JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

MATERIAL MANAGEMENT IN CONSTRUCTION PROJECT USING INVENTORY MODEL

[1]Miss. Tanvi S. Takankhar, [2]Mrs. Sneha K. Sawant.

[1]PG (M.E) Student, [2]Assistant Professor.
[1]Department of Civil Engineering, D. Y Patil College of Engineering, Akurdi.
[2]Department of Civil Engineering, D. Y Patil College of Engineering, Akurdi, Pune, India.

Abstract: Materials management is critical to the success of a construction project because it affects project schedule, cost and overall productivity. A systematic optimization strategy is often inadequate in traditional resource management approaches, leading to wasted resources and inefficient operations. This study proposes the use of a manual model to improve materials management practices in construction projects. This research aims to create a framework for optimizing inventory levels, applying procurement policies and strategies throughout the project life cycle by integrating inventory theory and project management principles. Through a comprehensive literature review, case study, and simulation, this study evaluates the effectiveness of different scheduling models to improve resource availability while reducing costs and reducing risk. The results provide valuable information to help construction workers and project managers adopt a data-driven approach to asset management, ultimately contributing to the success of purpose and stability. In this project, we prepared a construction materials management plan for a construction project, completed an industry survey, and identified different types of construction materials management. Finally, you should use your inventory management system to track material waste, material costs, and time management.

Index Terms: **Material management, inventory, material distribution, material cost, quality of material.**

I. INTRODUCTION

Material management is the management of material resources. It considers material costs and tries to reduce costs. Traditionally, we think of material costs\ as the price we pay to acquire materials, ie. their basic costs. We show this in the company's financial statements. This cost in itself is very high, because the materials make up 60-70 percent of the net price of the product. Effective materials planning is the key to successful construction projects. Materials management is the process of ensuring that the right quantities and qualities of materials are available at the appropriate time and place. Materials management is inadequate in processes such as planning, procurement, inventory management, storage, handling and transportation. Cost overruns and delays are common issues with construction projects. These problems can be avoided by implementing proper material management that ensures timely flow of material to the site, which in turn increases work/productivity and thus lowers project costs. Material cost management can be a useful tool in reducing project costs, as stated above. Materials planning and inventory are the two most important parts of materials management.

Material planning refers to the determination of specifications that satisfy the construction needs in accordance with the financial investment policy. The process of materials planning involves identifying, quantifying, and planning the required materials for a project. This article examines material planning through S-curve analysis and identifies the main causes of variances between planned material costs and actual material costs by interviewing contractors and engineers. Inventory management is aimed at maintaining a sufficient supply of materials to meet future demand. A certain financial investment is necessary to ensure that the materials are kept in good and usable condition.

Material planning refers to the determination of specifications that satisfy the construction needs in accordance with the financial investment policy. The process of materials planning involves identifying, quantifying, and planning the required materials for a project. This article examines material planning through S-curve analysis and identifies the main causes of variances between planned material costs and actual material costs by interviewing contractors and engineers. Inventory management is aimed at maintaining a sufficient supply of materials to meet future demand. A certain financial investment is necessary to ensure that the materials are kept in good and usable condition. An inventory model is used to manage construction projects, which involves the systematic planning and acquisition of materials, as well as their storage and disposal for effective project implementation. With a warehouse model, construction companies can optimize their material handling processes, minimize waste, reduce costs and improve project schedules. Key aspects of materials management using the warehouse model

are inventory recording, demand forecasting, supplier management and material usage tracking. This approach helps construction projects run smoothly by ensuring that the right materials are available at the right time and in the right quantity.

