

Application of ABC Analysis for Material Management of a Residential Building

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Abstract - The aim of this work is to highlight the importance of material management as materials make considerable percentage of total construction costs and inculcate its technique. Material management is beneficial towards the material savings and economic construction. These demands for the need of studying of the material management process and its assistances towards an organization. Items are classified according to their usage and cost occurred for discovering the critical items which need strict vigilance. The results showed that using material management technique helps in efficient material flow, better quality control and reduced material wastages. Manufacturing of construction materials consumes large amount of resources and money, therefore wastage of these materials should be avoided. Construction of structures is growing at a rapid pace. This proposes the need for employment of material management techniques in the construction activities. ABC analysis is used in this work for material management. In this work a case study of a Multi-storeyed building is considered with an aim of minimising wastage of materials by efficient material management. This helps to bring economy in construction.

Key Words: Project, Estimation, ABC Analysis and Material Management.

1. INTRODUCTION:

The construction industry is one of the largest industries in the world. It has a major role in the economic growth of a country. It is challenging than other industries owing to exclusive nature of every project, many conflicting parties are tangled and projects are inhibited by time, money, quality and high risk. This facilitates the need for efficient project management. The use of project management techniques facilitates a suitable plan which when executed leads to the completion of the project with the desired results.

1.1 Characteristics of a Project

The following are characteristics of a Project:

1. It has clearly-defined targets.
2. It is carried out by a group of interdependent tasks.

3. It is planned and has distinctive, identifiable phases.
4. It yields clearly-defined results.
5. It is restricted for time and space.
6. It is non-repetitive type in nature.

1.2 Material Management

During World War I in USA, the scarcity of materials was felt to a huge extent which posed challenges to the manufacturers to supply goods for the war. This generated the basis for materials management of large inventories in stores and for analyzing the complications arising in controlling the inventory cost problems and shortage elimination. Material management is an essential function for achieving economy.

In 20th century, with the advancing of the scientific management principles by F.W. Taylor, the economic usage of materials in all the establishments was alarmingly felt to cut-down the production cost.

Purchasing acquired significance during World War I. Howard T. Lewis was a purchasing professional from 1905 to 1945. He established the significance of thorough procurement to company's operation.

The shortage of materials, demand its management and also analyzing the problems arising to control inventory cost problems.

Construction material constitutes more than 50% of the total project cost. This necessitates the huge need for material management. Materials management consists of all the activities in the movement of materials into the organization. The performance of the process is controlled by the movement of materials.

“Material management is defined as the process to deliver right material at right place at right time in right quantity so as to minimize the cost of project”.

Materials management involves the planning, directing, controlling and coordinating of all the activities related with inventory and material requirements. This begins from the point of inception to their introduction into the manufacturing process.

1.3 Objectives of Materials Management

These objectives of materials management, contributes to the attainment of overall objectives of the company.

1. Primary Objectives: If the contribution of the objectives is direct they are called as "primary objectives". They are:

- i. Effective material planning.
- ii. Low cost for procurement.
- iii. Efficient storage and inventory control.
- iv. Continuity in supply and circulation of materials.
- v. Quality assurance.
- vi. Good supplier relations.
- vii. Development of personnel.
- viii. Good information system.

2. Secondary Objectives: If the contribution of the objectives is indirect they are called as "secondary objectives". They are:

- i. Efficient production scheduling.
- ii. Decision to make or buy.
- iii. Prepare specifications and standardisation of materials.
- iv. Provide assistance in product design and development.
- v. Predicting material demand and quantity.
- vi. Quality assurance of materials purchased.
- vii. Material handling.
- viii. Practicing value analysis and value engineering.
- ix. Evolving labour skills in materials management.
- x. Uninterrupted material flow.

1.4 Functions of Materials Management

Material management shelters all the aspects like material costs, supply and its utilization. It is divided into different functions, they are:

1. Materials planning and scheduling:

Material planning involves estimating of consumption of materials for arranging the supplies of a particular production plan. Determining either to make or buy seeing the financial facets, production capacity, availability and reliability on outside sources, setting procurement standards and specifications etc.

