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A Critical Analysis & Tracking of Material Management on Construction Site by using Web Based System

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Abstract: Material management is a critical factor influencing the cost, time, and efficiency of construction projects, as materials constitute a major portion of total project expenditure. However, conventional material management practices on construction sites are often characterized by manual processes, fragmented data handling, lack of real-time tracking, and poor coordination among stakeholders, leading to issues such as material wastage, overstocking, stock-outs, delays, and increased project costs. This study focuses on the critical analysis and tracking of material management on construction sites using a web-based system to address these challenges. The research evaluates existing material management practices, identifies key inefficiencies in storage, handling, procurement, and tracking, and proposes a dynamic, integrated, and technology-driven solution. The developed web-based system enables real-time monitoring of material flow, inventory levels, procurement status, and site consumption, ensuring better transparency and coordination among project stakeholders. The system further incorporates advanced features such as BIM integration, optimization-based material ordering, analogy-based decision support, and reclamation tracking to minimize waste and improve resource utilization. By aligning material procurement with construction schedules and enabling continuous data analysis, the proposed system enhances decision-making, reduces delays, and improves cost control. A comparative analysis of project performance before and after implementation demonstrates significant improvements in efficiency, inventory accuracy, and overall project productivity. The study concludes that web-based material management systems play a vital role in transforming traditional construction practices into more efficient, data-driven, and sustainable processes.

***Index Terms*–Material Management, Construction Site, Web-Based System, Real-Time Tracking, BIM Integration, Inventory Control, Procurement Management, Optimization Techniques, Analogy-Based System, Reclamation Tracking, Supply Chain Coordination, Construction Efficiency, Cost Control, Material Flow Analysis**

1. INTRODUCTION

Material management is a fundamental component of construction project success, as it directly influences project cost, time, quality, and overall productivity. In modern construction practices, materials typically account for nearly 40–60% of the total project cost, making their efficient planning, procurement, storage, and utilization critically important. However, despite this significance, many construction sites still rely on conventional and fragmented material management practices, such as manual record-keeping, disconnected spreadsheets, and informal communication systems. These traditional approaches often result in inaccurate inventory data, material wastage, delays in procurement, overstocking, stock-out situations, and poor coordination among stakeholders. Such inefficiencies not only increase direct and indirect project costs but also disrupt construction schedules, reduce labor productivity, and negatively affect overall project performance.

The complexity of construction projects has further increased in recent years, particularly in urban environments where space constraints, traffic congestion, multi-storey construction, and strict regulatory requirements add additional challenges to material handling and logistics. The dynamic nature of construction activitiescharacterized by frequent design changes, uncertain demand patterns, and varying site conditionsmakes it difficult to accurately forecast material requirements and align procurement with actual site execution. Moreover, the involvement of multiple stakeholders, including contractors, subcontractors, suppliers, and site engineers, often leads to fragmented supply chains and information asymmetry, resulting in delays, duplication of materials, and inefficient resource utilization. These challenges highlight the need for a more integrated, responsive, and data-driven approach to material management on construction sites.

In this context, the adoption of web-based material management systems has emerged as a practical and effective solution to overcome the limitations of traditional methods. A web-based system provides a centralized platform that enables real-time tracking, monitoring, and control of material flow across all stages of the construction process, including planning, procurement, storage, and usage. By integrating technologies such as Building Information Modelling (BIM), mobile applications, and automated data capture systems (e.g., barcoding or RFID), these platforms enhance transparency, improve communication among stakeholders, and ensure accurate and up-to-date information availability. This real-time visibility allows project teams to make informed decisions, respond quickly to changes, and minimize risks associated with material shortages, overstocking, and delays.

The present study focuses on the critical analysis and tracking of material management on construction sites using a web-based system. It aims to evaluate existing material management practices, identify key inefficiencies in storage, handling, tracking, and procurement, and develop a dynamic and integrated system that supports real-time decision-making. The proposed approach emphasizes the use of optimization techniques, analogy-based reasoning, and BIM integration to regulate material ordering, inventory control, and payment scheduling. Additionally, the system incorporates reclamation tracking to monitor surplus and reusable materials, thereby promoting cost efficiency and sustainable construction practices.

By comparing project performance before and after the implementation of the proposed system, this research seeks to demonstrate the effectiveness of web-based material management in reducing material waste, improving inventory accuracy, enhancing coordination, and optimizing resource utilization. Ultimately, the study contributes to the development of a more efficient, transparent, and intelligent material management framework that addresses the challenges of modern construction projects and supports improved project delivery in terms of cost, time, and quality.

2. Analysis

Optimum Storage

1. Optimum Storage of Site 1 – Niwara Pride

The optimum storage of materials at Site 1 – Niwara Pride is a critical aspect of effective material management, as it directly influences cost control, space utilization, material safety, and overall construction efficiency. Based on the analysis of Economic Order Quantity (EOQ), consumption patterns, and floor-wise material requirements, the storage strategy must be carefully planned to balance material availability with limited site space and handling efficiency. In this project, the adoption of a web-based material management system plays a key role in determining optimum storage levels by providing real-time data on inventory, consumption rate, and procurement schedules.

For **steel reinforcement**, the analysis indicates that the EOQ is relatively small and the material requirement per floor is limited. Therefore, storing steel below approximately 3.5 tonnes is considered economical and efficient. Excess storage should be avoided due to risks of corrosion, space blockage, and capital lock-up. The web-based system helps monitor stock levels and triggers reordering when minimum levels are reached, ensuring continuous availability without overstocking.

In the case of **RCC concrete and PCC concrete**, these materials are not suitable for storage due to their perishable nature and dependency on immediate usage after batching. Hence, they follow a just-in-time (JIT) supply approach, where materials are ordered and delivered as per daily or activity-based requirements. The system integrates scheduling data to align concrete delivery with site activities, minimizing waste and ensuring quality.

