

Cost Control & Cost Analysis of Residential Building

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Abstract—The study has been carried out by analysing the rates of the various structural elements based on the basic rates of raw material in present scenario. The various members of Building Construction Management such as Concrete, Reinforcement, Shuttering, Full Brick Bat Work, Half Brick Bat and Plaster were analysed based on the DSR and DAR.

The analysed rate were converted into Per Square feet based Rate Analysis by multiplying it with respective factor coefficients for example the coefficient of Concrete is .031 Cum/ Square feet, Reinforcement 4.9 Kg/Sft, Shuttering is 2.4 Sqm/Sft, Full Brick Masonry is .001Cum/Sft, Half Brick Bat is .025 Sqm/Sft, Internal Plaster 2.9 Sft/Sft, which results in directly computing the cost of project.

The cost of project was computed based on the Covered Area Rate Analysis method. In this method the computed rate was directly multiplied by the area of the floor. The Work done can be calculated by bifurcating the percentage of the release of the payment with respect to total cost of the project which resulted in creating a Budget of G+10 Storeys residential building. The budget was created on the theory of per floor slab estimation. The created cost per floor of Building was allocated in Primavera along with the Schedule of G+10 Storey Building. The same was used to create Monthly Spending Plan so as to monitor and minimize the cost of Building.

Keywords: Cost, Rate Analysis, Budget, Cash Flow (Monthly Spending Plan)

1. INTRODUCTION

Cost and Rate Analysis are the key segments in the field of Civil Construction Projects. The cost of any construction project includes the Personnel Cost – Salary & Wages; Employee Benefits; Equipment – Lease and Depreciation; Maintenance Contracts; Raw Material – Coarse Sand, Fine sand, aggregate 10 mm, Aggregate 20 mm, Bricks etc; Travel and Professional Trainings; Software annual amounts.

So, the total cost of the project basically comprises of two elements namely Fixed Cost and Variable Cost.

Fixed Cost basically includes Salaries, Employee Benefits, Equipment Maintenance Cost etc while on other hand the Variable Cost includes hourly wages, Outside Services like Raw material Supply rates.

This study will help the Project Managers, Planning Engineers to effectively manage the cost risk impacts of all project changes, and to complete the project within the project constraints regardless of any changes. The project manager is accountable to estimate the budget needed to finish project activities.

The aim of this text is so to see the subsequent aspects regarding the Estimating the Value of the Project.

1. Minimising the Value of Project while not compromising the schedule of the project.
2. Preparing the Cash Flow so as to directly highlight the irrelevant additional cost.

Monitoring and controlling the project budget ensures that only the appropriate project changes are included in the budget baseline, that information about authorized changes are communicated and corrective actions are taken by those In charge/Project Manager.

Cost management deals with the management of the costs of project resources. It includes the effective implementation of cost management process including estimating, planning, budgeting, monitoring and controlling cost with the objectives of project completion within the approved budgets and authorized variations. As we all know that before undertaking/ tendering any project it is necessary to calculate the probable value, as a result of the client one UN agency approaches for any project can raise probable value in order that they'll check whether or not the entire value lies in their budget.

During any construction process every Contractor or Project Manager of the project needs to compare actual cost and expenses against the forecasted budget or Planned Budget. If he finds any disparity between these values so the scheduled plan of that project is need to be updated so as to match the estimated situation as early on as possible. With this paper every technical individual could more efficiently and accurately manage cash flow during the construction process to prevent extra expenses and avoid project collapse.

The cost of construction or Budget of the Project is calculated by using thumb rule, not as much as accurate hence to get better accuracy of the construction we use software for calculating the more accurate estimation of building construction. The description of Building which was taken into analysis is as follows.

Table 1: Description of Site

| S.NO | ITEMS | DESCRIPTION |
|------|-----------------|--------------------------|
| 1 | Name of Site | Presidency Infra-heights |
| 2 | Storey | G+10 |
| 3 | Nature of Work | Civil Works |
| 4 | Scope of Work | 3 Nos Tower & Non-Tower |
| 5 | Area of 1 Tower | 145772 Sft |
| 6 | Nos of Tower | 3 Nos |

2. METHODOLOGY

In order to estimate the Spending Plan and Budget of the Project, the Primavera was also used. The Budget was planned firstly in excel based on Covered Area theory and then forecasted in Primavera. Primavera is one of the software which is being used in my project work. Primavera is powerful tools for Global Project Planning. Primavera is an enterprise project portfolio management software. It includes project management, scheduling, risk analysis, opportunity management, resource management, collaboration and control capabilities, and integrates with other enterprise software such oracle and SAP's ERP systems.

