INVENTORY MANAGEMENT AND COST ANALYSIS

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ABSTRACT

Construction materials constitute a large portion of the total cost in construction projects. It may account for 50-60% of the total project cost. Material management includes finding the availability, proper selection, procurement, inventory management and effective usage of materials at right time. 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. On preparing inventory chart and analyzing the cost estimate, the proper cost control over material procurement have been achieved to avoid surplus expenditure and better field material control.

Key word –Inventory, Cost, Procurement

1. INTRODUCTION

The inventory management is of maintaining an adequate supply of something to meet an expected demand pattern for a given financial investment. This could be raw materials, work in progress, finished products, or spares and other indirect materials. Inventory is one of the indicators of management effectiveness on the materials management front. Inventory turnover ratio (annual demand/ average inventory) is an index of business performance.

Inventory management deals with the determination of optimal policies and procedures for procurement of commodities. Since it is quite 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.

Before doing the inventory management for building the following basic information must be studied. The project site must be analysed completely for the stock management. The work progress must be known .And the interlocking activities of various works must be known in detailed manner.

For this inventory management, the project has been done for the upcoming construction work of the residential building.

In this project the inventory management is done for this residential building by analysing the site situation, quantity surveying according to the drawing, preparing the Microsoft Project scheduling, studying the interlocking activities. Creation of inventory chart is the final form of this inventory management project.

1.1 SCOPE

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 needed 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.
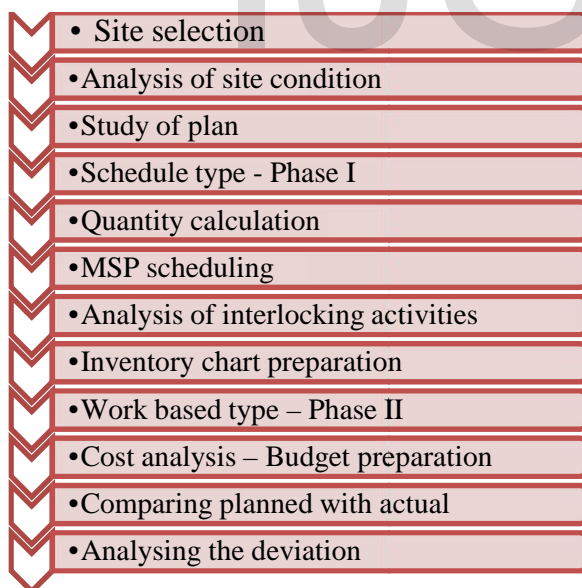
2. METHODOLOGY

- Site selection
- Analysis of site condition
- Study of plan
- Schedule type - Phase I
- Quantity calculation
- MSP scheduling
- Analysis of interlocking activities
- Inventory chart preparation
- Work based type – Phase II
- Cost analysis – Budget preparation
- Comparing planned with actual
- Analysing the deviation

Fig 1. Methodology

A. Site selection
Site selection is a key factor for project. The site must be easily accessible for all construction activities and must fulfil

the requirements of the function of the building.

B. Analysis of site condition

Site condition must be analysed completely before doing the construction activity. Site is situated in rural area and the material availability (lead distance) also analysed. Free space around the construction land is effectively used for store and stock management purpose.

C. Study of plan

For inventory management quantity calculation is important, Study of plan is also important. Plan and cross section of individual levels must be completely studied for quantity calculation. Vetted cross section and plans are used for quantity calculation.

D. Working method

The inventory management is done by any one of the following methods given below.

- Based on schedule of works
- Based on works involved

Based on schedule of works

It means work progress will be processed according to the previously prepared schedule. Schedule must be prepared for the work progress. Inventory management can be carried on the basis of scheduling of the project.

Based on works involved

Inventory management can be carried on the basis of works involved in the construction activity. This project is based on this type. For this type what are the activities involved must be ordered in the correct manner. And the interlocking activities are completely ordered.

E. Quantity calculation

For material calculation, quantity calculation is the first component to known

the volume of work for different quantities of different works.

F. MSP scheduling

To get better scheduling our projects and levelling our resources Microsoft Project (MSP) is used. The tasks, milestones are components that can be scheduled, cost estimated, monitored and controlled using this.

G. Analysis of interlocking activties

Inventory chart is prepared on the basis of work type, for this different interlocking of activities and activities ordered in a specified manner (i.e. Form substructure to roof level work) must be known.