For **brick masonry**, moderate storage is required because of its bulk usage and relatively stable nature. The analysis suggests maintaining stock for approximately one month, typically in the range of 7000–10000 units, depending on consumption rate. Proper stacking, protection from weather, and allocation of designated storage zones are essential. The web-based system assists in tracking stock levels and consumption trends, avoiding both shortages and excessive accumulation.

Plastering materials require a controlled and continuous supply rather than large storage. The study indicates that approximately two trips every three days are sufficient to meet site demand. Since plaster materials are sensitive to moisture and damage, limited storage with frequent replenishment is preferred. The system ensures timely scheduling of deliveries based on work progress and consumption rates.

For **flooring materials**, storage is planned floor-wise to reduce handling distance and improve efficiency. Materials are stored in stacks sufficient for one floor at a time, minimizing double handling and risk of damage. This approach also improves coordination with finishing activities and reduces site congestion. The web-based system helps in planning delivery schedules according to floor completion status and installation sequence.

Site 1 - Niwara Pride														
Sr. No.	Material	Floor	Quantity	Area	Material Rate	Unit	Total Cost	Annual Consumption	Cost Per Order	EOQ	Number of Orders	One Floor Quantity	Requirement of One floor Order	Optimum Storage	EOQ Quantity
1	**Steel Reinforcement**	10	84.32	2167	7000	MT	590240	295120	1100000	24866.58	12	8	2	<3.5 Tones Hence economic	4
2	**RCC Concrete**	10	455.09	2167	5800	cu. m	2639522	1319761	33000	10005.99	132	46	26	Not Stored	2
3	**PCC Concrete**	10	71.53	197	4500	cu. m	321885	160942.5	27000	3588.23	45	7	9	Not Stored	1
4	**Brick Masonry**	10	588.47	2167	4800	cu. m	2824656	1412328	21000	9076.66	156	59	31	Stored in months around 7000-10000	2
5	**Plaster**	10	14146.74	2167	200	sq. m.	2829348	1414674	15000	37612.15	38	141	8	2 trip per three days	19
6	**Flooring Material**	10	2137.49	2167	1850	sq. m.	3954356.5	1977178.25	48000	26153.33	76	214	15	store in stack for one floor	14

Table No 2.1 Optimum Storage of Niwara Pride

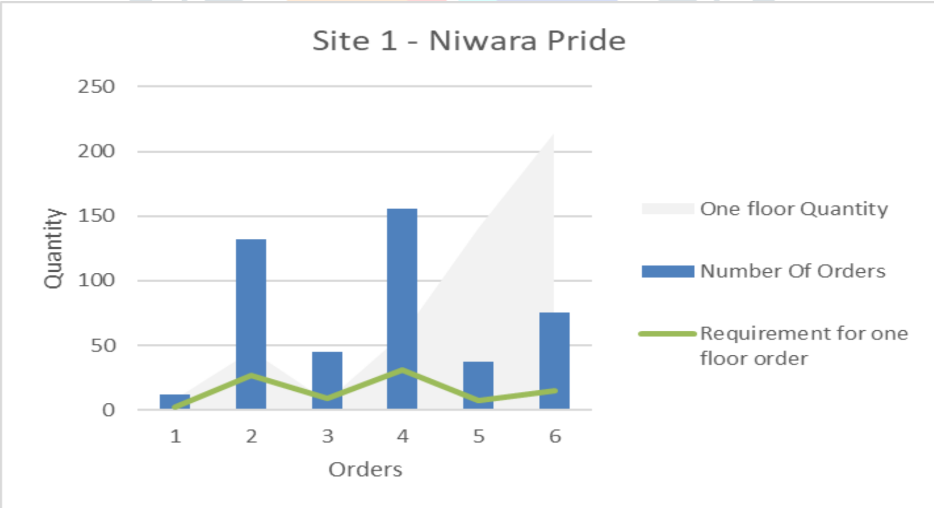

Figure 2.1 Optimum Storage of Niwara Pride

Overall, the optimum storage strategy at the site is achieved by integrating EOQ analysis, floor-wise demand, and real-time tracking through a web-based platform. This approach reduces material wastage, minimizes storage space requirements, improves handling efficiency, and ensures timely availability of materials.

2. Optimum Storage of Site 2- ACE Avenue

The optimum storage strategy for Site 2 – ACE Avenue is designed to balance material availability with space efficiency by using EOQ analysis and a web-based material management system. Materials like steel reinforcement are stored in limited quantities (below approximately 3.5 tones) to avoid corrosion, theft, and excess capital lock-up, while still ensuring continuous work. RCC and PCC concrete are not stored due to their perishable nature and are supplied using a just-in-time approach aligned with daily construction activities. For brick masonry, moderate storage is maintained based on monthly consumption (around 7000–10000 units), ensuring uninterrupted work without overloading site space. The web-based system enables real-time monitoring of inventory levels, consumption rates, and procurement schedules, ensuring timely reordering and better coordination among stakeholders.