Detailing the delivery of items to meet the scarcity of materials. This involves monitoring of actual deliveries in contrast to the schedules and taking distinct action for advancing if any short coming.

2. Purchasing:

This involves tracing and enhancement of supply sources, market study for procuring, negotiating prices, calling for tenders, selecting suppliers, issuing of purchase orders, vendor rates, preparation of material budget etc.

3. Store keeping:

Comprises stores layout, upgrading of storage system, stores control in terms of receipt and issuing of materials, stores records maintenance and stores accounting.

4. Inventory planning:

To avoid stock-out of materials and to ensure reduce the inventory holdings. Techniques like ABC analysis, analysis of lead times etc. are employed to determine minimum and maximum safety levels, re-order level etc. Maintenance of stock records should be ensured for better control.

5. Receiving, warehousing and transportation:

Comprises of reception of materials, moving them to stores, return of overruled materials after inspection. It ensures minimum trading, providing appropriate material handling equipment and provision of precise warehousing arrangement to eliminate losses.

6. Salvage and disposal of scrap and surplus:

Examining the circumstances of surpluses and obsolescence then find out alternative uses or disposal and to restrain such recurrences. Aggregating different types of scrap and swarf to obtain maximum prices while disposing off.

7. Miscellaneous functions:

Value analysis, standardization, production planning and control, vendor development and material handling.

1.5 Benefits of Material Management

An efficient system of material management is beneficial in the following ways:

1. Reduction in overall material budget.
2. Improved handling of material.
3. Lessening of repetitive orders.
4. Material is obtained at the desired time and in the desired quantities.
5. Enhancement in labour productivity.
6. Better project schedule.
7. Quality assurance.

8. Improved material handling.
9. Healthier relations with suppliers.
10. Better coordination.
11. Improved Inventory control.
12. Improved usage of stores space.

2. Methodology

In manufacturing industry, an organization requires to maintain a proper balance between critical stock-out and reducing inventory costs. Material cost sums up to be more than 50% of the total cost which demands for the need of managing materials.

Estimation is an integral part of material management. Material management is a balancing act. It is harmonizing the functions liable to plan and control the material flow. It maximizes the usage of firm's resources and deliver the essential level of customer's service and gives great profits to the organization.

The performance of the process is dependent on the flow of materials. Selective control is required in certain extents of material management like in inventory, items criticality, outdated stocks, inspection, purchasing order and receipt of materials, store-keeping and verification of bills. It becomes nearly impossible to keep in check the numerous items. This calls the need for material management.

2.1 Estimation

Estimation is a scientific manner of calculating a tentative cost for an engineering venture before the work executes. It is computed as per the plans and specifications. It differs from the actual cost after project completion.

It involves a detailed awareness of all construction procedures and materials and labor costs as well as experience, skill, farsightedness and a good judgment.

If the estimated cost does not differ by more than 5% to 10% from the actual cost of the work proposed, then it is considered to be a good estimate, excuse can be made under unusual and uncertain circumstances.

A detailed estimate for a case study is prepared to form the basis of the material management technique i.e. ABC analysis.

Steps involved in estimation are:

1. Calculation of every item of work is done.
2. Each item of work is then multiplied with its estimated existing rate which gives the cost of every item.
3. A totalling of all the work items is done to get total estimated cost.

4. The rates are generally confirming to the Schedule of Rates for the particular locality in addition to a premium to tolerate for the escalation in rates of labor and materials.

5. Typically, a percentage of 5% is added on the total estimated cost to allow for likely contingencies due to unexpected expenditure or other causes.

2.2 ABC Analysis

ABC analysis is a simple and analytical management tool. ABC analysis is a technique of categorizing inventory items according to their substantial impact on the overall expenditure of an organization. It grants a solution to faulty inventory administration within the purchased items or availed services.

