

Analysis of Construction Materials using Inventory Control Techniques

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Abstract:- Inventories represent the second largest asset category for construction companies, next to plant and equipment. Inventory would be the amount of raw materials, fuel and lubricants, spare parts and semi processed material to be checked inventories for the smooth running of construction firm. Nearly 60% of money is allotted for the inventory in a project. Since these resources are idle when kept in the stores, inventory is defined as an idle resource of any kind having an economic value. In this study, I only focus on raw material inventory for analysis of inventory control technique. Factor determination was conducted using RII method and SPSS software and data analysis upon inventory control were carried out using inventory control techniques like ABC and EOQ.

Keywords:- Inventory, Raw materials, RII, SPSS, ABC, EOQ.

I. INTRODUCTION

Construction materials constitute a large portion of the total cost in construction projects. In this inventory management is one of the single largest components to improve the productivity, cost efficient of a project and help to ensure timely completion of the project. Inventory management done in order to meet the supply of something to meet an expected demand for a given financial investment. This could be raw materials, work in progress, finished products, or spares and other indirect materials.

Inventory management deals with the various policies and procedures for procurement of commodities. Since it is bit difficult to imagine a real work situation in which required material will be made available at the point of use instantaneously, maintaining inventories becomes almost necessary. Every organization are in need of inventory for easy running of its activities. It act as a link between production and distribution process. Thus it is essential to have proper control and management of inventories. The nee of inventory management is to make sure that the availability of materials in appropriate quantity and when required and also to reduce investment in inventories.

In past, inventory control was not attended to be necessary. In fact overabundance of inventories were considered as expression of wealth. Management by then considered over stocking beneficial. But today firms have started to enclose effective inventory control. Manager, nowadays need compatible and productive inventory control in order to reduce cost and remain competitive. In construction

industry it is common problem that the actual cost of project goes above the estimated cost of a project. This problem requires a proper planning, management and control on project to resolve it. Cost of project can be constrained by proper inventory control system

For inventory control ABC analysis and EOQ is used in this project. In order to evaluate the performance of the inventory management, a questionnaire survey has been conducting for the analysis of factors affecting inventory management and referring the annual reports of the organization the required data for the application of inventory control techniques. An inventory control system is to be engineered to achieve the basic need for which the inventories are developed.

The basic objective of a good inventory control system is to be able to determine What to order, When to order, How much to order, and How much to carry in stock so as to gain economy in purchasing, storing, manufacturing and selling.

Mainly the inventory management on the multistory building was done to find out answers of two major questions, How many units to order and when to order.

II. SCOPE OF THE PROJECT

In construction industry one of the big problems is project delay due to material shortages. To overcome this problems, material should be procured at correct time and dumped at correct place. The basic purpose of inventory holding stocks in a material flow system are to double successful stage of following system is important purpose of inventory.

Main scope of the project is try to avoid the over dump and correct procurement of the material for building works at right time. This can be done with the help of inventory management. In this inventory system, the required amount of building material is calculated by detailed study of plan. The whole inventory management chart is classified into different dates for easy work flow. So the required amount of materials for different works is released according to it. It also increase the efficiency of work and it will flow continuously without any barrier.

Supervisor can easily understand the inventory chart, quantity of materials require for the work and purchase of the materials is done according to it. Over dumping of materials

occupies more land and amount will be released earlier. With the help of inventory chart the over dumping is avoided.

The study focuses on to minimize and control the construction cost of a construction project. To minimize the cost of a project there are different methods such as quality management, time management etc.

In this work I have applied the inventory control system to control the cost of project. Inventory management will be very useful in getting the right quality & right quantity of supplies at right time, having good inventory control & adopting sound methods of condemnation & disposal will improve the efficiency of the organization. If managers keep too much inventory on hand, they will waste money on storing it and lose money if inventories are damaged or stolen.

So another main scope of the project is the control of materials which get deteriorated, i.e. it avoids the wastage of materials. The study focuses on the assessment of factors influencing inventory management and analysis of inventory control technique on multistory buildings.

III. PREVIOUS WORK

I Literature survey is an integral part of any project. Literature survey has to be conducted to understand various aspects of the project and it helps in the successful completion of the project. A well planned literature review is characterized by a logical flow of Ideas, current and relevant references with consistent appropriate referencing style. It conveys an in depth information about the project.

