

## A study of on-site material management handling practices & rating of the different construction sites in Ahmadabad city.

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**ABSTRACT:** This paper is written to show the issue in material management system in construction projects as there is approximately 60% of the capital cost in construction project consist of Material cost. Therefore, it is essential to have proper material management system in order to have easy flow of materials, proper reuse of material and cost of construction project. The flow of material is an important factor for managing a productive and cost efficient site. By the proper management of materials at construction site the wastage of materials can be reduced, cost efficiency of a project and timely completion of project. Poor material management is the main reason in delaying of construction project.

**KEYWORDS:** Bar charts, Project related strand, Questionnaire survey, Rating, Statistical analysis and Suggestions.

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### I. Introduction:

Materials management is a process for planning, executing and controlling field and office activities in construction. The materials management system attempts to ensure that the right quality and quantity of materials are appropriately selected, purchased, delivered and handled on site in a timely manner and at a reasonable cost. Material management is an important element in project management. Materials represent a major expense in construction, so minimizing procurement costs improves opportunities for reducing the overall project costs. Poor materials management can result in increased costs during construction. Efficient management of materials can result in substantial savings in project costs. If materials are purchased too early, capital may be held up and interest charges incurred on the excess inventory of materials. Materials may deteriorate during storage or get stolen unless special care is taken. Delays and extra expenses may be incurred if materials required for particular activities are unavailable. Ensuring a timely flow of materials is an important concern of material management. For effectively managing and controlling materials, the performance of materials management should be measured. A performance measure calculates the effective working of a function. These performance measures may differ from system to system. Thus, efficient material management is an important factor in a construction project.

The study is based on key factors which affects management of materials. The key factors are as under timely updating, reuse of materials, contractor's involvement, material storage on site, alternative stock, allowable percentage of waste on site, inventory process. By analyzing these key factors would assist the proactive measures of project. This study will be serving as a guideline to have a proper and easy flow of material on site.

### I. OBJECTIVES:

- To have a better control over storing and inventory of materials.
- To facilitate better supply and management of material.
- To make sure that the materials are available at right time and right place.
- To reduce the waste of materials and maintain the flow of materials

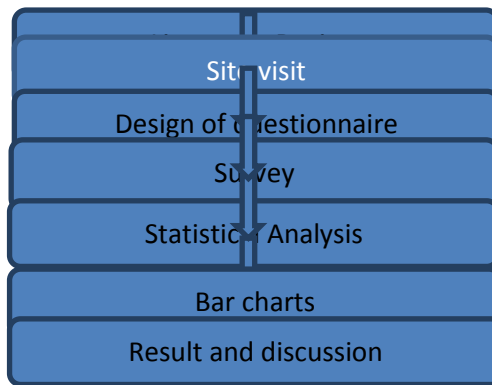
### II. Necessity of study:

In the present scenario in construction industry, there is custom of improper practice of material management done by most of the sites, due to which problems like lacking of materials, delay of completion of construction projects, economy crisis, etc arises. Lack of power designated to contractors causes incomplete knowledge of materials on site. So this study is very much important for proper reuse, less wastage and proper flow of materials on site.

### III. Methodology:

The methodology involves collection of literature and conducting study of mismanagement of materials on site. The study also continued to find the key factors affecting the performance of construction project. Based on the key factors a questionnaire is designed to understand more about the material management in the construction industry. Data is collected from the responsible persons from the site such as project manager, project engineer or site engineer, chief engineer. Questionnaire is designed on the basis of budget such as low, medium and high. Questionnaire is mainly focused on following areas.

- Company detail.
- Documentation details.
- Details of material usage.
- Details of material storage.
- Methods for wastage reduction.



