

# Microsoft Project Enabled Schedule and Resource Planning in Construction Management

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## Abstract

Construction projects frequently experience schedule slippage and cost escalation when activity dependencies, labour availability, material delivery, site access and subcontractor coordination are not represented in one integrated planning system. This paper develops a Microsoft Project enabled schedule and resource planning framework for a G+13 reinforced concrete residential building project located at Govind Nagar, Nashik, Maharashtra. The study uses genuine case data covering work breakdown structure, structural quantities, labour allocation, activity durations, cost distribution and resource-loaded work packages. The baseline plan gives a project duration of 907.56 days and a planned cost of Rs. 117,055,100.57. A resource-leveled plan is prepared by adjusting task logic, resource calendars, float use, repeated floor cycles, crew continuity, material flow and trade overlap within practical site constraints. The plan reduces project duration to 826.05 days and cost to Rs. 110,458,304.48, giving a saving of 81.51 days or 8.98% and Rs. 6,596,796.09 or 5.64%. The largest duration improvements are obtained in slab casting, RCC frame, lift-core RCC, foundations, masonry and MEP rough-in because these activities have high repetition, high resource intensity and strong influence on critical path continuity. The results confirm that disciplined WBS preparation, critical path tracking, resource leveling and cost-loaded scheduling can improve time-cost performance in high-rise residential construction without changing the project scope.

**Keywords:** *Microsoft Project; construction scheduling; resource leveling; critical path method; cost control; G+13 RCC building; resource-loaded schedule.*

## 1. Introduction

Construction project management depends on coordinated decisions related to time, cost, quality, resources, safety and contractual milestones. In residential high-rise construction, these decisions become more difficult because excavation, foundation, RCC frame, slab casting, masonry, plastering, services and finishing activities are interdependent. Recent studies on high-rise delay risks and cost overrun factors indicate that inadequate planning, weak project control, poor resource allocation, design changes and slow monitoring frequently convert small activity slippages into major time and cost deviations [1]-[4]. Therefore, a practical scheduling system must do more than list activities; it must connect WBS codes, dependencies, durations, calendars, resource availability, cost-loaded tasks and progress control in one traceable model. Microsoft Project is adopted in the present study because it provides activity sequencing, Gantt chart visualization, precedence relationships, critical path identification, baseline comparison, resource assignment, cost loading and progress tracking. The project contains 21 major work packages with a baseline duration of 907.56 days and a cost of Rs. 117.06 million. The problem observed in the baseline is that structural work, finishing work and service trades create high resource peaks if they are not balanced. Resource leveling is therefore required to reduce idle labour, prevent overlapping congestion and use available float without damaging the sequence of critical activities. Resource leveling studies show that balanced resource use can reduce peaks, valleys and costly fluctuations when float is consumed in a controlled manner [5], [6]. The objective of this paper is to prepare a compact case-based schedule and resource planning study using Microsoft Project principles. The paper focuses on WBS preparation, activity dependencies, resource-loaded scheduling, baseline comparison, plan development and interpretation of time-cost savings. The contribution is a practical framework that can be applied by project managers to monitor repetitive RCC

building work, especially where floor-cycle activities and service packages create pressure on labour, material and equipment planning.

## 2. Related Work and Research Gap

Construction delay literature consistently identifies resource planning, contractor monitoring, project control and coordination as central causes of schedule overrun. Vahedi Nikbakht et al. [1] examined delay factors in high-rise projects and noted the impact of resources, technical weaknesses and implementation control on time, cost and quality performance. Abdelalim et al. [2] reviewed global cost overrun drivers and highlighted planning and scheduling issues, estimation errors, design inefficiencies and site conditions as major causes of cost escalation. Alhammadi et al. [3] showed that cost overrun mitigation requires structured cost control and better management of building project processes. Aldammak et al. [4] identified poor contractor monitoring, weak project management teams and design faults as key delay factors along with the need for clear progress tracking and workforce approval systems. Resource leveling research provides the technical basis for revising a baseline construction schedule. Damci et al. [5] described float consumption rate as a practical approach for shifting noncritical activities along available float to improve daily resource utilization. Lin et al. [6] proposed an optimization-based resource leveling model and showed that leveling decisions must consider resource fluctuations rather than duration alone. Recent project scheduling studies further confirm that construction projects with limited labour, equipment and material capacity need dynamic allocation rules, particularly when activities compete for the same resource pool [7], [8]. Planning and scheduling studies using Microsoft Project and Primavera also show that software-based task logic, resource allocation and monitoring improve transparency in residential construction [9], [10]. The reviewed literature confirms that scheduling, resource leveling, cost control and complexity management are interconnected. However, many studies discuss delay factors or resource methods in general terms without providing a compact case-based paper using actual activity values from a building project. The present paper addresses this gap by presenting activity-wise duration, cost and resource interpretation for a G+13 residential project. The focus is not on theoretical algorithms; it is on how a planner can convert project quantities and WBS data into a controlled resource-loaded schedule with measurable time-cost improvement. Recent studies on project success criteria, high-rise duration optimization, software-based scheduling, buffer sizing and finance-based scheduling further support the need to connect time, cost, resources and cash-flow control in one planning structure [13]-[22].

Table 1. Literature focus used for the study

| Ref.       | Main focus                                          | Use in present paper                                                          |
|------------|-----------------------------------------------------|-------------------------------------------------------------------------------|
| [1]-[4]    | Delay and cost overrun factors in building projects | Justifies stronger baseline control, monitoring and workforce coordination    |
| [5], [6]   | Resource leveling and float-based scheduling        | Supports schedule preparation through float and resource balancing            |
| [7], [8]   | Resource-constrained project scheduling             | Supports constraint recognition and buffer-sensitive planning                 |
| [9], [10]  | Software-based construction scheduling              | Supports WBS, resource-loaded planning and schedule comparison                |
| [11], [12] | Complexity, cost and high-rise duration control     | Links schedule quality with time, cost, stakeholders and repeated work fronts |

## 3. Research Methodology

The methodology follows a quantitative case-study design. First, the selected building is divided into a work breakdown structure covering site mobilization, survey, excavation, foundation, plinth, slabs, RCC frame, staircase and lift core, masonry, plaster, flooring, openings, waterproofing, MEP work, painting, lift installation, external work and handover. Second, activity durations, quantities, labour categories and costs are entered as structured project data. Third, Microsoft Project logic is applied by assigning task dependencies, calendars, working durations, resources and costs. Fourth, the baseline is reviewed using the critical path and resource loading. Fifth, a resource-leveled plan is prepared by reducing avoidable idle time, preserving technical dependencies, improving crew continuity and balancing repeated floor cycles.



Fig. 1. Microsoft Project based research method flow

The schedule is not prepared by reducing the scope of work. It is prepared by improving sequence control and resource use. Activities with higher repetition, such as slab casting, RCC frame, masonry and MEP rough-in, are given greater planning attention because their crew productivity can improve when work fronts are released in a predictable sequence. Activities with limited compression potential, such as site survey, lift installation and handover, are adjusted conservatively. This logic is consistent with resource leveling literature, where activities are shifted within available float and resource peaks are reduced without arbitrary deletion of work [5], [7].

Table 2. Microsoft Project planning configuration

| Planning item  | Adopted approach                                      | Purpose                                            |
|----------------|-------------------------------------------------------|----------------------------------------------------|
| Schedule basis | WBS-based task list with activity dependencies        | Convert site work into traceable schedule packages |
| Calendar       | Working-day calendar with activity-specific durations | Represent practical site execution time            |
| Baseline       | Original duration and cost plan                       | Provide reference for time-cost comparison         |
| Resources      | Labour, equipment, materials and trade packages       | Identify overloaded work periods and idle time     |
| Cost loading   | Activity-wise cost assigned to WBS tasks              | Track financial impact of schedule decisions       |
| Leveling logic | Float use, crew continuity and controlled overlap     | Reduce congestion and improve resource utilization |

#### 4. Case Study and Project Data

The case project is a G+13 RCC residential building at Govind Nagar, Nashik, Maharashtra. The project includes repeated structural floors and several finishing/service packages, making it suitable for resource-loaded scheduling. The major structural quantities include site clearance of 2200 m<sup>2</sup>, excavation of 4800 m<sup>3</sup>, PCC of 420 m<sup>3</sup>, footing RCC of 980 m<sup>3</sup> and plinth-level column work of 760 m<sup>3</sup>. The structural phase is sequential at the beginning because survey, setting out, excavation, PCC and foundations cannot be freely overlapped without affecting quality and safety. However, repeated upper-floor operations allow better planning of formwork, reinforcement, concrete placement and inspection cycles.

