# COMPARATIVE STUDY OF ACTUAL AND CRASHED SCHEDULE OF BUILDING USING MSP

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**Abstract -** *Project management is main stream which overall makes a civil industry worth into existence in accordance with the control on constraints such as time and cost. This paper will mainly help out to differentiate actual and crashed schedule and their behavioral improvements in time according to the relative cost. Microsoft project software is used to enhance the scheduling adding Crashing, Slack time and alternative building material to the work planning activity. Crashing makes a proper inventory behavioral time benefits from the overtime of huge workforce and improvement in the duration of an activity using slack time in software. An alteration with the cost is maintained which helpful in retrogression of overall costs of the project.*

*The main aim is to reduce the improved development period from new time and to meet a specific deadline. The main motivation behind this project is to reduce time using crashing and slack (Time Optimization).For cost optimization alternative building material is used to reduce the cost and making project more well-organized and inexpensive.*

***Key Words*: scheduling and crashing, crashing trials, alternative material and techniques, crash ability, cost slope.**

## 1. INTRODUCTION

- Everyone wants to be more conservative when it comes into time constraint.
- Shorter duration work should be done giving more profitable results.
- Many projects have some risk and uncertainties which we not consider it orally but it comes into account when we execute it practically which makes increase in time, cost and over allocation of resources.
- To Overcome, Planning and Scheduling are done and to have crashed schedule Following Methods are used.

❑ Crashing Of an Activity.

❑ Crashing Using Microsoft Project.

❑ Slack Time.

If time is of secondary concern, each activity could be performed at its lowest possible normal cost. If cost is of secondary importance, each activity could be speeded up to be completed in the least crash time. Between these two limits lies the best or optimal solution. However, to find such solution, it requires the consideration of complex collection of concurrent, interrelated, and overlapping activities.

In order to counter the unforeseen delays, Project management is the application of knowledge, skill, tools and techniques to project activities to meet the project requirements. The primary focus of this research is to compare actual and crashed schedule by enhancing the schedule through Crashing, Slack time and alternative Techniques to the work planning activity using MSP.

## 2. METHODOLOGY

1. Data Collection.
2. Work breakdown structure.
3. Maximum duration is applied.
4. Adding Resources.
5. Assigning Resources.

- ❑ Crashing using overtime.
- ❑ Slack time for optimization.
- ❑ Time & Cost optimization using Alternative Building Material and Techniques.

6. Result showing Time and Cost Optimization.
7. Comparing actual and crashed schedule of the project.

## 3. PROJECT CASE STUDY

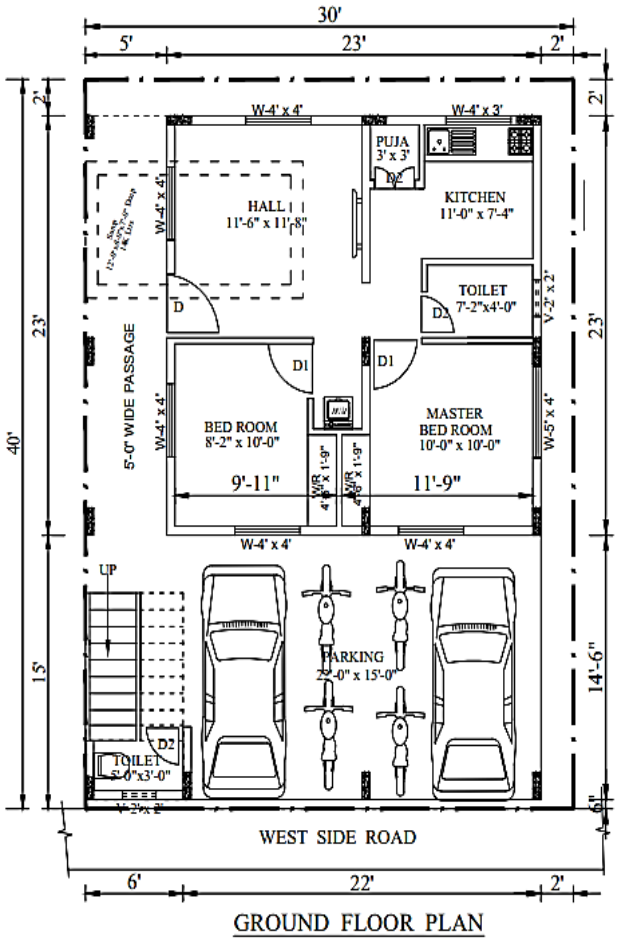
- The residential project of two floors (G+1) signed by the company for 8 months is completed. Client wanted his project to be completed in short time, accordingly construction was done by the company.
- In my opinion the time schedule of the project to reach client satisfaction can be reduced furthermore and can obtain the biggest profit from this project. So I replanned the project and tried to make a difference to show how to get the maximum profit by crashing.
- The project located in Hulimangala, Bangalore south, and it's about 1200 sqft.
- Structure Built up area