The basic task was to calculate the Budget and Cash flow of a G+10 storey Building. In order to calculate the total proposed cost of the project initially the Rate Analysis of Various Members was done in order to minimize the Cost of the Project. Excel was used to Create a detailed and easiest form of Rate Analysis.

The various items analysed per Unit are as follows.

1. Excavation
2. PCC
3. RCC
4. Shuttering
5. Brickwork
6. Plaster

In order to work out the impact of project change, the relevant literature was reviewed. The methodology adopted is impact of cost on project work. That is after calculating the total cost of project to reduce the large deviation in the project cost during the construction project due to various factors affecting the project.

The key method of the study is Per Unit Rate Analysis, Covered Area Estimation, Budgetary Financial Forecast and Cash flow.

For cost control on a project, the development plan and therefore the associated income estimates can provide the baseline reference for subsequent project monitoring and control.

For schedules, progress on individual activities and therefore the achievement of milestone completions are often compared with the project schedule to watch the progress of activities. Cash flow is incredibly essential in each construction project because it offers the detail plan regarding what proportion cash or quantity, we have a tendency to square measure disbursement on project as a money outflow and the way a lot of quantity we have a tendency to are becoming back from the project as money flow.

Cost of capital square measure prices related to one- off expenditure on acquisition, construction or improvement of great fastened assets as well as land, building and equipment that may be of use or benefit for quite one fiscal year.

Sequences of the study is as follows

1. Creating/ Making Per Unit Rate Analysis of Building elements
2. Analysing the Floor Area
3. Conversion of Rate Analysis into Construction Value Per Sft of Slab Area
4. Estimating the percentage of Release of payment per Head
5. Creating the budget according to the Budget Distribution Plan
6. Preparing the Schedule in Primavera
7. Quantification of Budgeted Cost from Excel to Primavera
8. Per Floor Planned Cost/ Budget can get derived.
9. Preparing the budget log Summary of WBS in Primavera
10. Preparing the Spending Plan per month based on the Schedule
11. Developing the Reports of the Budget, Cashflow, Spending Plan Per Month, Total Planned Cost of the Project.

3. RESULT AND DISCUSSION

Analyzing of Rates includes all indirect cost and Direct Cost of the project such as Water Charges, Scaffolding Charges, Electricity Charges, GST, Basic Rates of rawmaterial, Labour Rate, Profit of the Contractor. So initially a format of Rate Analysis was completed in excel in simplest form so that any Project manager can directly analyse the Per Unit Rate by directly putting the Present rates of Labour Components & Material Components.

The below table will reflect the analysed per unit rates based on DSR and DAR 2018 and base rates of raw material, the Rate were converted into the amount to be spend per Square feet of Slab Area of Building.

Table 2: Per Square feet Working Based on Rate Analysis Done

| S. no. | Item | Factor | Analysed Rates | Amount(Rs/Sft) |
|--------|---|--------------|----------------|----------------|
| 1. | Concrete | .031 Cum/Sft | 8297 Rs/Cum | 257.20 |
| 2. | Reinforcement | 4.60 Kg/Sft | 78.12 Rs/ Kg | 382.8 |
| 3. | Shuttering | 2.40 Sft/Sft | 39 Rs/ Sft | 94.54 |
| 4. | Brick Masonry | 0.01 Cum/Sft | 4717 Rs/ Cum | 47.17 |
| 5. | Half Brick Masonry | .025 Sqm/Sft | 1854 Rs/ Sqm | 46.36 |
| 6. | Internal Plaster | 1.00 Sft/Sft | 32 Rs/Sft | 93.93 |
| A. | Total (RS/SFT) | | | 981.99 |
| B. | Total Say (RS/SFT) | | | 982 |
| C. | Total of Concrete+ Reinforcement + Shuttering (RS/Sft) | | | 735 |

The total cost of the structure was bifurcated into payment to be claimed based on the scope of work. The scope of work of the project includes 3 Nos Tower and Non- Tower. The Percentage of each Tower was calculated to be 27.19 % and Non- Tower – 18.43 %. The Total area of one building was calculated to 145772 Sft.

