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Evaluate of Project Management in Facade Works by Using Building Information Modeling (BIM)

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Abstract: Facade conservation projects present unique challenges in construction management due to uncertainties in material conditions, task durations, and resource requirements. These uncertainties often lead to schedule delays and cost overruns, making effective planning and resource optimization essential. This study integrates project management principles with resource optimization models to develop a structured approach for allocating limited resources under uncertain conditions. The present study focuses on two major areas: (1) project management of construction activities and (2) resource optimization using advanced scheduling tools. Two construction projects—Project A and Project B—were selected to examine the effectiveness of resource levelling and cost optimization through Primavera P6.

Keywords*: resource, optimization, management, conservation*

1. Introduction

The Facade of a building serves as both its aesthetic identity and its environmental interface. It plays a critical role in thermal performance, weather resistance, acoustic comfort, and energy efficiency, in addition to contributing to architectural beauty and cultural significance. In Facade conservation projects, the challenge extends beyond design and construction—it involves preserving and upgrading the existing building envelope while retaining its historical, architectural, or cultural character. Facade conservation is increasingly gaining importance across the world as cities focus on sustainable redevelopment and heritage preservation. Structures of historical value often require Facade restoration or conservation to extend their service life and maintain their architectural integrity.

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These projects are technically demanding because they involve repairing, cleaning, stabilizing, and re-engineering existing Facades sometimes with partial replacement of materials while keeping the visual identity intact. Effective management of time, cost, and resources is essential for successful execution of Facade projects. Delays, cost overruns, and quality compromises are common due to the complex interface between old and new materials, uncertain existing conditions, and limited accessibility. Therefore, optimization of schedule and cost is vital for ensuring technical, financial, and heritage success.

2. Literature Review

Nathania Dwi Damayanti (2025): The use of Value Engineering increases the value and performance of projects, with many benefits for projects and organizations, such as economical, technical, and managerial. This study discusses the application of the Value Engineering method in a 10-storey hotel construction project that aims to identify and reduce unnecessary costs without reducing the quality, function, and aesthetics of the building. The process begins with the collection of project technical data such as Detailed Engineering Design and Cost Budget Plan. Analysis was carried out on several work items, including formwork, ceiling, and Facade, using the Breakdown Cost Model, FAST Diagram, and function analysis

Mohammad Mayouf (2024): Given the heightened importance of revolutionizing 4D BIM-based construction scheduling in modular construction, it has become vital to explore how 4D-BIM could be integrated with the lean concept. Therefore, this research aims to develop a lean-integrated process model to revolutionize the 4D BIM-based construction scheduling in modular construction projects. A case study approach was used to obtain the data. The data was obtained using semi-structured interviews with construction scheduling professionals, site observations, and extracts from the BIM model used within the selected case in the UK. Findings showed that conventional (component/object based) 4D BIM supersedes conventional scheduling methods in terms of foreseeing potential implications during design and construction

Yasser M. R. Aboelmagd (2024): The Earned Value Method is crucial for project forecasting because it provides an integrated approach to measuring cost, schedule, and performance which enables project managers in early identifying the deviations in the projects. Therefore, the study aimed to explore the role of earned value methodology in the construction projects of private and public sector buildings. For this purpose, the case study approach and quantitative data collected were analyzed on the cost performance index, schedule performance index, and cost variance percentage. The Project One public sector university building construction results indicated that the cost performance index was lower than 1 which indicated that there was no proper implementation of the earned value method in the cost forecasting