Site 2 - ACE Avenue														
Sr. No.	**Material**	**Floor**	**Quantity**	**Area**	**Material Rate**	**Unit**	**Total Cost**	**Annual Consumption**	**Cost Per Order**	**EOQ**	**Number of Orders**	**One Floor Quantity**	**Requirement of One floor Order**	**Optimum Storage**	**EOQ Quantity**
1	Steel Reinforcement	8	78.4	1734	7000	MT	548800	313600	1100000	25633.31	12	10	3	<3.5 Tones Hence economic	4
2	RCC Concrete	8	666	1734	5200	cu. m	3463200	1978971.429	33000	12940.30	153	83	33	Not Stored	2
3	PCC Concrete	8	78.5	154	4900	cu. m	384650	219800	27000	4018.53	55	10	12	Not Stored	1
4	Brick Masonary	8	308	1734	4800	cu. m	1478400	844800	21000	7019.97	120	39	26	Stored in months around 7000-10000	1
5	Plaster	8	11604	1734	210	sq. m.	2436840	1392480	15000	36416.64	38	145	8	2 trip per three days	17
6	Flooring Material	8	2455.6	1734	2000	sq. m.	4911200	2806400	48000	29967.45	94	307	20	store in stack for one floor	15

Table No. 2.2 Optimum Storage of ACE Infra Partnership

Figure 2.2 Optimum Storage of ACE Avenue

For finishing materials, plaster is supplied in small and frequent batches (approximately two trips every three days) to avoid damage and unnecessary storage, while flooring materials are stored floor-wise, maintaining stock only for one floor at a time. This reduces handling distance, minimizes breakage, and improves workflow efficiency. Overall, the integration of EOQ-based planning with a web-based tracking system helps optimize storage space, reduce material wastage, improve site safety, and enhance productivity by aligning material supply with actual construction progress.

3. Optimum Storage of Site 3- Anantparv

The optimum storage strategy for Site 3 – Anantparv is developed by integrating EOQ analysis, high material demand, and real-time monitoring through a web-based material management system. Due to the larger scale of the project and higher quantities involved, storage planning focuses on maintaining sufficient material availability while avoiding congestion and excess capital lock-up. For steel reinforcement, the requirement exceeds 3.5 tones, indicating that materials should be ordered as per demand in controlled batches rather than stored in large quantities. The web-based system helps track consumption trends and ensures timely procurement, preventing shortages while minimizing risks such as corrosion and theft. RCC and PCC concrete are not stored and are managed using a just-in-time approach, where deliveries are aligned with daily activity schedules to ensure quality and reduce wastage.

Site 3 - Anantparv

Sr. No.	Material	Floor	Quantity	Area	Material Rate	Unit	Total Cost	Annual Consumption	Cost Per Order	EOQ	Number of Orders	One Floor Quantity	Requirement of One floor Order	Optimum Storage	EOQ Quantity
1	Steel Reinforcement	8	148.53	3285	7000	MT	1039681.66	594103.8062	1100000	35281.57	17	19	4	>3.5 Tones needed to order as required	5
2	RCC Concrete	8	97.94	255	5200	cu. m	509294.12	291025.2101	33000	4962.38	59	12	13	Not Stored	1
3	PCC Concrete	8	1674.50	3285	4900	cu. m	8205034.09	4688590.909	27000	18559.85	253	209	55	Not Stored	4
4	Brick Masonary	8	583.49	3285	4800	cu. m	2800775.09	1600442.907	21000	9662.25	166	73	36	Stored in months around 7000-10000	2
5	Plaster	8	21983.36	3285	210	sq. m.	4616504.84	2638002.768	15000	50123.68	53	275	12	2 trip per three days	24
6	Flooring Material	8	4652.04	3285	2000	sq. m.	9304089.97	5316622.837	48000	41247.05	129	582	28	store in stack for one floor	21

Table No. 2.3 Optimum Storage of Anantparv

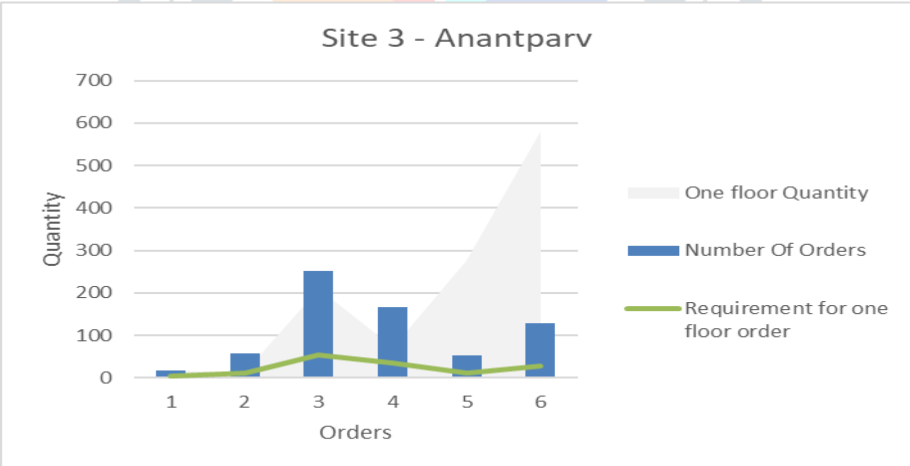

Figure 2.3 Optimum Storage of Anantparv

For bulk materials like brick masonry, moderate storage is maintained based on monthly consumption (approximately 7000–10000 units), ensuring continuous workflow without overloading the site. Plastering materials follow a frequent supply strategy, with approximately two trips every three days, as they are sensitive to moisture and damage. Flooring materials are stored floor-wise, maintaining stock sufficient for one floor at a time to reduce handling distance, minimize breakage, and improve coordination with finishing activities. Overall, the web-based system enables real-time tracking of inventory, demand, and delivery schedules, ensuring optimized storage, reduced wastage, better space utilization, and improved project efficiency.

4. Optimum Storage of Site 4- Grand Casa

The optimum storage strategy for Site 4 – Grand Casa is developed using EOQ analysis, material demand patterns, and real-time monitoring through a web-based material management system to ensure efficient use of space, cost control, and uninterrupted construction activities. For **steel reinforcement**, since the required quantity is below approximately 3.5 tones, it is economical to maintain limited stock on-site. This minimizes risks such as corrosion, theft, and capital blockage while ensuring continuous availability. The web-based system helps track stock levels and automatically supports timely reordering based on consumption. **RCC and PCC concrete** are not stored due to their perishable nature and are managed through a just-in-time (JIT) approach, where deliveries are aligned with daily construction schedules to maintain quality and avoid wastage.