### II. STUDY AREA:

Site no.	Name of site	Type of Construction	Budget	Area
1	Binori Mable	Residential	70 Cr	PrahladNagar
2	ShivalikShilp	Commercial	85Cr	S.G. Highway
3	H1	Residential	30 Cr.	ISRO
4	Government housing	Residential	55 Cr	S.G. Highway
5	Setu Square	Commercial	35 Cr	New C.G. Road
6	Shivalay Heights	Residential	1.5Cr	Motera
7	Pebble Bay	Residential	180 Cr	Chandkheda
8	Triksha Desire	Commercial	3 Cr	Chandkheda
9	United Square	Commercial	1 Cr	Chandkheda

### IV. Companies categorized on budget basis:

High	Medium	Low
Binori Mable	H1	Shivalay Heights
ShivalikShilp	Government Housing	Trikasha Desire
Pebble Bay	Setu Square	United Square

### Design of questionnaire:

Questionnaire is prepared using extensive literature review. The literature review was done through books, research papers, internet and leading construction management and engineering journals. Through site survey, all the critical factors were identified which affects the project. A total of six possible factors that were felt to have an effect on material management were determined. These main factors are project related strand, project manager related strand, project material management strand, project team related strand, environmental related strand and tools and techniques related strand. Similarly the sub factors of these main factors were determined and they are 30.

SR.NO	QUESTIONS	YES	NO	REMARKS
A.	<b>PROJECT RELATED STRAND</b>			
1)	What is your project value?			
2)	Do you draft any schedule?			
3)	Which scheduling technique is used?			
4)	Does your project run according to your schedule?			
5)	Are materials rendered prior the commencement of work?			
6)	Is your any activity is interdependent on each other?			
7)	Which activities are interdependent?			
8)	Do you record material usage detail?			
9)	How you record them?			
10)	Do you have any material scheduling details?			
B.	<b>PROJECT MANAGER RELATED STRAND</b>			
11)	Does site engineer has ability to maintain flow of workers and materials?			
12)	Is site engineer experienced?			
13)	Does he have effective leadership in managing materials and labours?			
14)	Does he have ability to handle shortage of materials?			
15)	Whether the roles and responsibilities are efficiently distributed or not?			
C.	<b>PROJECT MATERIAL MANAGEMENT STRAND</b>			
16)	Do you have any particular inventory process?			
17)	What is your inventory process?			
18)	Do you have any proper any storage of materials?			
19)	What is the process of on-site material management?			
20)	Are your materials reused on site?			
21)	Which materials are reused and where?			
22)	Do you have any flow cycle?			
23)	What is your flow cycle?			
D.	<b>PROJECT TEAM RELATED STRAND</b>			
24)	Do the contractor have ability to manage his workers and materials?			
25)	Is your contractor is involved in inventory and material storing process?			
26)	Is timely updating and monitoring is done?			
27)	Which technique do you used if changes occur?			
28)	Is the team committed towards goals?			
29)	Are subcontractor hired?			
30)	Any follow up from the main contractor?			
E.	<b>ENVIRONMENTAL RELATED STRAND</b>			
31)	Does economical environment affect the company?			
32)	Does the project change due to technological change in the society?			
33)	Do you have any waste management procedure?			
34)	What is the waste management procedure?			
F.	<b>TOOLS AND TECHNIQUES RELATED STRAND</b>			
35)	Proper monitoring and control check is conducted?			
36)	Quantity estimation and budgeting for individual activities is done?			
37)	Is the work conducted according to required quality standard?			
38)	Is any alternative provided for lack of materials?			

**V. Analysis of main factors:**

From the answers of questionnaire, the main strands were categorised in seven key factors which affects the onsite management of materials. The key factors are shown below:

**1) Timely Updating**

**Is timely updating and monitoring is done?**

VALID	FREQUENCY	%	VALID(%)	CUMULATIVE
WEEKLY	3	33.33	33.33	33.33
1 – 2 MONTHS	2	22.22	22.22	55.55
3-6 MONTHS	1	11.11	11.11	66.67
6- 12 MONTHS	3	33.33	33.33	100.00
TOTAL	9	100.00	100.00	

**2) Reuse of Materials:**

**Are your materials reused on site? Which materials are reused and where?**

SITE NO ->	1		2		3		4		5	
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
BRICK BATS	✓		✓		✓			✓	✓	
CEMENT PLASTER		✓	✓			✓		✓	✓	
STEEL	✓		✓			✓		✓	✓	
TILES	✓		✓		✓			✓	✓	

SITE NO.	6		7		8		9	
	YES	NO	YES	NO	YES	NO	YES	NO
BRICK BATS	✓		✓		✓		✓	
CEMENT PLASTER	✓		✓			✓		✓
STEEL		✓	✓			✓		✓
TILES	✓		✓		✓			✓

**3) Contractor’s Involvement:**

**Is your contractor is involved in inventory and material storing process?**

VALID	FREQUENCY	PERCENTAGE	VALID (%)	CUMULATIVE
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VERY OFTEN	2	22.22	22.22	22.22
OFTEN	1	11.11	11.11	33.33
SOMETIMES	1	11.12	11.12	44.45
NEVER	5	55.55	55.55	100.00
TOTAL	9	100.00	100.00	

4) **Material Storage on Site:**

Do you have any proper any storage of materials?

