A Study on Basic Material Waste in Building Industry: Main Causes and Prevention

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***Abstract*-In Construction, 4-M (Material, Manpower, Money, Machine) play crucial role. Material waste has been recognized as a major problem in the construction industry. This paper describes the main results of research studies carried out in Anand (Gujatrat) India that investigated the occurrence of material waste at 5 building sites located in different location of the Anand in India .Most of this waste can be avoided by strict supervision and control of material. The main causes of waste and necessary suggestion for reduce waste are discussed on this paper.**

KEY WORDS: Waste; Construction Material; Building

I. INTRODUCTION

This research work is based on material waste management in building construction Through the dissertation work, attempt is made to find reasons of wastage in construction industry and how it can be minimized .

In construction, 4-M (Material, Manpower, Money Machine) play crucial role. Depending on the type of a housing project, building materials account for 60 to 70% of the project cost. Through material waste management function, we can reduce the overall project cost by waste minimization or maximum utilization of resources (Material).

In general, a very high level of waste is assumed to exist in construction. Although it is difficult to systematically measure all wastes in construction, partial studies from various countries have confirmed that waste represents a relatively large percentage of production costs. A wide range of measures have been used for monitoring waste, such as excess consumption of materials (Skoyles 1976; Bossink and Brouwers 1996), quality failure costs (Cnudde 1991), and maintenance and repair costs, accidents, and nonproductive time (Oglesby et al. 1989).

Waste in the construction industry is important not only from the perspective of efficiency, but also concern has been growing in recent years about the adverse effect of the waste of building materials on the environment. This kind of waste typically accounts for between 15 and 30% of urban waste (Brooks et al. 1994; Bossink and Brouwers 1996; Forsythe and Marsden 1999). Building materials waste is difficult to recycle due to high levels of contamination and a large degree of heterogeneity (Bossink and Brouwers 1996), and often there is insufficient space for its disposal in large cities.

Measuring waste is an effective way to assess the performance of production systems because it usually allows areas of potential improvement to be pointed out and the main causes of inefficiency to be identified. Compared to traditional financial measures, waste measures
are more effective to support process management, since they enable some operational costs to be properly modeled and generate information that is usually meaningful for the employees, creating conditions to implement decentralized control.

It is concerned with waste measurement in the construction industry. Initially, waste is discussed from a conceptual point of view, and some previous studies of the waste of building materials are briefly analyzed (Carlos T. Formoso1; Eduardo L. Isatto).

II. SCOPE

- Limited to public building projects work
- For major material like cement, sand, brick, steel which used in R.C.C work, masonry work, plaster work etc

III. METHODOLOGY

- Data collection through site visit from various construction projects.
- Analyzed data to find out wastage proportion.
- Study the effect of wastage on project cost.
- Find the causes of wastage on site by experience and discussion with site engineer/builder/consultant.

IV. LITERATURE REVIEW

CONCEPT OF WASTE

According to the new production philosophy, waste should be understood as any inefficiency that results in the use of equipment, materials, labour, or capital in larger quantities than those considered as necessary in the production of a building. Waste includes both the incidence of material losses and the execution of unnecessary work, which generate additional costs but do not add value to the product (Koskela 1992). Therefore, waste should be defined as any losses reduced by activities that generate direct or indirect costs but do not add any value to the product from the point of view of the client.

Besides a clear understanding of the general concept of waste, it is helpful to use a classification of waste in different categories, in order to understand the wide range of possible corrective actions related to its prevention.

Regarding the possibility to control the incidence of waste, this study admits that there is an acceptable level of waste, which can only be reduced through a significant change in the level of technological development. Thus, waste can be classified in unavoidable waste (or natural waste), in which the investment necessary to its reduction is higher than the economy produced, and avoidable waste, when the cost of waste is significantly higher than the cost to prevent it. The percentage of unavoidable waste in each process depends on the company and on the particular site, since it is related to the level of technological development.

Waste can also be classified according to its origin, i.e. the stage that the main root cause is related to. Although waste is usually identified during the production stage, it can be originated by processes that precede production, such as materials manufacturing, training of human resources, design, materials supply, and planning.