II. AIM

The aim of material management in a construction project using inventory management is to ensure the efficient procurement, utilization, and control of materials throughout the project lifecycle. Materials management encompasses planning, procurement and control as its key responsibilities. It aims to increase productivity and is used to:

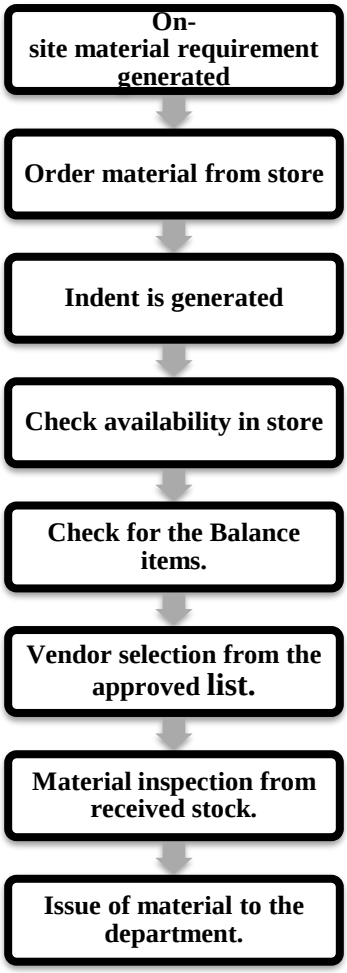
- Reduce cost.
- Improve profitability.
- Production efficiency.

III. OBJECTIVES

- Ensuring material availability at optimized inventory levels and the smallest deviation between planned and actual results.
- To apply Inventory Control Techniques such as ABC Analysis, EOQ Model, S curve analysis.
- To prepare specifications and standardization of materials.
- Forecasting demand and quality of materials requirement.
- Quality control materials purchases.

IV.METHODOLOGY

Materials management for a construction project is critical to ensure smooth operation, cost efficiency and timely completion. Using inventory models can help optimize material management processes. Here is a method for managing materials in a construction project using inventory models. Begin with a thorough assessment of project requirements, including required materials, quantities, lead times and budget constraints. Establish the hierarchy of materials based on their criticality, frequency and lead times. This classification helps to prioritize management activities. Define appropriate inventory policies for each material class. This includes setting posted points, order quantities and safety stock levels based on factors such as demand fluctuations and lead times. Identify reliable suppliers and build strong relationships to ensure timely delivery of materials. Negotiate contracts to secure favorable terms and prices. Utilize chronicled information, venture plans and other important components to estimate fabric request precisely. This makes a difference in keeping up ideal stock levels and maintaining a strategic distance from stock outs or overloading. Identify potential dangers such as supply chain disturbances, cost variances or quality issues. Develop contingency plans to moderate these risks and guarantee progression of material supply. Regularly survey and refine stock arrangements based on real execution information and criticism from project stakeholders. Ceaselessly search for openings to optimize stock levels, streamline forms and decrease costs. Foster collaboration and communication among project teams, procurement departments and suppliers to ensure alignment of goals and smooth coordination of material flows. Incorporate maintainability standards into fabric administration hones by optimizing transportation courses, minimizing squander and selecting eco- inviting materials wherever conceivable. Provide preparing to venture work force on appropriate material dealing with strategies, stock administration procedures and utilize of stock following framework to guarantee successful usage of the strategy.