H. Inventory chart preparation

Chart is the form of output, easily understandable by everyone. Therefore chart preparation is final output of the project. Based on activities, scheduled duration and materials the final inventory chart is prepared.

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.
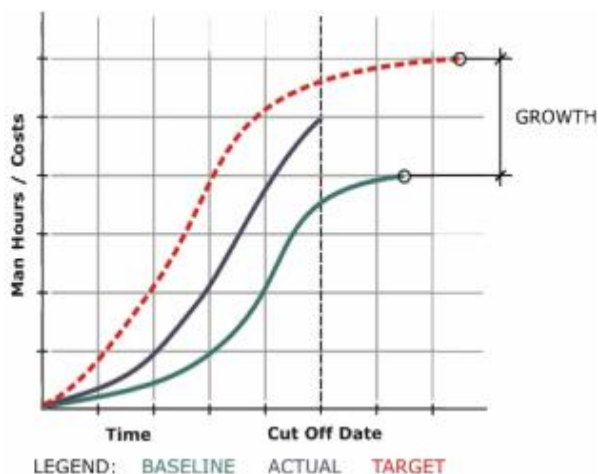
Fig 2. S Curve Analysis

3. PRINCIPLE OF INVENTORY MANAGEMENT

Materials inventory management is important, as materials constitute a large amount in construction costs. This is because the poor inventory management can affect not only to the increase in costs, but also contribute to schedule and project delays. 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. Inventory 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 inventories decisions are two types. They 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.

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 a number of stages. The construction industry is how maturing to recognize the need and importance of the inventory.

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 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.

3.1 Inventory Planning

- Production planning requires purchase and inventory planning decisions for an organization to control expenses and finances.
- To get the purchase benefits, discounts, reduced transportation and ordering cost the bulk purchase may be economical. Inventory of such materials are stored for longer time.

4. MICROSOFT PROJECT (MSP) SCHEDULING

The construction project owner or clients have given the finish date of the project to be completed before that we have a chance to plan for it. This is why we need to get better scheduling our projects and levelling our finite resources. The tool that is most widely used is Microsoft Project (MSP) it applies in project scheduling and resource levelling. In this we can able to fix the units of resources or we have to fix the duration of the project.

Most organisations have a hierarchical structure to break down the work. Typically, it looks like the Stage, Phase, Task, and Milestone. This is a way to organise and define the total scope of the project by decomposing the work to be done into tasks that the project team can execute

and create the required deliverables. The tasks, milestones are components that can be scheduled, cost estimated, monitored and controlled. A network diagram is used to show dependencies in a graphical form. MSP generates network diagram automatically.

MSP helps in utilising the resource constantly throughout the project. Ensures the resource is not over allocated. It helps the project manager to avoid delays caused by the bad allocation. MSP can automatically level resource based on resource calendar, task, dependencies, constrains. We can delay certain task, assign different resources, change the task dependencies, add task, remove task, material requirements etc,.

From this MSP scheduling, analysing of activities and their scheduling can be done. According to their scheduled duration, material resources procurement sheet is prepared finally analysing the deviation from the planned to the actual.

