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# Analyzing Material Management Techniques on Construction Project

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***Abstract*— The efficient procurement of material represents a key role in the successful completion of the work. Poor planning and control of material, lack of material when needed, poor identification of material, re-handling and inadequate storage cause losses in labor productivity and overall delays that can indirectly increase total project cost. Effective management of materials can reduce these costs. This paper is written to explore the current practices of Material Management so this study is conducted in two phases, First phase gives the Qualitative information regarding deviation in planned and actual materials in terms of S curve analysis using MSP tool and reasoning over the deviation is essential to know the effect of material planning before execution of project. Various comments on S curve analysis have given in terms of problems of administrative causes, consultant's causes, contractor's faults, and unavailability of resources. These major reasons of changes represented in terms of pie chart. To maintain sufficient stock of raw material in period of short supply, to protect inventory against deterioration and control investment in inventories and to keep it in an optimum level an inventory control techniques such as ABC and EOQ analysis is carried out in second phase of study to overcome the problems of stock out.***

*Key Word* —**Construction Materials, Cost Control, Inventory Control, Material Management.**

## I. INTRODUCTION

Construction material constitutes a major cost component in any construction project. The total cost of installed material may be 50% or more of the total cost. The goal of material management is to ensure that the materials are available at their point of use when needed hence, efficient procurement of material represents a key role in the successful completion of the work. It is important for the contractor to consider that there may be significant difference in the date that the material was requested or date when the purchase order was made, and the time at which the material will be delivered, thus material management is a key of project management."Material management is defined as the process to provide right material at right place at right time in right quantity so as to minimize the cost of project". Material management is concerned with the planning, identification, procuring, storage, receiving and distribution of material. The responsibility of Material management department for the flow of material from the time the material is ordered, received, and stored until they are used is the basic responsibility of material management. Materials represent a major expense in construction, so minimizing procurement cost improves opportunities for reducing the overall project cost. If materials are to be purchased too early, capital may be held up and interest charges incurred on the excess of inventory of materials. Delays and expenses may be incurred if material required for particular activity. Ensuring a timely flow of materials is an important concern of material management. Material planning and inventory control are the two most important measures as per as Material management is concerned. This paper mainly focus on variation in planned Vs actual material cost through S curve analysis and applying inventory control technique so as to minimize stock out problems and minimizes the total cost of inventory.

## II. LITERATURE REVIEW

### *A. Objectives of Material Management*

Material management system can bring following objectives

- Efficient material planning
- Buying or Purchasing
- Procuring and Receiving
- Storing and Inventory Control
- Supply and distribution of material
- Quality and assurance
- Improved efficiency
- Good supplier relationship

To fulfill all these objectives, it is necessary to establish a good coordination between all the employees of material management department

### *B. Benefits of Material Management*

An effective material management system can bring following benefits

- Reducing the overall costs of material
- Better handling of material
- Reduction in duplicated orders
- Material is on site when needed and in the quantities required
- Improvements in labor productivity
- Improvements in project schedule
- Quality control
- Better field material control
- Better relations with suppliers

### *C. Process of Material Management*

Material management process initiates from need generated from site then this information conveyed to store department and material is ordered in the store, indent is generated. Vendor selection is to be carried out for the least value and best items. Materials are received at store department and inspection is carried out.

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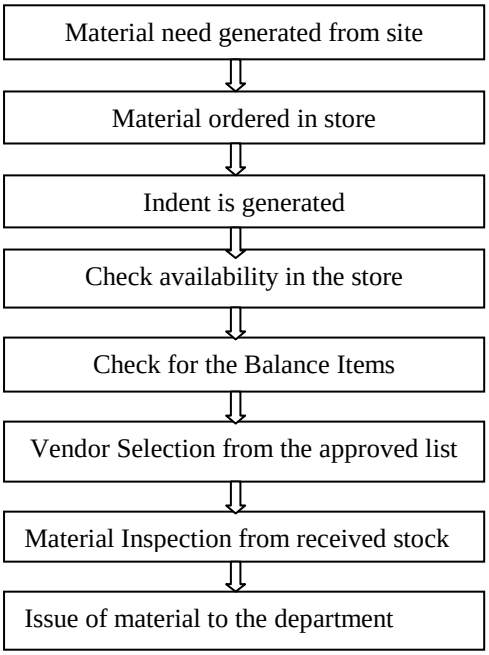


**Fig.1. Process of Material Management**

## III. OUTLINE OF REASEARCH WORK

### *A. Aim*

The aim of this research is to explore the existing common practices in construction projects & to apply inventory control technique so as to analyze the effect of material management on constructions projects.

