Cost Optimization of Residential Construction Project through Waste Management Technique

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Abstract

Material waste has been recognized as a major problem in the construction industry that has important implications both for the efficiency industry and for the environmental impact of the construction projects. Moreover, waste measurement plays an important role in the management of production system since it is effective way to assess their performance, allowing areas of potential improvement to be pointed out. This study describes the main results occurrence of material waste at two building sites located in different regions of Ahmedabad. Some typical figures for the waste of some key construction materials are provided and the main causes of waste in the sector are discussed. The results indicate that the waste of materials in the construction industry is fairly high and that a large variability in waste incidence is found across different projects. Most of this waste can be avoided by implementing inexpensive preventive measures, mostly related to managerial improvements.

Keywords: Waste management, Improvement strategies, resource management, material management.

I. Introduction

The Construction industry is characterized by challenges such as low productivity, lack of skilled labor, time and cost overruns, etc. These are connected with considerable waste present in the Construction sites. [1]

There is no Indian policy document which determine waste as part of cycle of production consumption-recovery. In fact, obstruction have been fragmented and are often adversary. The new municipal solid waste management rules 2000, which came into effect from January 2004, it is fail to even manage waste in cyclic process. [2]

Waste is relevant to all branches of industry; it is particularly important for the construction industry. In the construction industry manpower, material and machinery are major inputs and they are constituting almost 90% of the total cost of the project. In there are project material and machinery are constituting about 65-70% of the cost and labor constitute 20-25%. Thus it is economy in the material and labor that can significantly reduce the cost of a construction project. It is apparent that as construction project are very large as far as the quantum of work is concerned there will be some kind of wastage of resources in terms of manpower, material, and machinery. In sometime, a to check on wastage of material may lead into a lot of cost control on the project. [3]

Aim of this study,

To investigate the incidence of construction material waste in Indian construction industry and to prepare model for cost optimization of project by efficient construction waste management.

Objectives of this study,

To achieve above mention, aim of the study the following objective are identified:

1. To examine different types of construction waste.
2. To identify the critical sources and main causes of construction waste
3. To design and prepare a cost optimization model through waste management in construction project.
4. To study negative impacts of waste in construction work

II. Literature Review

Construction waste defined as "Any substance or object the holder discards, intends or is required to discard." [4] Material waste has been recognized as a major problem in construction industry that has important implication both for the industry and environmental impact of construction project. A very high level of waste assumed to exits in construction. Although it is difficult to systematically measure all waste in partial studies from various countries have confirmed that waste represents a relatively large percentage production costs. A wide range of measures have been used for monitoring waste, such as excess consumption of material, quality failure cots and maintenance and repair costs, accidents, and non-productive time [5].

Construction Waste Scenario in India;

In presence of construction waste and other insert material (e.g. dust and grit from road sweeping, drain silt) is significant about third of the total municipal solid waste generated in India [6]

There are two sources of generation of waste material namely, bulk generators and retail or small generator. Construction and repair of roads, bridges, flyovers etc. are classified under infrastructure development sector. Real estate sector consists of housing, industrial, and commercial building construction, demolition of unauthorized structures etc. Small commercial enterprises and individual house building teams are considered as retail or small generators. [7]

Fundamental Problem of Waste in the Construction industry:

Indian construction industry is highly employment intensive and accounts for approximately 50% of the capital outlay in successive five years plans of our country. The projected investment in this industrial sector continues to show a growing trend.

In construction activity leads to generation of solid wastes, like a sand, gravel, bricks, concrete, steel, metal, glass, paper, plastics etc. The management of C&D waste is major concerns for town planners due to increasing quantum od demolition's rubble, continuing shortage of dumping sites, increase in transportation and disposal cost and above all growing concern about pollution and environment deterioration.

Central Pollution Control Board (CPCB) has estimated current quantum of solid waste generation in India to the tune of 48 million tons per annum of which waste from construction industry accounts for 25% Management of such a high quantum of waste management system [8].

However, this sector is commonly characterized as a "backward industry" if compared with other sector of the economy as a results of factors such as: 1). Application of traditional process 2). Used low quality product 3). Large amount produced waste, and 4). High costs, including rework cots.

III. Research Area

To carry out research work for Waste Practices in 10 different residential sites with in Ahmedabad city are visited for collecting the response for the reasons for the waste for particular type of material. In this section, it is also noted down the probable reduce, reuse and recycle methods adopted by this 10 sites. Along with this, other two sites are targeted to collect the data to study the pattern and percentages of waste for concrete, reinforcement and bricks/blocks compare to the allowable percentages of material as per Indian standards and other organization.