ID		Task Name	Duration	Start	Finish	Predecessors
	0					
1		SWEET HOME	316 days	Thu 1/21/16	Tue 1/24/17	
2		SITE CLEARING	4 days	Thu 1/21/16	Mon 1/25/16	
3		SITE POOJA	1 day	Tue 1/26/16	Tue 1/26/16	2
4		FOOTING MARKING	3 days	Wed 1/27/16	Fri 1/29/16	3
5		BELOW GROUND LEVEL	54 days	Sat 1/30/16	Fri 4/1/16	4
6		FOOTING EXCAVATION	3 days	Sat 1/30/16	Tue 2/2/16	
7		SAND FILLING	1 day	Wed 2/5/16	Wed 2/3/16	6
8		PCC FOR FOUNDATION	1 day	Thu 2/4/16	Thu 2/4/16	7
9		REINFORCEMENT ROD FOR MAT - BAR BENDING	5 days	Mon 2/1/16	Fri 2/5/16	6FS-2 days
10		SHUTTERING	2 days	Fri 2/5/16	Sat 2/6/16	8,9SS+4 days
11		MAT FOUNDATION CONCRETE	1 day	Mon 2/8/16	Mon 2/8/16	10
12		DESHUTTERING	1 day	Tue 2/9/16	Tue 2/9/16	11
13		COLUMN SHOE MARKING	1 day	Tue 2/9/16	Tue 2/9/16	11
14		COLUMN REINFORCEMENT UPTO GROUND LEVEL	4 days	Wed 2/10/16	Sat 2/13/16	11SS+2 days
15		SHUTTERING	2 days	Fri 2/12/16	Sat 2/13/16	14SS+2 days
16		COLUMN CONCRETE UPTO GROUND LEVEL	3 days	Fri 2/12/16	Mon 2/15/16	15SS
17		DESHUTTERING	1 day	Tue 2/16/16	Tue 2/16/16	16
18		BACK FILLING	2 days	Thu 2/18/16	Fri 2/19/16	16FS+2 days
19		EARTH WORK EXCAVATION FOR SUMP	1 day	Tue 2/16/16	Tue 2/16/16	16
20		PCC FOR SUMP	1 day	Wed 2/17/16	Wed 2/17/16	19
21		SUMP BRICK WORK	3 days	Thu 2/18/16	Sat 2/20/16	20
22		SUMP PLASTERING	2 days	Mon 2/29/16	Tue 3/1/16	21FS+6 days
23		SUMP SLAB REINFORCEMENT & SHUTTERING	2 days	Fri 3/4/16	Sat 3/5/16	22FS+2 days
24		SUMP TOP SLAB CONCRETE	1 day	Mon 3/7/16	Mon 3/7/16	23
25		DESHUTTERING	1 day	Fri 4/1/16	Fri 4/1/16	24FS+21 days
26		EARTH WORK EXCAVATION FOR SEPTIC TANK	1 day	Tue 2/16/16	Tue 2/16/16	16
27		PCC FOR SEPTIC TANK	1 day	Wed 2/17/16	Wed 2/17/16	26
28		SEPTIC TANK BRICK WORK	3 days	Thu 2/18/16	Sat 2/20/16	27
29		SEPTIC TANK PLASTERING	2 days	Mon 2/29/16	Tue 3/1/16	28FS+6 days
30		SEPTIC TANK SLAB SHUTTERING & REINFORCEMENT	2 days	Fri 3/4/16	Sat 3/5/16	29FS+2 days
31		SEPTIC TANK SLAB CONCRETE	1 day	Mon 3/7/16	Mon 3/7/16	30
32		DESHUTTERING	1 day	Fri 4/1/16	Fri 4/1/16	31FS+21 days
33		PLINTH BEAM PCC	1 day	Mon 2/22/16	Mon 2/22/16	18FS+1 day
34		PLINTH BEAM REINFORCEMENT - BAR BENDING	5 days	Fri 2/19/16	Wed 2/24/16	17FS+7 days
35		PLINTH BEAM SHUTTERING	3 days	Tue 2/23/16	Thu 2/25/16	34SS+3 days
36		PLINTH BEAM CONCRETE	1 day	Fri 2/26/16	Fri 2/26/16	35
37		DESHUTTERING	1 day	Mon 2/29/16	Mon 2/29/16	36FS+1 day
38		SOIL FILLING AND CONSOLIDATION	4 days	Tue 3/1/16	Fri 3/4/16	36FS+2 days
39		GROUND FLOOR LEVEL	58 days	Sat 3/5/16	Mon 5/2/16	
40		BRICK WORK ABOVE BASEMENT FOR 2'	3 days	Sat 3/5/16	Tue 3/8/16	38
41		SOIL FILLING & CONSOLIDATION FOR 2' HEIGHT	2 days	Thu 3/17/16	Fri 3/18/16	40FS+7 days
42		PCC FOR GROUND FLOOR	2 days	Sat 3/19/16	Mon 3/21/16	41
43		COLUMN REINFORCEMENT UPTO GROUND FLOOR ROOF L	7 days	Mon 3/7/16	Mon 3/14/16	38FS+7 days
44		COLUMN CONCRETE UPTO GROUND FLOOR ROOF LEVEL	4 days	Mon 3/7/16	Thu 3/17/16	43SS+1 day
45		SHUTTERING FOR SLAB AND BEAM	7 days	Thu 3/24/16	Thu 3/31/16	42FS+2 days
46		GROUND FLOOR ROOF BEAM AND SLAB REINFORCEMEN	8 days	Sat 3/29/16	Mon 4/4/16	45SS+2 days

Project: RESIDENTIAL BUILDING Date: Mon 12/14/15	Task		Milestone	◆	External Tasks	
	Split	....	Summary		External Milestone	
	Progress		Project Summary		Deadline	