### *B. Objectives*

Objectives which have covered in this project study are as follows:

- To Compare Planned Vs Actual material consumption using MSP software then to find the problems in planning, purchasing, procurement & to suggest remedies regarding the material management.
- S Curve Analysis is used for comparison of planned and actual cost of construction material
- Reasoning over S curve Analysis.
- To apply Inventory Control Techniques such as A-B-C analysis.
- To apply EOQ analysis to "A" & "B" class inventories so as to avoid stock out.
- Apply inventory control technique so as to minimise the total cost of inventory

### *C. Research Methodology and Data Collection*

The research design used in this project is analytical in nature and the procedure using which the Researcher has to use facts or information already available and analyze this to make a critical evaluation of the performance.

**Data Collection**

In this research few methods of data collection are used which can be divided into two parts such

a) Primary source & b) Secondary Sources.

a) Primary Sources: Primary sources are those sources which gives pre idea about research. It also gives theoretical and practical concept.

- Literature Review: To know the current practices of Construction material management, literature review has been carried out thoroughly.
- Interviews: In order to find the observations, Interviews have been carried out with project manager, Billing Engineer & Store In charge.
- Tender Document: This is a very important source of primary data because this document gives the tender quantities for the live project.

b) Secondary Sources: Secondary data are collected through those data which are already in presence for specific purpose.

- MRN: MRN means "Material Requisition Note" is that source which gives an idea about requirement of material.
- Ledger Register: This provides the information regarding the order of material and Cumulative quantity of material till date.
- Daily Material Report: This report gives information regarding daily material consumption & stock available for further use for the project.
- Running Amount Bill: This is very important source of secondary data which gives the actual executed quantities required for the project.

***Research Methodology***

In this research the current material management practices are investigated. Material management is not just a concern during the monitoring stage in which construction is taking place. Decision about material procurement may also be required during initial planning and scheduling stage. Secondly during execution inventory control technique should be monitored periodically so as to maintain flow of material to avoid the delays. Basically this research is divided in two parts such as first one Qualitative analysis & second Quantitative analysis. Qualitative analysis: This analysis is carried out using MSP software for analyzing planned and actual material consumption through S curve analysis. Reasoning over the deviations curve is the s shaped graph produced by the the cumulative expenditure of certain parameters (man-hours cost) against time and it is the representation of project path. This analysis is carried for comparison of planned and actual cost for material.

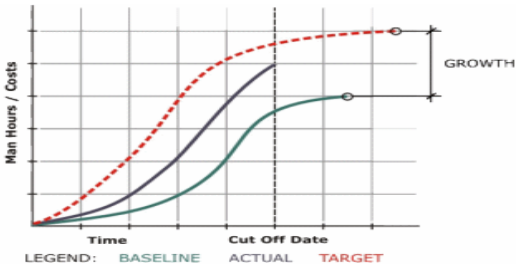


**Fig 2. S curve Analysis**

This analysis is carried out to study the deviation planned and actual material cost.

**Quantitative Analysis:** This study mainly focuses on Inventory Control techniques which includes ABC analysis, EOQ analysis and Calculation of Stock levels.

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"Inventory control refers to a system, which ensures the supply of required quantity and quality of inventory at the required time and at the same time prevent unnecessary investment in inventories."

**Objectives of Inventory Control**

- Maintain sufficient stock of raw material in period of short supply and anticipate price changes.
- Control investment in inventories and keep it at an optimum level.
- Protect inventory against deterioration, obsolescence and unauthorized use.

Inventory Control System is to secure the best balance between too much and too little inventory."

**1. ABC Analysis.**

The ABC inventory control technique is based on the principle that a small portion of the items may typically represent the bulk of money value of the total inventory in construction process, while a relatively large number of items may from a small part of the money value of stores. The money value is ascertained by multiplying the quantity of material of each item by its unit price. The items

**"A" Category** – 5% to 10% of the items represent 70% to 75% of the money value.

**"B" Category** – 15% to 20% of the items represent 15% to 20% of the money.

**"C" Category** – The remaining number of the items represent 5% to 10% of the money value.

The relative position of these items show that items of category A should be under the maximum control, items of category B may not be given that much attention and item C may be under a loose control.