3. Methodology

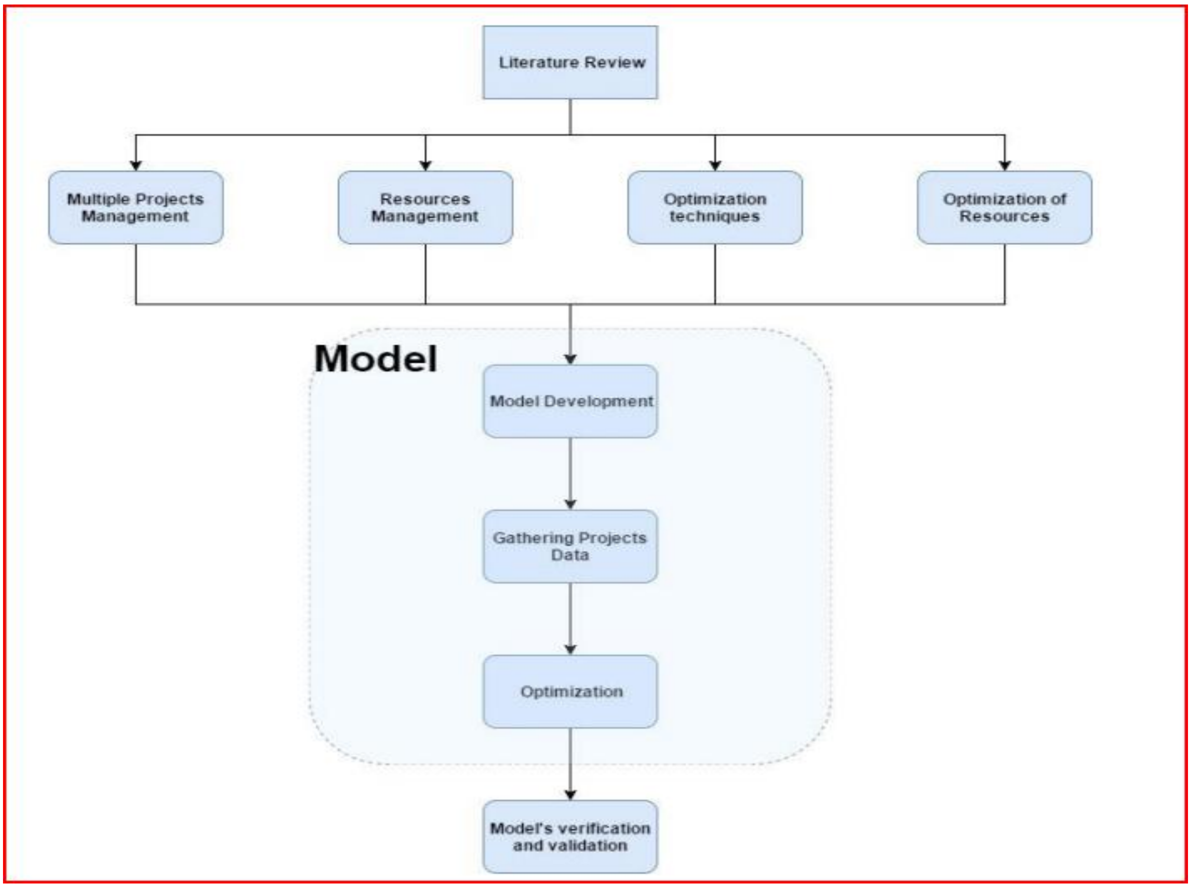


Figure 1. Case study flow diagram

4 Projects Description

PROJECT -A

Sl. No.	Particular	Details
1	Project Name	Budget Hotel
2	Project Type	Commercial – 4/5 Star Hotel
3	Project Location	Mahabubnagar, Telangana
4	Total Land Area	19,910 Sq. m (4.92 Acres)
5	Site Area Under Development	2,454 Sq. m (26,398 Sq. ft)
6	Number of Blocks	2 Blocks
7	Number of Floors	2 Basements + Ground + 7 Floors + 2 Roof Levels
8	Project Cost	₹ 30 Crores
9	Total Built-up Area	**15,097 Sq. m**

Floor Level	Area (Sq. m)
Basement Floor (Each)	2,259 Sq. m
Ground Floor	1,286 Sq. m
Typical Floor	1,147 Sq. m
Roof Area	632 Sq. m
Total Built-up Area	**15,097 Sq. m**

PROJECT B

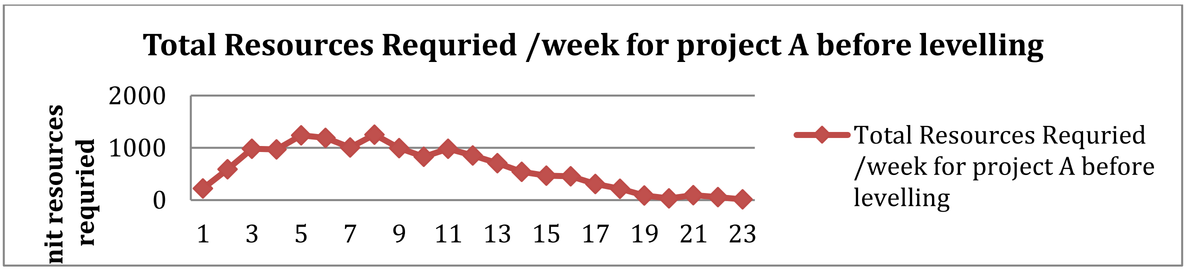
Sl. No.	Particular	Details
1	Project Name	Hospital Block
2	Project Type	Educational Institution
3	Project Location	Mahabubnagar, Telangana
4	Total Land Area	15,621 Sq. m (3.86 Acres)
5	Number of Floors	Ground + 2 Floors
6	Project Cost	₹ 10 Crores
7	Total Built-up Area	**12,302 Sq. m**