It is based on the Pareto Principle which states that "80% of the overall consumption value is based on only 20% of total items". The breakdown suggests that the inventories are of different values; hence it necessitates different tactics and management controls. The arrangement of categories is based on its anticipated value.

ABC analysis is an "inventory categorization method" which entails the dividing items into three categories, A, B and C: "A" contains the "most valuable items" and "C" consists the "least valuable items", whereas "B" contains items ranging between "A" and "C". It aims to focus on the critical few (A-items) and not on the trivial many (C-items).

In this analysis, various items are listed according to their total usage; unit cost and then total cost of items are calculated. Different parameters are listed in tabular format which make it easy for classifying items according to their cost and usage.

This approach states that, when reviewing inventory, items should be rated among A to C by the firm, establishing its ratings on the following rules:

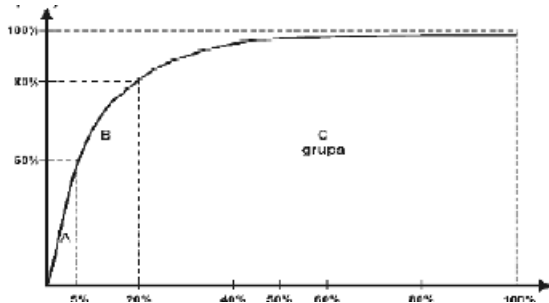
1. **A-items:** have the "highest annual consumption value" of goods i.e. 70%-80% of the annual consumption value of the company. Ironically, it accounts only 10%-20% of the total inventory items. They require stringent inventory control, more protected storage areas and improved sales forecasts, re-orders should be frequent, with weekly or even daily reorder; avoiding stock-outs on A-items is a priority.

2. **B-items:** are the interclass items, having medium consumption value i.e. 15%-25% of annual consumption value. It consumes around 30% of the total inventory items.

3. **C-items:** have the "lowest annual consumption value" of goods i.e. 10%-15% of the annual consumption value. On the contrary, it accounts for 50% of the total inventory items.

“The annual consumption value= (Annual Demand) x (Item Cost per Unit)”.

A graph is drawn which shows the classification of A, B and C items.



Graph representing Percentage of Items vs Percentage of Total Cost.

2.3 Steps for the Classification of Items

Following are the steps for the classification of items by ABC analysis:

1. The unit cost and the demand of each item is obtained over a given period.
2. Multiply the unit cost by the calculated annual usage to obtain the net cost.
3. All the items are listed out and arranged in a descending annual cost.
4. Sum up the cost and add up the number of items then, compute percentage on the total inventory of total cost and for total number of items consumed.
5. Draw a graph of percentage items vs percentage cost.
6. Mark from the curve the rational limits of A, B and C categories.

2.4 Benefits of ABC Analysis

ABC analysis is beneficial in the following ways:

1. It is a technique of allocating direct and overhead expenditures first associated with the critical activities of the firm. This process defines the areas generating maximum profit to the company in a better way.
2. It aids stringent and better controls of high-priority inventory.
3. It promotes efficient use of its resources to prioritize control of inventory over its impact on final outcome.
4. Resource allocation is more efficient during cycle counts.
5. Its objective is to achieve economy by efficiently managing the materials.

6. It safeguards control over expensive items in which a hefty amount is invested.

7. Clerical costs are substantially reduced and stock is retained at optimum level.

2.5 Limitations of ABC Analysis

Following are the limitations of ABC analysis:

1. Conflict with other cost systems. ABC cost allocation differs from the traditional cost system allocation.
2. This method needs more resources to maintain compared to the traditional costing systems.
3. This is a continuous process which needs added data measurement and collection.
4. It needs periodical assessment and updating.
5. This analysis is built on the monetary value of the materials in use. Other important factors are ignored.

2.6 Project Outline

A live project is undertaken as a case study for this work with built-up area of 57,535.6 Sq. Ft. This is a multi-storied building constructed with the view of providing both commercial as well as residential accommodations to the customers.