**2. EOQ analysis:** The EOQ refers to the order size that will result in the lowest total of ordering and carrying costs for an item of inventory. If a firm place unnecessary orders it will incur unneeded order costs. If a firm places too few order, it must maintain large stocks of goods and will have excessive carrying cost.

### *D. Details of Case Study*

***Company Profile:*** The case study which is selected for this project is Industrial Building under the guidance of SCON Project. **SCON Projects** (formerly known as Samarth Construction) is formed in January 1996. This year they have celebrated their 15th anniversary. In these 15 years, Company have successfully executed en-number of construction projects and achieved recognition in the construction field. SCON is a well reputed contracting firm in Pune, which belongs to mainly industrial projects. Company has various industrial projects going on and some of them are going to launch soon. SCON is a winner of **"BAI - Well Built Structure-2012"** award for its project Dohler India. **"LMT TOOLS INDIA. LTD."** is one of their project which has been selected as case study for this work.

## IV. REPORT ON PRESENT INVESTIGATION

Result from Qualitative Analysis:

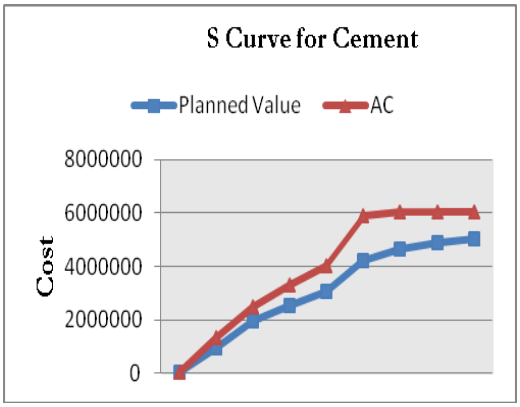


**Fig .2 S Curve for Cement**

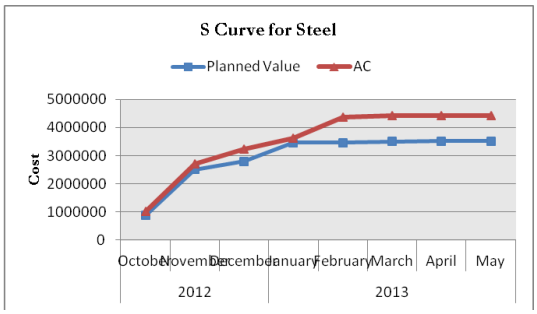


**Fig 3 S Curve for Steel**

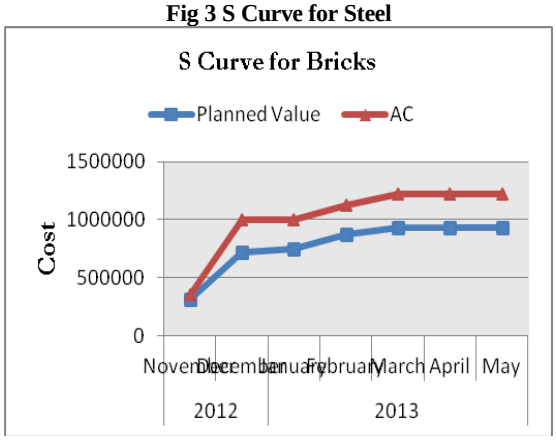


**Fig .4 S Curve for Bricks**

Above graphs shows the comparison of cumulative cost of planned actual material. This cost is less at initial stage. This S curve Analysis recognize that there is too much increase in material cost while actual execution. Though this is small project but material management aspect never differs whether it is small or big.

**Major Causes in Variation of project**

In various executed work remarks have be discuss and according pie chart is prepared in which main constraints are discuss.

1) Administrative Causes: This type of reasons covered such as level changes in excavation, tremendous increase in filling due to level changes.

2) Contractors Rework: It includes reasons like additional changes in structures.

3) Delayed in Material: Material is unavailable in proper time.

4) Consultant inefficiency: This reason includes reason from consultants view. It include like changes in drawing.

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5) Client reason: This reason includes from owner view. It includes like changes in sizes**.**

From the discussion with Project manager the reasons are found out over variation in quantities such as tender and actual executed quantities.