Table 3. Work breakdown structure for structural phase

| WBS | Activity            | Unit           | Quantity | Duration (days) | Dependency |
|-----|---------------------|----------------|----------|-----------------|------------|
| 1.1 | Site clearance      | m <sup>2</sup> | 2200     | 5               | Start      |
| 1.2 | Excavation          | m <sup>3</sup> | 4800     | 12              | 1.1        |
| 1.3 | PCC                 | m <sup>3</sup> | 420      | 6               | 1.2        |
| 1.4 | Footing RCC         | m <sup>3</sup> | 980      | 18              | 1.3        |
| 1.5 | Column up to plinth | m <sup>3</sup> | 760      | 20              | 1.4        |

Table 4. Structural and resource data used for planning

| Component | Quantity / value                              | Planning interpretation                                           |
|-----------|-----------------------------------------------|-------------------------------------------------------------------|
| Footings  | M20, 980 m <sup>3</sup> , 18 labour, 18 days  | Major early concrete package; direct dependency after PCC         |
| Columns   | M25, 1450 m <sup>3</sup> , 22 labour, 30 days | Repetitive vertical structural activity with floor-cycle learning |

| Component         | Quantity / value                   | Planning interpretation                                         |
|-------------------|------------------------------------|-----------------------------------------------------------------|
| Beams             | M25, 1680 m3, 25 labour, 35 days   | High coordination requirement due to formwork and reinforcement |
| Slabs             | M25, 2140 m3, 28 labour, 40 days   | Large-volume RMC work; schedule-driving structural package      |
| Slab cycle        | 820 m2, 150 mm, 123 m3 per floor   | Cycle reduces from 7 days to 5 days across upper floors         |
| Columns per range | 48 columns; 185 m3 to 170 m3 range | Duration reduces from 8 days to 6 days with repetition          |

The slab cycle data demonstrate the importance of repetition. Floors 1-3 require 7 days per slab cycle, floors 4-7 require 6 days, and floors 8-13 require 5 days. Similarly, the column cycle reduces from 8 days to 6 days over the floor ranges. These values justify the use of repeated floor planning in Microsoft Project because productivity improvement can be captured by updating durations, crews and logic for repetitive activities rather than keeping every floor cycle identical.

## 5. Microsoft Project Schedule Development

The baseline schedule is prepared by entering all major WBS activities as tasks, assigning durations and defining finish-to-start or controlled overlapping relationships. The Gantt view is used to verify task sequence, identify long-duration work packages and check critical or near-critical activities. In the present project, the longest work package is RCC frame superstructure at 160 days, followed by slab casting at 110 days, MEP rough-in at 67 days, masonry at 58 days and foundation at 49 days.

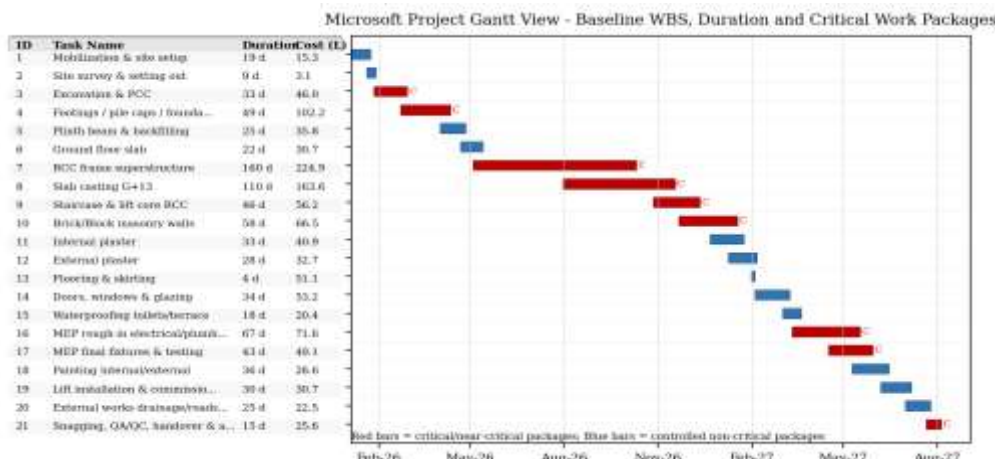


Fig. 2. Microsoft Project Gantt chart for baseline WBS schedule

The Gantt view shows how the WBS, task duration and cost-loaded activities are connected. Red bars represent critical or near-critical work packages, while blue bars represent controlled noncritical packages. The chart confirms that structural work and MEP work dominate the project timeline. When these activities are delayed, succeeding trades such as plastering, flooring, painting and handover are also affected. Therefore, Microsoft Project scheduling is useful because it allows the planner to view task relationships and resource impacts simultaneously instead of treating activities as isolated items.

Table 5. Overall project duration and cost summary

| Sr. | Activity                           | Duration (days) | Cost (Rs.)    |
|-----|------------------------------------|-----------------|---------------|
| 1   | Mobilization & site setup          | 19              | 1,533,472.93  |
| 2   | Site survey & setting out          | 9               | 306,694.59    |
| 3   | Excavation & PCC                   | 33              | 4,600,418.80  |
| 4   | Footings / pile caps / foundations | 49              | 10,223,152.89 |
| 5   | Plinth beam & backfilling          | 25              | 3,578,103.51  |
| 6   | Ground floor slab                  | 22              | 3,066,945.87  |

| Sr. | Activity                                | Duration (days) | Cost (Rs.)     |
|-----|-----------------------------------------|-----------------|----------------|
| 7   | RCC frame superstructure                | 160             | 22,490,936.35  |
| 8   | Slab casting G+13                       | 110             | 16,357,044.62  |
| 9   | Staircase & lift core RCC               | 46              | 5,622,734.09   |
| 10  | Brick/Block masonry walls               | 58              | 6,645,049.38   |
| 11  | Internal plaster                        | 33              | 4,089,261.16   |
| 12  | External plaster                        | 28              | 3,271,408.92   |
| 13  | Flooring & skirting                     | 4               | 5,111,576.44   |
| 14  | Doors, windows & glazing                | 34              | 5,316,039.50   |
| 15  | Waterproofing toilets/terrace           | 18              | 2,044,630.58   |
| 16  | MEP rough-in electrical/plumbing/fire   | 67              | 7,156,207.02   |
| 17  | MEP final fixtures & testing            | 43              | 4,907,113.39   |
| 18  | Painting internal/external              | 36              | 2,862,482.81   |
| 19  | Lift installation & commissioning       | 30              | 3,066,945.87   |
| 20  | External works drainage/roads/landscape | 25              | 2,249,093.64   |
| 21  | Snagging, QA/QC, handover & approvals   | 15              | 2,555,788.22   |
|     | Total                                   | 907             | 117,055,100.57 |

## 6. Resource and Cost-Loaded Planning

Resource-loaded planning is essential because a feasible construction schedule depends on the availability of labour, equipment and materials. The project labour allocation shows that helpers form the largest workforce, with an average of 52 and a peak of 60 workers. Masons average 38 and peak at 45 workers. Carpenters and bar benders have lower average numbers, 24 and 20 respectively, but higher daily wages of Rs. 850/day and Rs. 900/day because they are skilled trades. These values show that cost control depends not only on material rates but also on preventing idle skilled labour and avoiding sudden resource peaks.

| Resource Name    | Type      | Max Units   | Std. Rate    | Avg. Units | Peak Units |
|------------------|-----------|-------------|--------------|------------|------------|
| Mason            | Work      | 45 units    | Rs. 750/day  | 38         | 45         |
| Helper           | Work      | 60 units    | Rs. 450/day  | 52         | 60         |
| Carpenter        | Work      | 30 units    | Rs. 850/day  | 24         | 30         |
| Bar Bender       | Work      | 28 units    | Rs. 900/day  | 20         | 28         |
| Mixer 10/7 CFT   | Equipment | 2 nos       | Rs. 1800/day | 1          | 2          |
| Mixer 14/10 CFT  | Equipment | 2 nos       | Rs. 2400/day | 1          | 2          |
| RMC Pump/Transit | Equipment | As required | Package rate | 1          | 1          |
| MEP Crew         | Work      | 30 units    | Package rate | 18         | 30         |

Fig. 3. Microsoft Project resource sheet for labour and equipment inputs

The resource sheet image presents the same type of information entered in Microsoft Project before allocation to activities. The resource name, type, maximum units and rate support cost-loaded scheduling. When a resource is over-allocated, the planner can either shift a noncritical task within its float, increase temporary resource capacity or modify task overlap. This step is especially useful during RCC work, where masons, helpers, carpenters, bar benders, mixers and RMC support must be coordinated on the same work front.