Site 4 - Grand Casa

Sr. No.	Material	Floor	Quantity	Area	Material Rate	Unit	Total Cost	Annual Consumption	Cost Per Order	EOQ	Number of Orders	One Floor Quantity	Requirement of One floor Order	Optimum Storage	EOQ Quantity
1	Steel Reinforcement	11	101.75	2861	7000	MT	712250	356125	1100000	27316.05	13	9	2	<3.5 Tones Hence economic	4
2	RCC Concrete	11	730.52	2861	5800	cu.m	4237016	2118508	33000	12677.32	167	66	30	Not Stored	2
3	PCC Concrete	11	730.52	260	4200	cu.m	3068184	1534092	27000	11467.07	134	66	24	Not Stored	3
4	Brick Masonary	11	710.21	2861	4800	cu.m	3409008	1704504	21000	9971.43	171	65	31	Stored in months around 7000-10000	2
5	Plaster	11	13222.83	2861	300	sq.m.	3966849	1983424.5	15000	36363.21	55	120	10	2 trip per three days	12
6	Flooring Material	11	3611.31	2861	1850	sq.m.	6680923.5	3340461.75	48000	33994.40	98	328	18	store in stack for one floor	18

Table No. 2.4 Optimum Storage of Grand Casa

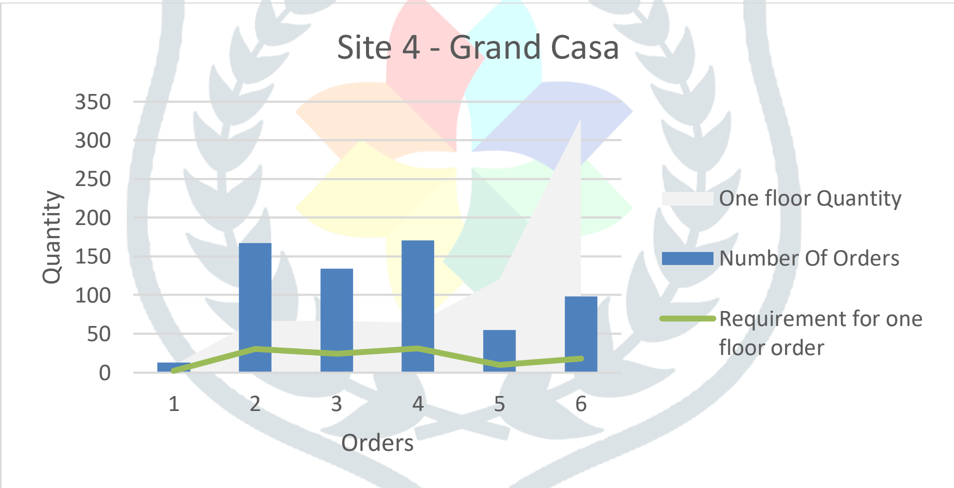

Figure 2.4 Optimum Storage of Grand Casa

For bulk materials like brick masonry, moderate storage is maintained based on monthly requirements (around 7000–10000 units), ensuring smooth workflow without causing site congestion. Plastering materials are supplied in small and frequent batches (approximately two trips every three days) to reduce storage needs and prevent damage due to moisture. Flooring materials are stored floor-wise, with stock maintained only for one floor at a time, reducing handling distance, minimizing breakage, and improving efficiency during finishing works. Overall, the web-based system enables real-time tracking of inventory, consumption, and delivery schedules, ensuring optimized storage, reduced material wastage, improved coordination, and enhanced project efficiency.

5. Optimum Storage of Site 5- 24 Jewels

The optimum storage strategy for Site 5 – 24 Jewels is formulated by considering high material quantities, EOQ analysis, and real-time monitoring through a web-based material management system. Due to the relatively larger consumption of certain materials, especially steel and brick masonry, the focus is on controlled ordering and efficient space utilization. For steel reinforcement, since the requirement exceeds 3.5 tones, materials are not stored in bulk but are ordered in phases as per demand. This reduces risks of corrosion, theft, and capital lock-up while ensuring continuity of work. The web-based system tracks consumption patterns and triggers timely procurement. RCC and PCC concrete are managed using a just-in-time (JIT) approach, as they cannot be stored, ensuring delivery is aligned with ongoing construction activities to maintain quality and avoid wastage.

Site 5 - 24 Jewels															
Sr.No.	Material	Floor	Quantity	Area	Material Rate	Unit	Total Cost	Annual Consumption	Cost Per Order	EOQ	Number of Orders	One Floor Quantity	Requirement of One floor Order	Optimum Storage	EOQ Quantity
1	Steel Reinforcement	7	130.9	4601	7000	MT	916300	610866.6667	1100000	35775.85	17	19	4	>3.5 Tones needed to order as required	5
2	RCC Concrete	7	171.01	4601	5200	cu.m	889252	592834.6667	33000	7082.58	84	24	18	Not Stored	1
3	PCC Concrete	7	171.01	670	4500	cu.m	769545	513030	27000	6406.43	80	24	17	Not Stored	1
3	Brick Masonary	7	3133.812	4601	1000	cu.m	3133812	2089208	21000	24186.32	86	448	19	Stored in months around 7000-10000	24
4	Plaster	7	11281.41	4601	380	sq.m.	4286935.8	2857957.2	15000	38783.86	74	161	16	2 trip per three days	10
5	Flooring Material	7	1367.45	4601	1291	sq.m.	1765377.95	1176918.633	48000	24154.61	49	195	10	store in stack for one floor	19

Table No 2.5 Optimum Storage of 24 Jewels

Figure 2.5 Optimum Storage of 24 Jewels

For bulk materials like brick masonry, storage is maintained based on monthly requirements (around 7000–10000 units), but due to higher demand at this site, careful planning is required to avoid congestion while ensuring uninterrupted work. Plastering materials are supplied in small and frequent batches (approximately two trips every three days) to minimize storage issues and prevent deterioration. Flooring materials are stored floor-wise, maintaining stock for one floor at a time to reduce handling distance, minimize breakage, and improve efficiency in finishing works. Overall, the web-based system plays a crucial role in optimizing storage by providing real-time data on inventory, consumption, and delivery schedules, leading to reduced wastage, improved coordination, better space utilization, and enhanced project performance.