**Table .1 Causes of variation in Project**

| Sr. No. | Causes of variation | No. Of reasons | Colour code | % of variation |
|---|---|---|---|---|
| 1 | Administrative reasons | 41 | Blue | 30.00 |
| 2 | Contractors rework | 35 | Red | 26.00 |
| 3 | Unavailability of material | 6 | Green | 5.00 |
| 4 | Consultants inefficiency | 27 | Violet | 20.00 |
| 5 | Owners decision | 25 | Grey | 19.00 |

**Result From Quantitative Analysis**

***EOQ Analysis:***

In this study EOQ analysis is performed on Cement, Reinforcement Steel, Bricks, Sand & Aggregate. While performing EOQ analysis Ordering Cost & Inventory Carrying Cost is assumed for each material with practical execution procedure of construction. Inventory carrying cost incurred for maintaining the inventory, This includes Cost of Storage, Insurance taxes, Deterioration & obsolescence this calculates in %. **Inventory Carrying Cost** = 20%

**Economic Order Quantity is calculated by following formula,**

$$Q = \sqrt{\frac{2 * Co * S}{Cu * I}}$$

where, Co = Ordering Cost,
S = Total Consumption
Cu = Cost of Item
I = Inventory carrying Cost

**Table No.2 EOQ Analysis**

| Name of Material | Annual requirement | EOQ | No. Of orders | Frequency Of ordering | Total cost of Inventory using EOQ in lacs |
|---|---|---|---|---|---|
| Cement | 11000 Bags | 464 | 24 | 11 | 31 |
| Steel | 121 MT | 11 | 11 | 24 | 53 |
| Bricks | 170000 Cum | 17500 | 10 | 27 | 12 |
| Sand | 1213 Cum | 34 | 35 | 7 | 11 |
| Aggregate | 263 Cum | 20 | 13 | 17 | 24 |

## V. SUMMARY AND CONCLUSION

1. Construction material constitutes a major cost component in any construction project. The total cost of material may be 50% of total cost; so that it is important for contractor to consider that timely availability of material is potential cause of successful completion of project.

2. **S curve analysis**: It is concluded that major causes of variations are as following :

- Due to unavailability of RCC Design drawings this causes problems to contractor to work out accurate actual quantities.
- Due to deviation in Items it will affect on material procurement and finally affects the total project budget.
- If the tender is quoted accurately so that non tender will not arises because basic rate of material fluctuate day to day leading to increase in cost. Instead of quantities that item should be quoted as Rate only item so it is profitable to contractor & Client.
- Due to uneven geographical conditions in case soling extra depth of excavation to be considered.
- From the pie chart conclusion is found out that administrative causes are 30% which affects directly on contractors rework, 5% reasons due to unavailability of material.

**3. EOQ Analysis**

- After EOQ analysis for cement it is concluded that economic order quantity which is 460 Bags & frequency of ordering 11days which has overcome the problems of Stock out successfully over the actual Site stock records.
- For B class material such as sand and aggregate on site material are ordered as per requirement because of space availability they could not maintain stock as per EOQ.
- After performance of EOQ on sand & Aggregate it can be concluded that those material does not gives satisfactory results because ordering frequency after EOQ was 7 days & 17 days but actually on site demand is as per daily requirement
- The Total cost of inventory after adoption of EOQ analysis is less than without adopting EOQ.
- Material Manager should maintain reports such as material to order between two dates, material assignments, waste control, when to purchase construction material, when material must be on site, and purchase order between two dates.

## VI. RECOMMENDATION

Now a day's various software is adopted for material management in big scale projects which are too much costly. In case of Big & small projects it is recommended to use ABC and EOQ analysis for inventory control in a year. Before any execution of project all detailed drawing is needed to be studied. R.C.C drawings should be available with the contractor before execution of the project so that all detailed study will be done. Incentive scheme should be adopted for staff members to attend training courses in construction material management so they are aware about material planning & scheduling at every stage.

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This is strongly recommended that the all drawings should be available as early as possible.

## VII. FUTURE SCOPE

- Material Planning and scheduling can be done at every stage using construction software such as MSP.
- Hit office also a very good software for maintaining material inward, issue records which gives the accurate results in terms of Reconciliation Report.
- An effective Inventory Control model can be developed using Regression Analysis is further scope of study.

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