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## Estimation Model on Facade in High-Rise Building

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**Abstract:** As we are aware with the increasingly competitive market in the construction industries due upcoming speedy and efficient techniques construction personnel have to be more careful in all their decisions. Many existing studies show schedule management focus on the planning stage particularly on schedule estimate based on labor and equipment resources. For this study, the facade was selected because of its importance in construction activity in terms of schedule estimation for high-rise construction. To develop a schedule estimation model for the facade, an in-depth case study was conducted. Results of case study have then used in Monte Carlo Simulation. Finally, by using the results of the simulation, a schedule estimation model for facade construction will be developed conducting multiple regression analysis. This developed model will help the project managers to easily, quickly and accurately perform schedule estimation when a problem occurs that may cause construction delay and time extension.

**Keywords:** Construction Management, Façade, Scheduling, Multiple Regression.

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### I INTRODUCTION

Indian cities are witnessing immense demographic expansion due to migration from surrounding villages leading to urban sprawl, housing demands, rise in the cost of land. Many citizens all over India migrate to the cities for better jobs and education. With an urban sprawl of kilometers, these face the problems of congestion, pollution, every day commuting to work place, competition, deforestation etc. In India, a building greater than 75ft (23m), generally 7 To10 stories are considered as high-rise. Also, a building is considered to be high-rise when it extends higher than the maximum reach available to firefighters. According to the building code of India, a tall building is one with four floors or more or a high-rise building is one 15 meters or more in height. Most of the tall buildings in India are in commercial capital Mumbai.

Comparing to other industries, more time and effort are required to establish project plans in the construction Industry. Moreover, when dealing with new projects such as high-rise buildings, the application of new technologies, lack of experience on the part of managers, and insufficient previous data make it more difficult to determine project durations. In labor driven scheduling lack of labors or unavailability of labors may cause a delay in a construction project. Therefore, it is necessary to make an estimation of resources on timely basis

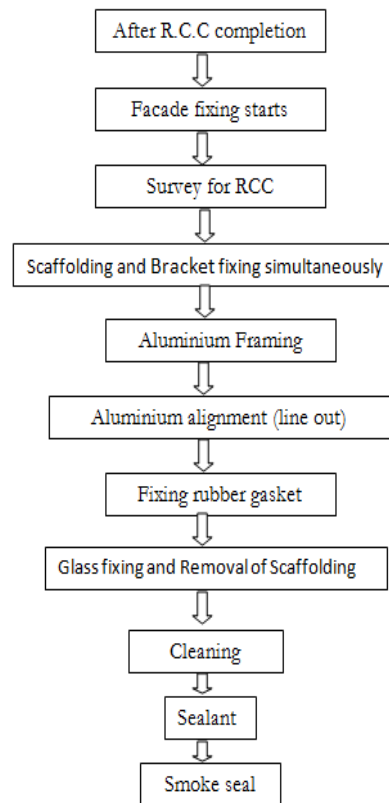
### II IMPORTANCE

During the construction phase, a construction project often faces problems that were not anticipated in the planning phase (i.e. weather, soil conditions, a labor strike, or the owner's financial instability). Because such unexpected circumstances can have a huge impact on the construction schedule, a schedule estimation method is needed that allows construction project managers to prepare for such unexpected occurrences in the construction phase. Many previous studies on construction schedule estimation have aimed at predicting and adjusting the duration of the construction in the project-planning key issues: (1) the labor resource-driven scheduling method, and (2) optimization scheduling and resource utilization. As a result, researchers have proposed various methodologies that can help improve labor availability and work continuity

### III FACADE

Facade of any building defines the architectural appearance of the building provides the view to the inside and outside of building also absorbs push and pull forces from the wind loads, bears its own weight as well as of another component of the building. The building facade allows sunlight to penetrate into the building while providing protection from the sun at the same time. It also

resists against rainwater and also handles humidity. Materials used for facade depend upon design plan, government approvals & availability. The construction process of the facade is as follows:



**Fig 1: Construction process of Façade**

#### **IV OBJECTIVES**

1. Preparation of easy operating schedule estimation model
1. To measure the strength of relationship between two variables
2. To study relationship between parameters affecting the scheduling of facade and showing its association
3. To apply Monte Carlo Simulation
4. To apply multiple regression analysis
5. Prediction and estimation of one dependent variable by knowing the two independent variables

#### **V MULTIPLE REGRESSION ANALYSIS**

A multiple regression models widely used and easy to operate is developed. Multiple regression is the average relationship between a dependent variable and two or more independent variable it analysis relation between dependent variables and several independent variables and then its effect on each other through available data. The correlation coefficient is used to measure the strength of the relationship between two variables. A positive value of correlation coefficient shows that the movements of variables are in the same direction. A negative value of correlation coefficient shows that the movements of the variable in opposite direction. Correlation coefficient lies between +1 to -1. Partial correlation is the degree of relationship between dependent variable and one particular independent variable keeping other constant. Prediction and Estimation of likely values of one variable for specified values of the other are done by using Regression equations.