Rate Vs Distance

1. Rate Vs Distance of Site 1- Niwara Pride

The Rate vs Distance analysis for Site 1 – Niwara Pride highlights the significant impact of transportation distance on overall material cost, emphasizing the importance of supplier location and logistics planning in construction material management. As the distance increases from 5 km to 15 km, the transportation percentage rises for all materials, which directly affects the final delivered rate. For example, steel reinforcement shows an increase in transportation cost from 1.5% at 5 km to 3.5% at 15 km, while RCC and PCC concrete experience even higher transportation impacts due to their bulk and volume, with costs rising up to 5% at longer distances.

Similarly, materials like brick masonry, plaster, and flooring show a consistent increase in transportation cost percentage with distance, leading to higher total rates per unit. This demonstrates that transportation plays a crucial role in determining the final cost of materials, especially for high-volume and frequently used items.

Site 1 - Niwara Pride								5km			10km			15km		
Sr. No.	Material	Floor	Quantity	Area	Material Rate	Unit	Total Cost	Material Cost	Transportation In Percentage	Total rate 5km	Material Cost	Transportation In Percentage	Total rate 10km	Material Cost	Transportation In Percentage	Total rate 15km
1	Steel Reinforcement	10	84.32	2167	7000	MT	590240	7000	0.015	7105	6650	0.025	6816.25	6300	0.035	6520.5
2	RCC Concrete	10	455.09	2167	5800	cu.m	2639522	5800	0.02	5916	5510	0.035	5702.85	5220	0.05	5481
3	PCC Concrete	10	71.53	197	4500	cu.m	321885	4500	0.02	4590	4275	0.035	4424.625	4050	0.05	4252.5
4	Brick Masonary	10	588.47	2167	4800	cu.m	2824656	4800	0.03	4944	4560	0.05	4788	4320	0.07	4622.4
5	Plaster	10	14146.74	2167	200	sq.m.	2829348	200	0.04	208	190	0.065	202.35	180	0.09	196.2
6	Flooring Material	10	2137.49	2167	1850	sq.m.	3954356.5	1850	0.025	1896.25	1757.5	0.04	1827.8	1665	0.055	1756.575

Table No. 2.6 Rate Vs Distance of Niwara Pride

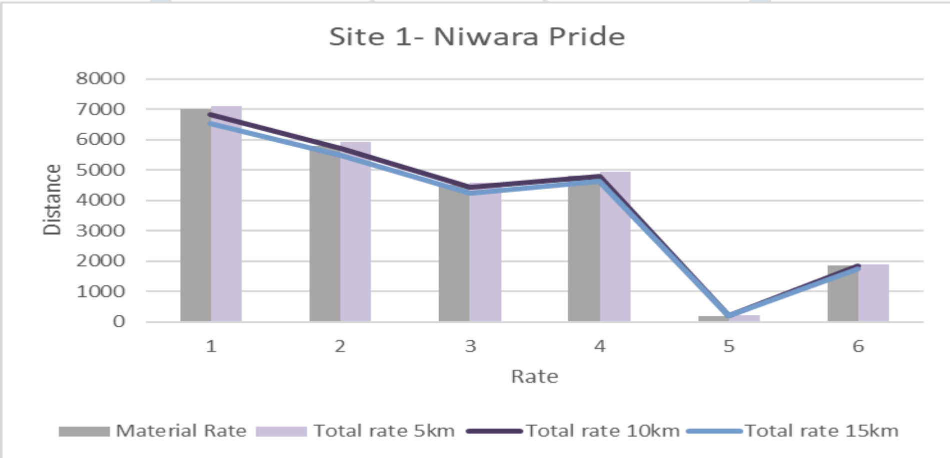

Figure 2.6 Rate Vs Distance of Niwara Pride

In this context, a web-based material management system becomes highly effective in optimizing procurement decisions by analyzing rate variations with distance in real time. The system enables comparison of multiple suppliers based on location, transportation cost, and material rates, helping project managers select the most cost-effective option. By integrating transportation data with material planning and scheduling, the system reduces unnecessary expenses, supports better supplier selection, and improves overall cost efficiency. Additionally, it helps in planning bulk orders, optimizing delivery routes, and minimizing long-distance procurement, ultimately reducing project costs and enhancing decision-making in material management.

2. *Rate Vs Distance of Site 2- ACE Avenue*

The Rate vs Distance analysis for Site 2 – ACE Avenue clearly demonstrates how transportation distance influences the final material cost and overall project expenditure. As the distance increases from 5 km to 15 km, the transportation percentage rises for all materials, leading to a noticeable increase in the total delivered rate. For instance, steel reinforcement shows an increase in transportation cost from 1.5% at 5 km to 3.5% at 15 km, while RCC and PCC concrete, being bulk materials, experience higher transportation impacts, reaching up to 5% at longer distances. Similarly, brick masonry shows a steady rise in transportation cost from 3% to 7%, and finishing materials like plaster and flooring also reflect increasing rates with distance due to added logistics and handling expenses. This trend highlights that transportation cost becomes a significant factor, especially for high-volume materials and longer procurement distances.