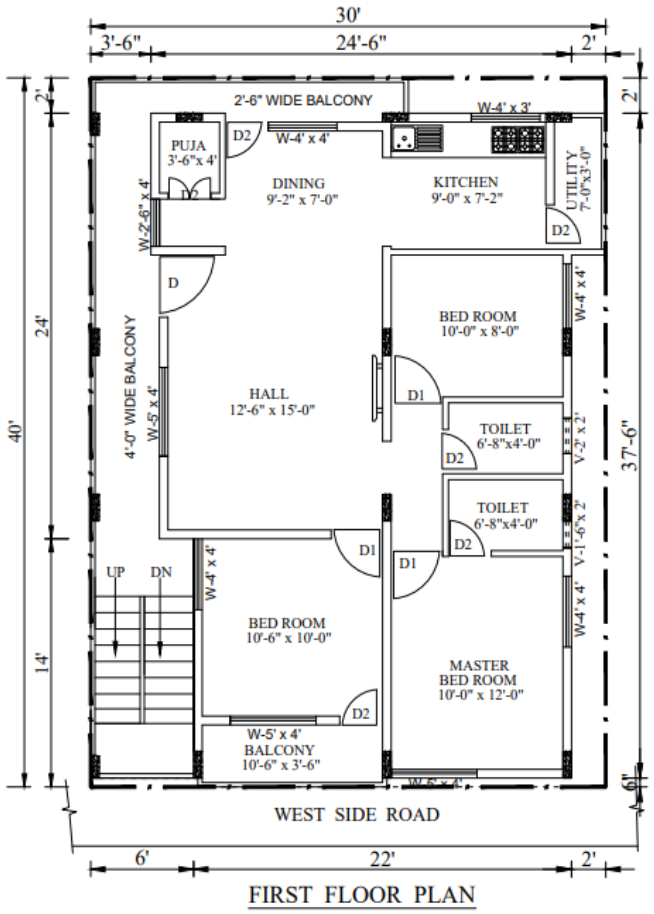
  Ground floor 772.00sqft

  Parking area 330.00sqft

  First floor 1102.00sqft

The rate before crashing ₹ 3,506,362/-, in numbers (Thirty five lakh sixty three thousand sixty two rupees only).



## 4. PROJECT PLANNING

- Project Planning is a general and most common term in construction management which refers to attain the expected goals and destinations. Planning is the key to bring the expected projects into reality or in existence

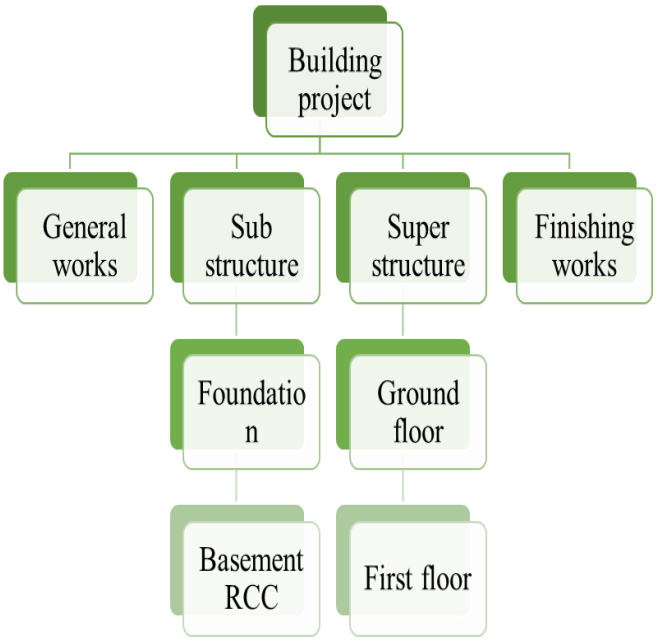



**Fig-1 Work breakdown structure:**

| General works | Substructure | Super structure | Finishing works |
|---|---|---|---|
| Site handover to contractor | Foundation | Ground floor | Plumbing |
| Document review & plan formation | Excavation | Column shuttering | Electrification work |
| site cleaning | PCC for footing | RCC of column up to lintel level | MS work |
| layout | Reinforcement cutting for footing &plinth beam | Brickwork up to lintel level | Steel railing |
| | Prepare & pour concrete | Lintel concreting | Water proofing |
| | Backfilling & compaction | Brickwork up to slab level | Flooring |
| | Basement RCC | staircase shuttering | Laying of tiles |
| | RCC of column up to plinth beam | RCC of staircase | external painting |
| | Plinth beam Shuttering | Centering & shuttering for slab | Door & window fixing |
| | Casting of Plinth Beam with RCC | Slab beam casting | internal Painting (with D&W painting) |
| | Ground Soling, Compaction & Flooring | RCC of slab | Glasswork |
| | | de shuttering | Handing over to client |

**Table-4.1 List of activities**

| Resource Name | Type | Material Label | Std. Rate | Cost/Use |
|---|---|---|---|---|
| **Type: Work** | **Work** | | | **₹ 6,500.00** |
| Bar bender | Work | | ₹ 800.00/day | ₹ 0.00 |
| Carpenter | Work | | ₹ 800.00/day | ₹ 0.00 |
| centering | Work | | ₹ 0.00/hr | ₹ 6,500.00 |
| Electrician | Work | | ₹ 800.00/day | ₹ 0.00 |
| Engineer | Work | | ₹ 20,000.00/mon | ₹ 0.00 |
| Female coolie | Work | | ₹ 450.00/day | ₹ 0.00 |
| guard | Work | | ₹ 11,000.00/mon | ₹ 0.00 |
| Head mason | Work | | ₹ 900.00/day | ₹ 0.00 |
| Helper | Work | | ₹ 500.00/day | ₹ 0.00 |
| JCB | Work | | ₹ 700.00/hr | ₹ 0.00 |
| Male coolie | Work | | ₹ 600.00/day | ₹ 0.00 |

**Table-4.2 List of resources**

- Activities cost and crew formation:

| Activities | Human resources | | | | | Budget labor total cost Per day |
|---|---|---|---|---|---|---|
| | Male coolie (₹ 600/day) | Female coolie (₹ 450/day) | Head mason (₹ 900/day) | Bar bender (₹ 800/day) | Carpenter (₹ 800/day) | |
| Site handover to contractor | | | | | | 0 |
| Document review & plan formation | | | | | | 0 |
| site cleaning | 3 | | | | | 1800 |
| layout | 3 | | | | | 1800 |
| excavation | 4 | | | | | 2400 |
| pcc for footing | 3 | 2 | 2 | | | 4500 |
| Reinforcement cutting for footing &plinth beam | | | | 4 | | 3200 |