The main classification of waste proposed in this study is by its nature, since it helps managers to understand the different forms of waste, why they occur and how to act in order to avoid them. The following classification resulted from a study developed at UFRGS, based on Shingo's seven wastes (Shingo, 1989) and on the analysis of some Brazilian building sites:

- **Overproduction**: related to the production of a quantity greater than required or earlier than necessary. This may cause waste of materials, man-hours or equipment usage. It usually produces inventories of unfinished products or even their total loss, in the case of materials that can deteriorate. An example of this kind of waste is the overproduction of mortar that cannot be used on time.
- **Substitution**: is monetary waste caused by the substitution of a material by a more expensive one (with an unnecessary better performance); the execution of simple tasks by an over-qualified worker; or the use of highly sophisticated equipment where a much simpler one would be enough.
- **Waiting time:** related to the idle time caused by lack of synchronization and levelling of material flows, and pace of work by different groups or equipments. One example is the idle time caused by the lack of material or by lack of work place available for a gang.
- **Transportation**: concerned with the internal movement of materials on site. Excessive handling, the use of inadequate equipment or bad conditions of pathways can cause this kind of waste. It is usually related to poor layout, and the lack of planning of material flows. Its main consequences are: waste of man hours, waste of energy, waste of space on site, and the possibility of material waste during transportation.
- **Processing:** related to the nature of the processing (conversion) activity, which could only be avoided by changing the construction technology. For instance, a percentage of mortar is usually wasted when a ceiling is being plastered.
- **Inventories**: related to excessive or unnecessary inventories which lead to material waste (by deterioration, losses due to inadequate stock conditions on site, robbery, vandalism), and monetary losses due to the capital that is tied up. It might be a result of lack of resource planning or uncertainty on the estimation of quantities.
- **Movement**: concerned with unnecessary or inefficient movements made by workers during their job. This might be caused by inadequate equipment, ineffective work methods, or poor arrangement of the working place.
- **Production of defective products**: it occurs when the final or intermediate product does not fit the quality specifications. This may lead to rework or to the incorporation of unnecessary materials to the building (indirect waste), such as the excessive thickness of plastering. It can be caused by a wide range of reasons: poor design and specification, lack of planning and control, poor qualification of the team work, lack of integration between design and production, etc.
- **Others:** waste of any nature different from the previous ones, such as burglary, vandalism, inclement weather, accidents, etc.

Cause of waste generation

There may be numerous causes responsible for the generation of waste in different systems. However, some general causes of waste generation at different stage have been perceived. The check list of causes of waste generation as below:

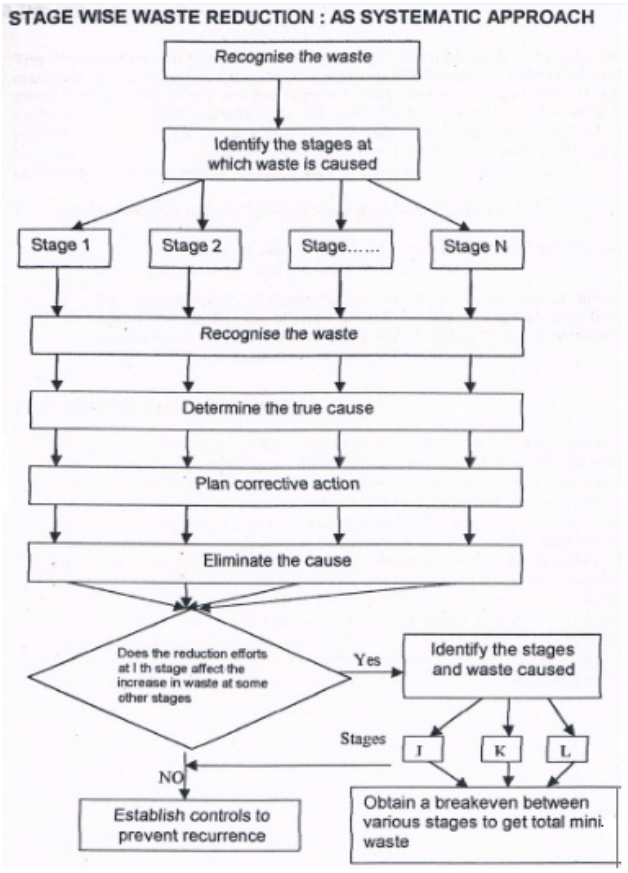
General

- Lack of material management system
- Poor house keeping & storage condition
- Poor quality control
- Adhoc procurement
- Contractors negligence
- Unconcerned supervisory staff
- Untrained labour
- Non-use of left over materials
- Theft and pilferage
- Change in design and specification
- Improper handling
- Loss during transportation and application.