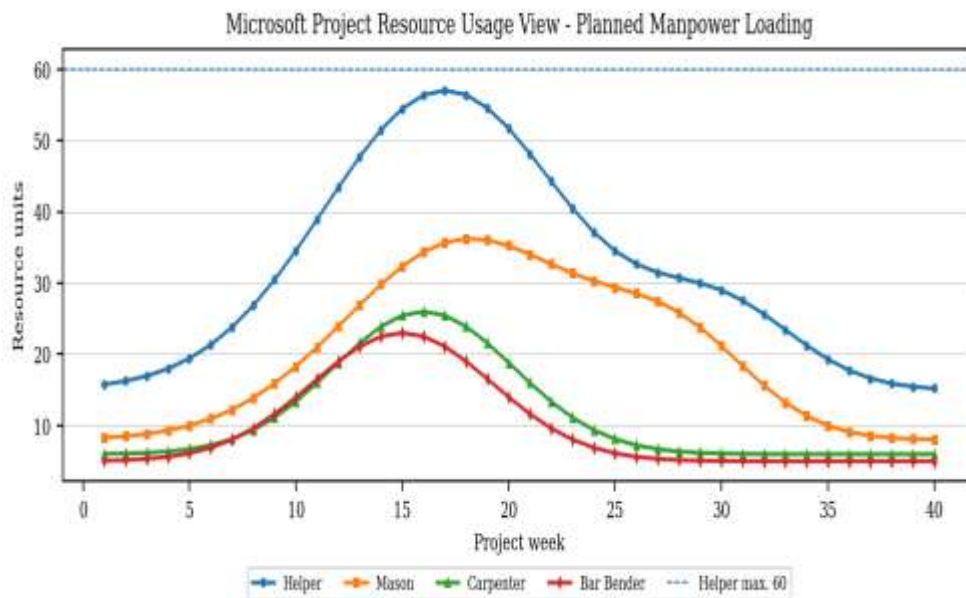


Fig. 4. Microsoft Project resource usage view showing manpower loading

The resource usage curve shows a structural peak around the middle of the project and a second service/finishing peak toward the later stage. The helper requirement approaches the maximum resource limit of 60 workers during major RCC cycles. Mason, carpenter and bar-bender profiles also peak during slab, beam and column work. The purpose of resource leveling is to smooth such peaks without extending the final completion date unnecessarily. Controlled adjustments in start dates and task overlap help maintain crew continuity and reduce costly idle time.

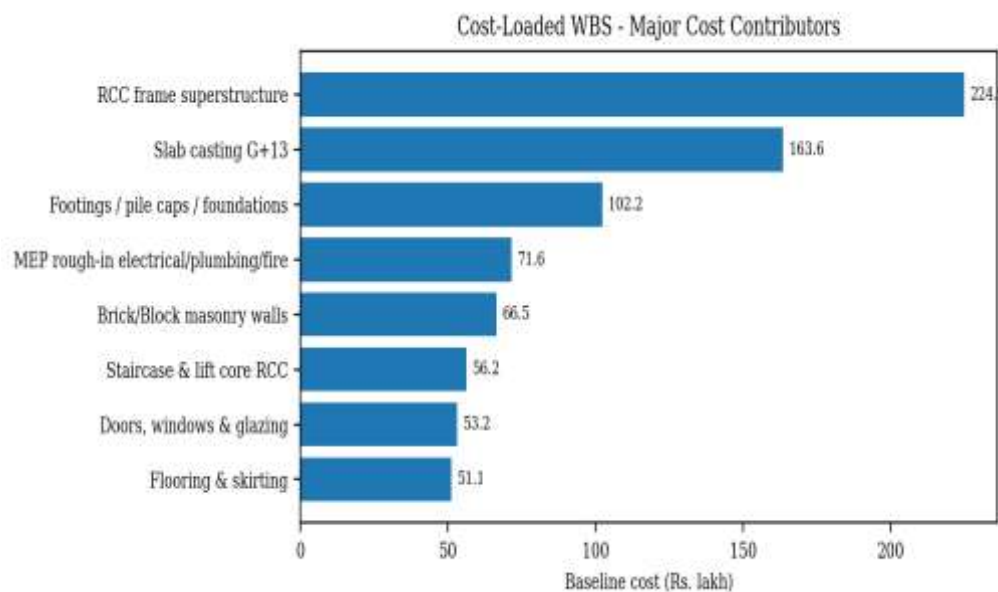


Fig. 5. Cost-loaded WBS showing major cost contributors

The cost-loaded WBS indicates that RCC frame and slab casting dominate the financial structure of the project. RCC frame has a baseline cost of Rs. 224.91 lakh, while slab casting has Rs. 163.57 lakh. Foundation, MEP rough-in, masonry, lift-core RCC and doors/windows are also important cost packages. Since these activities account for a large share of project cost, even a small improvement in resource planning can create measurable financial savings. Therefore, the plan focuses primarily on high-cost and high-duration activities.

## 7. Results and Discussion

The Gantt chart presents the complete MSP baseline schedule for the residential building project. It includes activity sequencing, duration, dependency, start date, finish date, and cost allocation. The baseline duration is approximately 907.56 days, with the project scheduled from 11 December 2025 to 10 May 2028 and an estimated cost of Rs. 11.71 crore. Early works such as mobilization, survey, excavation, PCC, foundation, and plinth activities establish the

structural base for subsequent floor cycles. The figure is important because it represents the deterministic plan against which ANN optimization is compared.

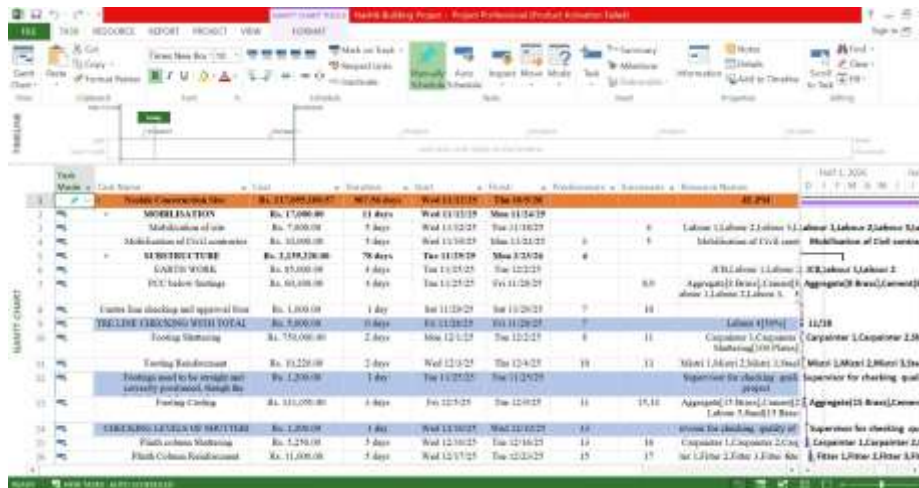


Fig 6. Project schedule Gantt chart

It also shows that conventional scheduling provides a clear activity framework but does not automatically identify resource-efficient alternatives. Therefore, the MSP chart becomes the baseline input for the ANN model.