Table 3. Bifurcation of Percentage of Payment Claiming Tower Wise

| S.NO | TOWER | PERCENTAGE OF CLAIMING PAYMENT | AREA IN SFT | TOTAL BUDGET COST OF BUILDING IN RS |
|------|---------|--------------------------------|-------------|-------------------------------------|
| 1 | TOWER-1 | 27.19% | 145772 | Rs. 29892836 |

| | | | | |
|---|-----------|----------|--------|---------------|
| 2 | TOWER-2 | 27.19% | 145772 | Rs. 29892836 |
| 3 | TOWER-3 | 27.19% | 145772 | Rs. 29892836 |
| 4 | NON-TOWER | 18.43% | | Rs. 20262044 |
| 5 | G. TOTAL | 100.00 % | | Rs. 109940552 |

Cost estimation models can be used for preliminary analysis of a project. The accuracy of project will always vary as the type of models used that is for short term projects; if it is long term project, the time series models have better result with less errors.

Cost estimation are often done either manually or employing a software. The manual cost estimation method depends upon expertise which basically do the estimation by thumb rule method. This includes an expert who is familiar with this project type. In this Study we used Covered Area Estimation. Budget is forecasted with Rs 735/ Sft of Slab Area derived from Table 2 Analysis of structure and the quantity of materials, labours, plant requirements and overhead costs will be done by the person as we discussed above. The Table -4 will highlight the Budget forecast of G+10 Storey Building. Increase in the percentage of payment represents the increase in rates due to vertical height/ lift of the building i.e. Lift Charge.

Table 4: Budget of G+10 Storey Building

| S. No. | Description | AREA (Sft) | % Due | % Claim | Amount (RS) | Budgeted cost (RS) |
|----------------|---------------------|------------|-------|---------|-------------|--------------------|
| 1 | Excavation | 145772 | 1.01% | 1.01% | 18,42,856 | 18,42,856 |
| 2 | Foundation | 145772 | 8.69% | 8.69% | 93,10,708 | 93,10,708 |
| 3 | First Floor Slab | 145772 | 1.54% | 1.54% | 16,49,999 | 16,49,999 |
| 4 | Second Floor Slab | 145772 | 1.55% | 1.55% | 16,60,713 | 16,60,713 |
| 5 | Third Floor Slab | 145772 | 1.56% | 1.56% | 16,71,427 | 16,71,427 |
| 6 | Fourth Floor Slab | 145772 | 1.57% | 1.57% | 16,82,142 | 16,82,142 |
| 7 | Fifth Floor Slab | 145772 | 1.58% | 1.58% | 16,92,856 | 16,92,856 |
| 8 | Sixth Floor Slab | 145772 | 1.59% | 1.59% | 17,03,570 | 17,03,570 |
| 9 | Seventh Floor Slab | 145772 | 1.60% | 1.60% | 17,14,285 | 17,14,285 |
| 10 | Eighth Floor Slab | 145772 | 1.61% | 1.61% | 17,24,999 | 17,24,999 |
| 11 | Ninth Floor Slab | 145772 | 1.62% | 1.62% | 17,35,713 | 17,35,713 |
| 12 | Tenth Floor Slab | 145772 | 1.63% | 1.63% | 17,46,427 | 17,46,427 |
| 13 | Eleventh Floor Slab | 145772 | 1.64% | 1.64% | 17,57,142 | 17,57,142 |
| G.TOTAL | | | | | | 2,98,92,836 |

The Budget is created amounting to Rs 2,98,92,836 of 1 Tower as discussed in Table-4. Further the Project schedule of G+10 Storey Building was created in Primavera and the data of Budget of Building of respective slabs was entered in the form of Work Breakdown Structure (WBS) and Activity. Sequence of activities was done by defining the relationship between the activities. Relationship of activities can be done in 4 forms. SS Relationship Start to Start; SF Relationship – Start to Finish; FS Relationship – Finish to Start; FF Relationship.