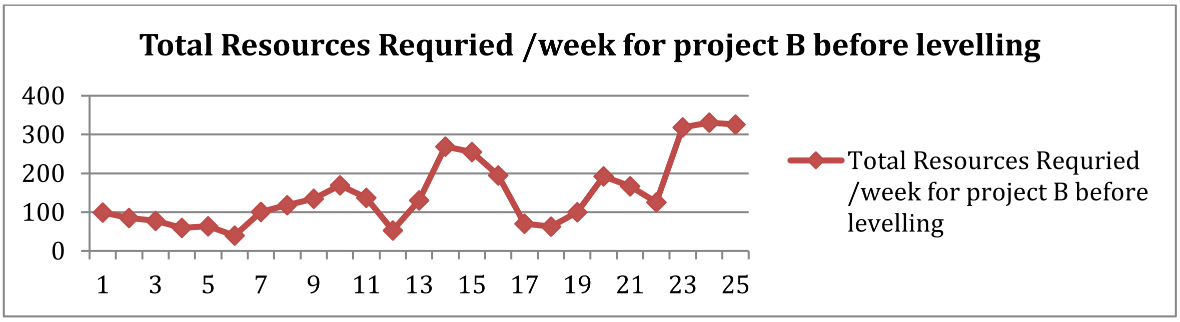
Floor Level	Area (Sq. m)
Ground Floor	4,350.76 Sq. m
First Floor (Typical)	3,876.72 Sq. m
Second Floor (Typical)	3,876.72 Sq. m
Total Built-up Area	**12,302 Sq. m**

5 Results And Discussions

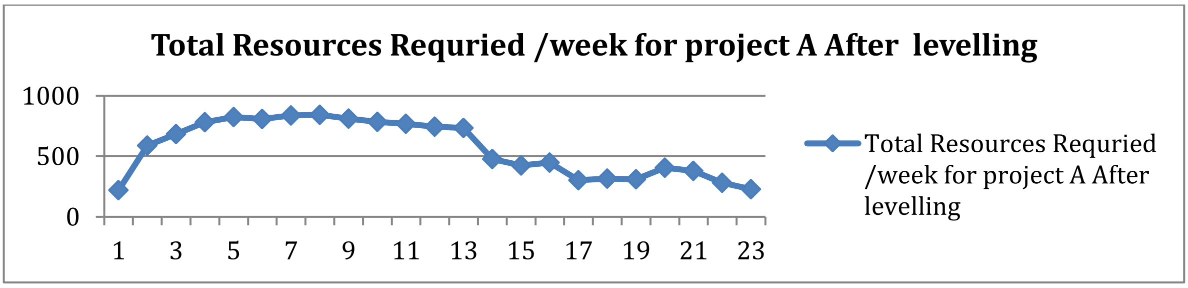
The scope of this study is focused on evaluating and optimizing resource allocation across two construction projects through systematic planning, scheduling, and levelling techniques. Construction companies need and adequate resource optimization to improve the profitability and productivity of the organization. The main aim during the construction process is completing the project on time and within the budget while meeting the established quality and requirements and specifications. Resource levelling helps an organization to make use of the available resources to the maximum. The idea behind resource levelling is to reduce wastage of resources i.e., to stop over allocation of resources.

