



Material Waste Management in Construction Sites

KEYWORDS

Recycle and reuse of materials, Material waste management, Construction waste, Disposal of waste material

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ABSTRACT *The objective of this paper is to study the material waste management in construction sites. The questionnaire is designed based on the attributes for material waste. The survey was conducted in and around Tamilnadu. The responses from project managers and contractor of major, minor and small projects were collected. The received responses were analyzed using SPSS. Based on the study, suggestions for waste reduction in construction sites are made.*

Nomenclature

SPSS Statistical Package for the Social Sciences
RCBC Rotary Cascading Bed Combustor
C&D Construction and Demolition

introduction

The increasing amounts of construction waste cause rapid depletion of landfill space available and bring about an increasing demand for natural aggregates, thereby inflicting ecological and environmental damages on the earth. Thus, how to reduce the generation of construction waste and how to ease the impact of wastes generated on the ecosystem are recognized as critical social issues on the global scale. This research is focused on modelling waste-handling processes in construction, with particular emphasis on mapping and simulation of on-site waste sorting processes.

Objectives of waste management

The main objective of material waste management is to reduce the material waste in on-site and off-site.

- To reduce the generation of construction wastes.
- To minimize the cost incurred for material wastage.
- To create an economical project by minimizing the materials.
- To formulate a simulation model for material wastes.

NEEDS FOR CONSTRUCTION WASTE MANAGEMENT

- Need for salvage, recycle and reuse of materials have proven to have economic benefits for the construction industry



Fig 1. Need for construction waste management

- To reduce the material wastage
- Proper disposal of waste material
- Ranging from low risk waste through to hazards waste

sources and causes of waste

- Construction waste stems from construction, and repairing work.
- Generation of the stream of waste is influenced by various classifications.

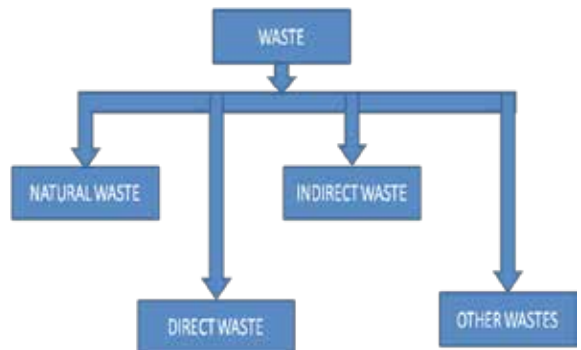


Fig 2. Sources of material waste

- Natural waste
- Natural waste is the wastage that will cost more than what is saved if tried to prevent.
- There is a certain limit up to which, waste materials can be prevented.
- Amount of natural waste is subjective to the cost effectiveness of the approaches used to manage it.
- For instance, cost of preventing wastage in a project with a good material controlling policy will be lesser than that of a project, which lacks in such a policy

Direct waste

- Waste that can be prevented and involves the actual loss or removal and replacement of material" is called as direct waste.
- Most of the time, the cost of direct waste does not end up in the cost of material, but followed with the cost of removing and disposing.
- Direct waste can be occurred at any stage of the construction process before the delivery of material to the site and after incorporating the materials at the building

Table I. Direct waste

Category	Reason	Example
Delivery waste	During the transportation of material to the site, unloading, and placing in to the initial storage	Bricks, glasses
Cutting and conventional waste	Cutting materials in to various sizes and uneconomical shapes	Formwork, tiles
Fixing waste	Dropped, spoiled or discarded material during fixing	Bricks, roof tiles
Application and residue waste	Damages occurs by succeeding trades	Painted surfaces
Criminal waste	Theft and vandalism	Tiles, Cement bags
Management waste	Lack of supervision or incorrect decisions of the management	Throwing away excess material
Waste due to wrong use	Wrong selection of material	Rejection of inferior quality marbles, tiles

Indirect waste

In this type of waste, the material does not get waste physically, but the payments for the material are wasted partly or wholly

