Project Material Management by ABC with EOQ Analysis

A Case study at Sindhu Apartments Mangaluru

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Abstract—**The efficient procurement and controlling 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 in adequate storage cause losses in labor productivity and overall delays that can indirectly increase total project cost. Effective management of materials can reduce these costs.. 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 by using inventory control techniques such as ABC and EOQ analysis .**

IndexTerms—**ABC analysis , Eoq analysis, Inventory control, Annual usage value.**

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I. INTRODUCTION

In any Construction Project material accounts for 50% to 60% of overall Project cost. Material management is specialized field in Project management and it deals with optimizing the cost of the materials used in a project. Main aim of material management getting the right quality & right quantity of supplies at right time. Materials consists both consumables and machinery(Equipments). Since equipment management has been developed as a specialized area , for practical purpose material management deals with the consumables. Main functions of material management are Material planning, Material purchasing and Material storing.

II. SCOPE AND OBJECTIVE

- To minimize the cost of the project through proper controlling and monitoring of materials.
- In the period of shortage in supply of material to maintain sufficient stock of material.
- To minimize the deterioration of the materials.
- ABC and EOQ Analysis carried out in order to overcome the problems of stock out to control the investment in inventories and to maintain it in a optimum level.

III. METHODOLOGY

Steps involved in ABC analysis
- Listing of all the material items used in the project along with **"Unit price"** and **"Quantity Consumed Annually"**.
- Annual usage value (AUV) as a criteria for classification ., AUV=[Unit cost x total no. of units consumed annually]
- Comparing the AUV of each Material item and arranging the items in the ranking order of AUV and computing the cumulative percentage units consumed and percentage cumulative AUV for each item.

Table 1 Comparison of AUV of each material

Item No (1)	Unit Cost (2)	Number of units used per annum (3)	AUV (2 X3)

Table 2 Computing the cumulative percentage units consumed and percentage cumulative AUV for each item

ITEM NO(1)	ITEM NAME(2)	UNIT COST(3)	NO.OF UNITS USED PER ANNUM(4)	UNIT(5)	AUV(6)	% OF TOTAL UNITS [(4)/Σ(4)]X100	CUM. % UNITS	% OF AUV [(6)/Σ(6)]X100	CUM. % OF AUV

- Draw the graph of cumulative % of AUV vs Cumulative % items .From the graph one can easily identify handful no. of items which contribute the substantially to AUV .
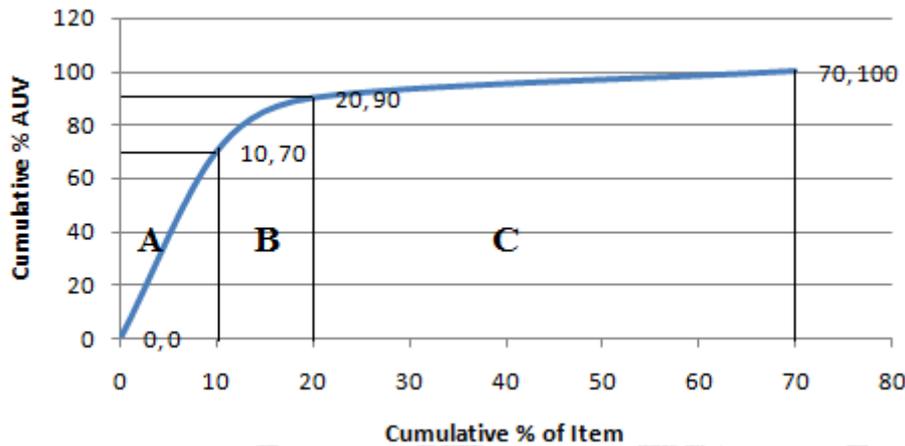

Fig. 1 Graph of Cumulative % AUV vs Cumulative % of Item.

- Separate the items into groups A,B,C .In A Group 10 % of Material consume 70 % of AUV,In B Group 20 % of items Consume 20 % of AUV, In C Group 70 % of items consume 10 % of AUV.