SITE NO ->	1		2		3		4		5	
MATERIAL	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
CEMENT	✓		✓		✓		✓		✓	
SAND	✓		✓		✓		✓			✓
STEEL	✓			✓	✓			✓		✓
BRICKS	✓		✓		✓		✓		✓	

SITE NO ->	6		7		8		9	
MATERIAL	YES	NO	YES	NO	YES	NO	YES	NO
CEMENT	✓		✓		✓			✓
SAND	✓		✓			✓		✓
STEEL		✓	✓		✓			✓
BRICKS	✓		✓		✓			✓

5) **Alternative (Storage):**

Is any alternative provided for lack of materials?

VALID	FREQUENCY	PERCENTAGE	VALID (%)	CUMULATIVE
YES	3	33.33	33.33	33.33
NO	6	66.67	66.67	100.00
TOTAL	9	100.00	100.00	

6) **Percentage of Material Waste on Site:**

PERCENTAGE	FREQUENCY
0 – 5 %	0
5 – 10 %	3
10 -15 %	3
>15 %	3
TOTAL	9

7) **Inventory Process:**

Do you have any particular inventory process?

What is your inventory process?

TYPE	FREQUENCY	PERCENTAGE	VALID (%)	CUMULATIVE
TENDER	4	44.44	44.44	44.44
MARKET SURVEY	3	33.34	33.34	77.78
CONTRACT	2	22.22	22.22	100.00
TOTAL	9	100.00	100.00	

**VI. Comparison of sites based on key factors:**

Comparison is carried out among high, medium and low budget projects to understand the reason behind the loop falls. Comparison is shown in the tabular form as shown below:

1. **HIGH BUDGET PROJECT**

BINORI	PEBBLE BAY
Reuse of materials	Reuse of materials
<ul style="list-style-type: none"> <li>• Bricks</li> <li>• Cement plaster</li> <li>• Steel</li> </ul>	<ul style="list-style-type: none"> <li>• Bricks</li> <li>• Cement plaster</li> </ul>

Contractor's Involvement	No Contractor's Involvement
Inventory process • Tender	Inventory process • Market Survey

2. **MEDIUM BUDGET PROJECT**

<b>H1 SITE</b>	<b>GOVERNMENT SITE</b>
Timely update • 3-6 months	Timely update • 6-12 months
Reuse of materials • Cement plaster	No Reuse
Contractor's Involvement • Sometimes	No Contractor's Involvement
Storage on Site • Proper Storage	Storage on Site • Bricks • Cement • Steel
Alternative • Good	No Alternative
Allowable Waste • 10-13%	Allowable Waste • > 15%
Inventory Process • Tender	Inventory Process • Contract

3. **LOW BUDGET PROJECT**

<b>SHIVALAY HEIGHTS</b>	<b>UNITED SQUARE</b>
Timely update • Weekly	Timely update • 6-12 months
Reuse of materials • Brick • Cement plaster	No Reuse
No Contractor's Involvement	No Contractor's Involvement
Storage on Site • Bricks • Cement • Steel	Storage on Site • Proper Storage
Alternative • Good	No Alternative
Allowable Waste • 10-13%	Allowable Waste • > 15%
Inventory Process • Market Survey	Inventory Process • Contract

**VII. Rating criteria:**

The rating criteria are based on the key factors. The site which fulfils all the seven key factors is rated 5 and the site which fulfils least or none of the key factors is rated 1. The 2, 3 and 4 rating shows the performance between 1 and 5.