Table II. Indirect waste

Category	Reason	Example
Substitution waste	Substitution of materials in work, which will incur losses to either contractor or client	Use of facing bricks for common bricks
Production waste	Contractor does not receive any payments for the work he has carried out	Use of excess plastering to rectify the uneven surfaces of brick walls
Negligence waste	Site errors because of the condemned work or use of additional material	Over excavation of foundation, resulting in the use of additional concrete
Operational waste	Unavailability of proper quantities in the contract document / the material that are left in the site	Formwork

Other wastes

Operational waste

Errors by trade persons or laborers, accidents due to negligence, damage to work done caused by subsequent trades, use of incorrect material

- Required quantity uncleared due to improper planning
- Equipment malfunctioning.
- Inclement weather.

Design waste

- Lack of attention paid to dimensional co-ordination,
- Changes made to the design while construction is in progress
- Designer’s inexperience in method and sequence of construction
- Lack of attendance paid to standard size available in the market
- Designer’s unfamiliarity with alternative products, complexity and errors
- Incomplete contract documents, selection of low quality products

Material handling waste

- Damages during transportation & inappropriate storage.
- Materials supplied in loose form.
- Use of material which are closed to working place.
- Unfriendly attitude of project team and laborers, theft.

Procurement waste

- Ordering errors
- Lack of possibilities to order small quantities

- Purchased products that do not comply with specification

methodology

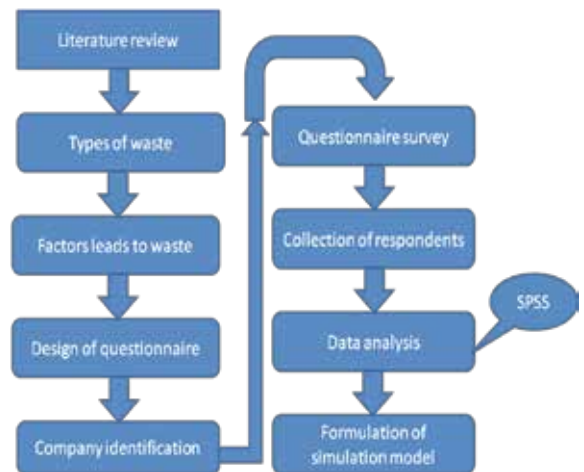


Fig 3. Methodology

design of questionnaire

A questionnaire was designed to understand more about the material management in the construction industry. Data was collected from the responsible persons from the site such as project manager, project engineer or site engineer. Questionnaire mainly focused on the following areas

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

result and discussion

Collected data were analyzed using statistical tools analysis method, SPSS (Statistical package for the social sciences) is a statistical analysis and data management software package. SPSS can take data from almost any type of file and use them to generate tabulated reports, charts, and plots of distribution and trends, descriptive statistics, and conduct complex statistical analyses.

Some of the analysis results of the questionnaire were shown below.

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	10	66.7	66.7	66.7
No	5	33.3	33.3	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 66.7 percent of the organization adopt waste management policy and remaining 33.3 has not adopted any waste management policy.

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
yes	12	80.0	80.0	80.0
no	3	20.0	20.0	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 80 percent of the organization considers reuse of the materials onsite and 20 percent of the organizations not consider reuse of materials on site

Table V. Re-use of materials off-site

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	8	3.3	53.3	53.3
No	7	46.7	46.7	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 53.3 percent of the organization considers reuse of the materials off-site and 46.7 percent of the organizations not consider reuse of materials off site.

Table VI. Appropriate sites for disposal of residential waste from the project

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	7	46.7	46.7	46.7
No	8	53.3	53.3	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 80 percent of the organizations consider for reducing the disposal cost from waste materials which may have commercial value and 20 percent of the organizations not consider reuse of materials on site

Table VII. Waste management procedures are monitored

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
yes	10	66.7	66.7	66.7
no	5	33.3	33.3	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 66.7 percent of the organization monitor the implementation of the agreed waste management and remaining 33.3 percent does not monitor.