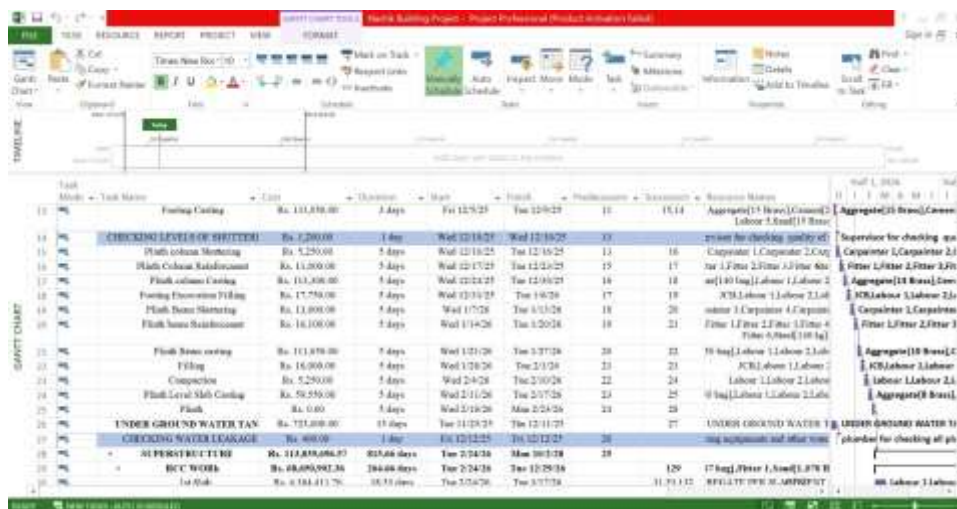
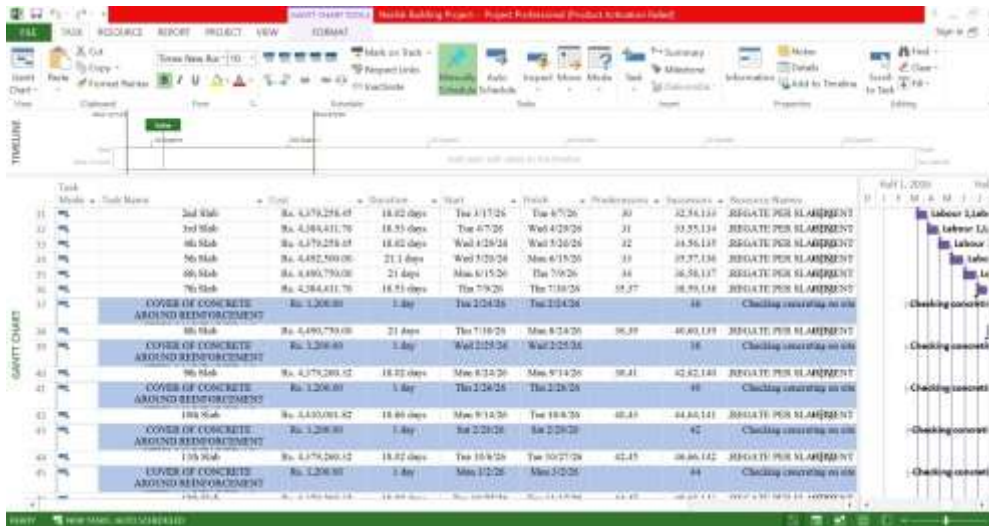


Fig 7. Substructure and RCC schedule

The substructure and RCC schedule highlights the early construction sequence from excavation to foundation, plinth, and initial RCC works. These activities are highly dependent on sequential completion because later elements cannot begin until earlier foundations and plinth works are completed. The WBS confirms site clearance, excavation, PCC, footing RCC, and column up to plinth as key early activities. Excavation and PCC together last 33 days in the baseline activity table, while foundation work lasts 49 days and costs Rs. 102.23 lakhs. After ANN optimization, foundation duration reduces to 44.38 days and cost to Rs. 95.69 lakhs. The figure therefore shows the first major opportunity for schedule and cost control through better coordination of equipment, labour, reinforcement, shuttering, and concrete operations.



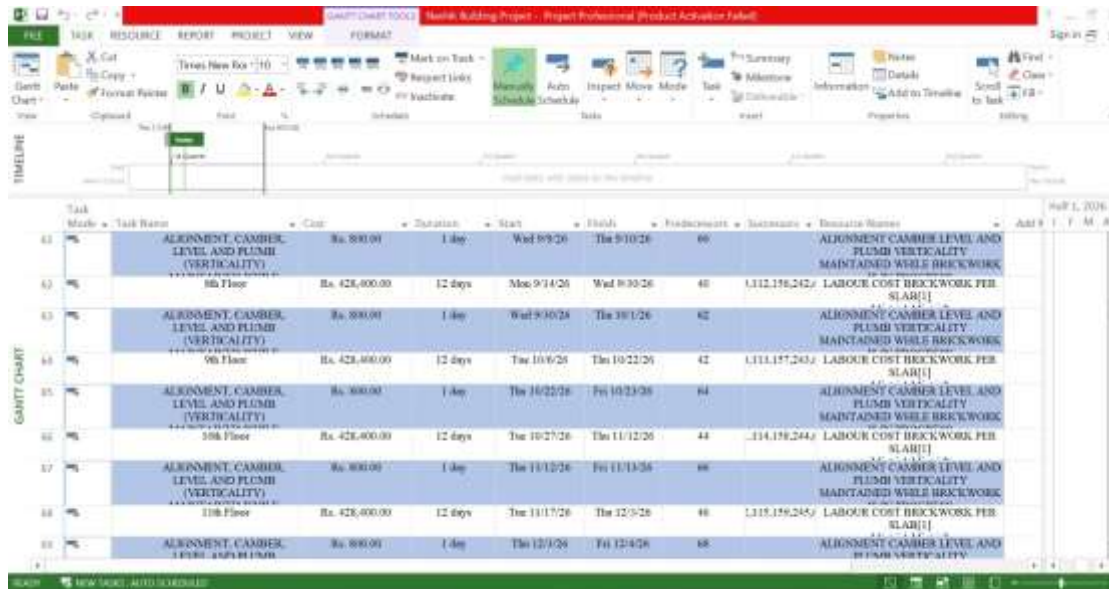


Fig 10. Brickwork alignment schedule

The brickwork alignment schedule represents the detailed organization of masonry work and associated alignment checks. Alignment checks are important because errors at this stage can lead to rework during plastering, openings, finishing, and service installation. The schedule shows that masonry is not only a quantity-driven activity; it also depends on quality-control steps and coordination with structural grids and service openings. In ANN optimization, masonry receives 9.42% duration saving and 6.40% cost saving, confirming that it offers meaningful improvement potential. The figure supports this finding because masonry work involves repeated units, labour crews, material movement, and zone-wise progress. Improved sequencing and resource deployment can therefore reduce waiting time, minimize rework, and improve downstream activity readiness.

