |
| 6 | 2 | 11 | 4 | 13 | | 30 |
| 7 | 4 | 16 | 3 | 6 | 1 | 30 |
| 8 | 3 | 14 | 5 | 7 | 1 | 30 |
| 9 | 8 | 17 | 2 | 3 | | 30 |
| 10 | 3 | 17 | 5 | 3 | 2 | 30 |
| 11 | 3 | 16 | 3 | 6 | 2 | 30 |
| 12 | 5 | 8 | 7 | 9 | 1 | 30 |
| 13 | 3 | 9 | 6 | 12 | | 30 |
| 14 | | 9 | 8 | 13 | | 30 |
| 15 | 4 | 15 | 3 | 8 | | 30 |
| 16 | 4 | 14 | 4 | 7 | 1 | 30 |
| 17 | 4 | 13 | 4 | 8 | 1 | 30 |
| 18 | 8 | 15 | 2 | 5 | | 30 |
| 19 | 3 | 14 | 5 | 8 | | 30 |
| Average | 4 | 14 | 4 | 7 | 1 | |
| Percentage | 13% | 46% | 13% | 25% | 3% | 100% |

**Table 1 Percentage Representation**

Based on the percentage the preference for the precast construction technique is known.

| USAGE OF PRECAST CONSTRUCTION TECHNIQUE | | | | |
|---|---|---|---|---|
| SA | Agree | Undecided | Disagree | SD |
| 100% | 75% | 50% | 25% | 0% |

| 13% | 46% | 13% | 25% | 3% |
|---|---|---|---|---|

46% agree to use the precast construction technique but doesn't use the precast construction in their site. Only 13% of companies precast construction in their site. Other 13% doesn't have any idea about the precast construction technique. 25% sticks on to the conventional construction technique. The last 3% never want to use the precast construction technique.

## EXISTING PLAN:
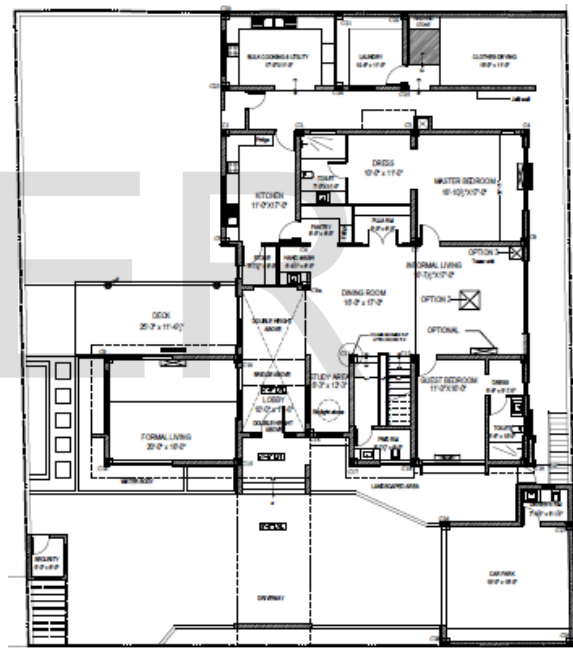


## CASES CONSIDERED:

The project is to be done considering the real time residential construction project. The four cases are taken into consideration followed by the sub-cases.

**CASE I (C$_1$)**       **:** Considering 3 floors

**CASE II (C$_2$)**      **:** Considering 5 floors

**CASE III (C$_3$)**    **:** Considering 7 floors

**CASE IV (C$_4$)**    **:** Considering 9 floors

The sub cases considered in the project are

**SUB-CASE I (SC$_0$)**   **:** No Changes

**SUB-CASE II (SC$_1$)**   **:** Changing beam and column into   precast

**SUB-CASE  III  (SC$_2$):** Changing beam, column and slab into precast

**SUB-CASE  IV  (SC$_3$):** Changing beam, column, slab and wall into precast

**SUB-CASE V (SC$_5$)**   **:**  Modular Structure

Time and Cost data are collected for the four different cases based the values got the data table is formed. Separate data tables are used to enter the time and the cost.
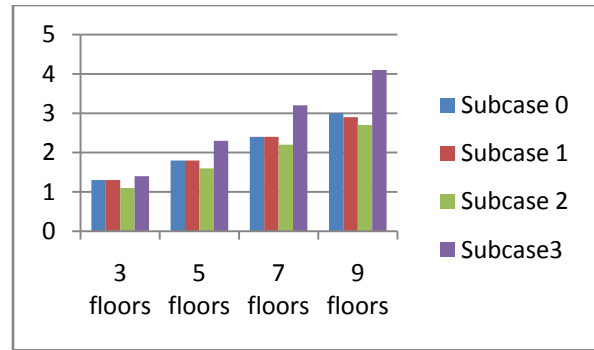