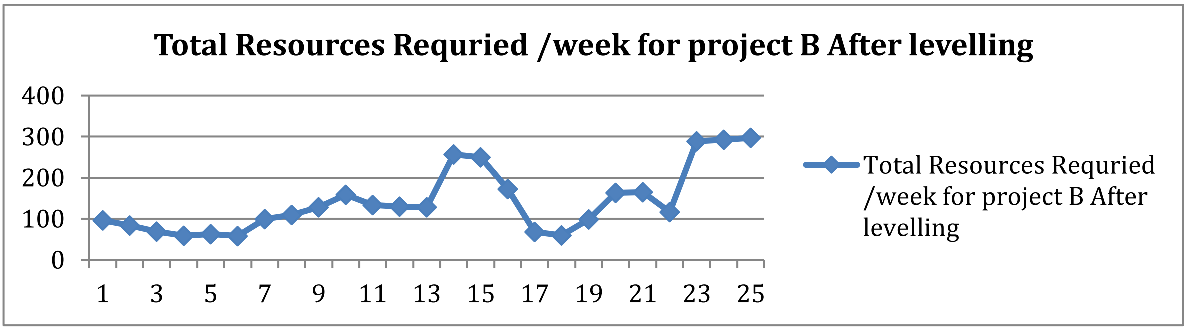
5.1 Before Resources Levelling

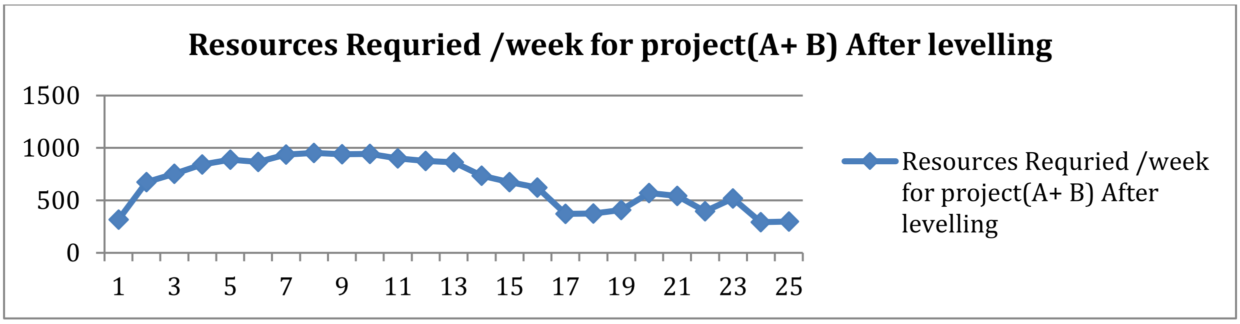




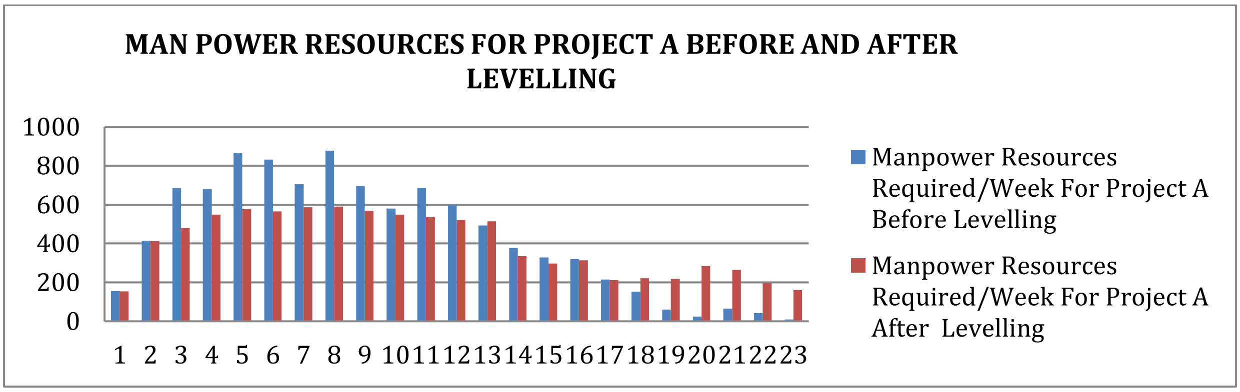