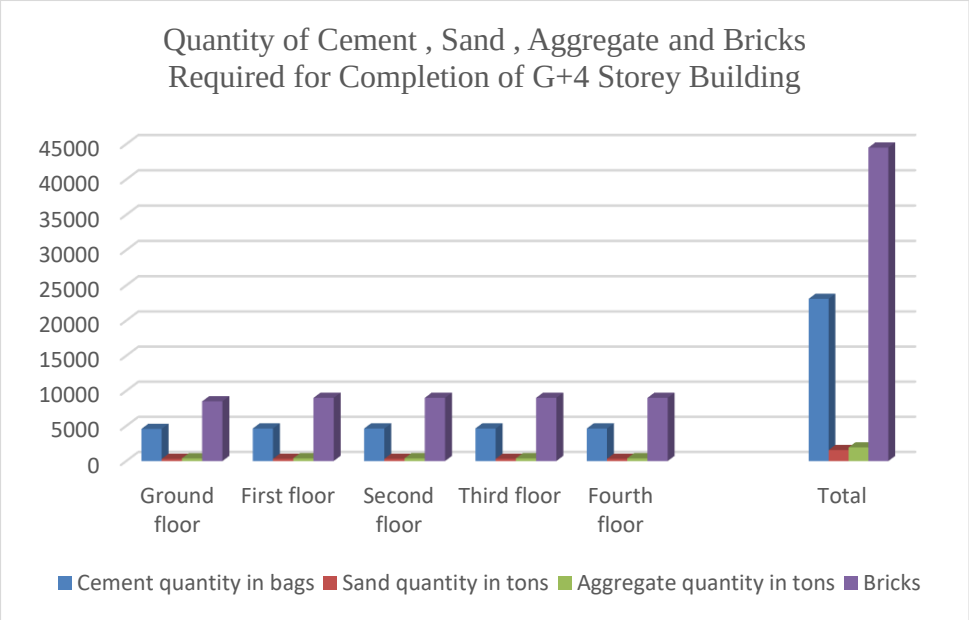


V. CASE STUDY

An ongoing venture of private residential apartment with Ground + 4 floor was implemented for the research work for case study.

5.1 Quantity and cost of materials

No. of floors	Cement quantity in bags	Sand quantity in tons	Aggregate quantity in tons	Bricks
Ground floor	4,573	305	380	8,500
First floor	4,628	315	390	9,000
Second floor	4,628	315	390	9,000
Third floor	4,628	315	390	9,000
Fourth floor	4,628	315	390	9,000
Total	23,085	1,565	1,940	44,500



Cement quantity and cost

No. of floors	cum	Quantity in kg	Bags	Rate	Amount
Ground floor	415	228665	4573	330	15,09,090
First floor	420	231420	4628	330	15,27,240
Second floor	420	231420	4628	330	15,27,240
Third floor	420	231420	4628	330	15,27,240
Fourth floor	420	231420	4628	330	15,27,240
Total	2095	1154345	23085	1650	76,18,050

Sand quantity and cost

No. of floors	Quantity kg	Tons	Rate	Amount
Ground floor	305000	305	2,100	6,40,500
First floor	315000	315	2,100	6,61,500
Second floor	315000	315	2,100	6,61,500
Third floor	315000	315	2,100	6,61,500
Fourth floor	315000	315	2,100	6,61,500
Total	1565000	1565	10,500	32,86,500/-

Aggregate quantity and cost

No. of floors	Quantity kg	Tons	Rate	Amount
Ground floor	380000	380	1,005	3,81,900
First floor	390000	390	1,005	3,91,950
Second floor	390000	390	1,005	3,91,950
Third floor	390000	390	1,005	3,91,950
Fourth floor	390000	390	1,005	3,91,950
Total	1940000	1940	5,025	19,49,700/-

Brick quantity and cost

No. of floors	Cum	In 1 cum	Tons	Rate	Amount
Ground floor	17	500	8500	7	59,500
First floor	18	500	9000	7	63,000
Second floor	18	500	9000	7	63,000
Third floor	18	500	9000	7	63,000
Fourth floor	18	500	9000	7	63,000
Total	89	2500	44500	35	3,11,500

Cost and Quantity

Sr No.	Materials	Cost	Unit	Quantity
1	Cement	76,18,050	Bags	23085
2	Sand	32,86,500	Tons	1565
3	Aggregate	19,49,700	Tons	1940
4	Brick	3,11,500	No. of	44500
	Total cost	1,31,30,750		

5.2 ABC Analysis

ABC analysis is one of the effectively used methods in inventory management. It is divided into three classes: Class A, Class B and Class C in descending order.