A detailed estimate of the building using structural and architectural plans for the work. This includes the land cost, contingency charges, labour cost and transportation and water charges. It gives the budget required for the project. An abstract sheet for the same is prepared.

After obtaining an estimate for different construction tasks, the materials are tabulated in a descending order of their total costs for the total usage of different materials. ABC analysis is applied, which classifies materials into different categories according to their highest amount occurred for individual materials to prioritize them. A graph for total percentage of items v/s total percentage of cost is plotted. This helps in managing various materials according to their criticality or impact on material cost. This technique aids for efficient material management.

Table -1: Total Project Cost

TOTAL CONSTRUCTION COST	Rs- 7,25,40,469/-
LAND COST	Rs-7,00,00,000/-
WATER AND TRANSPORTATION CHARGES IS 5% OF THE TOTAL COST	Rs-71,27,023/-
CONTRACTOR'S PROFIT IS 10% OF THE TOTAL COST	Rs-1,49,66,750/-

According to the estimate ₹ 16,46,34,242 (Rupees Sixteen crores Forty Six lakhs Thirty Four thousand Two hundred and Forty Two) is the probable cost for constructing a built-up area of 57,535.6 Sq.ft. The rate for per Sq.ft of area is ₹ 2861.31.

A comprehensive case study on material management at work site is done. Attempt has been made to improvise the material management measures. Analysis is done at the site based on cost input, such as ABC analysis. In ABC analysis, categorization of all materials into A, B and C type materials are done.

Using this technique, during construction, the releasing of materials can be as per the above concept, to strengthen financial control and proper scheduling and programming of the activities, thereby proceeding work progress efficiently.

After calculating different work quantities, items according to their quantity used was calculated. Unit price of each item is given and the total cost of each material was found. ABC analysis gives the following results:

Table-2: Classification of Items using ABC Analysis.

CATEGORY	ITEMS	% OF ITEM	% OF TOTAL COST	ACTION
CLASS A	SAND, STEEL, FLOORING.	20%	43%	CLOSE CONTROL
CLASS B	BLOCKS, CEMENT, PAINTING, DOORS, BATHROOM FITTINGS.	30%	37%	REGULAR REVIEW
CLASS C	AGGREGATES, WINDOWS, FORMWORK, ELECTRICAL FITTINGS, GLASS RAILING, KITCHEN PLATFORM, PIPES, PAVERS.	50%	20%	INFREQUENT REVIEW

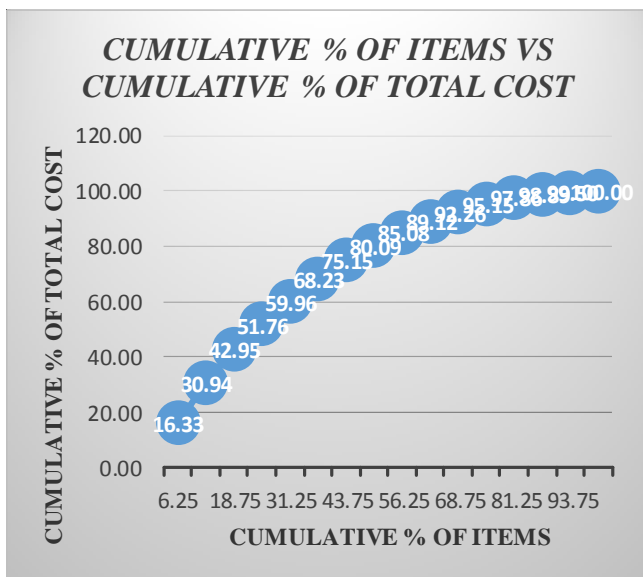


Chart -1: Graphical representation of ABC Analysis.

The graph is plotted with Cumulative % of Items as the x-axis and Cumulative % of Total Cost as the y-axis. The graph shows classification of different class of items required for ABC analysis. The items ranging to 20% are the A class items, up to 50% are the B class items and till 100% are the C class items.