**Table-4.3 Budget labor total cost**

| Activities | Materials | | | | | Budget material total cost |
|---|---|---|---|---|---|---|
| | PCC (3400/m3) | RCC (4450/m3) | Cement (350/bag) | Sand (950/ton) | Aggregate (700/ton) | |
| Site handover to contractor | | | | | | |
| Document review & plan formation | | | | | | |
| site cleaning | | | | | | |
| layout | | | | | | |
| excavation | | | | | | |
| pcc for footing | 5.87 | | | | | 19958 |
| Reinforcement cutting for footing &plinth beam | | | | | | |
| Prepare & pour concrete | | 9.13 | | | | 40628 |
| Backfilling & compaction | | | | | | |
| RCC of column upto plinth beam | | 2.03 | | | | 9034 |
| Plinth beam Shuttering | | | | | | |

**Table-4.4 Budget material total cost**

| Activities | Sub contracts | | | | | | Budget sub contract total cost |
|---|---|---|---|---|---|---|---|
| | Plumbing work | Electrical work | Tiles work | Flooring | Door work | Window work | |
| Plumbing | 112000 | | | | | | 112000 |
| Electrification work | | 132000 | | | | | 132000 |
| MS work | | | | | | | |
| Steel railing | | | | | | | |
| Water proofing | | | | | | | |
| Flooring | | | | 190000 | | | 190000 |
| Laying of tiles | | | 115000 | | | | 115000 |
| external painting | | | | | | | |
| Door & window fixing | | | | | 104000 | 68000 | 172000 |
| internal Painting (with D&W painting) | | | | | | | |
| glasswork | | | | | | | |

**Table- 4.5 Budget sub contract total cost**

## 5. SCHEDULING AND CRASHING OF PROJECT

| | Task Mode | Task Name | Duration | Predecess | Resource Names | Cost | Start | Finish |
|---|---|---|---|---|---|---|---|---|
| 1 | | Building project | 228 days | | | ₹3,506,362.47 | 2/21/2022 | 10/6/2022 |
| 2 | | General works | 10 days | | | ₹9,000.00 | 2/21/2022 | 3/2/2022 |
| 3 | | Site handover to contractor | 0 days | | | ₹0.00 | 2/21/2022 | 2/21/2022 |
| 4 | | Document review & plan formatio | 5 days | 3 | | ₹0.00 | 2/21/2022 | 2/25/2022 |
| 5 | | site cleaning | 3 days | 4 | Male coolie[300%] | ₹5,400.00 | 2/26/2022 | 2/28/2022 |
| 6 | | layout | 2 days | 5 | Male coolie[300%] | ₹3,600.00 | 3/1/2022 | 3/2/2022 |
| 7 | | substructure | 29 days | 2 | | ₹193,328.00 | 3/3/2022 | 3/31/2022 |
| 8 | | foundation | 14 days | | | ₹108,786.50 | 3/3/2022 | 3/16/2022 |
| 9 | | excavation | 2 days | 6 | Male coolie[400%],excavation[85.64 cum] | ₹4,800.00 | 3/3/2022 | 3/4/2022 |
| 10 | | pcc for footing | 3 days | 9 | Female coolie[200%],Male coolie[300%],Head mason[200% | ₹33,458.00 | 3/5/2022 | 3/7/2022 |
| 11 | | Reinforcement cutting for footing &plinth beam | 4 days | 10,9SS | Bar bender[400%] | ₹12,800.00 | 3/8/2022 | 3/11/2022 |
| 12 | | Prepare & pour concrete | 3 days | 11 | Female coolie[200%],Head mason[200%],Male coolie[300% | ₹54,128.50 | 3/12/2022 | 3/14/2022 |
| 13 | | Backfilling & compaction | 2 days | 12 | Male coolie[300%] | ₹3,600.00 | 3/15/2022 | 3/16/2022 |
| 14 | | Basement RCC | 15 days | 8 | | ₹84,541.50 | 3/17/2022 | 3/31/2022 |
| 15 | | RCC of column upto plinth bean | 7 days | 13 | Female coolie[200%],Male coolie[300%],Rcc[2.03 cum],He | ₹40,533.50 | 3/17/2022 | 3/23/2022 |
| 16 | | Plinth beam Shuttering | 3 days | 15 | shuttering[192 sqft],Male coolie[300%] | ₹10,200.00 | 3/24/2022 | 3/26/2022 |
| 17 | | Casting of Plinth Beam with RCC | 2 days | 16 | Female coolie[200%],Head mason[200%], Male coolie[300%],Rcc[3.44 cum],MIXER1 | ₹24,308.00 | 3/27/2022 | 3/28/2022 |
| 18 | | Ground Soling, Compaction & Flooring | 3 days | 17 | Female coolie[200%],Male coolie[300%], Aggregate[2 tons] | ₹9,500.00 | 3/29/2022 | 3/31/2022 |
| 19 | | Super structure | 103 days | 2,7 | | ₹1,926,417.13 | 4/1/2022 | 7/12/2022 |
| 20 | | Ground floor | 38 days | | | ₹829,871.00 | 4/1/2022 | 5/8/2022 |
| 21 | | Column shutteing | 3 days | 18 | Male coolie[300%],shuttering[290.5 sqft] | ₹12,662.50 | 4/1/2022 | 4/3/2022 |
| 22 | | RCC of column upto lintel level | 7 days | 21 | Female coolie[200%],Head mason[200%],Male coolie[300% | ₹94,528.50 | 4/4/2022 | 4/10/2022 |
| 23 | | Brickwork upto lintel level | 5 days | 22 | brickwork 4.5"[21 sq.m],Female coolie[200%],Head mason | ₹100,790.00 | 4/11/2022 | 4/15/2022 |
| 24 | | Lintel concreting | 4 days | 23 | Female coolie[200%],Head mason[200%],Male coolie[300% | ₹38,454.00 | 4/16/2022 | 4/19/2022 |
| 25 | | Brickwork upto slab level | 2 days | 24 | Female coolie[200%],Head mason[200%],Male coolie[300% | ₹38,880.00 | 4/20/2022 | 4/21/2022 |
| 26 | | staircase shuttering | 3 days | 25 | shuttering[95.8 sqft],Male coolie[300%] | ₹7,795.00 | 4/22/2022 | 4/24/2022 |
| 27 | | RCC of staircase | 4 days | 26 | Female coolie[200%],Head mason[200%],Male coolie[300% | ₹70,405.00 | 4/25/2022 | 4/28/2022 |