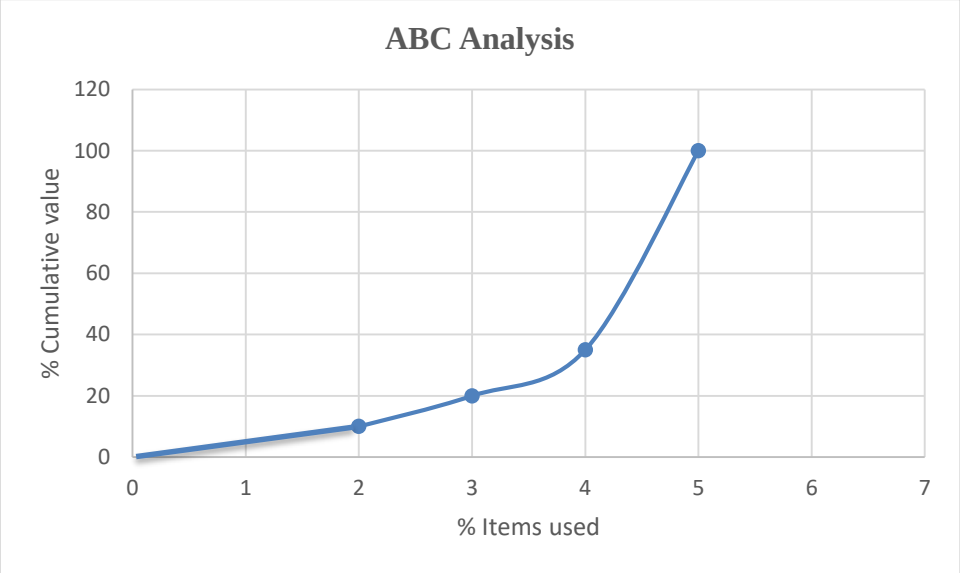
• Class A materials are the most valuable items in High Perceptions.

• Class B materials are of lower value than A moderate observations.

• Class C materials are lowest than B for low observations.

Calculation of ABC Analysis

Item	Units	Unit Price	Expenditure	Percentage	Rank	Cumulative Value Percentage	A/B/C
Cement	23,085	330	76,18,050	58.02	1	58.02	A
Sand	1,565	2100	32,86,500	25.03	2	83.05	B
Aggregate	1,940	1005	19,49,700	14.85	3	97.9	C
Brick	44,500	7	3,11,500	2.10	4	100	C
Total			1,31,65,750				



The value of money is equivalent to 60-70% of the total value, with 5-10% of items belonging to A Class goods.
The value of money is equivalent to 15-20% of the total value, with 15-20% of items belonging to B Class goods.
The value of money is equivalent to 5-10% of the total value, with 60-70% of items belonging to C Class goods.

"A Class" Material is cement
"B Class" Material is sand
"C Class" Material is aggregate and bricks

5.3 Safety stock

The margin of safety acts as a cushion against possible stock market transactions caused by unexpected commodity demand, while increasing the level of equity investment. Latency is always uncertain, and security levels are therefore determined independently of inventory. By utilizing ABC analysis for safety stock management in construction, we can enhance the efficiency of projects, decrease the risk of material shortages, and maximize project productivity. In effect, safety stock acts as a hedge to ensure that the company can meet customer demand even in the event of unexpected circumstances such as supplier delays, spikes in demand or other supply chain disruptions.
The distribution of points is as follows:

• Protects against fluctuations in demand: Safety stock helps reduce the risk of running out of stock due to unexpected spikes in customer demand. Companies can fill orders during times of high demand without losing sales opportunities or dealing with unhappy customers. This provides an extra buffer for inventories.

• Protection against supply chain disruptions: Treasury also provides protection against supply chain disruptions such as delays in receiving raw materials or components from suppliers. Transportation issues, supplier shortages, and natural disasters are among the many possible causes of disruptions. Even when faced with these difficulties, the safe box allows companies to continue operating without hindrance.

• Increased inventory investment: Although security storage increases the level of inventory investment, it is considered a necessary cost to ensure business continuity and customer satisfaction. By ensuring that inventory is kept secure, companies can minimize the potential costs associated with it. This includes lost sales revenue, reduced customer loyalty, and damage to brand reputation.