Site 2 - ACE Avenue								5km			10km			15km		
Sr. No.	Material	Floor	Quantity	Area	Material Rate	Unit	Total Cost	Material Cost	Transportation In Percentage	Total rate 5km	Material Cost	Transportation In Percentage	Total rate 10km	Material Cost	Transportation In Percentage	Total rate 15km

1	Steel Reinforcement	8	78.4	1734	7000	MT	548800	7000	0.015	7105	6650	0.025	6816.25	6300	0.035	6520.5
2	RCC Concrete	8	666	1734	5200	cu.m	3463200	5200	0.02	5304	4940	0.035	5112.9	4680	0.05	4914
3	PCC Concrete	8	78.5	154	4900	cu.m	384650	4900	0.02	4998	4655	0.035	4817.925	4410	0.05	4630.5
4	Brick Masonry	8	308	1734	4800	cu.m	1478400	4800	0.03	4944	4560	0.05	4788	4320	0.07	4622.4
5	Plaster	8	11604	1734	210	sq.m.	2436840	210	0.04	218.4	199.5	0.065	212.4675	189	0.09	206.01
6	Flooring Material	8	2455.6	1734	2000	sq.m.	4911200	2000	0.025	2050	1900	0.04	1976	1800	0.055	1899

Table No. 2.7 Rate Vs Distance of ACE Avenue

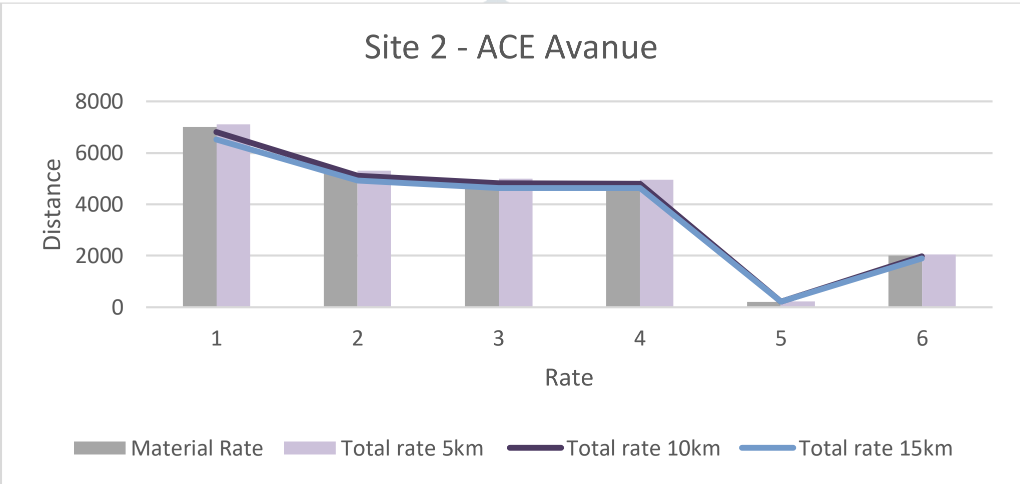

Figure 2.7 Rate Vs Distance of ACE Avenue

In this scenario, the implementation of a web-based material management system plays a crucial role in optimizing cost efficiency by enabling real-time comparison of material rates across different supplier distances. The system helps project managers select the most economical supplier by considering both base material cost and transportation charges. It also supports better planning of bulk procurement, route optimization, and scheduling of deliveries to reduce unnecessary transportation costs. By integrating rate vs distance analysis with procurement and inventory data, the system enhances decision-making, reduces overall project cost, and improves efficiency in material management on construction sites.

3. *Rate Vs Distance of Site 3- Anantparv*

The Rate vs Distance analysis for Site 3 – Anantparv highlights the strong influence of transportation distance on the overall material cost, particularly due to the large quantities involved in this project. As the distance increases from 5 km to 15 km, the transportation percentage rises across all materials, resulting in higher total delivered rates. For example, steel reinforcement shows an increase in transportation cost from 1.5% at 5 km to 3.5% at 15 km, while RCC and PCC concreteespecially PCC due to its very high-volumeexperience significant cost impacts, reaching up to 5% transportation cost at longer distances. Similarly, brick masonry shows an increase from 3% to 7%, and finishing materials such as plaster and flooring also reflect steady cost escalation due to higher logistics and handling expenses. Given the large-scale material consumption at this site, even small increases in transportation percentage result in substantial cost differences, making distance a critical factor in procurement planning.

Site 3 - Anantparv								5km			10km			15km		
Sr. No.	**Material**	**Floor**	**Quantity**	**Area**	**Material Rate**	**Unit**	**Total Cost**	**Material Cost**	**Transportation In Percentage**	**Total rate 5km**	**Material Cost**	**Transportation In Percentage**	**Total rate 10km**	**Material Cost**	**Transportation In Percentage**	**Total rate 15km**
1	Steel Reinforcement	8	148.53	3285	7000	MT	1039681.66	7000	0.015	7105	6650	0.025	6816.25	6300	0.035	6520.5
2	RCC Concrete	8	97.94	255	5200	cu.m	509294.12	5200	0.02	5304	4940	0.035	5112.9	4680	0.05	4914

3	PCC Concrete	8	1674.50	3285	4900	cu. m	8205034.09	4900	0.02	4998	4655	0.035	4817.925	4410	0.05	4630.5
4	Brick Masonry	8	583.49	3285	4800	cu. m	2800775.09	4800	0.03	4944	4560	0.05	4788	4320	0.07	4622.4
5	Plaster	8	21983.36	3285	210	sq. m.	4616504.84	210	0.04	218.4	199.5	0.065	212.4675	189	0.09	206.01
6	Flooring Material	8	4652.04	3285	2000	sq. m.	9304089.97	2000	0.025	2050	1900	0.04	1976	1800	0.055	1899