ID	Task Name	Duration	Start	Finish	Predecessors
47	ELECTRICAL PIPE LINING	1 day	Tue 4/5/16	Tue 4/5/16	46
48	GROUND FLOOR ROOF BEAM AND SLAB CONCRETE	1 day	Wed 4/6/16	Wed 4/6/16	47
49	STAIR CASE REINFORCEMENT IN THE GROUND FLOOR	1 day	Mon 4/4/16	Mon 4/4/16	46FS-1 day
50	STAIR CASE CONCRETE	1 day	Wed 4/6/16	Wed 4/6/16	48SS
51	STAIR CASE BRICK WORK	1 day	Fri 4/15/16	Fri 4/15/16	50FS+7 days
52	DESHUTTERING	1 day	Mon 5/2/16	Mon 5/2/16	48FS+21 days
53	FIRST FLOOR LEVEL	44 days	Tue 4/19/16	Wed 6/8/16	
54	COLUMN REINFORCEMENT UPTO FIRST FLOOR ROOF LE	8 days	Tue 4/19/16	Thu 4/28/16	48FS+10 days
55	COLUMN CONCRETE UPTO FIRST FLOOR ROOF LEVEL	4 days	Mon 4/25/16	Thu 4/28/16	54SS+5 days
56	BRICK WORK IN GROUND FLOOR	18 days	Tue 5/3/16	Mon 5/23/16	52
57	GROUND FLOOR SILL, LINTEL & LOFT REINFORCEMENT	3 days	Thu 5/12/16	Sat 5/14/16	58FS-10 days
58	GROUND FLOOR SILL, LITEL & LOFT CONCRETE	3 days	Sat 5/14/16	Tue 5/17/16	57FS-1 day
59	SHUTERING FOR SLAB AND BEAM	8 days	Fri 4/29/16	Sat 5/7/16	55
60	FIRST FLOOR ROOF BEAM AND SLAB REINFORCEMENT- B	9 days	Mon 5/2/16	Wed 5/11/16	59SS+2 days
61	ELECTRICAL PIPE LINING	1 day	Thu 5/12/16	Thu 5/12/16	60
62	FIRST FLOOR ROOF BEAM AND SLAB CONCRETE	1 day	Fri 5/13/16	Fri 5/13/16	61
63	STAIR CASE REINFORCEMENT IN THE FIRST FLOOR	1 day	Wed 5/11/16	Wed 5/11/16	60FS-1 day
64	STAIR CASE CONCRETE	1 day	Fri 5/13/16	Fri 5/13/16	62SS
65	STAIR CASE BRICK WORK	1 day	Mon 5/23/16	Mon 5/23/16	64FS+7 days
66	DESHUTTERING	1 day	Wed 6/8/16	Wed 6/8/16	62FS+21 days
67	SECOND FLOOR LEVEL	75 days	Thu 5/26/16	Mon 9/22/16	
68	COLUMN REINFORCEMENT UPTO SECOND FLOOR ROOF	8 days	Thu 5/26/16	Fri 6/3/16	62FS+10 days
69	COLUMN CONCRETE UPTO SECOND FLOOR ROOF LEVEL	5 days	Wed 6/1/16	Mon 6/6/16	68SS+5 days
70	BRICK WORK IN FIRST FLOOR	27 days	Tue 6/7/16	Thu 7/7/16	69
71	FIRST FLOOR SILL LITEL & LOFT REINFORCEMENT	5 days	Mon 6/27/16	Fri 7/1/16	70FS-10 days
72	FIRST FLOOR SILL LITEL & LOFT CONCRETE	3 days	Thu 6/30/16	Sat 7/2/16	71FS-2 days
73	SHUTERING FOR SLAB AND BEAM	9 days	Tue 6/7/16	Thu 6/16/16	69
74	SECOND FLOOR ROOF BEAM AND SLAB REINFORCEMEN	10 days	Fri 6/10/16	Thu 6/23/16	73SS+3 days
75	ELECTRICAL PIPE LINING	1 day	Wed 6/22/16	Wed 6/22/16	74
76	SECOND FLOOR ROOF BEAM AND SLAB CONCRETE	1 day	Thu 6/23/16	Thu 6/23/16	75
77	STAIR CASE REINFORCEMENT IN THE SECOND FLOOR	1 day	Tue 6/21/16	Tue 6/21/16	74FS-1 day
78	STAIR CASE CONCRETE	1 day	Thu 6/23/16	Thu 6/23/16	76SS
79	STAIR CASE BRICK WORK	1 day	Sat 7/2/16	Sat 7/2/16	78FS+7 days
80	DESHUTTERING	2 days	Tue 7/19/16	Wed 7/20/16	76FS+21 days
81	BRICK WORK IN SECOND FLOOR	29 days	Fri 7/8/16	Wed 8/10/16	70
82	SECOND FLOOR SILL, LITEL & LOFT REINFORCEMENT	5 days	Tue 7/26/16	Sat 7/30/16	81FS-14 days
83	SECOND FLOOR SILL, LITEL & LOFT CONCRETE	3 days	Fri 7/29/16	Mon 8/1/16	82FS-2 days
84	OVER HEAD TANK BRICKWORK	1 day	Thu 8/11/16	Thu 8/11/16	81
85	OVER HEAD TANK INNER PLASTERING	1 day	Fri 8/19/16	Fri 8/19/16	84FS+5 days
86	OVER HEAD TANK TOP SLAB REINFORCEMENT & SHUTTE	1 day	Sat 8/20/16	Sat 8/20/16	85
87	OVER HEAD TANK TOP SLAB CONCRETE	1 day	Mon 8/22/16	Mon 8/22/16	86
88	FINISHING WORK	142 days	Thu 8/11/16	Tue 1/24/17	
89	INNER PLASTERING IN GROUND FLOOR	17 days	Thu 8/11/16	Wed 8/31/16	81
90	INNER PLASTERING IN FIRST FLOOR	22 days	Thu 9/1/16	Mon 9/26/16	89
91	INNER PLASTERING IN SECOND FLOOR	23 days	Tue 9/27/16	Sat 10/22/16	90
92	GROUND FLOOR TILE LAYING	13 days	Tue 9/27/16	Tue 10/11/16	90