A. Steps involved in EOQ analysis

EOQ is mainly governed by the ordering cost and holding cost irrespective of the description of the material. For the known various figures of annual demand of material , finding out the EOQ value from which the physical quantity can be worked out by using determining no of orders and time intervals between orders for different materials . D = Annual demand (units), S =Cost per order (Rs) ,C = Cost per unit (Rs) , I = Holding cost (%) , H =Holding cost (Rs) = $I \times C$

$$EOQ = \sqrt{\frac{2 X D X S}{H}} \qquad (1)$$

$$\text{Expected no. of orders (N)} = \frac{D}{EOQ} \qquad (2)$$

$$\text{Expected time interval between order} = \frac{Working days / year}{N} \qquad (3)$$

IV. CASE STUDY

Selected site for case study is Sindhu Apartment Kottara chowki , Mangaluru . Sindhu is a Residential apartment with Ground+6floors in plot area 47cents. Project details is as follows Client- Prashanth , Prabhath and 34 others ,Main contractor - Nithinenterprises , Total duration of the project 16months , Total value of the project 62925807.21 and. Area details is total super build up area is 50717.03 sq.ft, and Total net area 37907.98 sq.ft.

Details required for the ABC analysis is collected from the site and estimated approximately regarding annual requirement of the material , then calculating the AUV and by using that values arranging the items in descending order, After that calculating cumulative % units and cumulative AUV It is show in the Table 3.

Table 3 ABC analysis

ITEM NO	ITEM NAME	UNIT COST	NO.OF UNITS USED PER ANNUM	UNIT	ANNUAL USAGE VALUE	% OF TOTAL UNITS [(4)/Σ(4)]X 100	CUMU. % UNITS	% OF AUV [(6)/Σ(6)]X1 00	CUMU. % OF AUV
1	STEEL	40700	205	Ton's	8343500	0.11	0.11	34.24	34.24
2	Cement(Penna)	360	13296	Bags	4786560	6.87	6.97	19.64	53.88
3	Vitrifiend nano tile 2'x2'	47.00	35000	Sft	1645000	18.08	25.05	6.75	60.63
4	Cement(Acc/ultrate ch)	380	2367	Bags	899460	1.22	26.27	3.69	64.32
5	FINE AGGREGATE	11.6	62681	Cft	727099.6	32.37	58.64	2.98	67.30
6	Other flush doors	7000.00	72	No's	504000	0.04	58.68	2.07	69.37
7	Bathroom ceramic tiles wall	46.00	10300	Sft	473800	5.32	64.00	1.94	71.31
8	Other Frp doors	6000.00	72	No's	432000	0.04	64.03	1.77	73.09
9	Granite(sadharahalli)	57.00	7175	Sft	408975	3.71	67.74	1.68	74.76
10	LATERITE MASONARY	18	21664	cft	389952	11.19	78.93	1.60	76.36
11	Main door wood	10500.00	36	No's	378000	0.02	78.95	1.55	77.92
12	Interior emulsion	4420.00	84	20ltr Tin	371280	0.04	78.99	1.52	79.44
13	Main door wood frame	10000.00	36	No's	360000	0.02	79.01	1.48	80.92
14	Transformer250kva	300000.00	1	No's	300000	0.00	79.01	1.23	82.15
15	COARSE AGGREGATE	31	8261	Cft	256091	4.27	83.28	1.05	83.20
16	Cable 1 sq mm(90m coil)	1000	250	No's	250000	0.13	83.40	1.03	84.22
17	Wall putty	960.00	207	40kg Bag	198720	0.11	83.51	0.82	85.04
18	Divertor Plate with body(full set)	2696.00	72	No's	194112	0.04	83.55	0.80	85.84
19	Cable 2.5 sq mm(90m coil)	2420	80	No's	193600	0.04	83.59	0.79	86.63
20	Bedroom door wood frame)	2600.00	72	No's	187200	0.04	83.63	0.77	87.40