Table No. 2.8 Rate Vs Distance of Anantparv

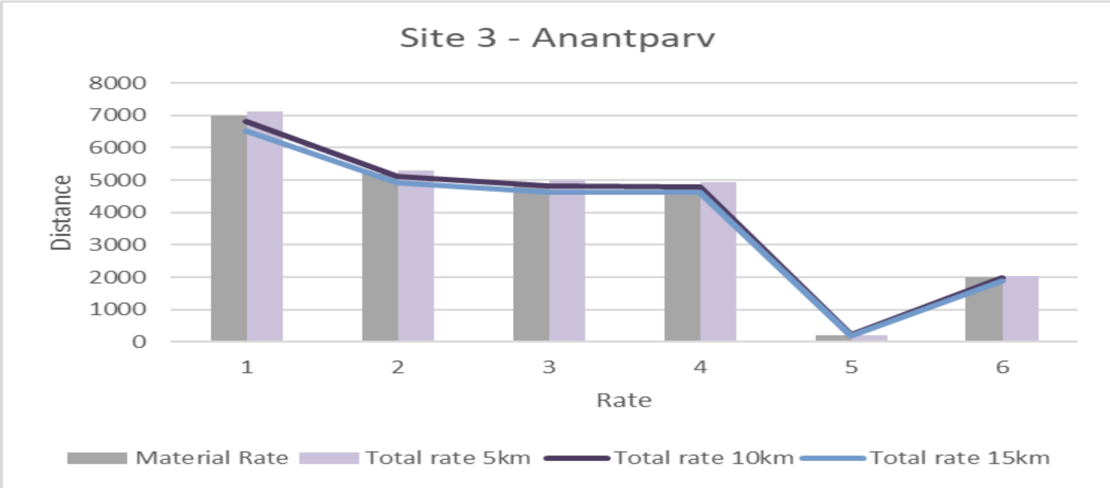

Figure 2.8 Rate Vs Distance of Anantparv

In this context, a web-based material management system plays a vital role in optimizing procurement decisions by enabling real-time analysis of rate variations with distance. The system allows project managers to compare suppliers based on location, transportation cost, and material rates, ensuring the selection of the most economical option. It also supports bulk procurement planning, delivery scheduling, and route optimization to minimize transportation expenses. By integrating rate vs distance data with inventory tracking and project scheduling, the system improves cost control, reduces unnecessary long-distance sourcing, and enhances overall efficiency in material management for large-scale construction projects like Site 3 – Anantparv.

4. *Rate Vs Distance of Site 4- Grand Casa*

The Rate vs Distance analysis for this site (Grand Casa) clearly shows how increasing transportation distance directly impacts the overall material cost and project expenditure. As the distance increases from 5 km to 15 km, the transportation percentage rises for all materials, resulting in higher delivered rates. For instance, steel reinforcement shows an increase in transportation cost from 1.5% at 5 km to 3.5% at 15 km, while RCC concrete increases from 2% to 5%, significantly affecting its already high base cost due to large quantities. Similarly, PCC concrete reflects a steady rise in cost with increasing distance, and brick masonry shows a higher transportation impact, increasing from 3% to 7%. Finishing materials such as plaster and flooring also exhibit gradual cost escalation due to higher logistics and handling charges. This analysis highlights that bulk materials and high-volume items are more sensitive to transportation distance, making supplier location a key factor in cost control.

Site 4 - Grand Case								5km			10km			15km		
Sr. No.	**Material**	**Floor**	**Quantity**	**Area**	**Material Rate**	**Unit**	**Total Cost**	**Material Cost**	**Transportation In Percentage**	**Total rate 5km**	**Material Cost**	**Transportation In Percentage**	**Total rate 10km**	**Material Cost**	**Transportation In Percentage**	**Total rate 15km**
1	Steel Reinforcement	11	101.75	2861	7000	MT	712250	7000	0.015	7105	6650	0.025	6816.25	6300	0.035	6520.5
2	RCC Concrete	11	730.52	2861	5800	cu.m	4237016	5800	0.02	5916	5510	0.035	5702.85	5220	0.05	5481
3	PCC Concrete	11	730.52	260	4200	cu.m	3068184	4200	0.02	4284	3990	0.035	4129.65	3780	0.05	3969
4	Brick Masonry	11	710.21	2861	4800	cu.m	3409008	4800	0.03	4944	4560	0.05	4788	4320	0.07	4622.4
5	Plaster	11	13222.83	2861	300	sq. m.	3966849	300	0.04	312	285	0.065	303.525	270	0.09	294.3