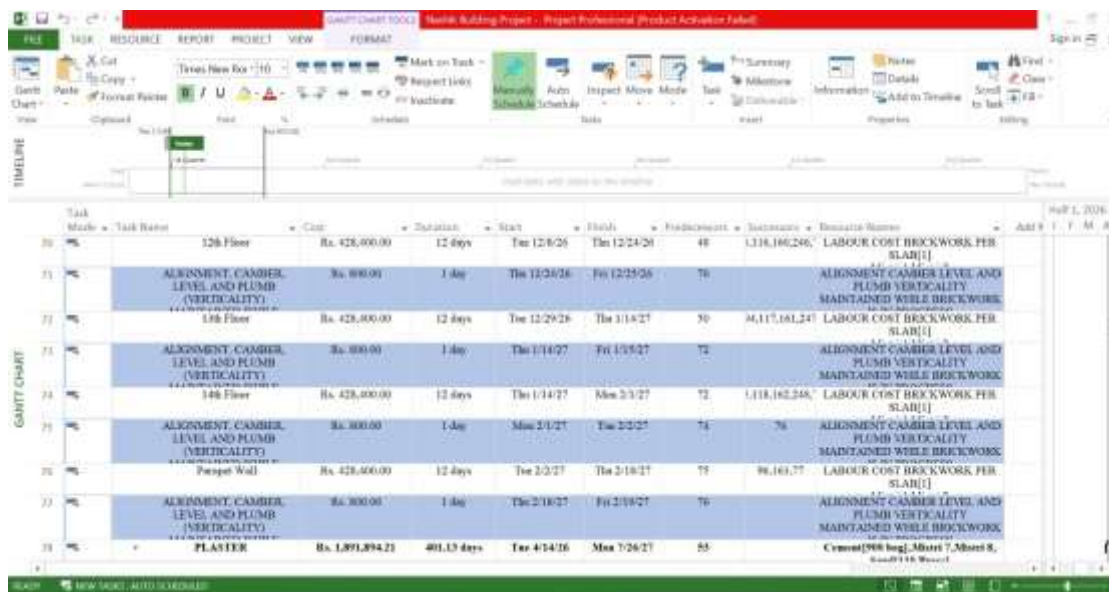


Fig 11. Upper floor brickwork schedule

The upper floor brickwork schedule illustrates the continuation of masonry activities in higher floors and associated parapet or wall-related tasks. Upper-floor masonry is affected by vertical transportation, material staging, labour movement, and availability of completed slab levels. These constraints make resource planning critical. If blocks, mortar, or crews are not available at the correct floor and time, labour productivity decreases and following plaster or MEP tasks are delayed. The ANN model captures such resource-related dependencies through activity repetition, material flow, and coordination index. The optimized masonry duration of 52.54 days and cost of Rs. 62.20 lakhs reflect improved coordination compared with the MSP baseline. Thus, the figure supports the need for data-driven control in repetitive upper-floor architectural works.

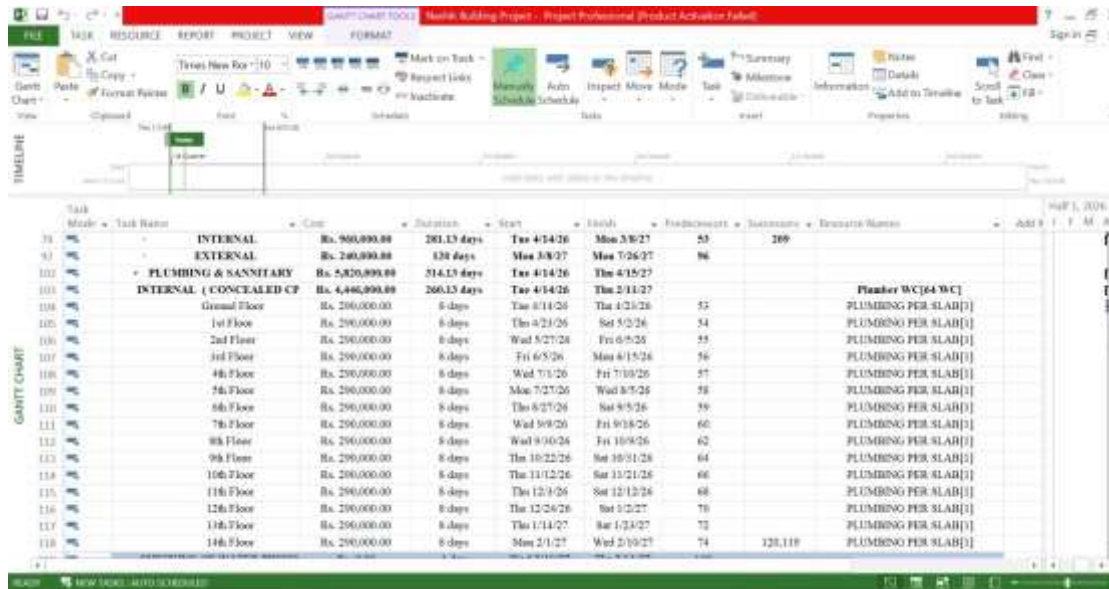


Fig 12. Plumbing and sanitary schedule

The plumbing and sanitary schedule shows service activities divided across internal, external, and concealed work packages. Service works are schedule-sensitive because they must coordinate with masonry, plaster, slab openings, wall chases, waterproofing, and final fixture installation. In the activity-wise comparison, MEP rough-in reduces from 67.00 days to 60.69 days, giving 9.42% duration saving. Its cost reduces from Rs. 71.56 lakhs to Rs. 67.55 lakhs, saving 5.60%. MEP final work reduces from 43.00 to 40.30 days and cost reduces from Rs. 49.07 lakhs to Rs. 47.11 lakhs. The figure therefore demonstrates that service coordination is a major area where ANN-based resource and sequencing optimization can improve project performance.

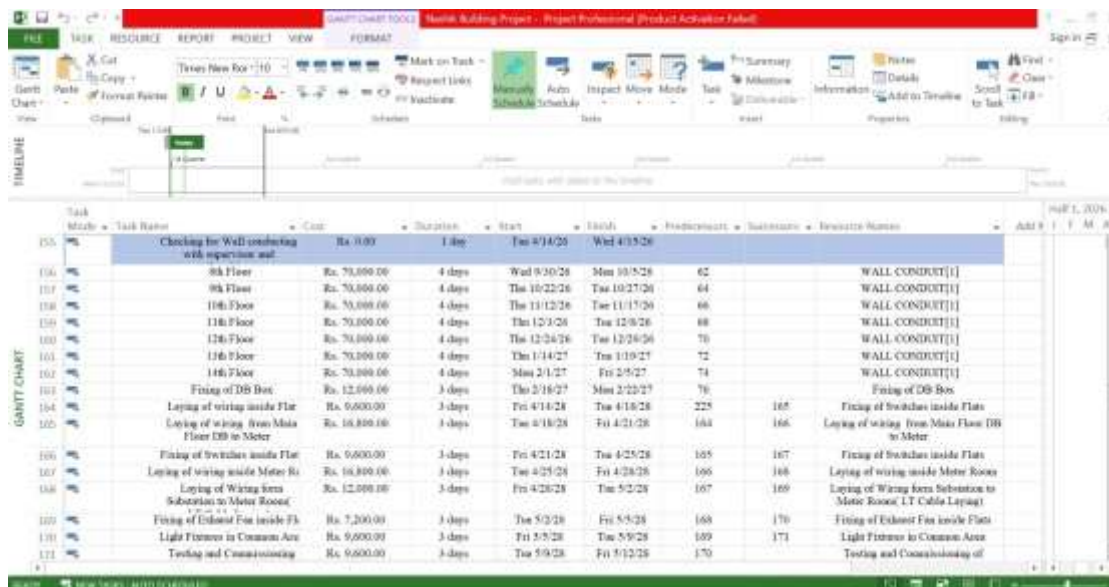


Fig 13. Electrical services schedule

The electrical services schedule presents conduit checking, DB box fixing, wiring, testing, and final service-related activities. These operations interact strongly with masonry, plaster, false ceiling, flooring, painting, and handover stages. Electrical scheduling requires careful sequencing because early rough-in delays can affect plastering and finishing, while late final fixture work can delay commissioning. The ANN model improves service performance by using resource and coordination features rather than treating electrical tasks as isolated activities. In the combined MEP results, rough-in shows 9.42% duration saving and 5.60% cost saving, while final MEP shows 6.28% duration saving and 4.00% cost saving. The figure confirms that service work is a coordination-driven package where learning-based planning can reduce idle time and rework.