21	Panel board	180000.00	1	No's	180000	0.00	83.63	0.74	88.14
22	4" BRICK MASONARY	21	8283	cft	173943	4.28	87.91	0.71	88.85
23	Flush valve 40mm Single	2325.00	72	No's	167400	0.04	87.94	0.69	89.54
24	Western commodo soft close	4113.00	36	No's	148068	0.02	87.96	0.61	90.15
25	Western commodo normal close	4040.00	36	No's	145440	0.02	87.98	0.60	90.74
26	Cable 4 sq mm(90m coil)	3540	40	No's	141600	0.02	88.00	0.58	91.32
27	Meter	3750.00	36	No's	135000	0.02	88.02	0.55	91.88
28	Exterior emulsion	4150.00	30	20ltr Tin	124500	0.02	88.03	0.51	92.39
29	With out key cylindrical lock Toilet and balconies doors	162	647	No's	104814	0.33	88.37	0.43	92.82
30	Angle cock	310.00	324	No's	100440	0.17	88.54	0.41	93.23
31	Wash basin(with half ped)	2767.00	36	No's	99612	0.02	88.55	0.41	93.64
32	Bathroom tiles floor	38.00	2400	Sft	91200	1.24	89.79	0.37	94.01
33	Other door concreteframe 3' op	900.00	90	No's	81000	0.05	89.84	0.33	94.35
34	06A One Way Switch	40.00	1800	No's	72000	0.93	90.77	0.30	94.64
35	Other door concreteframe 2' 6"op	875.00	72	No's	63000	0.04	90.81	0.26	94.90
36	Fan Regulator	240.72	252	No's	60661.44	0.13	90.94	0.25	95.15
37	Cable 1.5 sq mm(90m coil)	1500	40	No's	60000	0.02	90.96	0.25	95.39
38	Pillar cock	768.00	72	No's	55296	0.04	91.00	0.23	95.62
39	Spout	761.00	72	No's	54792	0.04	91.03	0.22	95.85
40	Stop cock concealed	741.00	72	No's	53352	0.04	91.07	0.22	96.07
41	Conduit pipe(3/4")Heavy	48	1080	Length	51840	0.56	91.63	0.21	96.28
42	With key cylindrical lock Bed room doors	72.00	691	No's	49752	0.36	91.98	0.20	96.48
43	Conduit pipe(3/4")lnormal	40	1224	Length	48960	0.63	92.62	0.20	96.68

44	Ventillator concreteframe	650.00	72	No's	46800	0.04	92.65	0.19	96.88
45	12 Way SPN DB	1290	36	No's	46440	0.02	92.67	0.19	97.07
46	Health Faucet	635.00	72	No's	45720	0.04	92.71	0.19	97.25
47	Interior primer	3740.00	12	50kg Bag	44880	0.01	92.72	0.18	97.44
48	Main door	36.00	1236	No's	44496	0.64	93.35	0.18	97.62
49	Sink cock (kitchen)	1145.00	36	No's	41220	0.02	93.37	0.17	97.79
50	16A Switch With Indicator	102.23	396	No's	40483.08	0.20	93.58	0.17	97.96
51	Over shower with arm	531.00	72	No's	38232	0.04	93.61	0.16	98.11
52	06A One Way Socket	50.00	720	No's	36000	0.37	93.99	0.15	98.26
53	Exterior primer	3110.00	11	20ltr Tin	34210	0.01	93.99	0.14	98.40
54	16A Switch With Indicator	79.14	396	No's	31339.44	0.20	94.20	0.13	98.53
55	Wash basin	803.00	36	No's	28908	0.02	94.21	0.12	98.65
56	Brass Handle for main door	36	778	No's	28008	0.40	94.62	0.11	98.76
57	3/3 Deep block	29	936	No's	27144	0.48	95.10	0.11	98.87
58	Metal Box 2 Modular	35	720	No's	25200	0.37	95.47	0.10	98.98
59	2Module Plate	32.98	720	No's	23745.6	0.37	95.84	0.10	99.07
60	Nozzle tap (utility)	594.00	36	No's	21384	0.02	95.86	0.09	99.16
61	Bend(3/4")	6	3240	No's	19440	1.67	97.54	0.08	99.24
62	6" BRICK MASONARY	29	596	cft	17284	0.31	97.84	0.07	99.31
63	Metal Box 3 Modular	50	288	No's	14400	0.15	97.99	0.06	99.37
64	Metal Box 9 Modular	100	144	No's	14400	0.07	98.07	0.06	99.43
65	Waste coupling half thread	192.00	72	No's	13824	0.04	98.10	0.06	99.49
66	9Module Plate	92.33	144	No's	13295.52	0.07	98.18	0.05	99.54
67	Metal Box 8 Modular	90	144	No's	12960	0.07	98.25	0.05	99.60
68	3Module Plate	43.69	288	No's	12582.72	0.15	98.40	0.05	99.65
69	Fan hook junction	46	252	No's	11592	0.13	98.53	0.05	99.69
70	Metal Box 6 Modular	80	144	No's	11520	0.07	98.61	0.05	99.74
71	8Module Plate	78.32	144	No's	11278.08	0.07	98.68	0.05	99.79
72	Coupling(3/4")	5	1800	No's	9000	0.93	99.61	0.04	99.83

73	6Module Plate	61.01	144	No's	8785.44	0.07	99.68	0.04	99.86
74	Metal Box 4 Modular	60	144	No's	8640	0.07	99.76	0.04	99.90
75	06A Two Way Switch	58.53	144	No's	8428.32	0.07	99.83	0.03	99.93
76	4Module Plate	47.82	144	No's	6886.08	0.07	99.91	0.03	99.96
77	T.V.Socket	55.23	72	No's	3976.56	0.04	99.94	0.02	99.98
78	Telephone Socket	51.11	72	No's	3679.92	0.04	99.98	0.02	99.99
79	Bell Push 1M	60.18	36	No's	2166.48	0.02	100.00	0.01	100.00
		Σ4	193634	Σ6	24370369.3				