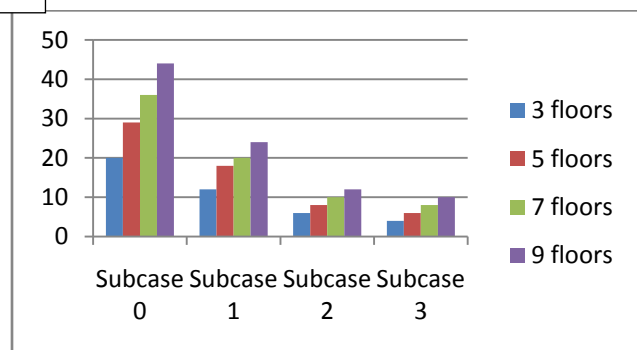**CHART 1: COST DIFFERENCE**

**X Axis - No's of floors**

**Y Axis – Cost in Crores**

| SUB-CASES | | | | | |
|---|---|---|---|---|---|
| | SC$_0$ | SC$_1$ | SC$_2$ | SC$_3$ | SC$_4$ |
| C$_1$ | 1yr8m | 1yr | 6m | 4m15d | |
| C$_2$ | 2yr5m | 1yr6m | 8m10d | 7 m | |
| C$_3$ | 3yr | 1yr8m | 10m | 8m18d | |
| C$_4$ | 3yr8m | 2yrs | 1yr | 10m | |

**TABLE 3: DURATION TABLE**

| SUB-CASES | | | | | |
|---|---|---|---|---|---|
| | SC$_0$ | SC$_1$ | SC$_2$ | SC$_3$ | SC$_4$ |
| C$_1$ | 1.3cr | 1.3cr | 1.1cr | 1.4cr | |
| C$_2$ | 1.8cr | 1.8cr | 1.6cr | 2.3cr | |
| C$_3$ | 2.4cr | 2.4cr | 2.2cr | 3.2cr | |
| C$_4$ | 3cr | 2.9cr | 2.7cr | 4.1cr | |

**TABLE 2: COST TABLE**

**NO OF FLOORS**



**CHART 2: TIME VARIATION**

**X Axis – Subcases**

**Y Axis – Duration in months**

**EARNED VALUE ANALYSIS:**

Cost and Time is analyzed using Earned Value Analysis. EVA is used for measuring the date of completion and cost of completion of the project. For earned value analysis the following values should be considered.

### 1). Planned Value:

Budgeted cost of work schedule.

### 2). Actual cost:

Actual cost of work performed.

### 3). Earned value:

Budgeted cost of the work performed.

These three values are combined to determine the work being accomplished as per plan. Different measures to different types of tasks. So the Earned value analysis can also be used for different construction techniques. From this analysis earned value percentage is known by which the mathematical equations are formed.

**MATHEMATICAL EQUATION:**

The mathematical Equations are generated using the Earned Value Percentage. A linear equation is created based on the cost and time values estimated and scheduled for the existing plan for the precast and the conventional construction technique. Helps to find which construction technique is efficient.

**DATA SHEET:**

Data sheets were prepared in comparison between the conventional and the precast construction technique. Based on their cost and time data's collected from the construction firms.

**GENERAL DETAILS:**

**Precast construction technique:**

| S.No | Elements | Description |
|------|----------|-------------|
| **1.** | Grade of concrete | **M35** |
| **2.** | Grade for Grout | **M40** |
| **3.** | Admixture | **CpW(Replacement to reduce water usage)** |
| | **Properties** | |
| | • Appearance | **White\Pale yellow** |
| | • Chlorine | **0.05 max** |
| | • Rate of Solution in water | **5wt\*90$Degree$** |
| | • Density | **0.89** |
| | • %Added to the weight of the cement | **0.2%to0.3%** |
| | (No need of excess curing) | |
| | • 1cum of Concrete | **200ml** |
| **4.** | Concrete\cum | **R.5000** |
| **5.** | **Machineries** | |
| | 1).Concrete vibrator(PV-2) | **Rs.15000+5000** |
| | • No | **10** |
| | 2).Table vibrator | **R.54000** |
| | • No | **1** |
| | 3).Bar bending eqp | **Rs.2.2 lakhs** |