5.2 After Resources Levelling

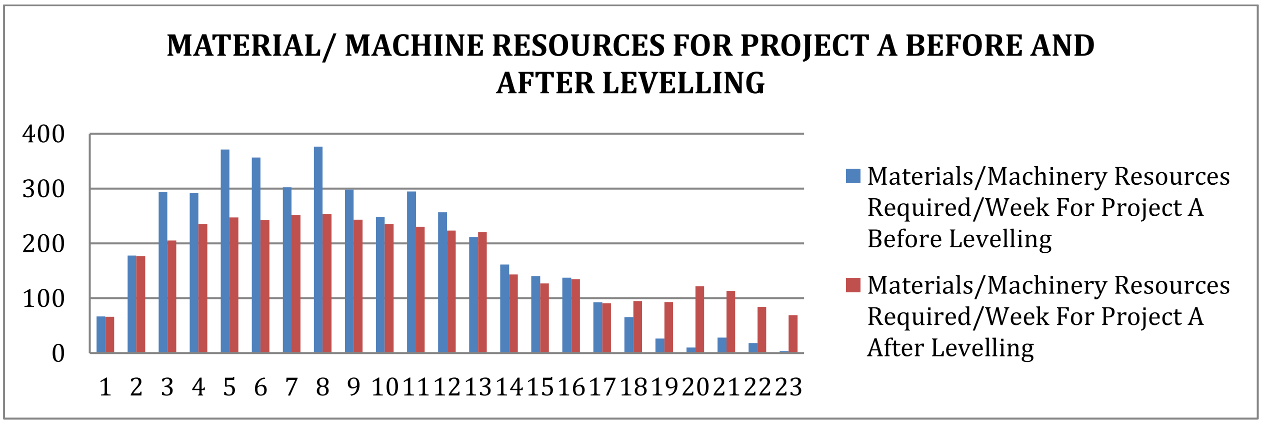


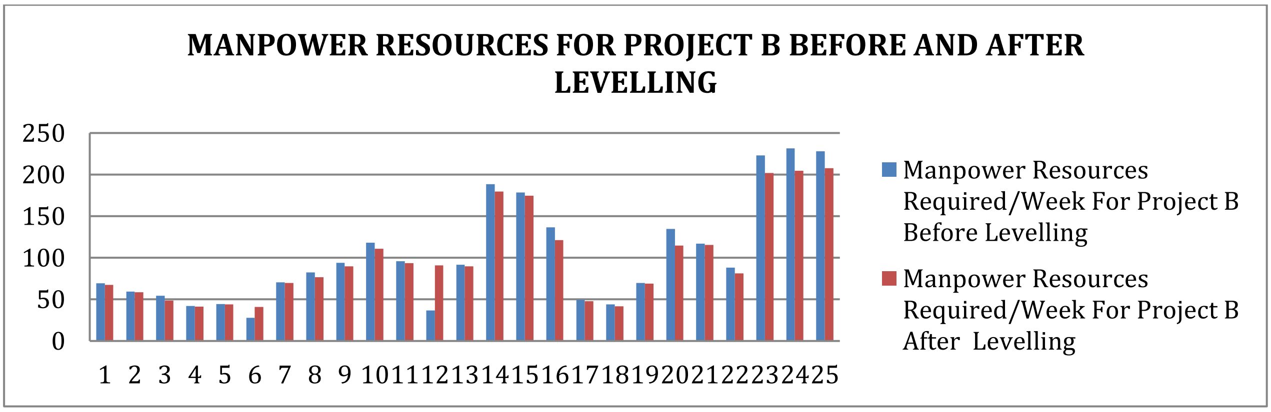