<b>Key Factors</b>	<b>Factors</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1	Timely updating	Yearly	6-12 months	3-6 months	1-2 months	Weekly
2	Reuse of materials	Minimum	Bricks	Bricks, cement plaster	Bricks, cement plaster, steel	Maximum reuse
3	Contractor's involvement	Never	sometimes	Partly	Often	Very often
4	Storage of materials on	Poor storage	Bricks	Bricks, cement	Bricks, cement and	All materials

	site				steel	
5	Alternative	No	Worse	good	Better	Best
6	Allowable waste	>15%	13-15%	10-13%	7-10%	<7%
7	Inventory process	Least economy	Lower economy	Low economy	Medium	Economical

**VIII. Analysis:**

The overall rating of each site is taken as the sum of each rating to the total number of activities considered for the rating.

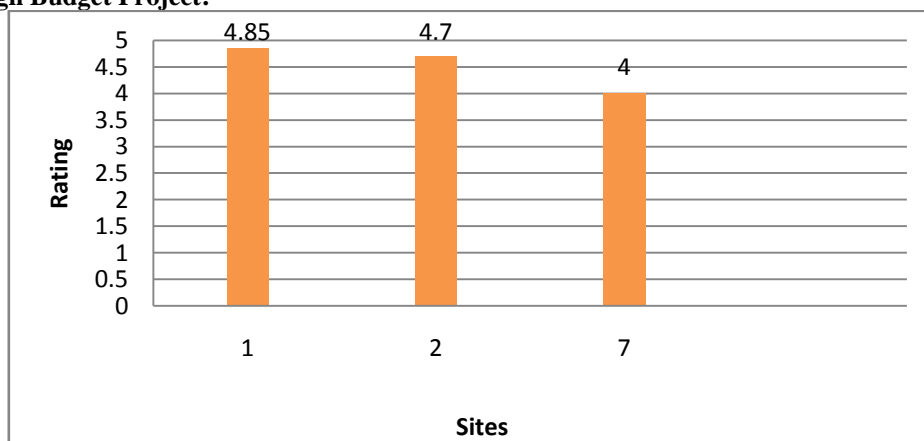
SITE NO	CALCULATION	FINAL RATING
1	5+4+5+5+5+5+5/7	4.85
2	5+5+5+4+5+4+5/7	4.7
3	3+3+2+5+3+3+5/7	3.43
4	2+1+1+4+1+1+2/7	1.71
5	4+5+1+3+3+3+3/7	3.14
6	5+3+1+4+3+3+3/7	3.14
7	5+3+1+5+5+5+4/7	4
8	3+4+2+1+3+2+2/7	2.43
9	2+1+1+1+1+1+1/7	1.14

The bar chart shown below represents the rating of 9 sites on a scale of 0 to 5.



**REASON FOR LOOP FALL:**

1) **High Budget Project:**

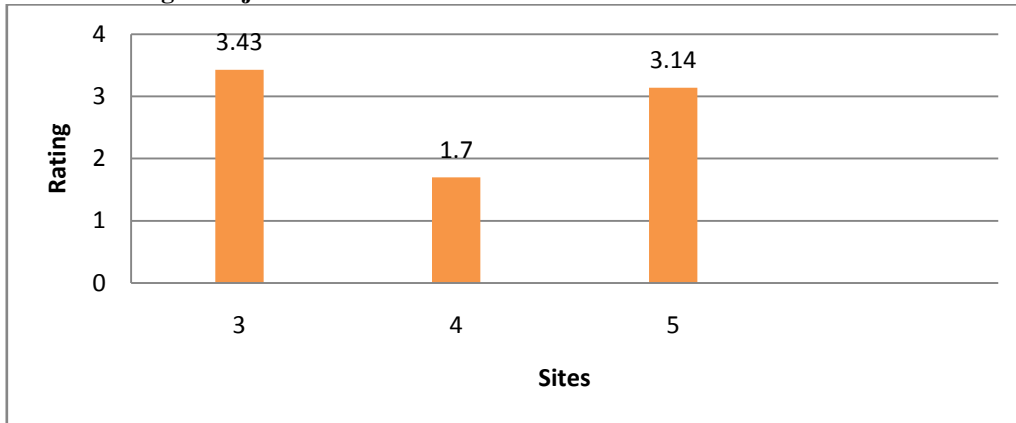


From the graph, we can observe that in comparison to the bars of sites 1 & 2 there is drastic change in bar of site 7.