Separating the materials in to ABC by referring to the graph , It shown in the figure 2.
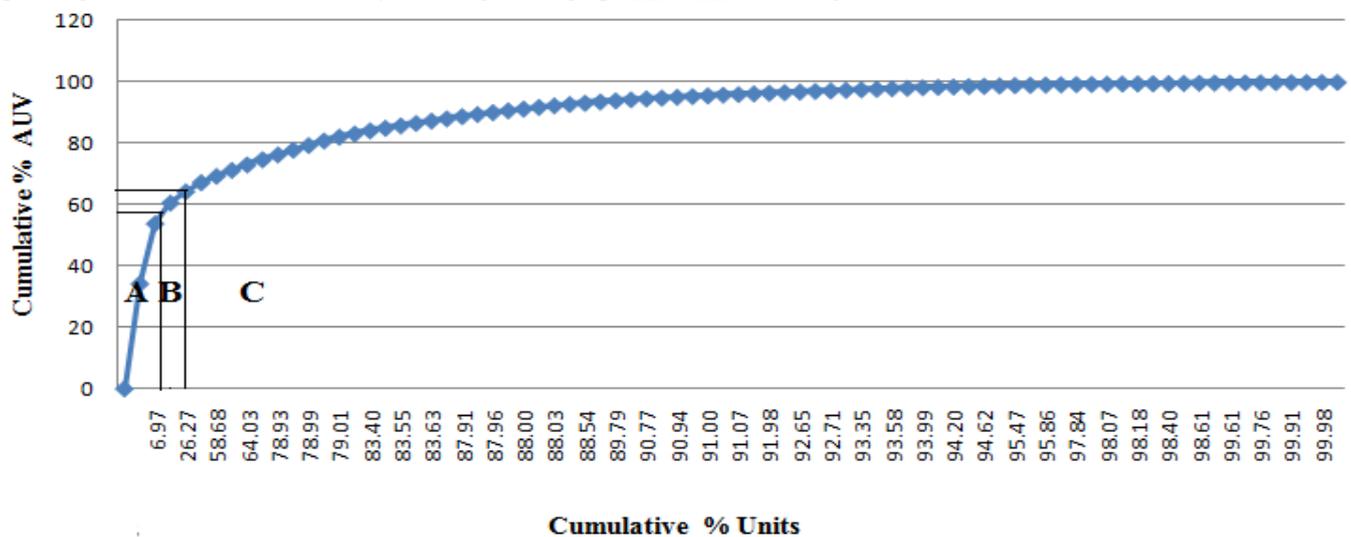

Cumulative % Units

Fig. 2 Graph of Cumulative % AUV vs Cumulative % of Item.

For the EOQ Analysis details collected from the site required for estimating approximately regarding annual requirement of the material by using that calculating the EOQ and then finding out no.of orders , based upon consumption period of that respective materials in the project finding the frequency of order. It is shown in the Table 4.

By using EOQ Analysis values finding out the total cost required for the materials it is shown in the Table 4 and actually incurred cost in site without material management shown in Table 5. In Fig 3 Comarison Bar chart Between With and without material management.

Table 4 EOQ Analysis

SL.NO	NAME OF THE MATERIAL	ANNUAL REQUIREMENT	UNIT	FIXED COST PER ODER(Rs)	EOQ	NO OF ORDERS	FREQUENCY OF ORDERING(Days)
1	Cement(Acc/ultratech)	2367	Bags	800	224	10.57	28
2	Cement(Penna)	13296	Bags	800	544	24.44	12
3	STEEL	205	Ton's	10	23	8.91	28
4	LATERITE MASONARY	21664	cft	400	1552	13.96	19
5	4" BRICK MASONARY	8283	cft	400	743	11.15	24
7	FINE AGGREGATE	62681	Cft	250	3675	17.06	18
8	COARSE AGGREGATE	8261	Cft	250	816	10.12	26

Table 5 With Material Management

Sl.no	Description	Quantity	Unit	Total amount
1	Cement Acc	2464	Bags	995520
2	laterite	21728	Cft	787808
3	Steel	207	Tons	7937065
4	Coarse aggregate	8976	Cft	298958
5	4" Brick	8173	Cft	470261
6	Cement Penna	13056	Bags	4991360
7	Fine aggregate	62475	Cft	1096310
			TOTAL	**16577282**