After plotting the graph for different items according to the “% of items” vs “% of total cost”, they are categorized according to their impact on total cost of materials. This categorization is shown in the tabulation.

The percentage of different items under Class A, Class B and Class C for their total percentage of items used is as represented in the pie chart below.

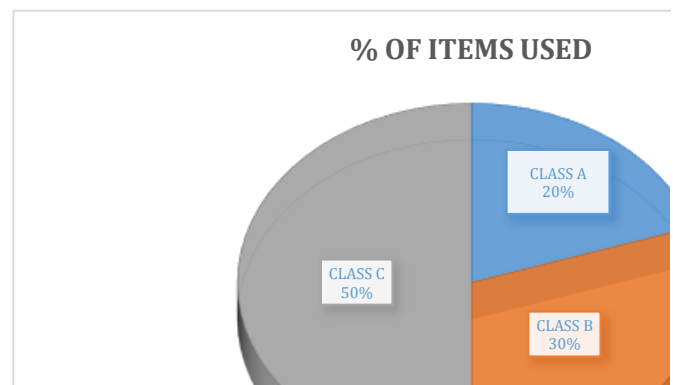


Chart -2: Graph representing % of Items used.

The impact of items in A, B and C category on the total material cost is highlighted by the pie chart shown below.

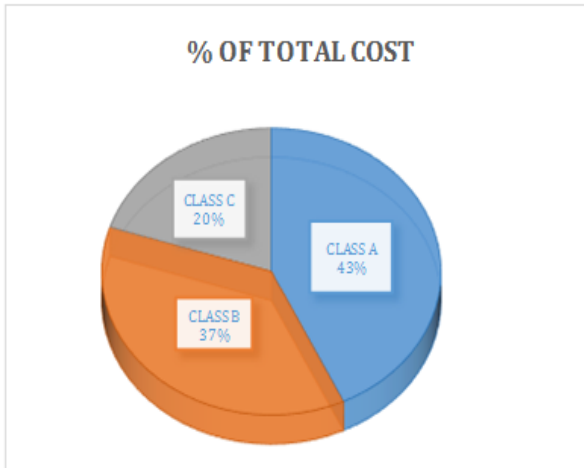


Chart -3: Graph representing % of Total Cost.

ABC Analysis gives a complete knowledge of various materials used in a residential project and its impact on the total project cost. It pays attention on those items that make maximum conceivable savings. Proper application of material management technique reduces the wastage of materials on site and intimates the stock-outs and need for purchasing of materials.

3. CONCLUSION:

Project Management plays a key role in making a project successful. This work mainly deals with the material management which is an integral part of project management. The following conclusions can be drawn from the work carried. They are:

1. In construction environment, an organization requires to maintain a balance between critical stock-outs and reducing inventory costs. From this study, it is established that this analysis helps in managing the materials well for both raw material and for finished goods. It helps to understand the problems occurring in purchasing and safety stock.
2. From the results of ABC Analysis, we conclude that material management in construction of a project is of high importance as the material cost contributes to 62.87% of the total construction cost of the project.
3. The ABC analysis shows that:
 - i. Class A items contributes 43% of the total material cost. It is found sand, steel and flooring belong to this class.
 - ii. Class B items contributes 37% of the total material cost. It is found blocks, cement, painting, doors and bathroom fittings belong to this class.
 - iii. Class C: 20% items contributes of the total material cost. It is found aggregates, windows, formwork, electrical fittings, glass railing, kitchen platform, pipes and pavers belong to this class.

It shows that the categorization technique used for material management where accuracy and control increases from C to A.

Based on ABC Analysis, the need for control, requirement, check and stocks of the items is as concluded in the table.

Table-2: Level of Supervision for Materials categorically.

Particulars	A- Class Items	B- Class Items	C- Class Items
Control	High	Intermediate	Low
Requirement	Low	Intermediate	High
Check	Tight	Intermediate	Low
Safety Stock	High	Low	Rare

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