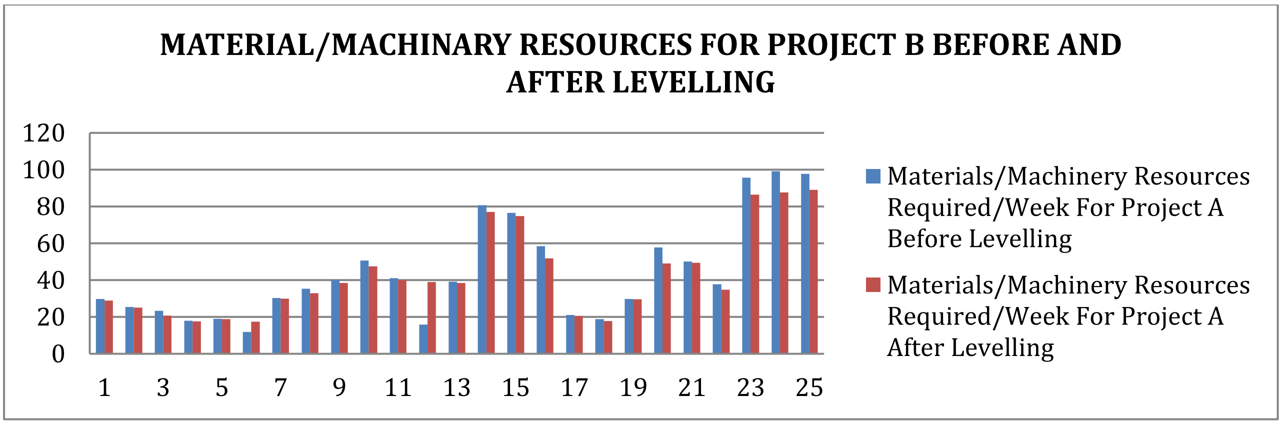


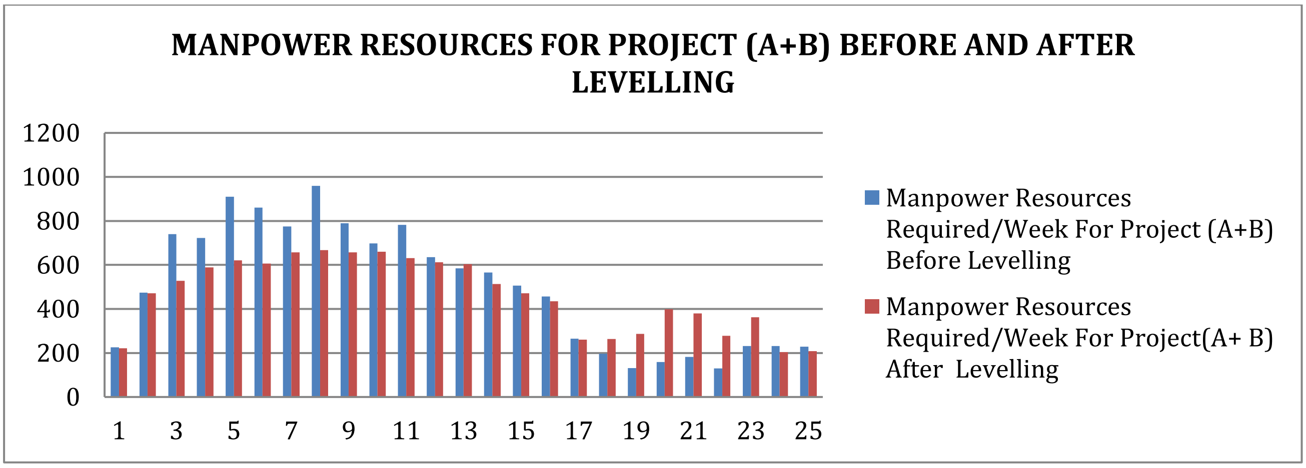
5.3 Manpower/Material/Machine Resources For Project A & B