Project: RESIDENTIAL BUILDING
Date: Mon 12/14/15

Task	Milestone ◆	External Tasks
Split	Summary	External Milestone
Progress	Project Summary	Deadline

ID	Task Name	Duration	Start	Finish	Predecessors
93	FIRST FLOOR TILE LAYING	25 days	Wed 10/12/16	Wed 11/9/16	92
94	SECOND FLOOR TILE LAYING	27 days	Thu 11/10/16	Sat 12/10/16	93
95	PARAPET WALL BRICK WORK IN TOP FLOOR	3 days	Thu 8/11/16	Sat 8/13/16	88
96	TOTAL OUTER PLASTERING	20 days	Mon 10/24/16	Tue 11/15/16	91
97	CORRIDOR TILE LAYING	3 days	Mon 12/12/16	Wed 12/14/16	94
98	STAIR CASE TILE LAYING	3 days	Thu 12/15/16	Sat 12/17/16	97
99	PARKING TILE LAYING	4 days	Mon 12/19/16	Thu 12/22/16	98
100	TOP ROOF TILE LAYING	9 days	Fri 12/23/16	Mon 1/2/17	99
101	COMPOUND WALL BRICKWORK	7 days	Wed 11/16/16	Wed 11/23/16	96
102	COMPOUND WALL PLASTERING	10 days	Thu 11/24/16	Mon 12/5/16	101
103	PAINTING 1 COAT WHITE WASH	15 days	Sat 9/17/16	Tue 10/4/16	89FS+14 day
104	PAINTING 2 COAT PATTY	25 days	Thu 11/10/16	Thu 12/8/16	93
105	PAINTING 1 COAT PRIMER	14 days	Fri 12/9/16	Sat 12/24/16	104
106	PAINTING 2 COAT PAINT	26 days	Mon 12/26/16	Tue 1/24/17	105

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Task	Milestone ◆	External Tasks
Split	Summary	External Milestone
Progress	Project Summary	Deadline

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Fig 3. MSP Scheduling

5. ANALYSIS ON COST

5.1 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.

5.2 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.

6. CONCLUSION

Inventory management deals with material procurement. From this study how to do an inventory management for building structure is known. Where there may be deviations occur during construction, due to the quantities calculated are as per drawings but during execution many deviations occurs on site. The main factors to be considered during the chart preparation are the site condition and the interlocking activities. While considering these activities the inventory chart is more effective. Inventory chart based on activates is basic chart for site engineers and management people to schedule the material procurement and allocate the cost according to it, to avoid surplus expenditure spend for the material.

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