Table 6 Without Material Management

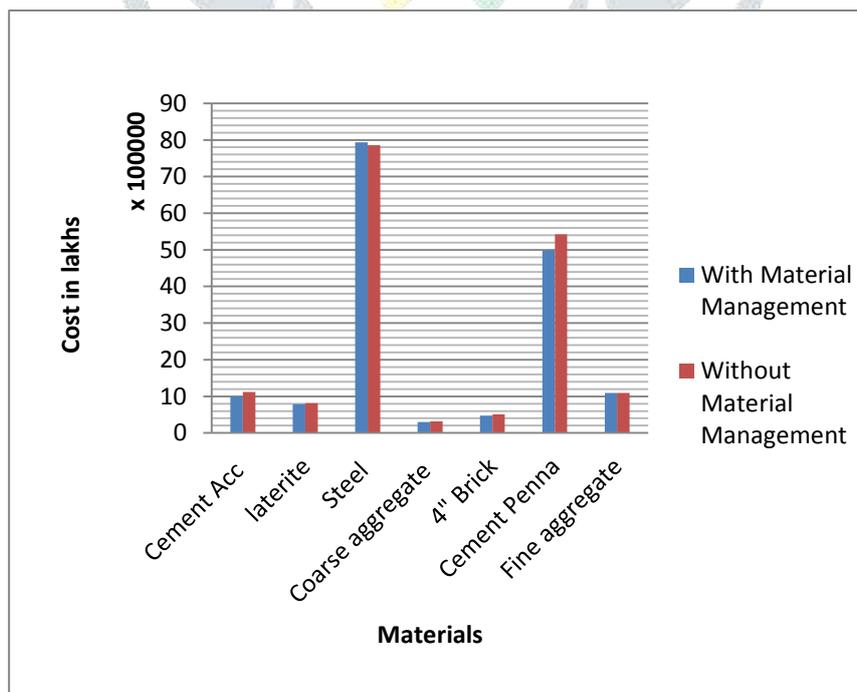| Sl.no	Description	Quantity	Unit	Total amount
1	Cement Acc	2790.0	Bags	1115800
2	laterite	22030.0	Cft	813080
3	Steel	204.9	Tons	7860677
4	Coarse aggregate	9250.0	Cft	319750
5	4" Brick	8173.0	Cft	506000
6	Cement Penna	13963.0	Bags	5421195
7	Fine aggregate	62475.0	Cft	1092080.8
			TOTAL	**17128583**

Fig. 3 Comparison between With and Without Material Management.

V. RESULTS

ABC Analysis Curve in Fig 2 clearly separates the items in to 3 Groups. In that A and B group materials requires close monitoring and control. Because nearly 65% of the cost required for the materials covered by these two groups. From this analysis its observed overall cost of the material depends on controlling and monitoring of these A and B group materials. By referring Table 5 and Table 6 it clearly indicates by adopting EOQ for s in Material management results in reducing the cost required for materials and from this timely procurement wastage of material is reduced. By this case study work shows nearly 1% savings in overall cost of the project by adopting EOQ for structural materials.
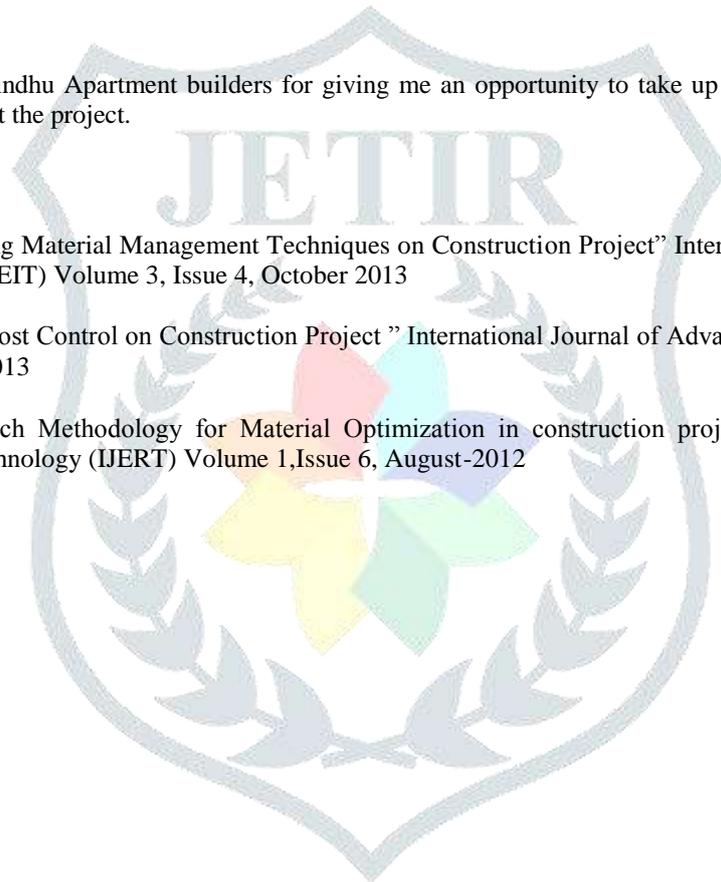
VI. CONCLUSION