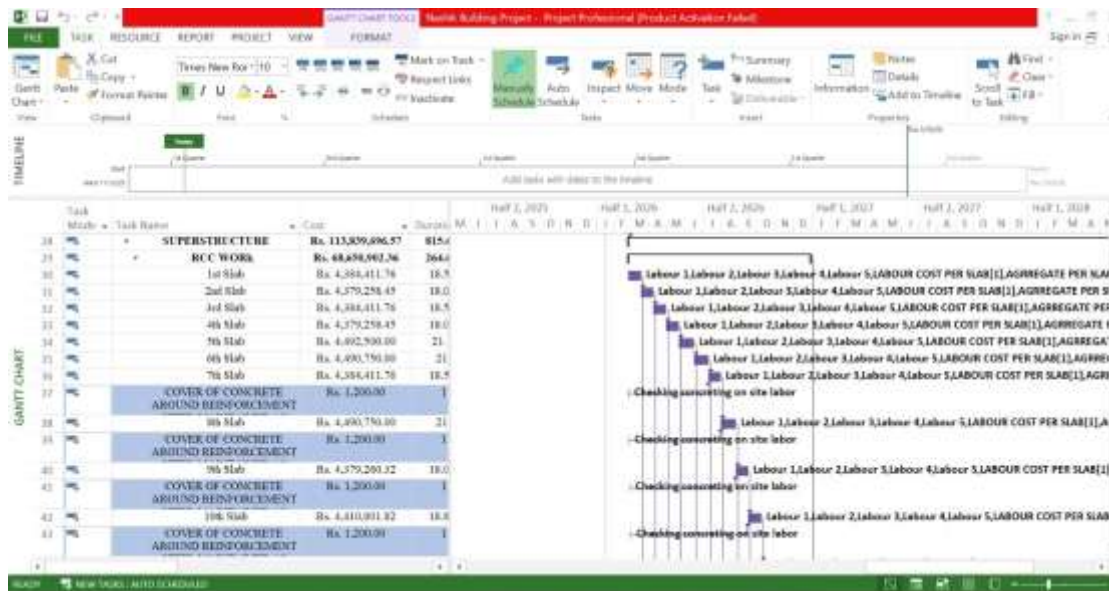


Fig 14. Superstructure RCC scheduling

The superstructure RCC scheduling figure focuses on slab-wise RCC progression from lower to upper floors. RCC frame superstructure is the highest duration and cost activity, requiring 160 days and Rs. 224.91 lakhs in the MSP baseline. After ANN optimization, it reduces to 141.16 days and Rs. 208.72 lakhs, saving 11.78% time and 7.20% cost. This major improvement is justified because RCC frame work depends on repeated column, beam, slab, reinforcement, shuttering, and concreting cycles. The figure also shows why deterministic scheduling may underuse learning effects across floors. ANN optimization captures repetition and resource intensity, thereby improving activity cycle planning. The graph confirms that the largest project gains arise from optimizing structural work rather than only minor finishing tasks.

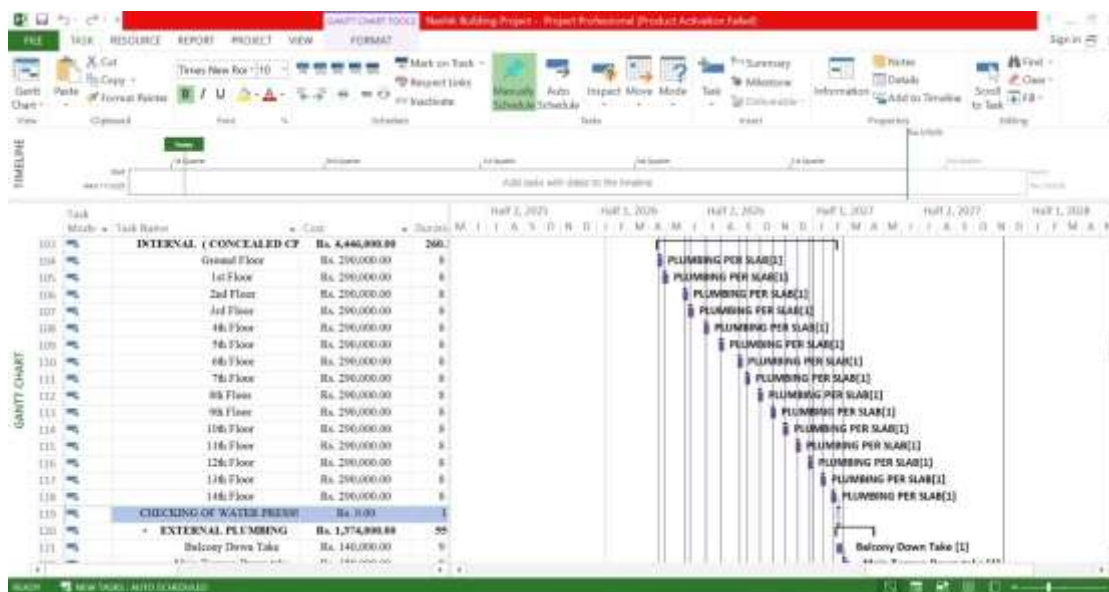


Fig 15. Concealed plumbing schedule

The concealed plumbing schedule shows floor-wise hidden service work, which must be completed before plastering, waterproofing, tiling, and final finishes. Concealed plumbing is critical because later corrections are costly and time-consuming. The schedule reveals the need for coordination among plumbing crews, masonry completion, wall chasing, inspection, and material supply. Although the figure is part of the service schedule, it directly affects downstream activities such as waterproofing and finishing. The ANN model improves the MEP rough-in package from 67.00 to 60.69 days, indicating that concealed service coordination benefits from optimized resource planning. The figure therefore demonstrates how ANN can support a smoother transition from structural and masonry work to services and finishing, reducing delays caused by incomplete hidden installations.

The resource-levelled plan reduces the total project duration from 907.56 days to 826.05 days. The time saving is therefore 81.51 days, corresponding to 8.98%. The project cost reduces from Rs. 117,055,100.57 to Rs. 110,458,304.48,

giving a saving of Rs. 6,596,796.09 or 5.64%. The improvement is obtained by resource balancing, controlled overlapping, better continuity of repeated floor cycles and reduction of idle time in high-cost activities. The plan does not change the project scope; it changes the planning quality and resource deployment pattern.

Table 6. Baseline and schedule summary

| Performance parameter | Baseline plan      | plan               | Saving           | Improvement |
|-----------------------|--------------------|--------------------|------------------|-------------|
| Project duration      | 907.56 days        | 826.05 days        | 81.51 days       | 8.98%       |
| Project cost          | Rs. 117,055,100.57 | Rs. 110,458,304.48 | Rs. 6,596,796.09 | 5.64%       |
| Cost in crore         | Rs. 11.71 crore    | Rs. 11.04 crore    | Rs. 0.66 crore   | 5.64%       |

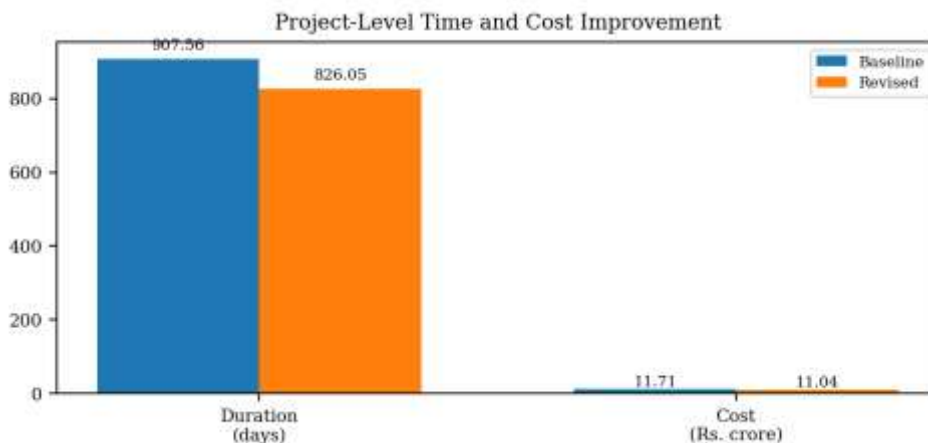


Fig. 16. Project-level duration and cost improvement

The overall result demonstrates that schedule improvement and cost improvement occur together when resource planning is applied to high-impact activities. The duration saving of 81.51 days is higher than the cost saving percentage because material quantities remain unchanged. Labour and equipment costs are more sensitive to improved sequencing, reduced idle time and smoother work-front availability. This confirms that resource leveling is a planning control method rather than a scope reduction method.