5.4 EOQ Analysis

The Economic order quantity (EOQ) model is utilized in construction projects to determine the appropriate quantity of materials to order, thereby reducing inventory costs while meeting demand. Managing the procurement of materials is crucial to successfully managing construction projects. Additionally, raw materials are essential for efficient project delivery. A number of assumptions are utilized in this method:

- Demand is known, constant and independent.
- Lead time- that is, the time between placement and receipt of the order is known and constant.
- Instantaneous replenishment i.e the receipt of inventory is instantaneous and complete.
- No shortage is permitted.
- No safety stock is provided.
- Quantity discounts are not possible.

.

The formula for Economic Order Quantity is:

$$Q = \sqrt{(2 \times Co \times S)/(Cu \times I)}$$

Co= Order costs (per order, generally including shipping and handling)
S= Annual Demand (quantity sold per year)
Cu= Unit costs (per year, per unit)
I= Inventory carrying cost (18%)

Table EOQ Analysis

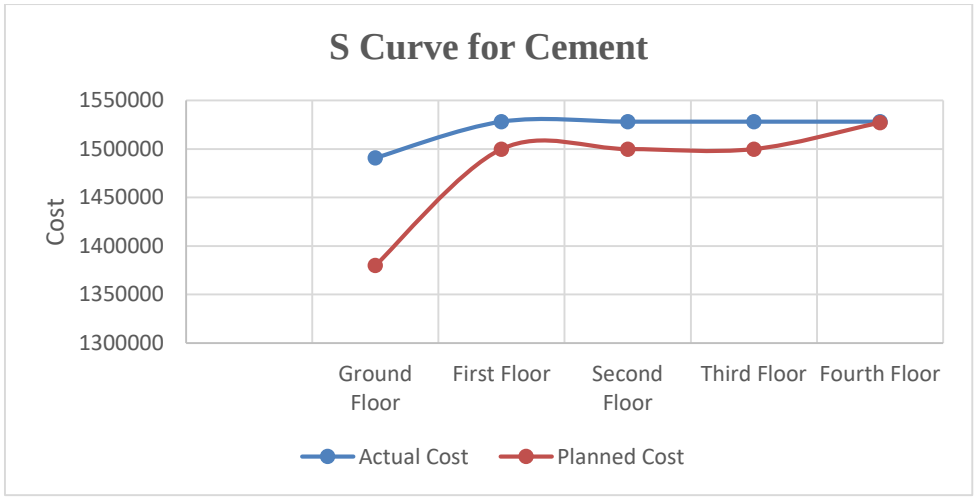
Name of items	Annual Requirement	EOQ	No. of orders	Cycle time	Total cost/ year in lakhs	Inventory Carrying Cost	Ordering cost
Cement	23085	748	31	12	74	18513	18518
Sand	1565	44	35	10	32	6930	7114
Aggregate	1940	72	27	13	19	5427	5389
Brick	44500	1128	39	9	3	593	592