ABC analysis and EOQ analysis plays an important role in Material management .During this present work due to unavailability of proper data, reduction in cost could not be judged properly and also percentage of savings is less because contractor has given some importance to material management. But these two analysis surely help in wastage control, right incoming quantity, proper control and reduce the lead time.

ACKNOWLEDGEMENT

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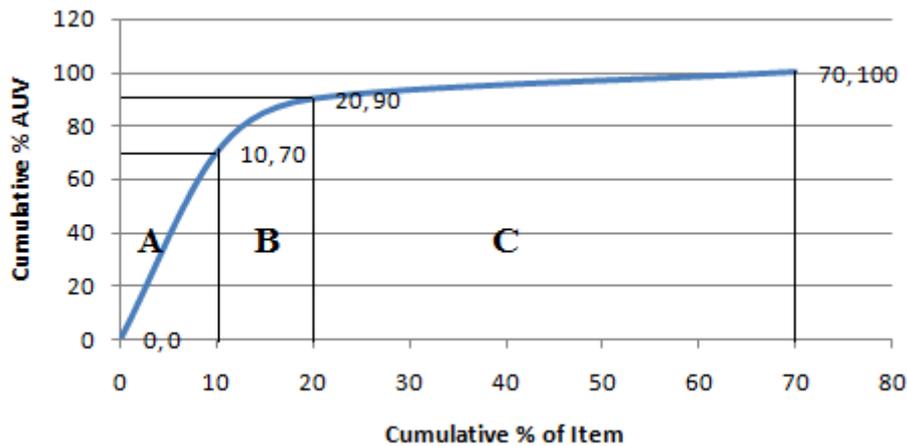
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26	Cable 4 sq mm(90m coil)	3540	40	No's	141600	0.02	88.00	0.58	91.32
27	Meter	3750.00	36	No's	135000	0.02	88.02	0.55	91.88

28	Exterior emulsion	4150.00	30	20ltr Tin	124500	0.02	88.03	0.51	92.39
29	With out key cylindrical lock Toilet and balconies doors	162	647	No's	104814	0.33	88.37	0.43	92.82
30	Angle cock	310.00	324	No's	100440	0.17	88.54	0.41	93.23
31	Wash basin(with half ped)	2767.00	36	No's	99612	0.02	88.55	0.41	93.64
32	Bathroom tiles floor	38.00	2400	Sft	91200	1.24	89.79	0.37	94.01
33	Other door concreteframe 3' op	900.00	90	No's	81000	0.05	89.84	0.33	94.35
34	06A One Way Switch	40.00	1800	No's	72000	0.93	90.77	0.30	94.64
35	Other door concreteframe 2' 6"op	875.00	72	No's	63000	0.04	90.81	0.26	94.90
36	Fan Regulator	240.72	252	No's	60661.44	0.13	90.94	0.25	95.15
37	Cable 1.5 sq mm(90m coil)	1500	40	No's	60000	0.02	90.96	0.25	95.39
38	Pillar cock	768.00	72	No's	55296	0.04	91.00	0.23	95.62
39	Spout	761.00	72	No's	54792	0.04	91.03	0.22	95.85
40	Stop cock concealed	741.00	72	No's	53352	0.04	91.07	0.22	96.07
41	Conduit pipe(3/4")Heavy	48	1080	Length	51840	0.56	91.63	0.21	96.28
42	With key cylindrical lock Bed room doors	72.00	691	No's	49752	0.36	91.98	0.20	96.48
43	Conduit pipe(3/4")lnormal	40	1224	Length	48960	0.63	92.62	0.20	96.68
44	Ventillator concreteframe	650.00	72	No's	46800	0.04	92.65	0.19	96.88
45	12 Way SPN DB	1290	36	No's	46440	0.02	92.67	0.19	97.07
46	Health Faucet	635.00	72	No's	45720	0.04	92.71	0.19	97.25
47	Interior primer	3740.00	12	50kg Bag	44880	0.01	92.72	0.18	97.44
48	Main door	36.00	1236	No's	44496	0.64	93.35	0.18	97.62
49	Sink cock (kitchen)	1145.00	36	No's	41220	0.02	93.37	0.17	97.79
50	16A Switch With Indicator	102.23	396	No's	40483.08	0.20	93.58	0.17	97.96
51	Over shower with arm	531.00	72	No's	38232	0.04	93.61	0.16	98.11