Specific

- Wrong use of various grade of metal
- Silt content in sand
- Improper cutting of steel
- Use of dry cement
- Non-utilisation of cut piece of steel Mishandling of cement bags
- Excess mortar/concrete preparation for cement, sand and aggregates

Flow Chart: 1 Reduction of waste



Project delays

- Delays in the preparation and receipt of drawings from consultants.
- Lack of planning
- Information delay
- Delay in approval of design and specification
- Change in designs, specifications and materials
- Errors in project planning
- Personal interests
- Unrealistic labour planning
- Delay in approvals from government authorities
- Problems in contract administration
- Poor coordination of activities of contractors and consultants.
- Delay in procuring technical expertise
- Non availability of power, water and other infrastructural facilities.
- Adverse climatic condition
- Law and order problems
- Contractors and Labour problem
- Delay in material selection and approval
- Lack of finance
- Breakdown in construction equipment.

Reduction of Waste through below mention point:

- Towards Zero wastage
- The design stage
- Site management
- Standardization
- Codification

Storage Management Function

- Identification (Codification)
- Stock control
- Identing
- Transport receipt and inspection
- Storage
- Safety, security, preservation
- Issue and dispatch
- Disposal of scrap/surplus
- Identification of obsolete/unserviceable and slow moving item
- Stores records/stores accounting
- Stock verification.

Overview view of paper

The aim of this research work is to find reasons of material wastage on construction site of multi storyed buildings and how it can be minimized. So, overall project cost can be reduced or profit maximised.

My research study is conducted in Anand district and it's limited to residence building work.

In which 5 different building survey and compare the wastage of building material to each other.

The Data on estimated and actual consumption of major materials, namely: Cement, Reinforcement steel, Bricks, Sand and Coarse Aggregate are collected. For each projects negative variance or wastage worked out. From this wastage, which effected on productivity of project.

V. STUDY RESULT

Table:1 Cement

Project No	Total Consumption		W*a*stage (bags)	Wastivity (%)
	Estimated (bags)	Actual (bags.)		
1	15300	15700	400	2.61
2	75421	77051	1630	2.16
3	4400	4550	150	3.40
4	4320	4600	180	4.16
5	12450	12900	450	3.61

Table:2 Reinforced Steel

Project No	Total Consumption		Wastage (Kg)	Wastivity (%)
	Estimated (Kg.)	Actual (Kg.)		
1	121892	123750	1858	1.52
2	514982	533000	18018	3.49
3	36966.2	38500	1533.8	4.15
4	52525	54022	1497	2.85
5	122468	125250	2782	2.27

Table:3 Sand

Project No	Total Consumption		Wastage (CFT)	Wastivity (%)
	Estimated (CFT)	Actual (CFT)		
1	48500	52500	4000	8.25
2	238600	264800	26200	10.98
3	23850	26000	2150	9.01
4	12900	14700	1800	13.95
5	35000	38000	3000	8.57

Table:4 Coarse Aggregate ***CFT=Cubic Foot***

Project No	Total Consumption		W*a*stage (CFT)	Wastivity (%)
	Estimated (CFT)	Actual (CFT)		
1	39000	40500	1500	3.86
2	221500	229000	7500	3.39
3	15200	15700	500	3.29
4	19700	20100	400	2.03
5	53200	54700	1500	2.82

Table:5 Brick

Project No	Total Consumption		Wastage (No.)	Wastivity (%)
	Estimated (No.)	Actual (No.)		
1	268000	273103	5103	1.90
2	1635000	1650000	25000	1.53
3	134000	143000	9000	6.71
4	68000	75000	7000	10.29
5	50000	54000	4000	8.00

Rakesh j. Hingu ,"Wastage of building materials during construction of structure" ,Dissertation report, June 2010,

$$wastivity = \frac{wastage}{estimated\ consumption} \times 100$$

Suggestion for reducing wastage

- Strict supervision and control of materials
- Creating an awareness of consequences of waste and educating staff.
- Correct material planning and ordering.
- Intensifying security
- Effective site management
- Introducing incentive schemes.
- Improving material quality
- Improving storage facilities.
- Good line of communication between top management and workers.
- Use of shop made item like door/window frames.
- Imposing conditions to minimise wastage when negotiating workers/sub contractors
- Establishing proper method of measuring sand, aggregate purchasing.
- Improving transport system.

VI. CONCLUSION

In construction industries, there are numbers of constraints eg. Labour, Environment, Location. so, zero waste is not possible for any type of project.

Even after some extent of wastage rate allowable in each project, this limit extended beyond the allowable limit, which ultimately effect on project profit or return on investment (ROI).

In our case it should be obvious from result, that the actual consumption exceeded the estimated consumption for every item, in every project, i.e. the incidence of wastage is universal.

To compare the material wastage on different construction of project at Anand and also give the necessary suggestion for reduce waste at site.

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