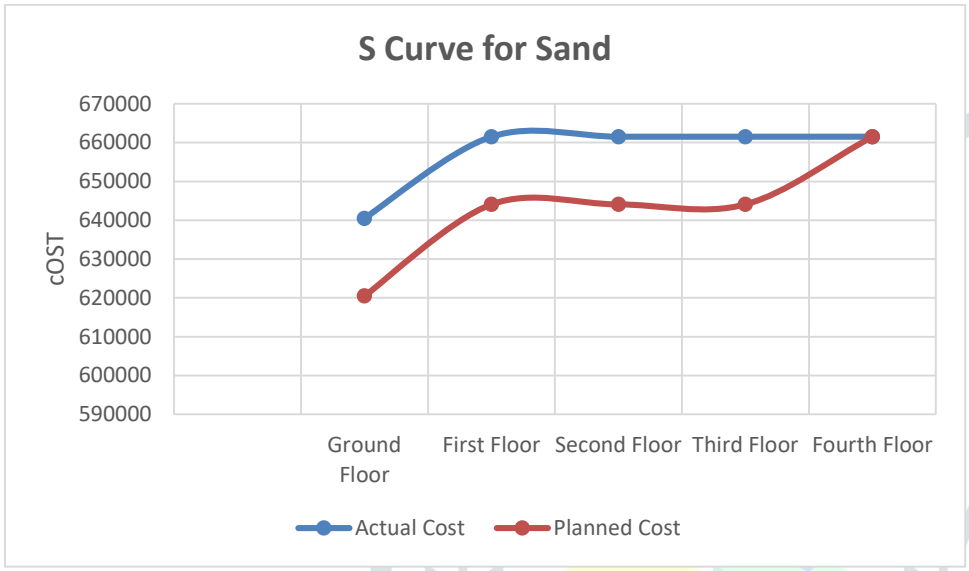
5.5 S - Curve Analysis

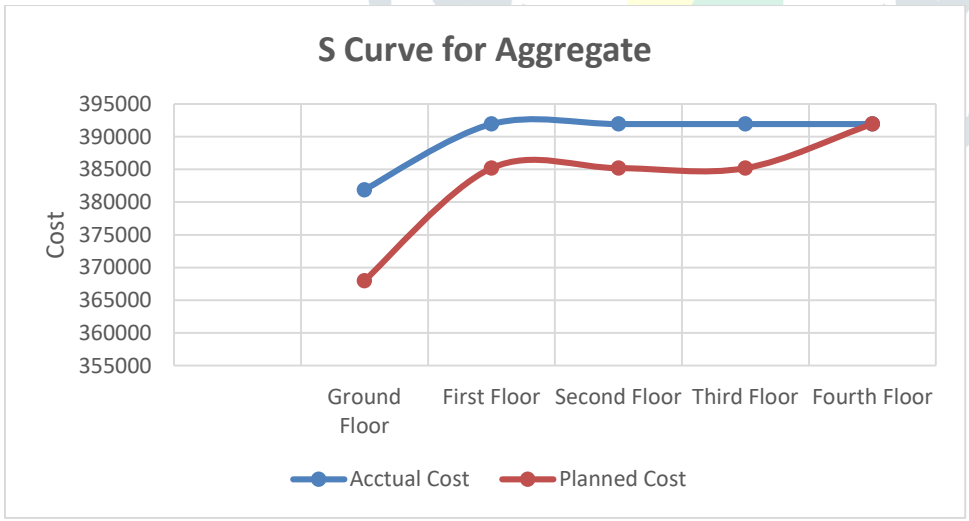
In construction project management, including residential projects, S-curve analysis can be utilized to a significant extent. It is called an S-curve because the graphical representation of project progress usually resembles the letter S. When building a residential project, it works like this:

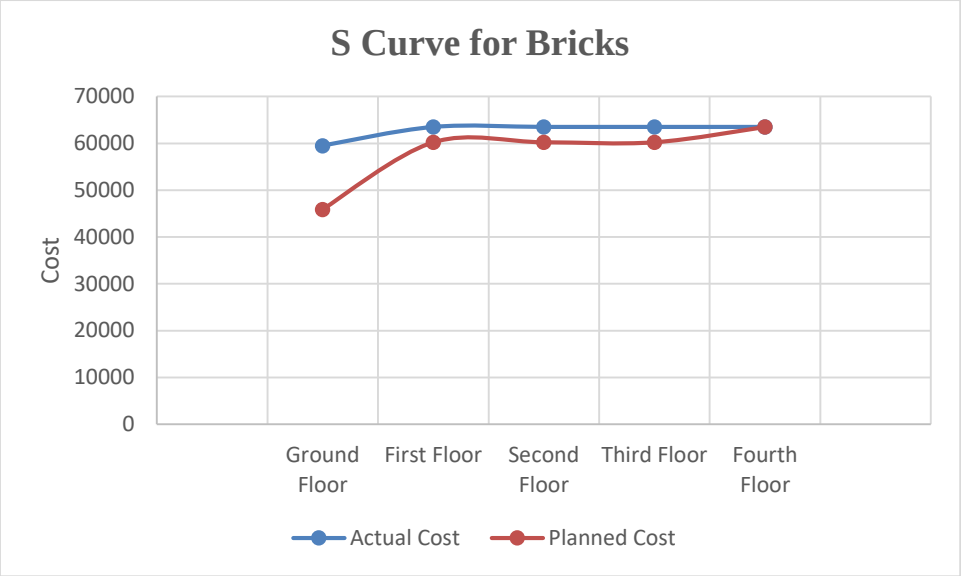
1. **Understanding the S-Curve:** The S-Curve describes the cumulative progress of a project over time. As the project begins, activities such as planning, design, and preliminary work tend to proceed at a slower pace. As the project progresses, progress accelerates and culminates in the construction phase. In the final stages, progress slows down as more touches and final checks are carried out.
2. **Data collection:** To create an S-curve, regularly collect data about the progress of the project. It contains information about completed tasks, costs and schedules.
3. **Drawing the curve:** Using the collected data, an S-curve is drawn on the graph, with time on the horizontal axis and project progress on the vertical axis (usually expressed as a percentage of completion).
4. **Analysis of progress:** The assessment tool used by project managers can help them determine whether the project is on schedule, behind time or ahead of its planned completion date by comparing actual progress to planned progress. This analysis identifies areas where the project plan may not be as planned and makes the necessary changes to maintain that progress.
5. **Resource allocation:** S-curve analysis also helps in resource allocation. By identifying the most crucial resources during the project's life cycle, it facilitates the planning of labor, materials, and equipment.
6. **S-curves:** The use of S curves allows stakeholders to easily measure and make informed decisions about progress.
7. **Forecasting:** Based on the shape of the S-curve and the current progress of the project, project managers can forecast the expected completion date and budget at completion.

The use of S-curve analysis in residential construction can assist in tracking various stages of construction, such as site preparation, basic works, foundation work, framing, HVAC and electrical installations, interior decoration, or landscaping. It facilitates the completion of the project on budget and within schedule.


S Curve for Cement
1550000
1500000
1450000
1400000
1350000
1300000
Cost
Ground Floor
First Floor
Second Floor
Third Floor
Fourth Floor
Actual Cost
Planned Cost


S Curve for Sand
670000
660000
650000
640000
630000
620000
610000
600000
590000
cOST
Ground Floor
First Floor
Second Floor
Third Floor
Fourth Floor
Actual Cost
Planned Cost


S Curve for Aggregate
395000
390000
385000
380000
375000
370000
365000
360000
355000
Cost
Ground Floor
First Floor
Second Floor
Third Floor
Fourth Floor
Acctual Cost
Planned Cost



VI. RESULT

The results show that both internal and external influences the pricing of the commodity. An structured literature analysis identified approaches for effective materials management that allowed the project to be completed on time and within budget. This is because the improper use of construction materials has a negative influence on the entire performance of building projects in terms of time, cost, quality, and productivity. This demonstrates the importance of advance planning and material availability in reducing overall project costs. Here we can see the reduction in material loss. Avoiding income losses is critical throughout the construction process. It was discovered that significant studies were undertaken primarily to identify construction waste management solutions during the construction project phase. The most successful material management systems in the construction industry, resulting in a significant boost in project efficiency. Let's look at some of the major points:

1. S-Curve Analysis: This method compares planned asset costs with real-time costs. Identifying the causes of variances can help contractors and engineers improve materials planning processes and better manage project budgets.

2. ABC Planning and Economic Order Quantity (EOQ): These methods help correct out-of-stock problems and reduce overhead costs. ABC sequencing is based on importance, while EOQ analysis determines the optimal order quantity to reduce inventory holding costs and stockout.

3. Cost saving: With 60-70% of construction project costs related to material purchases, asset management is critical to cost control. By implementing these technologies, the project aims to reduce material costs while maintaining quality and schedule.