The Project Schedule in primavera is basic task. We need to create Budget in Primavera which we created in excel described above in Table 4

4. CONCLUSION

The following items were analyzed in excel Sheet and results were found as follows

- Excavation Work – 183 RS/ Cum
- PCC Work- 5435 RS/Cum
- RMC Laying- 8297 Rs / Cum
- Reinforcement- 78122 RS / MT
- Shuttering – 424 RS / Sqm
- Brick Work 230 mm -4717 RS / Cum
- Brick Work 115 mm – 1854 RS /Sqm
- Plaster Work- 349 RS/Sqm

Finally a time phased budgeted cost report was created in Primavera which concludes the monthly Spending plan of Building .

The Below reports are showing the Project Summary which indicates the total budget of the project , it allows the director/ owner to get the idea of his expenses in upcoming time in order to minimize any shortage of money for completion of the Project. It will allow every owner to maintain his budget so that there would not be any informal shortage of money to complete the project in time. The monthly spending plan will clear his ideas to minimize the cost of the project in order to maintain the equilibrium between the Planned Budget and Actual expenditure of the Project.

THE MIRAGE PROJECTS

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CASH FLOW/ MONTHLY SPENDING PLAN

| WBS Name | Current Budget | Actual Total Cost | Unallocated Budget | | 01-Mar-20 -31-Jul-21 | Mar 2020 | Apr 2020 | May 2020 | Jun 2020 | Jul 2020 | Aug 2020 |
|---------------------|-----------------|-------------------|--------------------|-------------------------------|----------------------|----------|----------|--------------|--------------|----------------|----------------|
| | | | | | | | | | | | |
| THE MIRAGE PROJECTS | Rs29,892,836.00 | Rs164,560.00 | Rs0.00 | Cum Remaining Total Cost | | | | Rs19,054.55 | Rs412,770.91 | Rs1,110,907.28 | Rs2,096,701.82 |
| | | | | Cum Actual Cost | | | | Rs19,000.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 |
| | | | | Cum Planned Value Labor Units | | | | 535 | 1773 | 4236 | 7542 |
| | | | | Planned Value Cost | | | | Rs185,054.55 | Rs392,276.37 | Rs698,136.36 | Rs985,794.55 |
| | | | | Planned Value Labor Units | | | | 535 | 1238 | 2464 | 3306 |
| | | | | | | | | | | | |
| STRUCTURE | Rs29,892,836.00 | Rs164,560.00 | Rs0.00 | Cum Remaining Total Cost | | | | Rs19,054.55 | Rs412,770.91 | Rs1,110,907.28 | Rs2,096,701.82 |
| | | | | Cum Actual Cost | | | | Rs19,000.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 |
| | | | | Cum Planned Value Labor Units | | | | 535 | 1773 | 4236 | 7542 |
| | | | | Planned Value Cost | | | | Rs185,054.55 | Rs392,276.37 | Rs698,136.36 | Rs985,794.55 |
| | | | | Planned Value Labor Units | | | | 535 | 1238 | 2464 | 3306 |
| | | | | | | | | | | | |
| TOWER-1 | Rs29,892,836.00 | Rs164,560.00 | (Rs2.00) | Cum Remaining Total Cost | | | | Rs19,054.55 | Rs412,770.91 | Rs1,110,907.28 | Rs2,096,701.82 |
| | | | | Cum Actual Cost | | | | Rs19,000.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 |
| | | | | Cum Planned Value Labor Units | | | | 535 | 1773 | 4236 | 7542 |
| | | | | Planned Value Cost | | | | Rs185,054.55 | Rs392,276.37 | Rs698,136.36 | Rs985,794.55 |
| | | | | Planned Value Labor Units | | | | 535 | 1238 | 2464 | 3306 |
| | | | | | | | | | | | |
| FOUNDATI | Rs11,153,564.00 | Rs0.00 | Rs11,153,564.00 | Cum Remaining Total Cost | | | | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 |
| | | | | Cum Actual Cost | | | | | | | |
| | | | | Cum Planned Value Labor Units | | | | 40 | 40 | 40 | 40 |
| | | | | Planned Value Cost | | | | Rs19,054.55 | | | |
| | | | | Planned Value Labor Units | | | | 40 | | | |
| | | | | | | | | | | | |
| 1ST FLOOR | Rs1,649,998.00 | Rs164,560.00 | Rs0.00 | Cum Remaining Total Cost | | | | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | |
| | | | | | | | | | | | |