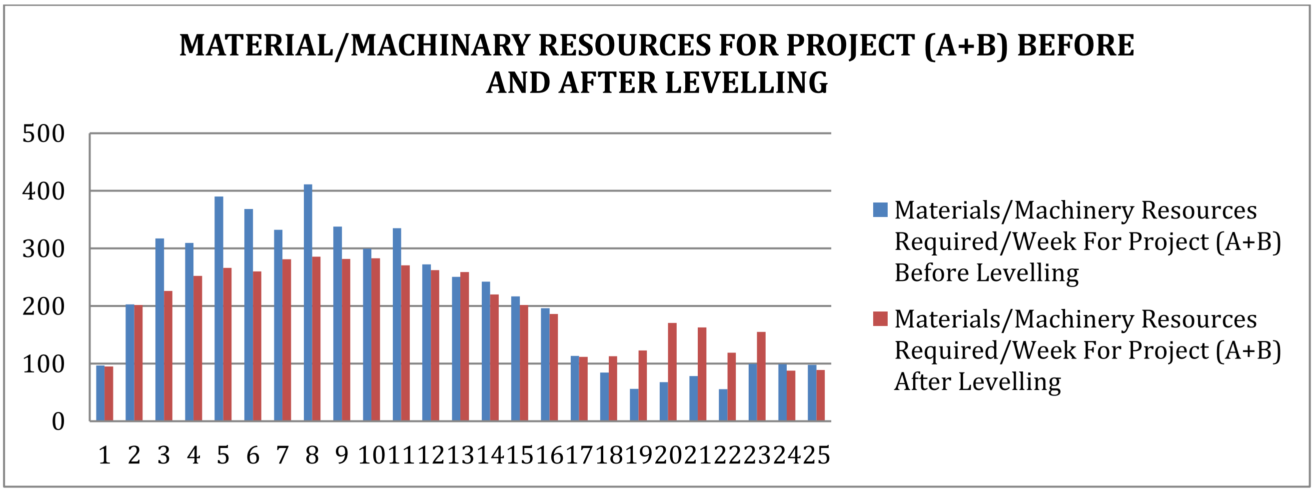










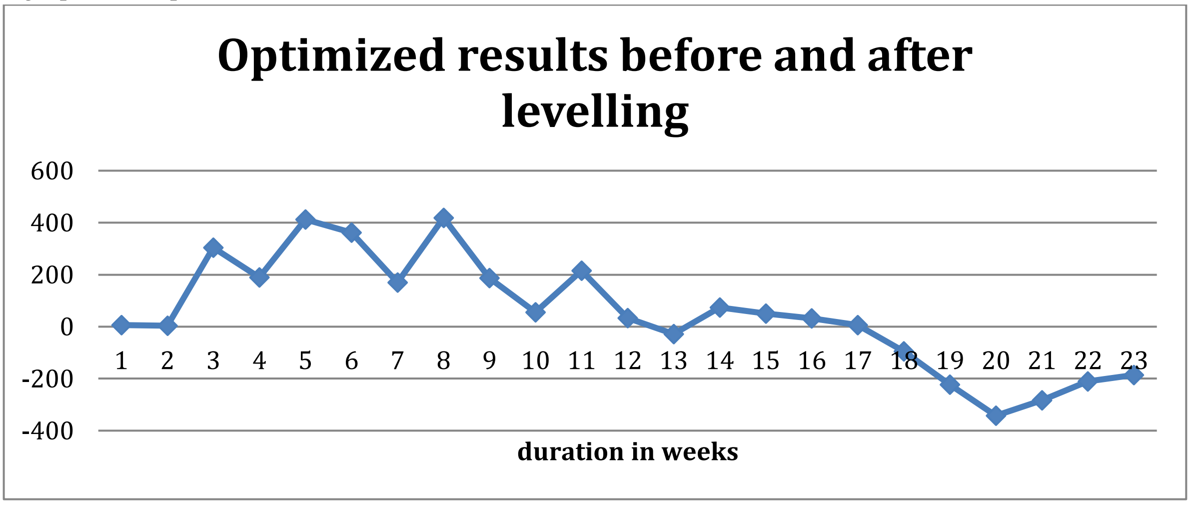


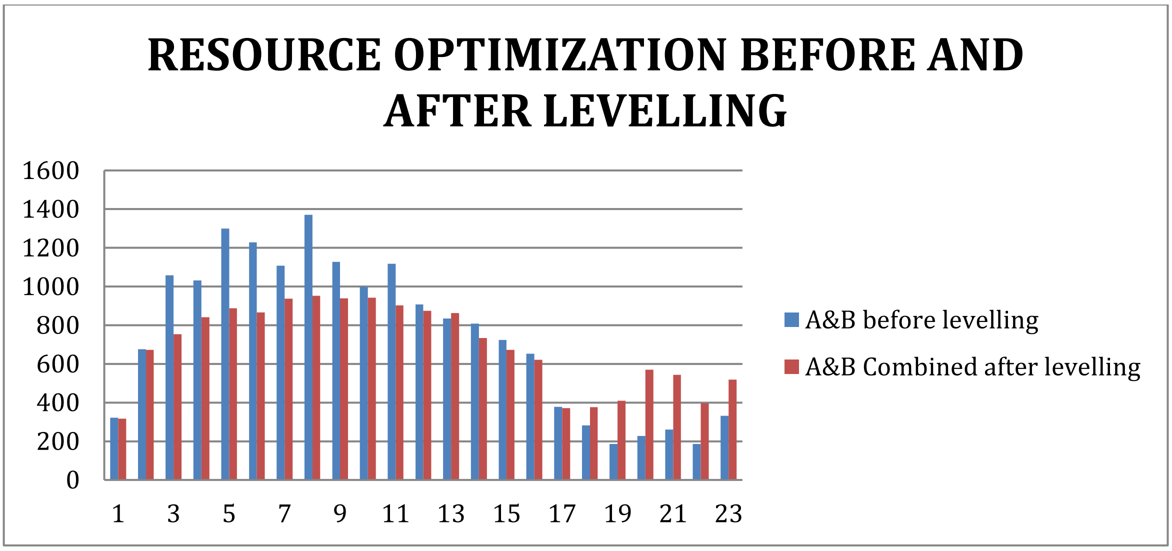
6 Optimizations Of Resources

Duration (weeks)	A&B before levelling	A&B Combined after levelling	Optimized results
week1	322.3	316.54	5.76
week2	676.48	673.18	3.3
week3	1057.49	753.95	303.54
week4	1031.53	841.64	189.89
week5	1300.05	887.57	412.48
week6	1228.87	866.62	362.25