In [1] Angel Raphella. Set. al., (2014) studied the process of analyzing the company's current forecasting model and recommending an inventory control model to help them solve their current issue. The study concluded that Inventory problems of too great or too small quantities on hand can cause business failures. If an organization experiences stock-out of a critical inventory item, production halts could result. Inventory management indicates the broad frame work of managing inventory. The inventory management technique was more useful in determine the optimum level of inventory and finding answers to problem of safety stock and lead time. Inventory management had become highly developed to meet the rising challenges in most Corporate entities.

In [2] Anuprakash. Net. al., (2013) The following research paper emphasizes on study of stock management in various companies and also analyzes the data using various inventory analyzation techniques. The main objective of the study is to analyze the inventory control practices adopted by small, medium or large scale companies. Various analysis such as ABC, FSN analysis are used. For various types of companies a questionnaire is used in the methodology. The questionnaire is different for large, medium and low scale companies. Based on the various questions the inventory is analyzed using various statistical approaches and representing the data in tabular format as well as graphical format.

In [3] Hemishkumar Patel et. al., (2014) analyzes the factors, which affects material management and inventory management. The factors are ranked on the basis of survey on construction firms in Gujarat and the factors are ranked in

accordance with relative importance index technique and importance index technique. They concluded with analyzing important factor which affect material management "misunderstanding of owner requirements by design engineer" and factor which affect inventory management was "a responsible official should authorize purchase".

In [4] Sindhu. Set. al., (2014) studied with performance analysis of inventory management system in construction industries in India. The main objective of the study was to analyze the inventory management control adopted and the effective utilization of inventory at the construction site. The first part based on conducting questionnaire survey in various construction companies. In second part, analyzing those results by using Statistical Package for Social Sciences SPSS. Main inventory management risk were being identified in construction industries in India such as lack of storage space, problems with de-centralized processing, inadequate training practices, improper financial support in ordering of materials, difficulty in delivery of long lead materials.

In [5] Dr. G. Brindha et. al., (2014) The management and control of inventory is a problem common to all organizations in any sector of the economy. This paper discusses the effective use of resources available to the company and also to avoid the out of stock danger to supply the inventory materials at the right time. Also reduction of risk of avoidance of high obsolescence is discussed. The three main types of inventories are raw materials, work in progress and finished goods. The inventories are differentiated into high and low levels based on their use on site. Also periodic review system is used to monitor the inventory. Various tools of inventory management such as ABC analysis, Economic Order Quantity, FSN, VED, SDE, GOLF analysis are explained using the available data.

In [6] Dr. K. Nirmalkumar et. al., (2012) Based on the analysis, the result shows that below points were focused mainly in Construction Industries, Involvement of contractor in material management, need for stock management, managing stock in growth of company, importance to stock comparing other works and maintaining safety in storing. Inventory management system is considered to perform a key role in an organization, which is responsible to complete the company's project in a specific budget within a certain period of time.

In [7] Tom Jose. Vet. al., (2013) Analyzed an Inventory Management System is an important element in an organization and is comprised of a series of processes, which provide an assessment of the organization's inventory. He considered the inventories in a company which make washing machines in all these analysis and checked the variation in the EOQ & no. of unit purchased. They concluded that there is a variation in the EOQ & no. of unit purchased. It was understood that the company was not following EOQ for purchasing the materials. So, the inventory management was not satisfactory. From calculation of safety stock, we could able to determine how much the company can hold the inventory in reserve stock per annum.

In [8] Kariuki James et.al.,(2013) examine the review of the factors influencing effectiveness of inventory control; Ministry of State for Provincial Administration and Internal Security, Nairobi. The Important findings from the study reported that delays in procurement of goods, frequent stock-outs and uncertain change of prices were some of the effects of long bureaucratic procurement procedure. According to the study inadequate and untimely dispatch of funds had an effect in inventory control. The study also revealed that unavailability of stationeries/stores records, lack of specific time or date for both posting stores records, lack of adequate qualified and well trained staff hinders effective performance. The researcher recommends that too much red tape and rigid rules and policies should be avoided; current inventory control practices and procedure need to be reviewed and redesigned.

In [9] Phani Madhavi.Tet.al.,(2013)studied about all the issues occurring in the company because of improper maintenance of material management. He points out that cost of the project can be controlled by taking necessary actions towards the cost variance. Therefore a methodology is used to find and evaluate the procurement process involved in material management and launch a continuous improvement was developed and applied to monitor and control the process. A great possibility for improvement was found out if state of the art technologies such as, electronic mail, electronic data interchange (EDI), and analysis were applied to the procurement process. These will helped to reduce the root causes for many types of problems that were found out.