Table VIII. Selling of wasted materials

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	12	80.0	80.0	80.0
no	3	20.0	20.0	100.0
Total	15	100.0	100.0	

From the above table it is inferred from that 80 percent of the organization are selling the wasted materials and remaining 20 percent of the organization are not so.

Table IX. Record maintenance for waste materials

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Yes, periodical basis	4	26.7	26.7	26.7
Yes once in a while	7	46.7	46.7	73.3
No	4	26.7	26.7	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 26.7 percent of the organization maintain the periodical basis record for material wastage, 46.7 percent of the organization maintain the record once a while and rest of the organization not maintaining the record.

Table X. Education program for engineers

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
yes	11	73.3	73.3	73.3
no	4	26.7	26.7	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 53.3 percent of the organization has manual for engineers on education program and rest of 46.7 percent does not have.

Table XI. Contractors commitment to waste management

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
very often	8	53.3	53.3	53.3
Often	5	33.3	33.3	86.7
sometime	2	13.3	13.3	100.0
Total	15	100.0	100.0	

The inference made from response of employers is 53.5 percent of the contractors are committed, 33.3 percent are often committed and 13.3 percent are committed sometime.

Table XII. Contractors involvement in waste management

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
very often	5	33.3	33.3	33.3
Often	9	60.0	60.0	93.3
Never	1	6.7	6.7	100.0
Total	15	100.0	100.0	

The inference made from responses of the employees is 33.3 percent are involved very often, 60 percent are often involved and 6.7 percent never involves.

Table XIII. Co-operation of engineers for reducing wastes

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
very often	6	40.0	40.0	40.0
Often	8	53.3	53.3	93.3
sometime	1	6.7	6.7	100.0
Total	15	100.0	100.0	

The inference made from responses of employees is 40.0 percent of the co-operation is involved very often, 53.3 percent are often involved and 6.7 percent are sometime involved in the co-operation of supervisor or engineers in the waste management.

Table XIV. Effects of material wastage at site

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Reduction waste	3	20.0	20.0	20.0
Decrease productivity	5	33.3	33.3	53.3
Decrease in quality work	7	46.7	46.7	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 20 percent of employees say that it reduces waste, 33.3 percent says it will decrease productivity and remaining 46.7 percent says decrease in the quality work.

Table XV. Sources of material waste

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Operational waste	8	53.3	53.3	53.3
Design waste	3	20.0	20.0	73.3
Material handling waste	1	6.7	6.7	80.0
Procurement waste	3	20.0	20.0	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 53.3 percent of employees say operational waste, 20 percent say design waste, 6.7 percent says material handling waste and 20 percent say procurement waste is the main source for material wastage.

Table XVI. Sources of wastage of more steel reinforcement

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Careless of workmanship	3	20.0	20.0	20.0
Poor quality of materials	1	6.7	6.7	26.7
Bars of large diameters	5	33.3	33.3	60.0
Short unusable pieces produced when bars are cut	6	40.0	40.0	100.0
Total	15	100.0	100.0	

From the above table it is inferred that 20 percent of employees say careless of workmanship, 6.7 say poor quality of materials, 33.3 percent says bars of large diameters and 40 percent of employees say short unusable pieces produced when bars are cut will leads to more wastage of steel reinforcement.

conclusion

This study clearly indicates that, most of the materials in construction sites get wasted because of the erroneous waste management policy and failure in records maintenance. Contractor's poor involvement and lack of knowledge in the material management intensifies the problem further.

The maximum amount of sand, brick and steel gets wasted all because of its storage condition. Whatever the project cost is high, the storage for sand, brick and steel is open at the site and due to impossible storage, these materials gets more wasted. This increase in waste not only increase the total cost of the project but also the span of the project also gets delayed.

Hence it is suggested to provide a proper storage for all these materials at the site and the handling should be done in a proper manner. More careful is needed while placing and transporting the materials. If we reduce these types of waste; the project can be completed in an economical and effective manner

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