52	06A One Way Socket	50.00	720	No's	36000	0.37	93.99	0.15	98.26
53	Exterior primer	3110.00	11	20ltr Tin	34210	0.01	93.99	0.14	98.40
54	16A Switch With Indicator	79.14	396	No's	31339.44	0.20	94.20	0.13	98.53
55	Wash basin	803.00	36	No's	28908	0.02	94.21	0.12	98.65
56	Brass Handle for main door	36	778	No's	28008	0.40	94.62	0.11	98.76
57	3/3 Deep block	29	936	No's	27144	0.48	95.10	0.11	98.87
58	Metal Box 2 Modular	35	720	No's	25200	0.37	95.47	0.10	98.98
59	2Module Plate	32.98	720	No's	23745.6	0.37	95.84	0.10	99.07
60	Nozzle tap (utility)	594.00	36	No's	21384	0.02	95.86	0.09	99.16
61	Bend(3/4")	6	3240	No's	19440	1.67	97.54	0.08	99.24
62	6" BRICK MASONARY	29	596	cft	17284	0.31	97.84	0.07	99.31
63	Metal Box 3 Modular	50	288	No's	14400	0.15	97.99	0.06	99.37
64	Metal Box 9 Modular	100	144	No's	14400	0.07	98.07	0.06	99.43
65	Waste coupling half thread	192.00	72	No's	13824	0.04	98.10	0.06	99.49
66	9Module Plate	92.33	144	No's	13295.52	0.07	98.18	0.05	99.54
67	Metal Box 8 Modular	90	144	No's	12960	0.07	98.25	0.05	99.60
68	3Module Plate	43.69	288	No's	12582.72	0.15	98.40	0.05	99.65
69	Fan hook junction	46	252	No's	11592	0.13	98.53	0.05	99.69
70	Metal Box 6 Modular	80	144	No's	11520	0.07	98.61	0.05	99.74
71	8Module Plate	78.32	144	No's	11278.08	0.07	98.68	0.05	99.79
72	Coupling(3/4")	5	1800	No's	9000	0.93	99.61	0.04	99.83
73	6Module Plate	61.01	144	No's	8785.44	0.07	99.68	0.04	99.86
74	Metal Box 4 Modular	60	144	No's	8640	0.07	99.76	0.04	99.90
75	06A Two Way Switch	58.53	144	No's	8428.32	0.07	99.83	0.03	99.93
76	4Module Plate	47.82	144	No's	6886.08	0.07	99.91	0.03	99.96
77	T.V.Socket	55.23	72	No's	3976.56	0.04	99.94	0.02	99.98
78	Telephone Socket	51.11	72	No's	3679.92	0.04	99.98	0.02	99.99
79	Bell Push 1M	60.18	36	No's	2166.48	0.02	100.00	0.01	100.00
		Σ4	193634	Σ6	24370369.3				