In [10] Aggarwal et.al., (2013) analyzed that the complete inventory management system of the company is satisfactory with the help of inventory management tools such as ABC (Always Better Control) analysis and EOQ (Economic order quantity). The intention is to find out the ways of managing the inventory properly, so that there would be a less impact on the profits and sales of the company

IV. PROPOSED METHODOLOGY

Materials inventory management is important, as materials constitute a large amount in construction costs. A poor inventory management can lead to increase in project costs as well as delay in project schedules. This delays will indirectly affects in every stage of the completion of the project. Therefore, those engaged in inventory should have an awareness of the interlocking activities contained in the process.

Inventory control is essential to provide flexibility in operating a system. It is important to business because, it reduces cost while aiding customer relations, which permits smooth operation of production and utility process of the firm. Management is that aspect of current assets management, which is concerned with maintaining optimum investment in inventory and applying effective control system so as to minimize the total inventory cost.

Basic inventory decisions are:-

- The inventory item is empty and to fill again.
- How much of an item to order when the inventory of that item is to be filling again.

Procurement is next step of the inventory. Inventory defines when and where the material is need as per plan or design according to interlocking activities. Inventory is normally performed at Inventory should not be performed without considering the design and construction schedule of a project.

It is essential that procurement will be considered as a grand plan involving several levels and it will depend on the interlocking activities. If we not known the interlocking activities entire system lead to delay of the fore coming activities.

Different functional managers of an organization may view inventory from different points, leadings to conflicting objectives. This calls for an integrated system approach to planning of inventories so that conflicting objectives can be scrutinized to enable the system to operate at minimum total inventory - related-cost- explicit costs such as purchase price as well as implicit costs such as carrying, shortage, transportation and inspection costs.

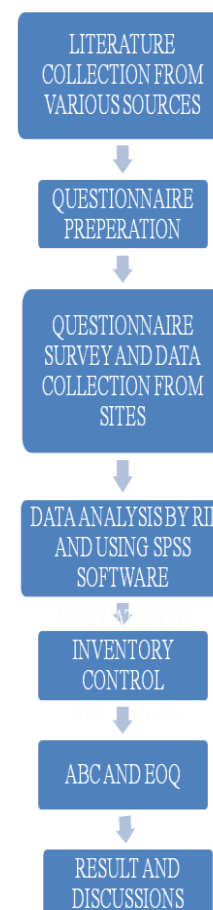


Fig 1:- Flowchart showing methodology

- Factors influencing inventory management was identified based on literature survey.
- A detailed questionnaire will be prepared as a part of the research. The questionnaire consisted of two sections mainly. The first section to be filled was regarding the company details are included. The second section consisted of open ended questions.

- A questionnaire was developed to collect pertinent information about the major factors affecting inventory management on multistory construction buildings.
- After identifying sites for data collection, questionnaire survey was conducted along with collection of other parameters necessary for to carryout inventory control techniques.
- In this study, I only focus on raw material inventory for analysis of inventory control technique.
- Factor determination was conducted using IRR method and data analysis upon inventory control were carried out using inventory control techniques like ABC and EOQ. Inventory cost optimization was successfully employed by using EOQ analysis.

There are several factors which affects optimization of inventory cost in multistory buildings. Major factors were selected according to the literature analysis. Some of the important factors are listed below:-

- Accepting goods before scheduled date
- Change order affects material quantity and quality
- Lack of Control in stock overflow
- Criteria maintained for stock materials
- Large distance from project site to storage yard
- Involvement of contractor in material management
- A responsible official authorizes purchase
- Greater Importance to stock comparing other works
- Maintaining safety in storing
- Training for stock management practices
- All adjustments to inventory approved by the Managing Director/senior management
- Provisions made for obsolete and inactive item
- Receiving materials than ordered
- Establishment of Purchase order process
- Get damaged goods from it stored.

Factor analysis were carried out using both RII method and by using SPSS. and the next analysis was inventory control technique analysis. This analysis were carried out using both EOQ and ABC analysis.

V. RESULT

The study was performed considering 20 factors affecting optimization of inventory cost. The factors were ranked upon RII method and using SPSS software. Inventory control technique, EOQ was used for inventory cost optimization and checks that any reduction in cost of inventory is occurring on construction of multistory buildings. ABC analysis is a qualitative inventory control technique carried out using the collected data for comparing with EOQ model.