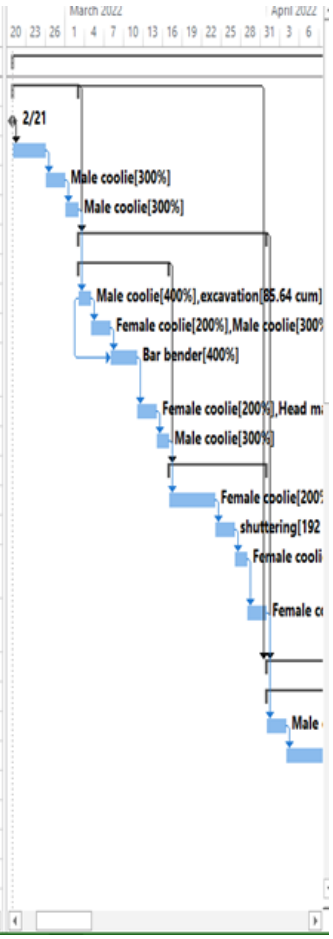



**Fig-2 Scheduling with Normal duration**

- The schedule is a tool or a technic of every project management team which is used and practiced to predict most probable project completion time and thus enabling the in/ on time resources conception which are budgeted on the particular work.

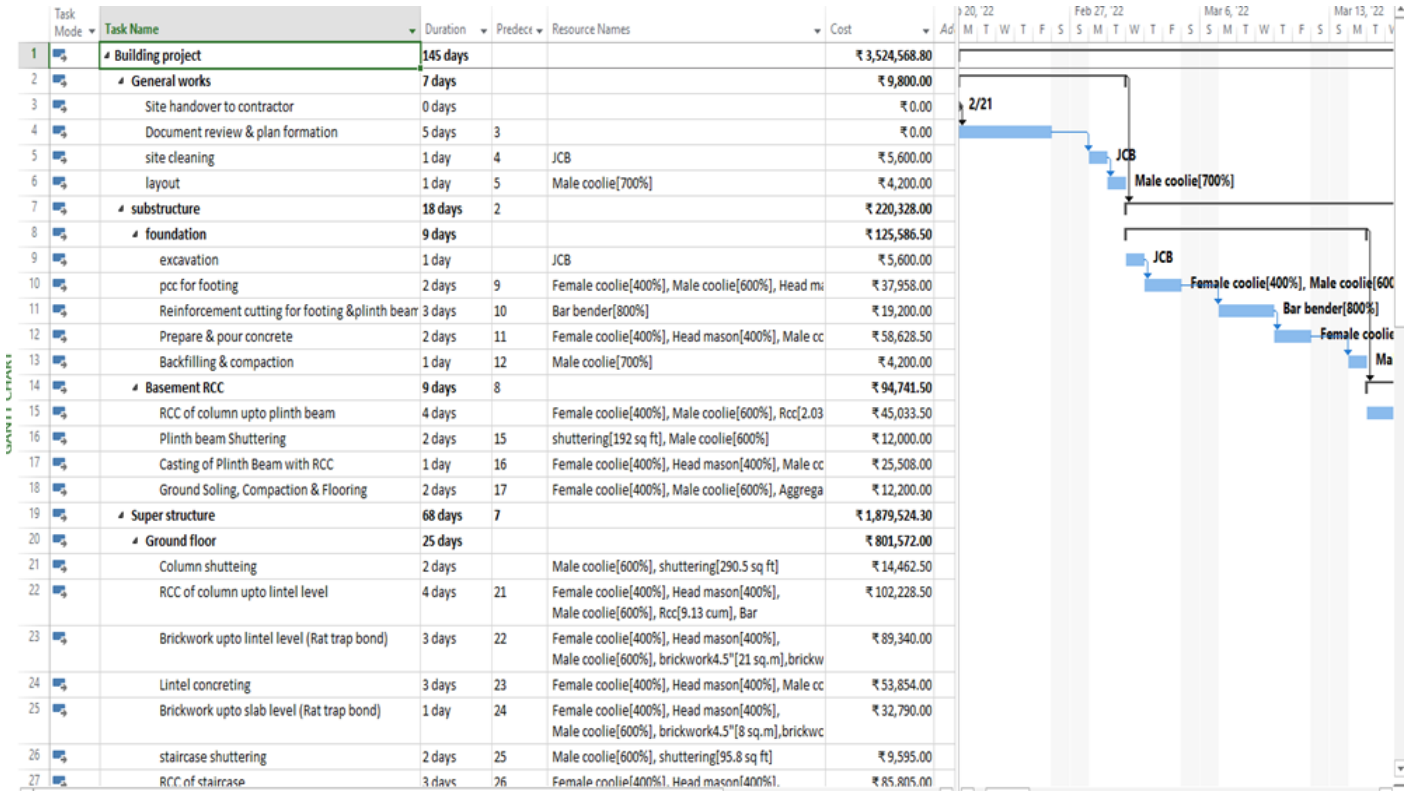
- The normal duration of the project is 228days