#### **VI METHODOLOGY**

1. The site at World Trade Centre has been visited.
2. Data related to resource and duration has been collected from the site for phase 1, phase 2, phase 3.
3. Multiple regression was carried on the acquired data then to improve, more data was to be generated.
4. To acquire more data Monte-Carlo Simulation has been developed.
5. The data acquired from simulation has used for correlation and regression.
6. The correlation coefficient of all data has been carried out and checked for its strength and association.
7. Regression equation can be obtained for prediction and estimation of dependent variable by knowing independent variable

#### **VII ANALYSIS**

For analysis purpose data has been collected from World Trade Centre Kharadi as provided in the table. By using the data provided and applying the formula of correlation and regression following has been estimated:

- Correlation coefficient
- Partial correlation

- Regression equations

• Table 1: Data collection from Site

WTC	Area m <sup>2</sup>	Labors (no)	Duration (months)
Phase 1	18580	70	4
Phase 2	111483.65	100	18
Phase 3	15000	50	12

Monte Carlo Simulation

It is a method of simulation by sampling technique. The steps involved in carrying out Monte Carlo Simulation are:

1. Select the measure of objective function of the problem whether it is to be minimized or maximized
2. Identify the variables that affect the measure of effectiveness
3. Determine cumulative probability distribution of each variable selected in step 2. Plot this distribution with values of variables along x-axis and cumulative probability along y axis
4. Get a set of random numbers
5. Consider a random number as a decimal value of the cumulative probability distribution. Enter the cumulative distribution plot along the y axis. Project the point of intersection down on x axis
6. Record the values generated in step 5. Substitute in the formula chosen for measure of effectiveness and find its simulated value
7. Repeat steps 5 and 6 until sample is large enough
8. 100 runs have been carried out to obtain 100 data. These data will further be evaluated in correlation and regression Sample reading from Monte Carlo Simulation.

Table 2: Sample reading from Monte Carlo simulation

AREA	LABORS	DURATION
45000	90	-4
45000	90	-4
135000	30	24
45000	60	18
-45000	100	10
45000	70	10
45000	80	-2
45000	70	24
45000	90	-2
45000	60	4
45000	90	-4
45000	40	4
45000	90	18
45000	70	10
45000	80	11
-45000	120	-2
135000	40	10
135000	30	24
45000	70	16
135000	40	16

**VIII RESULTS**

Results obtained analysis are as follows:

I

Correlation coefficient	0.930	0.0803	0.528
Partial correlation coefficient	1	1	-0.99

Table 3: Results obtained by applying Monte Carlo

II

Correlation coefficient	-0.2442	0.0537	-0.54
Partial correlation coefficient	-0.257	-0.095	-0.546

Table 4: Results on generated data from Monte Carlo

Regression equation:

$$X_1 = a + b_{12.3} * X_2 + b_{13.2} * X_3$$

Where,  $b_{12.3} = (r_{12} - r_{13} * r_{23} / 1 - r_{23}^2) * (s_1 / s_2)$

$$b_{13.2} = (r_{13} - r_{12} * r_{23} / 1 - r_{23}^2) * (s_1 / s_3)$$

a,  $b_{12.3}$ ,  $b_{13.2}$ - constant

- Regression equation obtained
- $X_1 = 0.702 * 17783.27 * (X_2) + 0.433 * 63711.92 * (X_3)$
- $X_2 = -1.62 * 3.58 * (X_3) + 3.75 * 5.6 * 10^{-5} * (X_1)$
- $X_3 = 0.8787 * 1.57 * 10^{-5} * (X_1) + (0.616) * 0.28 * (X_2)$
- These equations can be used to predict the values such Area, Labors, Duration

**CONCLUSION**

Facade fixing must be done to start with finishing activities and avoid financial lock up. According to this study to avoid delay and shortage of resources this model can be used to evaluate the resources required at the moments of delay and keep up the work going smoothly and in a speedy manner.

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