Ranking of various factors according to their significance and calculating their Relative Importance Index (RII) was used to analyze the survey results.

The RII is calculated using the equation

$$RII = \sum W / AXN$$

Where, W –weighting given to each factor by the respondent

A –The highest weight

N –Total no of respondent

Coordination of receiving, issuing, accounting and storing responsibilities was the factor ranked first. Hence for the successful inventory management, coordination between receiving, issuing, accounting and storing department is necessary. The second rank was goes to the factor that a responsible official authorizes purchase. So greater importance is given to the person who authorizes purchase.

Spss is a software used for statistical analysis. The name stands for Statistical Package for Social Science. It is a comprehensive and statistical analysis and data management solution.

The SPSS analysis was carried out successfully as per means of each factor which affects inventory cost optimization and the major factor is the one having higher mean value. The analysis in SPSS is a confirmation over RII method. The major factor that is coordination between receiving, issuing, accounting and storing departments having mean value and the next leading factor –a responsible official authorize purchase.

Coordination of receiving, issuing, accounting and storing responsibilities, A responsible official authorizes purchase and maintaining safety in storing are the major three factors influencing inventory management thus in turn affects inventory cost optimization.

Receiving, issuing, accounting and storing of the appropriate raw materials of right quality, right quantity, at right place in right time so as to coordinate and schedule the production activity in an integrative manner in an organization. That is each department related to the storing of inventory should be interconnected with one another for effective inventory management.

- *Inventory Control Techniques*

Inventory control techniques like ABC analysis and EOQ analysis was carried out using the collected data from three sites of multistory buildings.

EOQ analysis of three multistory buildings were carried out effectively. No of units ordered represents the actual order of inventory as per estimate. EOQ represents the optimum order quantity, which was to be ordered for to reduce the inventory cost.

From Table 1 , it was very clear that there was a wide variation in actual order quantity and Economic Order Quantity of all the raw materials including steel, cement, M-sand etc existing in the site. So the inventory management in the firm is not satisfactory.

Product	Unit	Annual demand (M)	Unit price (S)	Ordering cost(Co)	Carrying cost(Cc) In %	EOQ	No of units ordered	No of orders
Steel	Kg	335801	31	18000	24	40309.35	30000	8.33
Cement	Bag	13206	400	10000	24	1658.00	1400	7.96
Msand	M ³	10252	158	17000	24	3031.86	3000	3.38
Coarse aggregate (20 mm)	M ³	13229	95	15000	24	4172.12	3000	3.17
Laterite stone	Unit	22790	45	7000	24	5435.31	4500	4.19
P-sand	M ³	826	174	10000	24	628.96	400	1.31
Coarse aggregate (40 mm)	M ³	730	69	5500	24	696.35	350	1.04

Table 1. EOQ analysis of 1st Multistory building

Sl no:	Product	Inventory cost without inventory management	Inventory cost with inventory management
1	Steel	13238.80	122867.95
2	Cement	103638.92	68628.57
3	M-sand	104705.20	90767.41
4	Coarse aggregate(20 mm)	114454.32	72475.37
5	Coarse aggregate (12 mm)	32302.19	28549.92
Total		368339.43	383289.22

Table 4 . Optimization of inventory cost on 2nd multistory building

Sl no:	Product	Inventory cost without inventory management	Inventory cost with inventory management
1	Steel	241704.00	190233.22
2	Cement	95884.24	81183.72
3	M Sand	59322.26	58689.72
4	Coarse aggregate (20 mm)	67584.00	49137.07
5	Laterite stone	38720.32	32062.87
6	P-sand	20698.88	13198.87
7	Coarse aggregate (40 mm)	11527.36	5806.904
Total		535441.06	430312.37

Table 2. Optimization of inventory cost on 1st multistory building

From Table 2 there was a wide variation in inventory cost ,i.e.1 lakh exists between before the application of inventory management and after the application of inventory management per order. So optimization of inventory cost could be successfully employed with EOQ.