### 5.1 DURATION CRASHING

| Activities | no of crew | Actual duration | no of crew | Crashed duration |
|---|---|---|---|---|
| Building project | | 228 days | | 145 days |
| General works | | 10 days | | 7 days |
| Site handover to contractor | | 0 days | | 0 days |
| Document review & plan formation | | 5 days | | 5 days |
| site cleaning | 1 | 3 days | 2 | 1 day |
| layout | 1 | 2 days | 2 | 1 day |
| substructure | | 29 days | | 18 days |
| foundation | | 14 days | | 9 days |
| excavation | 1 | 2 days | 2 | 1 day |
| pcc for footing | 1 | 3 days | 2 | 2 days |
| Reinforcement cutting for footing &plinth beam | 1 | 4 days | 2 | 3 days |
| Prepare & pour concrete | 1 | 3 days | 2 | 2 days |
| Backfilling & compaction | 1 | 2 days | 2 | 1 day |
| Basement RCC | | 15 days | | 9 days |
| RCC of column up to plinth beam | 1 | 7 days | 2 | 4 days |
| Plinth beam Shuttering | 1 | 3 days | 2 | 2 days |
| Casting of Plinth Beam with RCC | 1 | 2 days | 2 | 1 day |
| Ground Soling, Compaction & Flooring | 1 | 3 days | 2 | 2 days |
| Super structure | | 103 days | | 68 days |
| Ground floor | | 38 days | | 25 days |
| Column shuttering | 1 | 3 days | 2 | 2 days |
| RCC of column up to lintel level | 1 | 7 days | 2 | 4 days |
| Brickwork up to lintel level | 1 | 5 days | 2 | 3 days |
| Lintel concreting | 1 | 4 days | 2 | 3 days |
| Brickwork up to slab level | 1 | 2 days | 2 | 1 day |
| staircase shuttering | 1 | 3 days | 2 | 2 days |
| RCC of staircase | 1 | 4 days | 2 | 3 days |
| Centering & shuttering for slab | 1 | 3 days | 2 | 2 days |
| Slab beam casting | 1 | 2 days | 2 | 1 day |
| RCC of slab | 1 | 4 days | 2 | 3 days |
| De shuttering | 1 | 1 day | 2 | 1 day |
| First floor | | 40 days | | 27 days |
| Column shuttering | 1 | 3 days | 2 | 2 days |
| RCC of column up to lintel level | 1 | 7 days | 2 | 4 days |
| brickwork up to lintel level | 1 | 6 days | 2 | 4 days |
| lintel concreting | 1 | 4 days | 2 | 3 days |
| Brickwork up to slab level | 1 | 3 days | 2 | 2 days |
| staircase shuttering | 1 | 3 days | 2 | 2 days |
| RCC of staircase | 1 | 4 days | 2 | 3 days |
| Centering & shuttering for beam & slab | 1 | 3 days | 2 | 2 days |
| Slab beam casting | 1 | 2 days | 2 | 1 day |
| RCC of slab | 1 | 4 days | 2 | 3 days |
| DE shuttering | 1 | 1 day | 2 | 1 day |
| Parapet wall | 1 | 3 days | 2 | 2 days |
| plastering external(incl,PW) | 1 | 12 days | 2 | 8 days |
| plastering internal | 1 | 10 days | 2 | 6 days |
| Finishing works | | 86 days | | 52 days |
| Plumbing | 1 | 7 days | 2 | 4 days |
| Electrification work | 1 | 7 days | 2 | 4 days |
| MS work | 1 | 8 days | 2 | 5 days |
| Steel railing | 1 | 5 days | 2 | 3 days |
| Water proofing | 1 | 4 days | 2 | 3 days |
| Flooring | 1 | 12 days | 2 | 7 days |
| Laying of tiles | 1 | 8 days | 2 | 5 days |
| external painting | 1 | 10 days | 2 | 6 days |
| Door & window fixing | 1 | 12 days | 2 | 7 days |
| internal Painting (with D&W painting) | 1 | 7 days | 2 | 4 days |
| glasswork | 1 | 5 days | 2 | 3 days |
| Handing over to client | 1 | 1 day | 2 | 1 day |

**Table-5.1.1 duration crashing**

**Example**: PCC for footing
To finish this activity, the crew should be formed from 7 Labors, PCC & mixer. So, we assumed to have 1 crew with budget total cost / day = 4500rupees. We found that this crew with 100% productivity will finish the required amount of work in 3 days.
Total labor cost = 4500 x 3 = 13500 rupees.
Material cost (PCC & mixer) = 19958 rupees.
Therefore total amount required for this activity is **33458 rupees**.
**Crashing;** now we assumed we have 2 crews but we found that if the one crew give productivity of 100%, the two crews won't get a completion rate by 200% due to **crowdedness** and **the lack of supervisors** and other considerations .So we assumed that if we have 2 crew the productivity will increase by 160% to 170%
So this activity will be finished in 2 days with a total cost of **37958 rupees**