IV. Research Methodology

The practical limitation of resources has constrained the survey component of this study to the construction field in Ahmedabad. A questionnaire was chosen as the principal survey method. Most questions were asked by using a five point Likert scale, which permit different statistical techniques to be used to analyses the collected data.

An industry wide empirical questionnaire survey was conducted between January and February of 2018 to seek the opinions of various key project stakeholders in Ahmedabad on the wastage of material. Reason on reuse, reduce & recycle of wastage material. Based on the contemporary literature and a series of previous face to face interviews different key factors were identified for concrete, reinforcement, brick or block which formed basis of the empirical survey questionnaire. Respondents were invited to rate each of the identified factors according to a five-point scale 1=Very less; 2=Less; 3=Average; 4=High; and 5=Very high with reference to the specific project they had participated in. Respondents were also requested to give suggestion from their personal discretion.

Questionnaire Design:

The Questionnaire were divided into two sections:

- In first section, two sites are targeted to collect the data to study the pattern and percentages of waste for concrete, reinforcement and bricks/blocks compare to the allowable percentages of material as per Indian standards and other organization.

- In second section, questionnaire floated to know the probable waste reasons of construction material like concrete, reinforcement and brick and their reuse pattern adopted by selected sites under study.

V. Data collection and Analysis

For above mention two site, as different number of cycle has been performed to study actual waste. There are total 46 cycle has been recorded. In which there 16 cycle is for concrete & Block, and 14 cycle for reinforcement. The following chart are shows the permissible waste Vs actual waste percentage for all cycle for different material.

The questionnaire are 10 different residential sites with in Ahmedabad city are visited for collecting the response for the reasons for the waste for particular type of material. In which response is for concrete, reinforcement and bricks/blocks the following table shows the reason and reuse of construction waste material.

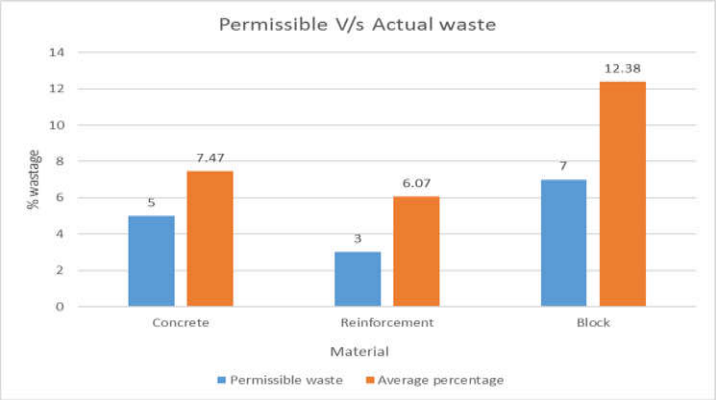

Figure 1 Permissible Vs Average Actual waste of various **material**

In the Figure 1, the bar chart shows Permissible Vs Actual waste of block for informal way of understanding. In the chart Permissible waste of concrete is 5% and Average Actual waste is 7.47% same as the reinforcement and block Permissible waste are 3% & 7% and the Average Actual waste is 6.07% & 12.38%. Average of concrete waste is 150% more than the permissible waste. Average of reinforcement waste is 200% more than the permissible waste. Average of brick waste is 175% more than the permissible waste.

Reason for Concrete waste

There is different type of reason of concrete waste like a transportation, storage of material, placing of concrete, mixing of concrete, estimation of concrete and the scraping off concrete. In a transportation maximum12 respondents are average reason for concrete waste. In a storage maximum 14 respondents are less reason for concrete waste. In a placing of concrete 15 respondents are very less reason for concrete waste. In a mixing of concrete 14 less reason for concrete waste. In an estimation 15 respondents are less reason for concrete waste. In a scraping 15 very less reason for concrete waste. In there are maximum waste of concrete due to transportation of material and the minimum waste of concrete due to Estimation & scraping off concrete.

Reuse of concrete waste

There is different type of reuse of concrete waste like a land filling, approach way, temporary flooring and PCC work. In a land filling maximum15 respondents are average reuse of concrete waste. In an approach way maximum 15 respondents are less reuse of concrete waste. In a temporary flooring 15 respondents are less reuse of concrete waste. In a PCC work 16 average reuse of concrete waste. In there are maximum reuse concrete waste in the landfilling and the minimum reuse concrete waste in the Approach way.