week7	1107.55	937.99	169.56
week8	1371.48	952.73	418.75
week9	1126.96	939.36	187.6
week10	997.84	942.58	55.26
week11	1117.94	901.86	216.08
week12	908	874.47	33.53
week13	835.13	862.89	-27.76
week14	807.65	733.96	73.69
week15	723.12	672.8	50.32
week16	653.33	621.22	32.11
week17	378.16	371.66	6.5
week18	281.51	375.68	-94.17
week19	186.69	409.35	-222.66
week20	226.7	569.06	-342.36
week21	260.53	543.4	-282.87
week22	185.77	396.72	-210.95
week23	331.66	517.77	-186.11
Total	17116.74	15963	**6.74%**

The comparison shows that resource levelling and combination of Projects A and B have led to an overall optimization of 6.74% in total weekly resource demand, reducing the cumulative requirement from 17,116.74 units to 15,963 units. Significant resource savings are observed during the early and mid-project phases (Weeks 3–12), where large positive optimized values indicate effective peak reduction and smoother allocation. However, negative optimized values in later weeks (Weeks 13–23) indicate a shift and redistribution of resources toward the later stages, confirming that levelling has transferred peak loads rather than eliminated them entirely, resulting in a more balanced and manageable overall resource profile.





As per the above figure the total resources required for project A+B before and after levelling is shown for a period of 23 weeks, there is a significant reduction in resources after combined levelling, rather than individual levelling of projects.

7.Total Reduction In Project Cost After Levelling Resources Will Be

PROJECT A	30 CRORES
PROJECT B	10 CRORES
TOTAL	40 CRORE
AS PER LEVELLING THE DIFFRENCE IS 6.74%	
TOTAL PROJECT COST * RESOURCES DIFFERENCE	
40 CRORES *(6.74/100)	
2.6 CRORES	

The total project cost of Projects A and B combined is ₹40 crore (Project A: ₹30 crore and Project B: ₹10 crore). Based on the resource levelling results, an overall optimization of 6.74% is achieved in resource utilization. Applying this percentage reduction to the total project cost:

$$\text{Cost Saving} = 40 \text{ crore} \times \frac{6.74}{100} = 2.696 \text{ crore}$$
$$\approx ₹\mathbf{2.6} \text{ crore}$$

This indicates that resource levelling can potentially lead to a cost saving of approximately ₹2.6 crore, primarily due to reduced peak manpower demand, improved equipment utilization, lower overtime requirements, and minimized idle resources, thereby enhancing the overall cost efficiency of the combined project execution.

8. Conclusions

- Maximizing resource utilization efficiency by directly measuring and minimizing undesirable resource fluctuation. In project completion times some other variables also affect construction projects such as activity durations, early start time, late start time, early completion time, late completion time.
- The first case consisted of a scheduling and allocation of resources for individual projects is done. In project A (Land mark hotel Block 1) consist of 223 activities and having project duration of 161 days, and project B (BLOCK 2) consist of 170 activities with a completion time period of 175 days.
- Optimization techniques adopted for the analysis of current projects (A & B) fluctuations have been observed during compilation.
- The above results show, when projects (A & B) optimized individually the summation of resources are 17116.74.
- When levelling of both the projects (A & B) combining the resources is optimized from 17116.74 to 15963**, (6.74 %)** have been reduced.
- While the resources of project (A & B) scheduling and its allocation shows its peak performance in the middest of the projects, methodology shows depreciation at initial and concluding stages of allocation.
- As per the above results there is a decrease in resources unit for project A and project B of 6.74% and there is a reduction of cost of the project as the percentage of resources are reduced by using resources levelling method.
- The reduction of total project cost (A+B) is about 2.6 crores by using resources levelling method and optimization of resources in multiple projects.
- The duration of the project is also reduced by optimization of resources for multiple projects.
- A potential direction for further study could be to develop for the optimal utilization of limited resources for organization having multiple projects.

9. Future Scope Of Study

One important avenue for further research is the development of improved models of resource optimization for multiple projects. The model developed in this dissertation is felt to be generally applicable but this is an initial model and further refinements are important to understand how to effectively assign workers to tasks.

An important area for further work would be developed a feedback process for projects having limited resources and are bounded in a fixed time.

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