4. Variation Management: The price of the property will affect the profitability of the project. The program aims to minimize the impact of price changes and ensure that inventory levels are adequate and not exceeded by analyzing the volume of economic demand for specific assets such as cement.

5. Data Collection and Analysis: Conducting research and gathering information about the industry helps create effective materials management strategies. By scrutinizing this information, one can identify areas where material waste can be minimized, which in turn optimizes costs.

6. Low-cost solutions: Instead of expensive inventory management software, the project supports the use of simple and cost-effective techniques such as ABC classification and EOQ analysis. The implementation of this method makes it possible for more contractors and designers to handle materials efficiently.

VII. CONCLUSION

According to this study, the implementation of proper material management resulted in a 35% increase in overall project efficiency. This project document gave instructions on the use of basic tools to manage materials effectively. The results of S-curve analysis reveal disparities between the anticipated and actual material expenses. But the main cause of this difference has been determined. By addressing these reasons, contractors and engineers can enhance their material planning skills and ensure project management is in order. By applying ABC classification and EOQ analysis, storage problems can be resolved to minimize costs associated with storage. Rather than using oversized inventory management software, designers and contractors can use these cost-efficient and efficient inventory handling techniques. Purchasing materials makes up 60-70% of the expenditure in the construction industry. The contractor or customer may experience profit or loss due to a substantial difference. This is rare. Despite the existence of real inventory, economic analysis of cement order volume and 748 bag issues during re-quest days solved most problems related

to inventory. In this project, we have proper usage of construction materials for the construction process and also map industries and collect all information about material waste management. The inventory management system can assist in analyzing all the pertinent data to minimize material expenses.

The outcomes indicate that inventory models, including EOQ and ABC analysis, can significantly impact materials management in construction projects, leading to improved efficiency, cost savings, and project outcomes.

VIII. REFERENCES

1. A.A.Lakade, Prof. A.K.Gupta, Prof. D.B. Desai, A project management approach using ERP and primavera in construction industry", IOSR journal of mechanical and civil engineering (IOSR-JMCE), ISSN: 22781684, PP: 21-24.

2. Sachin S. Pal, Prof. Himanshu Ahire (2015), "Study of material management techniques on construction project", International Journal of Informative & futuristic research",Volume 2, Issue.

3. Albaloushi, H.; Skitmore, M. Supply Chain Management in the UAE Construction Industry. Int. J. Constr. Manag. 2008, 8, 53–71. [CrossRef].

4. Ashwini R. Patil, Smita V. Pataskar "Analyzing Material Management Techniques on Construction Project", International Journal of Engineering and Innovative Technology, Volume 3, Issue 4, page no. 96-100, October 2013.

5. Augiseau, V.; Barles, S. Studying construction materials flows and stock: A review. Resource. Conserve. Recycle. 2017, 123, 153–164. [CrossRef].

6. Ballard, G. The Last Planner System of Production Control. Ph.D. Thesis, University of Birmingham, Birmingham, UK, 2000.

7. Barbosa, F.; Wetzel, J.; Mischke, J.; Ribeirinho, M.J.; Sridhar, M.; Parsons, M.; Bertram, N.; Brown, S. Reinventing Construction: A Route to Higher Productivity, 2017.

8. Bock, T. The future of construction automation: Technological disruption and the upcoming ubiquity of robotics. Atom. Constr. 2015, 59, 113– 121. [CrossRef].

9. By George stukhart, „construction materials quality management", journal of performance of constructed facilities, Vol.3, No.2, page no.100-112, May 1989.

10. By Lansford C. Bell, George Stukhart, Costs and benefits of materials Management systems", journal of construction engineering and management", Vol. 113, No. 2, page no. 222-234, June, 1987.

11. D. P. Patil (2017) "Application of Inventory Management in Construction Industry", International Journal on Recent and Innovation Trends in Computing and Communication, Volume 5, Issue 6.

12. Deepak M.D (2015), "An Empirical case study of material management in material management in residential project", International Research Journal of Engineering and Technology, volume 2, Issue 4.