6	Flooring Material	11	3611.31	2861	1850	sq.m.	6680923.5	1850	0.025	1896.25	1757.5	0.04	1827.8	1665	0.055	1756.575

Table No.2.9 Rate Vs Distance of Grand Casa

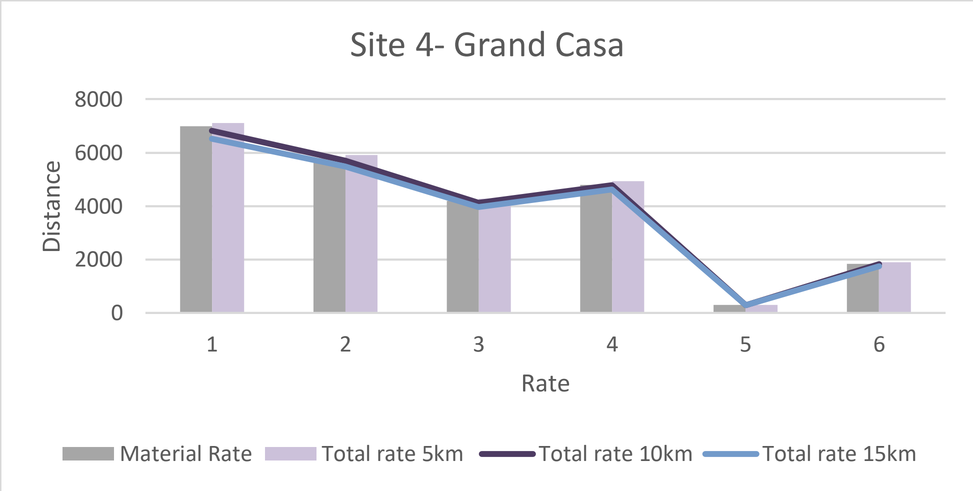

Figure 2.9 Rate Vs Distance of Grand Casa

In this context, a web-based material management system plays a crucial role in optimizing procurement decisions by providing real-time insights into rate variations based on distance. The system allows project managers to compare suppliers at different distances and select the most cost-effective option by considering both base material cost and transportation charges. It also supports better planning of bulk orders, efficient delivery scheduling, and route optimization to reduce unnecessary transportation costs. By integrating rate vs distance analysis with inventory tracking and project scheduling, the system enhances decision-making, minimizes overall material cost, and improves efficiency and transparency in construction material management.

5. Rate Vs Distance of Site 5- 24 Jewels

The Rate vs Distance analysis for Site 5 – 24 Jewels highlights the direct relationship between transportation distance and the final cost of construction materials, especially in a project with high material quantities like brick masonry and plaster. As the distance increases from 5 km to 15 km, transportation percentages rise across all materials, resulting in higher delivered rates. For example, steel reinforcement shows an increase from 1.5% to 3.5%, while RCC and PCC concrete increase from 2% to 5%, significantly affecting total costs due to their bulk usage. Brick masonry, which has a very high quantity at this site, shows a transportation increase from 3% to 7%, making it one of the most cost-sensitive materials to distance. Similarly, finishing materials such as plaster and flooring also show gradual cost escalation due to increased logistics and handling charges. This clearly indicates that transportation distance plays a crucial role in overall project cost, particularly for high-volume and frequently used materials.

Site 5 - Jewels								5km			10km			15km		
Sr. No.	**Material**	**Floor**	**Quantity**	**Area**	**Material Rate**	**Unit**	**Total Cost**	**Material Cost**	**Transportation In Percentage**	**Total rate 5km**	**Material Cost**	**Transportation In Percentage**	**Total rate 10km**	**Material Cost**	**Transportation In Percentage**	**Total rate 15km**
1	Steel Reinforcement	7	130.9	4601	7000	MT	916300	7000	0.015	7105	6650	0.025	6816.25	6300	0.035	6520.5
2	RCC Concrete	7	171.01	4601	5200	cu.m	889252	5200	0.02	5304	4940	0.035	5112.9	4680	0.05	4914
3	PCC Concrete	7	171.01	670	4500	cu.m	769545	4500	0.02	4590	4275	0.035	4424.625	4050	0.05	4252.5
3	Brick Masonry	7	3133.812	4601	1000	cu.m	3133812	1000	0.03	1030	950	0.05	997.5	900	0.07	963
4	Plaster	7	11281.41	4601	380	sq.m.	4286935.8	380	0.04	395.2	361	0.065	384.465	342	0.09	372.78
5	Flooring Material	7	1367.45	4601	1291	sq.m.	1765377.95	1291	0.025	1323.275	1226.45	0.04	1275.508	1161.9	0.055	1225.8045

Table No. 2.10 Rate Vs Distance of 24 Jewels

Figure 2.10 Rate Vs Distance of 24 Jewels

In this context, the implementation of a web-based material management system becomes essential for optimizing procurement and cost efficiency. The system enables real-time comparison of material rates from suppliers located at different distances, allowing project managers to select the most economical source. It also supports efficient planning of bulk orders, delivery scheduling, and route optimization to minimize transportation costs. By integrating rate vs distance analysis with inventory tracking and construction scheduling, the system enhances decision-making, reduces unnecessary long-distance procurement, and improves overall cost control and efficiency in material management on construction sites.

CONCLUSION

The present study on critical analysis and tracking of material management on construction sites using a web-based system clearly demonstrates that material management plays a decisive role in determining project cost, time efficiency, and overall productivity. Through the detailed analysis of five construction sites, it is evident that conventional material management practices often lead to inefficiencies such as overstocking, material shortages, wastage, and increased transportation costs. The study highlights that improper storage planning, lack of coordination between procurement and site execution, and absence of real-time data significantly affect project performance. By applying techniques such as Economic Order Quantity (EOQ), optimum storage planning, and rate vs distance analysis, the research establishes that material flow can be systematically controlled to reduce unnecessary costs and improve operational efficiency.

The implementation of a web-based material management system proves to be highly effective in overcoming these challenges by providing a centralized, real-time platform for tracking inventory, monitoring consumption, and managing procurement activities. The system enhances transparency among stakeholders, enables data-driven decision-making, and ensures that materials are available at the right time and in the right quantity. Features such as just-in-time delivery for non-storable materials, floor-wise storage planning, and supplier selection based on transportation cost optimization significantly reduce wastage, storage issues, and delays. Additionally, integration with advanced tools like BIM further improves planning accuracy and coordination between design and execution phases.

Overall, the study concludes that the adoption of a web-based material management system leads to substantial improvements in inventory accuracy, cost control, space utilization, and project scheduling. It minimizes risks associated with manual processes and supports a more structured and efficient approach to construction management. The findings strongly suggest that integrating technology-driven solutions into material management practices is essential for modern construction projects, as it enhances productivity, ensures sustainability, and contributes to successful project delivery within budget and time constraints.

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