Figure 1. Project Summary & Monthly Spending Plan

| Sep 2020 | Oct 2020 | Nov 2020 | Dec 2020 | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | Jun 2021 | Jul 2021 | Period Total |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Rs2,857,907.28 | Rs3,663,145.46 | Rs4,430,450.92 | Rs5,184,256.37 | Rs5,974,683.65 | Rs6,484,567.28 | Rs7,084,469.10 | Rs7,121,516.37 | Rs7,133,916.37 | Rs7,145,916.37 | Rs7,152,752.74 | Rs7,152,752.74 |
| Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 |
| 10246 | 13078 | 15785 | 18552 | 21287 | 23039 | 25306 | 25455 | 25540 | 25623 | 25670 | 25670 |
| Rs761,205.46 | Rs805,238.18 | Rs767,305.46 | Rs753,805.46 | Rs790,427.27 | Rs509,883.64 | Rs599,901.82 | Rs37,047.27 | Rs12,400.00 | Rs12,000.00 | Rs6,836.36 | Rs7,317,312.74 |
| 2704 | 2832 | 2707 | 2768 | 2735 | 1752 | 2267 | 149 | 85 | 83 | 47 | 25670 |
| Rs2,857,907.28 | Rs3,663,145.46 | Rs4,430,450.92 | Rs5,184,256.37 | Rs5,974,683.65 | Rs6,484,567.28 | Rs7,084,469.10 | Rs7,121,516.37 | Rs7,133,916.37 | Rs7,145,916.37 | Rs7,152,752.74 | Rs7,152,752.74 |
| Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 |
| 10246 | 13078 | 15785 | 18552 | 21287 | 23039 | 25306 | 25455 | 25540 | 25623 | 25670 | 25670 |
| Rs761,205.46 | Rs805,238.18 | Rs767,305.46 | Rs753,805.46 | Rs790,427.27 | Rs509,883.64 | Rs599,901.82 | Rs37,047.27 | Rs12,400.00 | Rs12,000.00 | Rs6,836.36 | Rs7,317,312.74 |
| 2704 | 2832 | 2707 | 2768 | 2735 | 1752 | 2267 | 149 | 85 | 83 | 47 | 25670 |
| Rs2,857,907.28 | Rs3,663,145.46 | Rs4,430,450.92 | Rs5,184,256.37 | Rs5,974,683.65 | Rs6,484,567.28 | Rs7,084,469.10 | Rs7,121,516.37 | Rs7,133,916.37 | Rs7,145,916.37 | Rs7,152,752.74 | Rs7,152,752.74 |
| Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 | Rs164,560.00 |
| 10246 | 13078 | 15785 | 18552 | 21287 | 23039 | 25306 | 25455 | 25540 | 25623 | 25670 | 25670 |
| Rs761,205.46 | Rs805,238.18 | Rs767,305.46 | Rs753,805.46 | Rs790,427.27 | Rs509,883.64 | Rs599,901.82 | Rs37,047.27 | Rs12,400.00 | Rs12,000.00 | Rs6,836.36 | Rs7,317,312.74 |
| 2704 | 2832 | 2707 | 2768 | 2735 | 1752 | 2267 | 149 | 85 | 83 | 47 | 25670 |
| Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 | Rs19,054.55 |
| 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | Rs0.00 |
| | | | | | | | | | | | Rs19,054.55 |
| | | | | | | | | | | | 40 |
| Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 | Rs346,640.00 |

Figure 2. Project Summary & Monthly Spending Plan

The Figure -1&2 are the Primavera generated reports showing how much money to be spend in each month till project completion according to the occurrence of the activities. The Project manager can revise and reschedule the plan of project if there is shortage or surplus amount of money in particular month during the construction phase. Through this report we can also define the factor affecting the Cost of the project including drastic changes in the basic rates of material & labour Component. According to the which every Project manager will try to lower the unexpected and inequitable rise in the prices. Monthly Expenditure will also help Project manager to ask for the fluent cashflow at site in order to complete the project in time limit. Several Resource constraints also affect the Project Timeline and Cost Plan. So, in order to refrain from such delay or shortage the monthly expenditure plan is necessary for any construction project.

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