| | Task Mode | Task Name | Duration | Predece | Resource Names | Cost |
|---|---|---|---|---|---|---|
| 1 | | Building project | 145 days | | | ₹ 3,524,568.80 |
| 2 | | General works | 7 days | | | ₹ 9,800.00 |
| 3 | | Site handover to contractor | 0 days | | | ₹ 0.00 |
| 4 | | Document review & plan formation | 5 days | 3 | | ₹ 0.00 |
| 5 | | site cleaning | 1 day | 4 | JCB | ₹ 5,600.00 |
| 6 | | layout | 1 day | 5 | Male coolie[700%] | ₹ 4,200.00 |
| 7 | | substructure | 18 days | 2 | | ₹ 220,328.00 |
| 8 | | foundation | 9 days | | | ₹ 125,586.50 |
| 9 | | excavation | 1 day | | JCB | ₹ 5,600.00 |
| 10 | | pcc for footing | 2 days | 9 | Female coolie[400%], Male coolie[600%], Head ma | ₹ 37,958.00 |
| 11 | | Reinforcement cutting for footing &plinth beam | 3 days | 10 | Bar bender[800%] | ₹ 19,200.00 |
| 12 | | Prepare & pour concrete | 2 days | 11 | Female coolie[400%], Head mason[400%], Male cc | ₹ 58,628.50 |
| 13 | | Backfilling & compaction | 1 day | 12 | Male coolie[700%] | ₹ 4,200.00 |
| 14 | | Basement RCC | 9 days | 8 | | ₹ 94,741.50 |
| 15 | | RCC of column upto plinth beam | 4 days | | Female coolie[400%], Male coolie[600%], Rcc[2.03 | ₹ 45,033.50 |
| 16 | | Plinth beam Shuttering | 2 days | 15 | shuttering[192 sq ft], Male coolie[600%] | ₹ 12,000.00 |
| 17 | | Casting of Plinth Beam with RCC | 1 day | 16 | Female coolie[400%], Head mason[400%], Male cc | ₹ 25,508.00 |
| 18 | | Ground Soling, Compaction & Flooring | 2 days | 17 | Female coolie[400%], Male coolie[600%], Aggrega | ₹ 12,200.00 |
| 19 | | Super structure | 68 days | 7 | | ₹ 1,879,524.30 |
| 20 | | Ground floor | 25 days | | | ₹ 801,572.00 |
| 21 | | Column shutteing | 2 days | | Male coolie[600%], shuttering[290.5 sq ft] | ₹ 14,462.50 |
| 22 | | RCC of column upto lintel level | 4 days | 21 | Female coolie[400%], Head mason[400%], Male coolie[600%], Rcc[9.13 cum], Bar | ₹ 102,228.50 |
| 23 | | Brickwork upto lintel level (Rat trap bond) | 3 days | 22 | Female coolie[400%], Head mason[400%], Male coolie[600%], brickwork4.5"[21 sq.m],brickw | ₹ 89,340.00 |
| 24 | | Lintel concreting | 3 days | 23 | Female coolie[400%], Head mason[400%], Male cc | ₹ 53,854.00 |
| 25 | | Brickwork upto slab level (Rat trap bond) | 1 day | 24 | Female coolie[400%], Head mason[400%], Male coolie[600%], brickwork4.5"[8 sq.m],brickwc | ₹ 32,790.00 |
| 26 | | staircase shuttering | 2 days | 25 | Male coolie[600%], shuttering[95.8 sq ft] | ₹ 9,595.00 |
| 27 | | RCC of staircase | 3 days | 26 | Female coolie[400%], Head mason[400%], | ₹ 85,805.00 |



**Fig-3 Scheduling with crashed duration**

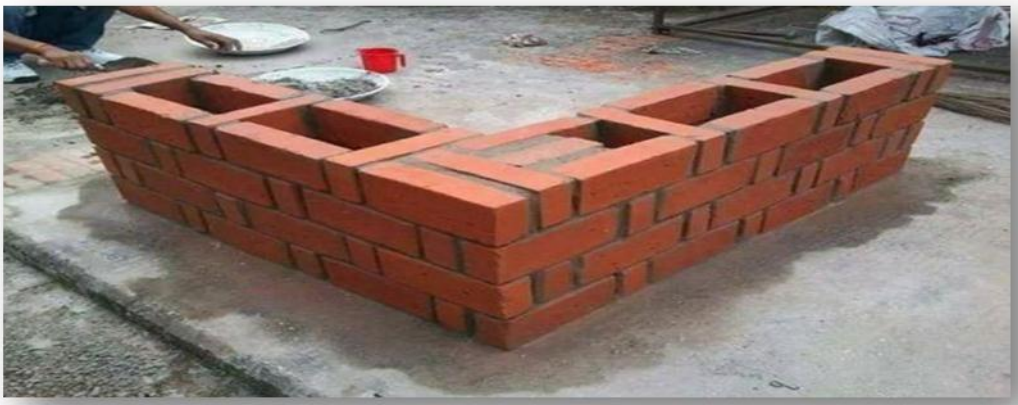
The main approaches for crashing of an activity in Microsoft project is:
1. Apportioning additional resources to the project which makes easy way for crashing of an activity.
2. Overtime allocated to the resources mainly human resource.
3. Hiring additional resources.
4. For Early completion extra payments.

### 5.2 ALTERNATIVE BUILDING MATERIAL AND TECHNIQUE

- Alternate material and technique not only crash the time but also cuts down the overall cost

❖ **Rat trap bond**

❑ Rat trap bond is a cavity wall construction and leads to reduction in the quantity of bricks required for masonry work
❑ By adopting this method of bonding of brick masonry compared to traditional English/Flemish bond masonry, it is possible to reduce in the material cost of bricks by 25% and 10% to 15% in the masonry cost.
❑ The cavity in red trap bond provides effective thermal and sound insulation.



❖ **Plank & Joist Roofing System**

- Precast RCC Plank and Joist is a system which consists of two types of precast structural elements Plank (which is like a small component of a bigger roof slab) and Joist. After placing precast elements ,in-situ concrete is placed to give flat surface
- The technology can prove economical if the number of planks and joists are more- such as in the case of a 2 or 3 storied buildings.
- Cost - Overall cost reduction by 15-20% because of reduction in steel consumption and because of faster roof construction once the walls are complete. It doesn't require any material for shuttering during construction.
- Time- Saves construction time – the slab can be ready in 2-3 days as compared to at least 14-21 days for a conventional RCC slab
- Quality -Centralized production provides a better, durable and consistent quality roof as compared to the quality of conventional RCC roofs in mountain regions

❖ **Polycarbonate glass**

- Polycarbonate is a material which contains a group of carbonates in their chemically build structure. Polycarbonate is mainly as similar to a conventional transparent glass but inflexible as plastic. Polycarbonate glass is easily installed, cut and easily available in ribbed single sheet or flat twin-wall thicknesses.
- Use of polycarbonate sheet is much lesser than the cost of toughened glass. Polycarbonate sheet is light weight, good fire resistant, provide UV protection and has high impact resistance.

### 5.2 PROJECT CRASHING METHOD

- The Project Crashing method was used to find the optimum duration and minimum cost of the project. The procedure for shortening project duration can be summarized in the following steps:
- Draw the project network diagram.
- CPM calculations and identify the critical path, use normal durations and costs for all activities.
- Compute the cost slope for each activity from the following equation: **cost slope = crash cost – normal cost / normal duration – crash duration**
- Start by shortening the activity duration on the critical path which has the least cost slope and not been shortened to its crash duration.
- Reduce the duration of the critical activities with least cost slope until its crash duration is reached or until the critical path changes..
- The cost increase due to activity shortening is calculated as the cost slope multiplied by the time of time units shortened.
- Continue until no further shortening is possible, and then the crash point is reached.
- This is the project direct-cost / time relationship. By adding the project indirect cost to this curve to obtain the project time / cost curve. This curve gives the optimum duration and minimum cost.