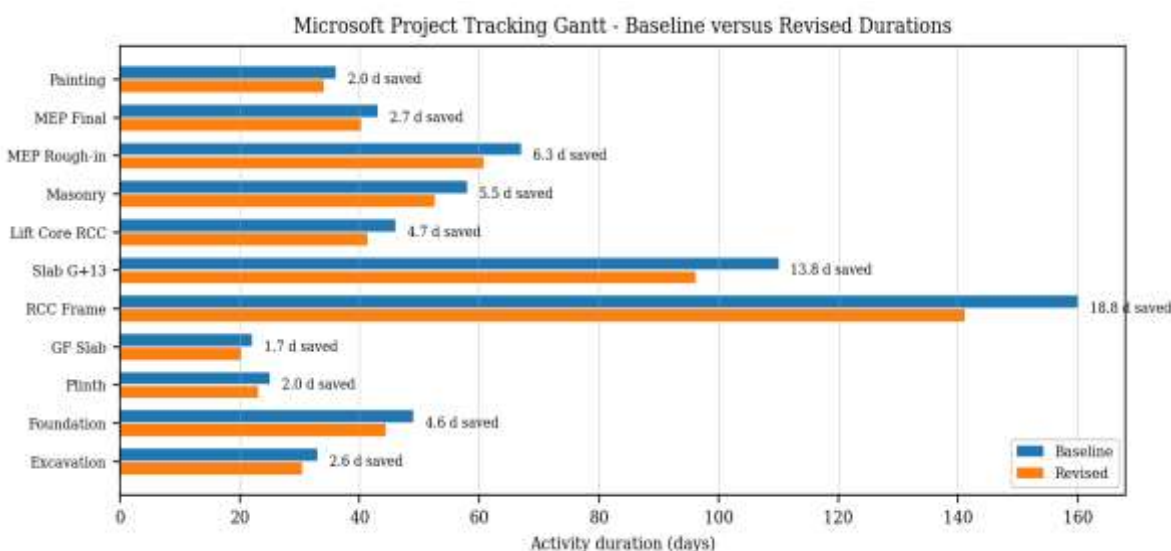


Fig. 17. Microsoft Project tracking Gantt for baseline and activities

The tracking Gantt highlights that slab casting, RCC frame, lift-core RCC, foundation, masonry and MEP rough-in provide the strongest improvement. Slab casting reduces from 110.00 days to 96.18 days, saving 13.82 days. RCC frame reduces from 160.00 days to 141.16 days, saving 18.84 days. MEP rough-in reduces from 67.00 days to 60.69 days, saving 6.31 days. These values show that the greatest scheduling gains are obtained where repeated work fronts, resource continuity and trade coordination can be improved.

## 8. Activity-Wise Comparative Analysis

Table 7. Activity-wise baseline and comparison

| Sr. | Activity          | Base days | Rev. days | Day save % | Base cost L | Rev. cost L | Cost save % |
|-----|-------------------|-----------|-----------|------------|-------------|-------------|-------------|
| 1   | Mobilization      | 19.00     | 17.81     | 6.28       | 15.33       | 14.72       | 4.00        |
| 2   | Survey            | 9.00      | 8.65      | 3.92       | 3.07        | 2.99        | 2.40        |
| 3   | Excavation        | 33.00     | 30.41     | 7.85       | 46.00       | 43.80       | 4.80        |
| 4   | Foundation        | 49.00     | 44.38     | 9.42       | 102.23      | 95.69       | 6.40        |
| 5   | Plinth            | 25.00     | 23.04     | 7.85       | 35.78       | 34.06       | 4.80        |
| 6   | GF Slab           | 22.00     | 20.27     | 7.85       | 30.67       | 29.44       | 4.00        |
| 7   | RCC Frame         | 160.00    | 141.16    | 11.78      | 224.91      | 208.72      | 7.20        |
| 8   | Slab G+13         | 110.00    | 96.18     | 12.56      | 163.57      | 150.48      | 8.00        |
| 9   | Lift Core RCC     | 46.00     | 41.31     | 10.20      | 56.23       | 53.08       | 5.60        |
| 10  | Masonry           | 58.00     | 52.54     | 9.42       | 66.45       | 62.20       | 6.40        |
| 11  | Internal Plaster  | 33.00     | 30.15     | 8.64       | 40.89       | 38.93       | 4.80        |
| 12  | External Plaster  | 28.00     | 25.80     | 7.85       | 32.71       | 31.14       | 4.80        |
| 13  | Flooring          | 4.00      | 3.75      | 6.28       | 51.12       | 49.07       | 4.00        |
| 14  | Doors/Windows     | 34.00     | 32.13     | 5.50       | 53.16       | 51.46       | 3.20        |
| 15  | Waterproofing     | 18.00     | 17.15     | 4.71       | 20.45       | 19.96       | 2.40        |
| 16  | MEP Rough-in      | 67.00     | 60.69     | 9.42       | 71.56       | 67.55       | 5.60        |
| 17  | MEP Final         | 43.00     | 40.30     | 6.28       | 49.07       | 47.11       | 4.00        |
| 18  | Painting          | 36.00     | 34.02     | 5.50       | 28.62       | 27.71       | 3.20        |
| 19  | Lift Installation | 30.00     | 28.82     | 3.93       | 30.67       | 29.93       | 2.40        |
| 20  | External Works    | 25.00     | 23.43     | 6.28       | 22.49       | 21.59       | 4.00        |
| 21  | Handover          | 15.00     | 14.41     | 3.93       | 25.56       | 24.94       | 2.40        |

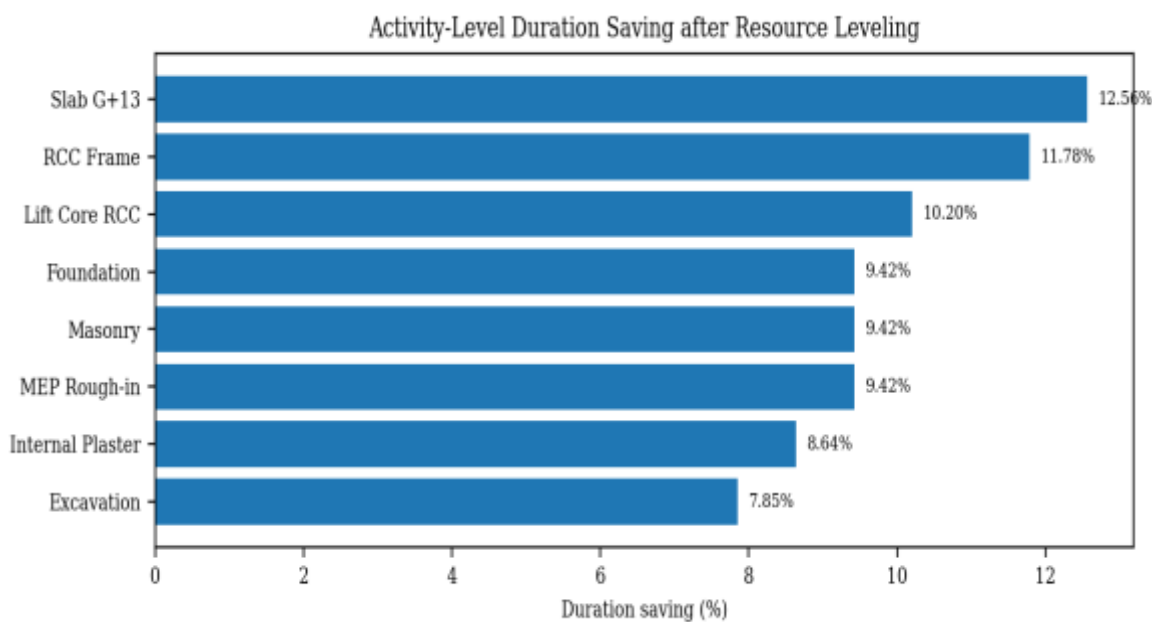


Fig. 18. Activity-level duration saving after resource leveling

Activity-wise results confirm that the plan improves performance primarily in activities where the schedule can practically influence productivity. Slab G+13 shows the highest duration saving of 12.56% and the highest cost saving of 8.00%. RCC frame gives 11.78% duration saving and 7.20% cost saving. Lift-core RCC gives 10.20% duration

saving. Foundation, masonry and MEP rough-in each give 9.42% duration saving. In contrast, survey, lift installation, waterproofing and handover show lower improvements because these tasks have limited float, specialized dependencies or approval-based completion requirements. The comparison also shows that cost saving is slightly lower than duration saving in nearly every activity. This is technically realistic because material cost is largely fixed once the scope and quantities are defined. For example, RCC frame and slab casting cannot reduce cement, steel or concrete quantity through scheduling alone; however, better crew movement, reduced waiting time and smoother equipment utilization can reduce time-dependent costs. This explains why the project achieves 8.98% duration saving but 5.64% cost saving at the overall level.