| | | | | |
|---|---|---|---|---|
| | • No | **1** | Grouting(P) | |
| | 4).Cutting Machine | **Rs.1.75 lakhs** | Erection (P) | |
| | • Blade | **Rs.10000** | Machinery(P) | |
| | • No | **1** | | |
| | • Cuts upto | **32mm** | **4.** | Reinforcement |
| | 5).Mini Mixer (Grouting) | **Rs.40000** | | |
| | • No | **2** | **5.** | Stirrups |
| | 6).Tower Crane (1Month/Double shift 24hrs) | **Rs.2.5 lakhs** | | |
| | 7).Mobile Crane (1Month/12hrs) | **Rs.1.65 lakhs** | | |
| | 8).Hydra Crane (1Month/24hrs) | **Rs.50000** | | |

Reinforcement / Stirrups / Duration table (right column):

| SNo | Elements | Precast | Conventional |
|---|---|---|---|
| **4.** | Reinforcement | **16mmdia 20mmdia 25mmdia** | **16mmdia 20mmdia** |
| **5.** | Stirrups | **8mmdia 10mmdia @200mm Spacing (Less no of rebar due to the pipes used for grout.)** | **Same** |
| **6.** | Duration | **15 columns per day** | **Takes longer due to shuttering and curing** |

Left column continued:

| | | |
|---|---|---|
| **6.** | **Labours** | **150 Labours/day** |
| | Helper(8hrs) | **Rs.350/Labour** |
| | Mason(8hrs) | **Rs.400/Labour** |
| | Steel Fitter(8hrs) | **Rs.400/Labour** |
| | Carpenter(8hrs) | **Rs.400/Labour** |
| | Operator(8hrs) | **Rs.500/Labour** |

**COLUMN:**

| SNo | Elements | Precast | Conventional |
|---|---|---|---|
| 1. | Grade of Concrete | **M35** | **M25** |
| 2. | Size of column | **0.45*0.23** | **0.45*0.23** |
| 3. | **Rate per cum** Concrete Labour Steel Shuttering Handling Corrugated pipe(P) | **Rs.28880** | **Rs.12350** |

**BEAM:**

| SNo | Elements | Precast | Conventional |
|---|---|---|---|
| 1. | Grade of Concrete | **M35** | **M25** |
| 2. | Size of Beam | **0.23*0.45** | **0.23*0.45** |
| 3. | **Rate per cum** Concrete Labour Steel Shuttering Handling Corrugated pipe(P) Grouting(P) Erection (P) | **Rs.22475** | **Rs.15000** |

| | | | |
|---|---|---|---|
| | Machinery(P) | | |
| 4. | Reinforcement | 20mmdia 25mmdia | Same |
| 5. | Duration | 4 to 5 Beams per day | Takes longer due to shuttering and curing |

**SLAB:**

| SNo | Elements | Precast | Conventional |
|---|---|---|---|
| 1. | Grade of Concrete | M35 | M25 |
| 2. | **Rate per cum** Concrete Labour Steel Shuttering Handling Corrugated pipe(P) Grouting(P) Erection (P) Machinery(P) | Rs.18000 | Rs.14000 |
| 3. | Topping concrete | **Rs.9000** | Not required |
| 4. | Duration | 4 to 5 Beams per day | Takes longer due to shuttering and curing takes more than 30 Days |

**WALL:**

| SNo | Elements | Precast | Conventional |
|---|---|---|---|
| 1. | Grade of Concrete | M35 | M25 |
| 2. | **Rate per cum** | Rs.20500 | Rs.3661 |
| 3. | Duration | 15 walls per day | Takes a long time |

**CONCLUSION:**

The cost details has been estimated for each and every cases that are taken into account and the difference in cost and time between the precast and the conventional construction technique are found out. Further the analysis is to be done with the data's collected and estimated with the help of the existing plan. And the mathematical equation will be generated to give an optimized solution in order to use the precast construction in all the construction projects.

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