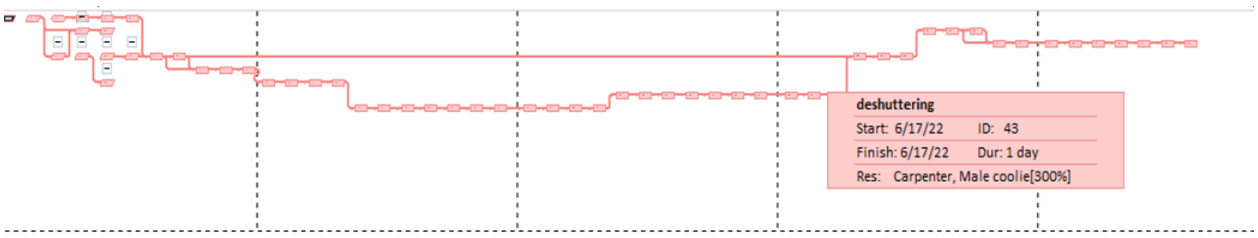



**Fig-4 Network Diagram**

| Task Name | Actual duration | Actual cost | Crashed duration | crashed Cost | Crash ability | cost slope |
|---|---|---|---|---|---|---|
| **Building project** | **228 days** | **₹ 3,506,362.47** | **145 days** | **₹ 3,524,568.80** | | |
| **General works** | **10 days** | **₹ 9,000.00** | **7 days** | **₹ 9,800.00** | | |
| **Site handover to contractor** | 0 days | ₹ 0.00 | 0 days | ₹ 0.00 | 0 | 0 |
| **Document review & plan formation** | 5 days | ₹ 0.00 | 5 days | ₹ 0.00 | 0 | 0 |
| **site cleaning** | 3 days | ₹ 5,400.00 | 1 day | ₹ 5,600.00 | 2 | 100 |
| **layout** | 2 days | ₹ 3,600.00 | 1 day | ₹ 4,200.00 | 1 | 600 |
| **substructure** | **29 days** | **₹ 193,328.00** | **18 days** | **₹ 220,328.00** | | |
| **foundation** | **14 days** | **₹ 108,786.50** | **9 days** | **₹ 125,586.50** | | |
| **excavation** | 2 days | ₹ 4,800.00 | 1 day | ₹ 5,600.00 | 1 | 800 |
| **pcc for footing** | 3 days | ₹ 33,458.00 | 2 days | ₹ 37,958.00 | 1 | 4500 |
| **Reinforcement cutting for footing &plinth beam** | 4 days | ₹ 12,800.00 | 3 days | ₹ 19,200.00 | 1 | 6400 |
| **Prepare & pour concrete** | 3 days | ₹ 54,128.50 | 2 days | ₹ 58,628.50 | 1 | 4500 |
| **Backfilling & compaction** | 2 days | ₹ 3,600.00 | 1 day | ₹ 4,200.00 | 1 | 600 |
| **Basement RCC** | **15 days** | **₹ 84,541.50** | **9 days** | **₹ 94,741.50** | | |
| **RCC of column upto plinth beam** | 7 days | ₹ 40,533.50 | 4 days | ₹ 45,033.50 | 3 | 1500 |
| **Plinth beam Shuttering** | 3 days | ₹ 10,200.00 | 2 days | ₹ 12,000.00 | 1 | 1800 |
| **Casting of Plinth Beam with RCC** | 2 days | ₹ 24,308.00 | 1 day | ₹ 25,508.00 | 1 | 1200 |

**Table-5.3.1 Crash ability & cost slope**

### 5.3.1 DIRECT AND INDIRECT COST

- Direct cost: Normal cost which will be assigned on to a selected work package or project activity

Direct cost = 3506362 rupees

- Indirect cost : Cost that can't be related to any particular work package or project activity

Engineer = 20000/month

Supervisor = 18000/month

Guard = 11000/month

So if we estimate the total supervisory salaries in Month will be = 49000 rupees.

Indirect cost per day = 1633.33 rupees

### 5.3.2 CRASHING TRIALS

| *Trial NO.* | *DURATIONCRASHING* | *DIRECT COST* | *INDIRECT COST* | *TOTAL COST* |
|---|---|---|---|---|
| 1 | 227 | 3470887 | 370766 | 3841653 |
| 2 | 226 | 3435412 | 369132 | 3804544 |
| 3 | 225 | 3414628 | 367499 | 3782127 |
| 4 | 224 | 3393844 | 365866 | 3759710 |
| 5 | 222 | 3375155 | 362599 | 3737754 |
| 6 | 221 | 3368055 | 360965 | 3729020 |
| 7 | 220 | 3361965 | 359331 | 3721296 |
| 8 | 218 | 3350515 | 356064 | 3706579 |
| 9 | 217 | 3346120 | 354430 | 3700550 |
| 10 | 215 | 3341652 | 351163 | 3692815 |
| 11 | 213 | 3341852 | 347896 | 3689748 |
| 12 | 212 | 3342452 | 346262 | 3688714 |
| 13 | 211 | 3343052 | 344628 | 3687680 |
| 14 | 208 | 3345152 | 339728 | 3684880 |
| 15 | 207 | 3345952 | 338094 | 3684046 |
| 16 | 205 | 3347752 | 334827 | 3682579 |
| 17 | 200 | 3352352 | 326660 | 3679012 |
| 18 | 196 | 3356552 | 320126 | 3676678 |
| 19 | 191 | 3361952 | 311959 | 3393911 |
| 20 | 190 | 3363152 | 310325 | 3673477 |
| 21 | 187 | 3366752 | 305425 | 3672177 |
| 22 | 186 | 3368102 | 303791 | 3671893 |
| 23 | 183 | 3372302 | 298891 | 3671193 |
| 24 | 180 | 3376802 | 293992 | 3670794 |
| 25 | 177 | 3382101 | 289092 | 3671193 |
| 26 | 176 | 3383901 | 287458 | 3671359 |
| 27 | 175 | 3385701 | 285824 | 3671525 |
| 28 | 174 | 3387501 | 284190 | 3671691 |
| 29 | 173 | 3389301 | 282556 | 3671857 |
| 30 | 172 | 3391101 | 280922 | 3672023 |
| 31 | 169 | 3397467 | 276022 | 3673489 |
| 32 | 165 | 3406467 | 269488 | 3675955 |
| 33 | 162 | 3414166 | 264588 | 3678754 |
| 34 | 159 | 3421865 | 259688 | 3681553 |
| 35 | 158 | 3424565 | 258054 | 3682619 |
| 36 | 157 | 3428765 | 256420 | 3685185 |
| 37 | 156 | 3433265 | 254786 | 3688051 |