EOQ analysis of 2nd multistory building is shown in table 3 and its optimization of inventory cost in table 4

Product	Unit	Annual demand(M)	Unit price (S)	Ordering cost(Co)	Carrying cost(Cc)	EOQ	Noof units ordered	No of orders
Steel	Kg	121000	45	18000	24	20083	18500	6.02
Cement	Bag	10241	370	10000	24	1519	1000	6.74
M-sand	M3	23991	158	17000	24	4638	4000	5.17
Coarse aggregate (20 mm)	M3	28790	95	15000	24	4051.59	3890	4.68
Coarse aggregate (12 mm)	M3	19193	40	7500	24	5476	4850	3.5

Table 3. EOQ analysis of 2nd Multistory building

Product	Unit	Annual demand(M)	Unit price (S)	Ordering cost(Co)	Carrying cost(Cc)	EOQ	Noof units ordered	No of orders
Steel	Kg	142000	47	18000	24	21288	20000	6.67
Cement	Bag	13242	400	10000	24	1661	1300	7.97
M-sand	M3	31021	165	17000	24	5161	4500	6.01
Coarse aggregate (20 mm)	M3	37226	95	15000	24	6999	6400	5.32
Coarse aggregate (12 mm)	M3	25200	45	7000	24	5715	5200	4.41
P sand		31100	48	10000	24	7348	6950	4.23

Table 5. EOQ analysis of 3rdmultistory building

Sl no:	Product	Inventory cost without inventory management	Inventory cost with inventory management
1	Steel	144840.00	17098.91
2	Cement	103489.64	81288.58
3	M-sand	120850.60	105892.11
4	Coarse aggregate(20 mm)	91769.76	84268.16
5	Coarse aggregate (12 mm)	36976.40	33621.84
6	P Sand	48427.98	46029.84
Total		546354.38	488199.44

Table 6. Optimization of inventory cost on 3rd multistorey building

From Table 5 it was very clear that here also a wide variation in actual order quantity and Economic Order Quantity exists. So the inventory management in the firm is not satisfactory.

From Table 6 there was a wide variation in inventory cost ,nearly 60000 exists between before the application of inventory management and after the application of inventory management per order. So optimization of inventory cost could be successfully employed with EOQ.

• *Reorder Point*

Reorder point describes the point at which next order is to be placed. The reorder point of the three multistorey building is as shown table below:

Sl no	Raw material	Unit	Demand	Lead time	Reorder point
1	Steel	Kg	40309.35	0.041	1652
2	Cement	Bag	1658.00	0.011	18
3	M –sand	M3	3031.86	0.011	33
4	Coarse aggregate(20 mm)	M3	4172.12	0.027	79
5	Laterite stone	Unit	5435.31	0.038	207
6	P-sand	M3	628.96	0.011	7
7	Coarse aggregate(40 mm)	M3	696.35	0.019	26

Table 7. Reorder point of first multistorey building

Sl no	Raw material	Unit	Demand	Lead time	Reorder point
1	Steel	Kg	20083	0.055	1104
2	Cement	Bag	1519	0.011	17
3	M-sand	M ³	4638	0.011	46
4	Coarse aggregate(20 mm)	M ³	4051.59	0.027	109
5	Coarse aggregate(12 mm)	M ³	5476	0.027	148

Table 8. Reorder point of Second multistorey building

The Reorder point for three multistorey building is found out. So by using reorder point , we can place order at right time with right quantity of raw material, which will effectively help in management of inventories

Sl no	Raw material	Unit	Demand	Lead time	Reorder point
1	Steel	Kg	21288	0.055	1167
2	Cement	Bag	1661	0.013	22
3	M-sand	M ³	5161	0.013	67
4	Coarse aggregate (20 mm)	M ³	6999	0.027	189
5	Laterite	Unit	5715	0.038	217
6	P sand	M ³	7348	0.013	95

Table 9. Reorder point of third multistorey building

The lead time vary according to material and the location of site as per availability. So by considering lead time, reorder point was calculated successfully.

• *Abc Analysis*

ABC analysis of 3 multistorey buildings were carried out and results shown below.