Separating the materials in to ABC by referring to the graph , It shown in the figure 2.
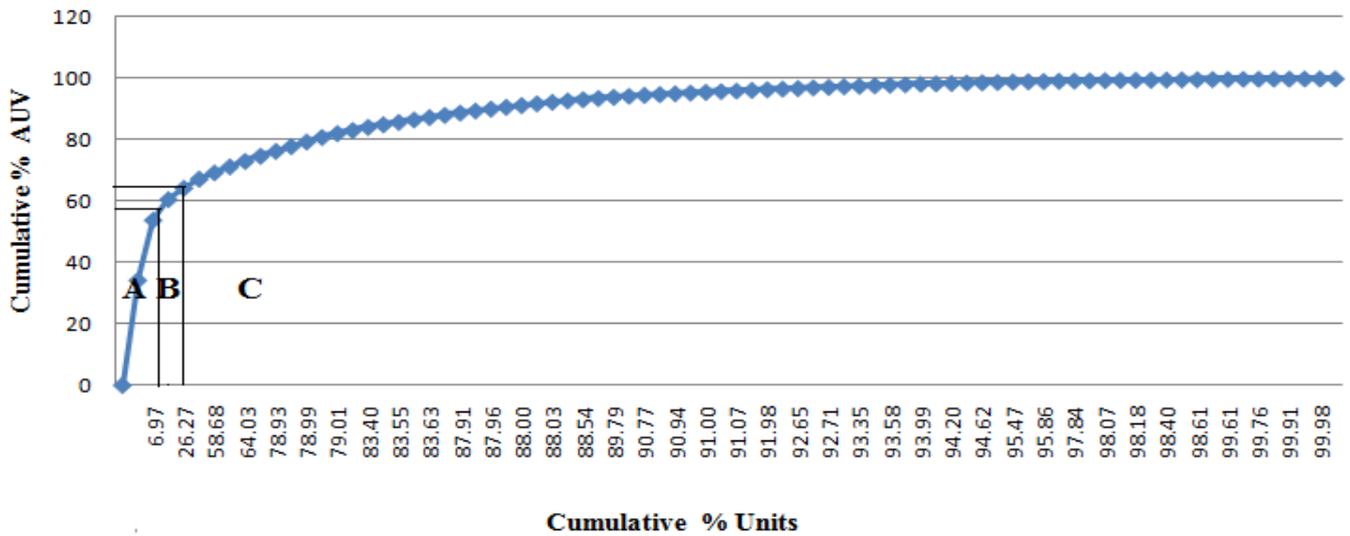
Fig. 2 Graph of Cumulative % AUV vs Cumulative % of Item.

For the EOQ Analysis details collected from the site required for estimating approximately regarding annual requirement of the material by using that calculating the EOQ and then finding out no.of orders , based upon consumption period of that respective materials in the project finding the frequency of order. It is shown in the Table 4.

By using EOQ Analysis values finding out the total cost required for the materials it is shown in the Table 4 and actually incurred cost in site without material management shown in Table 5. In Fig 3 Comarison Bar chart Between With and without material management.

Table 4 EOQ Analysis

SL.NO	NAME OF THE MATERIAL	ANNUAL REQUIREMENT	UNIT	FIXED COST PER ODER(Rs)	EOQ	NO OF ORDERS	FREQUENCY OF ORDERING(Days)
1	Cement(Acc/ultratech)	2367	Bags	800	224	10.57	28
2	Cement(Penna)	13296	Bags	800	544	24.44	12
3	STEEL	205	Ton's	10	23	8.91	28
4	LATERITE MASONARY	21664	cft	400	1552	13.96	19
5	4" BRICK MASONARY	8283	cft	400	743	11.15	24
7	FINE AGGREGATE	62681	Cft	250	3675	17.06	18
8	COARSE AGGREGATE	8261	Cft	250	816	10.12	26

Table 5 With Material Management

Sl.no	Description	Quantity	Unit	Total amount
1	Cement Acc	2464	Bags	995520
2	laterite	21728	Cft	787808
3	Steel	207	Tons	7937065
4	Coarse aggregate	8976	Cft	298958
5	4" Brick	8173	Cft	470261
6	Cement Penna	13056	Bags	4991360
7	Fine aggregate	62475	Cft	1096310

			TOTAL	**16577282**

Table 6 Without Material Management

Sl.no	Description	Quantity	Unit	Total amount
1	Cement Acc	2790.0	Bags	1115800
2	laterite	22030.0	Cft	813080
3	Steel	204.9	Tons	7860677
4	Coarse aggregate	9250.0	Cft	319750
5	4" Brick	8173.0	Cft	506000
6	Cement Penna	13963.0	Bags	5421195
7	Fine aggregate	62475.0	Cft	1092080.8
			TOTAL	**17128583**

Fig. 3 Comparison between With and Without Material Management.

XI. RESULTS

ABC Analysis Curve in Fig 2 clearly separates the items in to 3 Groups. In that A and B group materials requires close monitoring and control. Because nearly 65% of the cost required for the materials covered by these two groups. From this analysis its observed overall cost of the material depends on controlling and monitoring of these A and B group materials. By referring Table 5 and Table 6 it clearly indicates by adopting EOQ for s in Material management results in reducing the cost required for materials and from this timely procurement wastage of material is reduced. By this case study work shows nearly 1% savings in overall cost of the project by adopting EOQ for structural materials.

XII. CONCLUSION

ABC analysis and EOQ analysis plays an important role in Material management .During this present work due to unavailability of proper data, reduction in cost could not be judged properly and also percentage of savings is less because contractor has given some importance to material management. But these two analysis surely help in wastage control, right incoming quantity, proper control and reduce the lead time.

ACKNOWLEDGEMENT

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