| | | | | |
|---|---|---|---|---|
| 38 | 155 | 3437765 | 253152 | 3890917 |
| 39 | 151 | 3455765 | 246618 | 3902383 |
| 40 | 150 | 3460565 | 244984 | 3705549 |
| 41 | 149 | 3466965 | 243350 | 3710315 |
| 42 | 148 | 3482365 | 241716 | 3724081 |
| 43 | 147 | 3497765 | 240082 | 3737847 |
| 44 | 146 | 3513165 | 238448 | 3751613 |
| 45 | 145 | 3528565 | 236815 | 3765380 |

**Table-5.3.2 Crashing trials**

Indirect cost of the project = 228*1633.33 = 372400 rupees

## 6. RESULT AND DISCUSSION

### ❑ Result for Time Optimization

- The duration which is conventionally observed is 228 days which is being decreased by crashing and with the help of slack time. The approximately reduced duration is 145 days.
- Majorly for optimizing time the methodology extra human resources are used and work easily without any hectic situations.
- The time optimization is also depending on how well a contractor organizes his work schedule with a proper utilization of material, machineries and human resource

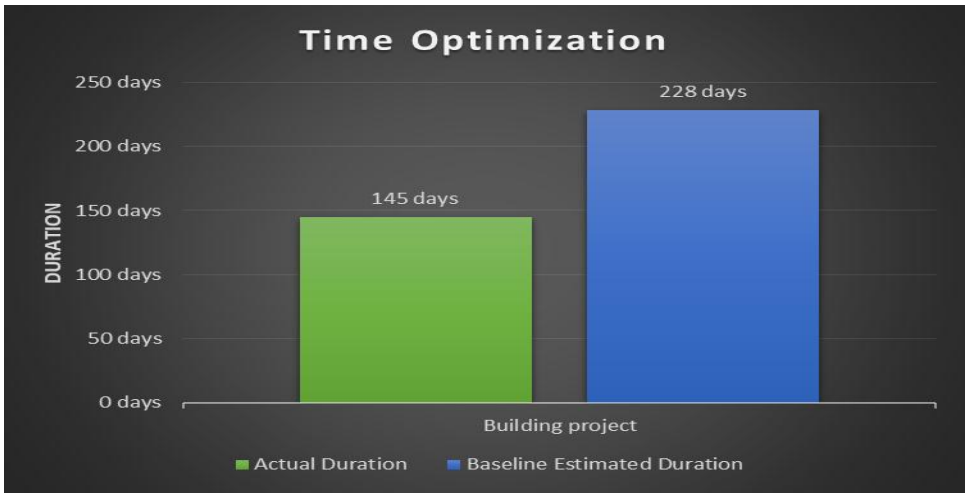



**Fig-5 Comparison of actual time and crashed time of the project**

### ❑ Result For Cost Optimization

- Project cost optimization is done by using the alternative building oriented materials which readily cut down the cost of the project but also satisfies owner with an economical result.
- So for alternative building material an insulated structural toughened glass is replaced by polycarbonate glass, regular brick masonry is replaced by Rat trap bond technique and regular RCC of slab is replaced by Plank and joist roofing system, which cuts the cost of the project.

- The cost of polycarbonate sheet is ₹650/ sqm which is considerably very much less compared to toughened glass which is ₹2400/sqm and by rat trap bond and plank joist roofing system cost reduced up to 30% for each replaced activity.
- The cost of the project is ₹3878761 , by applying crashing and by applying the alternative material cost the overall cost of the building is reduced by ₹3761401


**Fig-6 Comparison of actual cost and crashed cost of the project**

## 7. CONCLUSION

- From the results we can make two comparative conclusions:

  1) Comparison of actual time and crashed time of the project.

  2) Comparison of actual cost and crashed cost of the project.

- From project crashing we can conclude that

1) Project crashing cost and indirect cost have inverse relationship.

2) Indirect cost increases as project duration increases.

3) Crashing cost are highest when the project is shortened, to overcome this we have used alternate materials and techniques.

- This project concludes that any relative construction project mainly depends on the Time and Cost constraints which gives a proper economical weightage to any project.
- A proper planning and scheduling will also make a huge difference in construction project considering the labor management
- Proper management, interpersonal management, technical management, and the use of technology in building projects may all help to reduce delays.
- Client wanted his project to be completed faster, company can still reduce the time to reach client satisfaction and he didn't obtain the biggest profit from this project. So, after completion of the project, crashing is done to make a difference and show how to get the maximum profit from it.
- Addition of human resources and alternative building materials like toughened glass is replaced by polycarbonate glass, regular brick masonry is replaced by Rat trap bond technique and regular RCC of slab is replaced by Plank and joist roofing system, which cuts the time as well as cost of the project.

- As a result, the total duration of project was 228 days and it was reduced to 145 days using crashing and also cost of ₹117360 was decreased from the actual cost.

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## BIOGRAPHIES

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