Reason for reinforcement waste

There is different type of reason of reinforcement waste like a drawing, cutting & bending, fixing and BBS calculation. In a drawing maximum13 respondents are average reason for reinforcement waste. In a cutting and bending maximum 12 respondents are average reason for reinforcement waste. In a fixing of reinforcement 17 respondents are very less reason for reinforcement. In a BBS calculation of reinforcement 14 very less & less reason for reinforcement waste. In there are maximum waste of reinforcement due to drawing and the minimum waste of reinforcement due to BBS calculation of reinforcement.

Reuse for reinforcement waste

There is different type of reuse of reinforcement waste like a land lapping, welding, temporary support service steel. In a lapping maximum16 respondents are less reuse of reinforcement waste. In a welding maximum 19 respondents are less reuse of reinforcement waste. In a temporary support 16 respondents are average reuse of reinforcement waste. In a service steel 16 average reuse of reinforcement waste. In there are maximum reuse reinforcement waste in the Temporary support and the minimum reuse reinforcement waste in the service steel.

Reason of brick waste

There is different type of reason of brick waste like a transportation, handling, placing and type of bond. In a transportation maximum 12 respondents are average reason for brick waste. In a handling maximum 10 respondents are average reason for brick waste. In a fixing of brick 14 respondents are less reason for brick. In a type of bond 22 respondents are very less reason for brick. In there are maximum waste of brick due to Transportation & Handling of brick and the minimum waste of brick due to types of bond.

Reuse of brick waste

There is different type of reuse of brick waste like a waterproofing, landscaping and temporary structure. Respondents were invited to rate each of the identified factors according to a five-point scale 1=Very less; 2=Less; 3=Average; 4=High; and 5=Very high with reference to the specific project they had participated. In a water proofing maximum13 respondents are high reuse of reinforcement waste. In a land scraping maximum 10 respondents are less reuse of brick waste. In a temporary structure 13 respondents are average reuse of brick waste. In there are maximum reuse brick waste in the water proofing and the minimum reuse brick waste in the landscaping.

VI. Conclusion

The work can be seen as an attempt to provide the waste management interested part of society with a construction waste management. Hence, to a certain extent, the present work represents a pioneering attempt in that it is proposal for a shift of waste management views. The results of study have confirmed that the level of material waste in the construction industry is fairly high and that much of this waste is predictable and avoidable.

This paper discusses the main results of study, aimed at measuring the waste of materials a building projects and at identifying main causes. The paper suggests that the level of material waste is very high, but that improving the performance of the industry in this respect does not demand much investment from the companies. Some general strategies for reducing waste are proposed. In general, companies need to improve their control systems so that their waste becomes apparent and easier to eliminate.

The fact that most companies were unware of the magnitude of waste at their sites indicates a lack of transparency in the performance of their production systems. Indeed, very few of the sites had organized records on the actual delivery, storage and consumption of materials. The analysis of sources of waste indicated that a large proportion of material waste occurs because flow activities, such as material delivery, inventories, transportation and handling, are often neglected by site management. This is probably a result of the conceptual model of production currently used by the industry, which encourages the management effort to be focused on the conversion activities. It must be pointed out that the waste of materials tends to increase the amount of non-value-adding activities and thereby the waste of other resources such as labor and equipment time. For instance, the excess of material that needs to be purchased tends to increase stock, the demand of the transportation system and the effort necessary to remove debris from the site. These problems might also negatively affect health and safety condition.

Cost of materials when compared to the total cost of project may well be over, hence materials should be judiciously utilized and handle. Giving incentives to workers for good handling of material greatly minimizes waste on construction sites as well as trying to make workers have a sense of belonging the firm. And most effective way minimization waste on sites is to have experts to supervise the work and appoint a site waste manager.

Recommendation

From the above conclusion, the following recommendation are suggested for minimization of construction material on site:

- Construction waste recycling and reusing is a viable option in construction waste management and from further studies or research can be performed on some construction waste like broken aggregates or demolished concrete to establish the feasibility of this option. It would be worthwhile extending the investigation to other building material like brick, timber, broken glass, sanitary wares and similar items.

- There should be awareness programs for all construction companies on construction waste management through reuse and recycle. Also formal education should be given to storekeepers and the foramen on effective material handling and system.

- The use of computer software should be adapted for storing records on construction site and for construction planning.

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