**Causes:**

- The reason behind the fall are left over steel is not used.
- There is no involvement of contractor in Inventory process.
- Due to difference in selection of inventory process, i.e. Market Survey & Tender .
- Market Survey is time consuming as compared to Tender

**2) Medium Budget Project:**

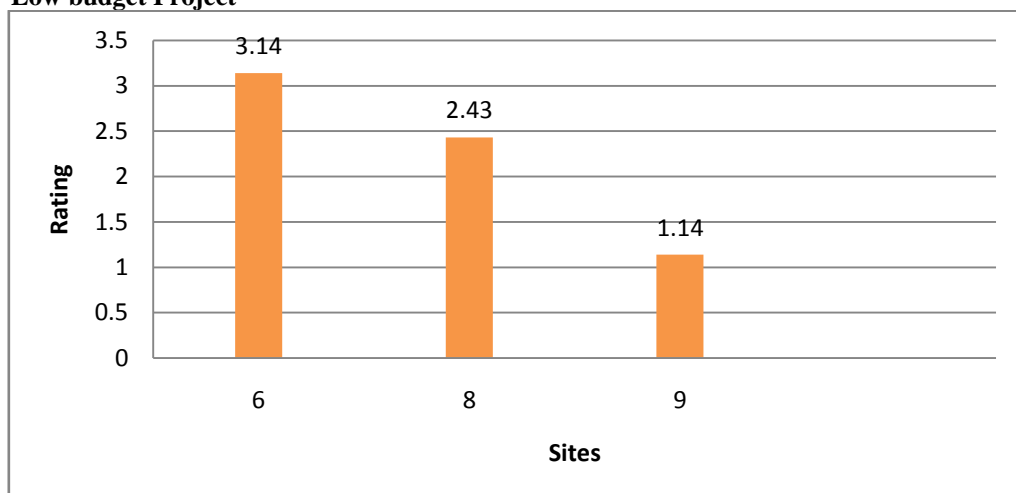


From the graph, we can observe that in comparison to the bars of sites 3 & 5 there is drastic change in site 4.

**Causes:**

- They update the records of materials after the completion of each work, due to which leftovers are acquired in limited amount in any activity.
- They do not reuse any materials which can be reused such as cement plaster, used bricks and steel, which can be reused in many activities.
- No involvement of contractor in the inventory process, due to which the availability of materials is not known by the contractor and which results into improper utilization of materials causing a hike in the overall cost.
- There is no alternative for shortage of materials on site, which results into delay of work and increase in overall cost.
- As the allowable wastage becomes greater than 15%, which is greater than the allowable limit, there is increase in the overall cost of materials.
- The inventory process is fixed before the commencement of the project, due to this reason they are deprived of an opportunity to market survey or various economic tenders, which results into an increase in the overall cost of the project.

**3) Low budget Project**



From the graph, we can observe that in comparison to the bars of sites 6 & 9 there is drastic change in site 9.

**Causes:**

- They update the records of materials after the completion of each work, due to which leftovers are acquired in limited amount in any activity.
- They do not reuse any materials which can be reused such as cement plaster, used bricks and steel, which can be reused in many activities.
- No involvement of contractor in the inventory process, due to which the availability of materials is not known by the contractor and which results into improper utilization of materials causing a hike in the overall cost.
- There is no alternative for shortage of materials on site, which results into delay of work and increase in overall cost.
- As the allowable wastage becomes greater than 15%, which is greater than the allowable limit, there is increase in the overall cost of materials.
- The inventory process is fixed before the commencement of the project, due to this reason they are deprived of an opportunity to market survey or various economic tenders, which results into an increase in the overall cost of the project.
- There is no storage of material on-site due to this reason the quality of materials deteriorate & wastage is also increased. Hence this will directly affect the cost of materials.

### **IX. Conclusion:**

- Weekly updating should be adopted to know the exact quantity of materials used.
- Proper reuse of material should be brought into practice.
- There should be ample involvement of the contractor from the beginning to the commencing point of a project.
- Best alternative should be sought, when required by the agency.
- Percentage allowable waste should be least in order to reduce high wastage of materials.
- Tender should be adopted rather than opting for a particular agency, which will help in the economic aspect of project.
- Proper storage should be available for the materials, lest to keep the quality of material intact.

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