## 9. Validation of the Microsoft Project Plan

The plan is validated by checking whether the schedule improvement is obtained through acceptable planning actions. A resource-leveled plan is considered valid only when it keeps the technical scope unchanged, respects major construction dependencies, preserves safety and quality hold points, and avoids unrealistic compression of approval-based activities. In the selected project, the same 21 work packages are retained in both the baseline and schedules. The plan changes task timing, resource continuity and overlap control, but it does not remove excavation, foundation, RCC frame, slab casting, masonry, MEP, finishing, lift installation or handover activities. This confirms that the reported saving is a planning efficiency result rather than a scope-reduction result.

Validation is also carried out by comparing the activities with high savings against their resource and repetition characteristics. Slab casting and RCC frame are suitable for higher improvement because they are repetitive floor-cycle activities. Foundation and lift-core RCC are suitable for moderate improvement because they are major structural packages but include more quality and inspection constraints. Survey, waterproofing, lift installation and handover are suitable for only small improvement because they depend on technical checks, specialist work or administrative approvals. This pattern confirms that the plan follows construction logic and does not apply a uniform reduction percentage to all activities.

## 10. Schedule Monitoring and Control

After the baseline schedule is saved, Microsoft Project should be used as a live control document rather than a one-time planning file. The most important tracking fields are baseline start, baseline finish, actual start, actual finish, percentage complete, remaining duration, start variance, finish variance, work variance and cost variance. These fields allow the planning engineer to identify whether the project is losing time because of delayed task start, slow productivity, resource shortage, late material delivery or delayed approvals. For a high-rise RCC project, weekly updating is more suitable than monthly updating because structural floor cycles and MEP rough-in work can lose several days before the delay becomes visible in a monthly progress review.

The schedule should be controlled through look-ahead planning. A three-week look-ahead schedule can be extracted from Microsoft Project to check whether drawings, materials, labour, formwork, reinforcement, inspections and subcontractor handovers are ready before the task start date. This prevents the schedule from becoming a paper plan only. For example, if slab casting is planned after reinforcement fixing and electrical sleeves, the look-ahead review must confirm that shuttering, steel, RMC, pump, inspection team and curing arrangement are available. Such checks convert the resource-loaded schedule into a practical site execution tool.

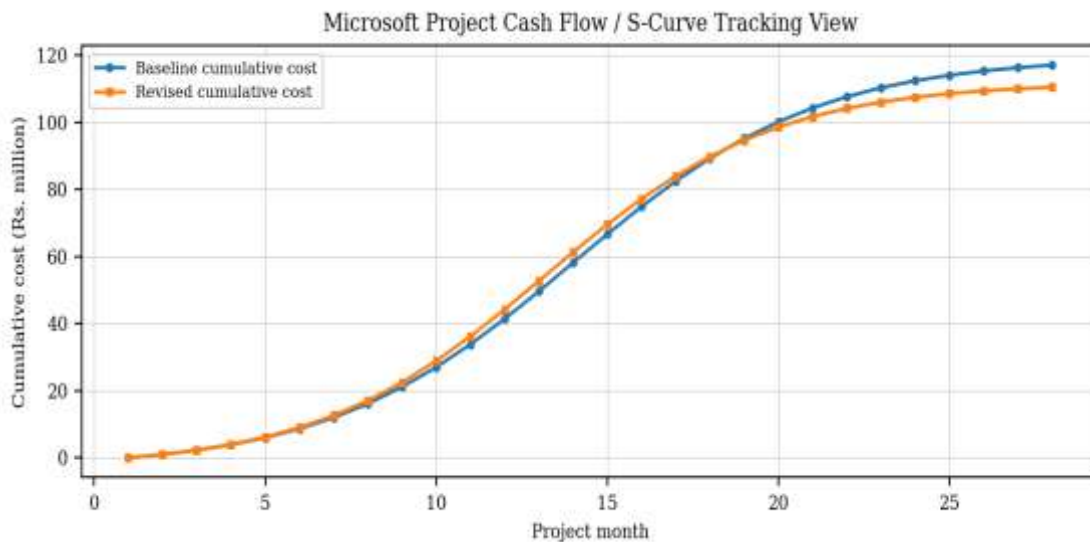


Fig. 19. Microsoft Project cash-flow S-curve for baseline and plan

The S-curve provides a financial control view for the project. The baseline cumulative cost reaches Rs. 117.06 million, while the curve reaches Rs. 110.46 million. The curve remains lower because smoother sequencing reduces time-dependent cost exposure. In project control practice, the S-curve should be compared with actual expenditure at each progress update. If actual cost rises faster than planned cost while physical progress remains low, the project manager must check wastage, idle labour, subcontractor claims, rework and procurement inefficiency. Thus, the S-curve connects the schedule plan with cash-flow monitoring.

## 11. Managerial Implications and Recommendations

The results provide practical implications for project managers and planning engineers. First, the WBS must be detailed enough to separate structural, masonry, finishing and MEP packages because each package has a different resource pattern. Second, repetitive floor cycles should be monitored separately because they provide the largest opportunity for time saving. Third, cost-loaded scheduling should be used from the baseline stage so that a planner can identify high-value activities before applying resource changes. Fourth, resource leveling should be carried out with attention to float and work-front availability rather than by shifting activities randomly. Fifth, the schedule must be updated frequently because resource balance achieved during planning can fail if material approvals, inspections or subcontractor handovers are delayed. For the selected project, managerial attention should be concentrated on six work packages: RCC frame, slab casting, foundation, masonry, MEP rough-in and lift-core RCC. These packages together determine the main time-cost performance of the project. The planning engineer should update their actual start, actual finish, percentage completion, remaining duration and resource assignment every week. If the actual progress falls behind the planned curve, Microsoft Project can be used to compare the current schedule with the saved baseline and identify whether delay recovery should be achieved through additional crew deployment, sequence, overtime, or rescheduling of noncritical work. The first recommendation is to freeze a realistic baseline before major execution begins, because an unapproved or frequently changing baseline cannot measure variance correctly. The second recommendation is to link cost with activity packages at the start of the schedule rather than adding cost at the end of the project. The third recommendation is to keep separate resource groups for masons, helpers, carpenters, bar benders, equipment and MEP crews because each resource group has a different availability and wage effect. The fourth recommendation is to use weekly schedule updating with site photographs, inspection status and material readiness notes. The fifth recommendation is to use the S-curve and tracking Gantt together so that time delay and cost impact are reviewed in the same meeting.

## 12. Limitations and Future Scope

The paper is limited to one G+13 residential building case and uses activity-group data rather than a complete daily site progress database. The plan represents a planning-level resource-leveled scenario and should be verified during execution through weekly progress updates. Future work can add earned value analysis, site productivity records, planned versus actual S-curves, contractor cash-flow tracking and delay responsibility analysis. Future studies may also compare multiple high-rise projects in different cities to evaluate whether similar duration and cost savings are achievable under different labour markets, access conditions and subcontractor arrangements. Future work should also include a detailed baseline file with all individual floor activities, resource calendars, holiday calendars, material

procurement lead times and subcontractor mobilization dates. A more detailed schedule would allow separate analysis of free float, total float, resource over-allocation and critical path change after each progress update. The method can also be extended by comparing planned value, earned value and actual cost so that schedule variance and cost variance are reported quantitatively. This would make the construction control system stronger for contract administration, delay claims and management decision-making.

### 13. Conclusion

This paper presents a Microsoft Project enabled schedule and resource planning study for a G+13 RCC residential project. The project baseline duration is 907.56 days with a planned cost of Rs. 117,055,100.57. After resource leveling and revision of activity sequencing, the project duration becomes 826.05 days and the cost becomes Rs. 110,458,304.48. The net saving is 81.51 days or 8.98% in time and Rs. 6,596,796.09 or 5.64% in cost. Activity-wise results show that slab casting gives the highest duration saving of 12.56%, followed by RCC frame at 11.78%, lift-core RCC at 10.20%, foundation at 9.42%, masonry at 9.42% and MEP rough-in at 9.42%. These results demonstrate that disciplined WBS preparation, baseline comparison, critical path review, resource leveling and cost-loaded scheduling can produce measurable improvement in high-rise residential construction planning. The study confirms that reliable project data and practical scheduling control are sufficient to identify time-cost savings without changing the technical scope of work.

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