Product	unit	Annual demand	Unit price	Annual consumption	% of annual consumption	% of cumulative annual consumption	Class
Steel	Kg	335801	31	10409831	52.61	52.61	A
Cement	Bag	13206	400	5282400	26.70	79.31	B
M sand	M ³	33634	48	1614432	8.16	87.47	B
Coarse aggregate (20 mm)	M ³	43401	29	1258629	6.36	93.83	B
Laterite stone	Unit	22790	45	1025550	5.18	99.01	C
P-sand	M ³	2710	53	143630	0.73	99.74	C
Coarse aggregate (40 mm)	M ³	2396	21	50316	0.26	100	C

Table 10. ABC analysis of 1st multistory building

Product	unit	Annual demand	Unit price	Annual consumption	% of annual consumption	% of cumulative annual consumption	Class
Steel	Kg	142000	47	6674000	30.46	30.46	A
Cement	Bag	13242	400	5296800	24.18	54.64	A
M sand	M ³	31021	165	5118465	23.36	78.00	B
Coarse aggregate (20mm)	M ³	37226	95	3536470	16.14	94.14	B
Laterite	Unit	25200	45 45	1134000	5.18	99.32	C
P sand	M ³	3100	48	148800	0.68	100	C

Table 11. ABC analysis of 2nd multistory building

Product	unit	Annual demand	Unit price	Annual consumption	% of annual consumption	% of cumulative annual consumption	Class
Steel	Kg	121000	45	5445000	32.80	32.83	A
Cement	Bag	10441	370	3863170	23.26	56.09	A
M sand	M ³	23991	158	3790578	22.83	78.92	B
Coarse aggregate (20 mm)	M ³	28790	95	2735050	16.47	95.39	B
Coarse aggregate (12 mm)	M ³	19193		767720	4.61	100	C

Table 12. ABC analysis of 3rd multistory building

ABC analysis was carried out using annual consumption value. From the analysis of three multistory buildings, it was clear that steel and cement were the A class items. A class items includes raw materials which needs very strict control and a very low amount safety stocks. Apart from this frequent ordering is also adopted.

For B class items, which needs only moderate control and low safety stocks. Here M- sand and 20mm coarse aggregate coming under this category. The items belonging to the category of C class items- P sand, Laterite and 12mm coarse aggregate are to be not paid much attention as in the case of A class items and high amount of safety stock should kept on sites.

Cement and steel ,A class items-should need maximum follow up and these inventories should handle by senior officers. For to made a keen observation on A class items, weekly control statement should be prepared. But in the case of C class item, ie Psand, Laterite and 12mm coarse aggregate, no need of follow up and the inventories can be handled by anyone on the site. There is no need of preparing weekly control reports, if necessary quarterly year control reports have to be placed.

VI. VI CONCLUSIONS AND FUTURE SCOPE

After conducting questionnaire survey, the analysis were carried out using both RII method and SPSS software and it has been observed that the major factor affects inventory management are Coordination of receiving, issuing, accounting and storing responsibilities, A responsible official authorizes purchase, maintaining safety in storing. So for successful inventory management we have to focus on these factors.

Inventories are maintained for the operational smoothness which they can effect by uncoupling successive stage of production, whereas the monetary value of inventory serves as a guide to indicate the size of the investment made to achieve this operational convenience. So inventory control technique, EOQ was adopted for to calculate economic order quantity ie optimum order quantity for to manage inventories.

By adopting EOQ model, it was very clearly verified that a reduction in inventory cost of multistory building. The purchase of bulk amount of inventories without any criteria must lead to wastage of inventory in the form deterioration, obsolescence ,repair etc. thus in turn affects the entire project cost. By adopting EOQ, we can reduce the inventory cost by purchasing only optimum quantity of materials along with reorder point, which gives the point at which reorder should placed.

ABC analysis is also an inventory control technique refers to Always Better Control .As a result of analysis it was clear that steel and cement were the A class items, needs very strict control and frequent ordering is also adopted. M- sand and 20 mm coarse aggregate are B class items, which needs only moderate control and low safety stocks. The items belonging to the category of C class items are to be not paid

much attention as in the case of A class items and high amount of safety stock should kept on sites.

Thus as a combination of EOQ and ABC analysis can be successfully implied on sites. The right quantity was selected as per EOQ and purchasing has to be done as per ABC analysis. That is A class items, steel and cement needs strict control on purchasing and frequent ordering should employed with right quantity (economic order quantity). But in case of P sand and laterite, C class items needs bulk purchasing with optimum order quantity, EOQ.

- *Scope For Future Study*

Safety stock, ie A stock which is maintained additionally in order to reduce the risk that the item will be out of stock should be amalgamated with the economic order quantity for smooth running of firm.

This study related to the EOQ model carried out on only 3 sites and the consideration of this study limited to raw materials only. For more generalization it can extends to various sites and should take into account all inventories such as equipment ,fuel and lubricants, spare parts , semi processed goods, finished goods etc.

Developing other significant inventory control techniques which can be practically implemented on sites.

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