



Categorization of Construction Waste

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Abstract

Waste in the construction industry has been the theme of several research projects around the world in recent years. Researchers implement different methods to reduce the amount of waste in the construction industry. In the construction industry, contractors only consider physical waste which leads the project to cost overruns. i.e. material waste. Construction industry is also affected by time overrun. Impact of time overrun on the construction projects is considerably high and requires special attention in addition to physical waste. In the present study, construction waste is categorized in mainly of two types: value added waste and non-value added waste. This categorization includes both-material waste as well as time waste, which are main causes of occurrence of waste. A case study was also carried out at a residential building project in Ahmedabad, Gujarat to get the idea about the percentage of waste occurs in a construction project.

1 Introduction

Construction industry is the large industry it considerably affects the economy of the country. In the developing countries like India, construction industry plays an essential role in development and economical growth of the country. As the construction industry is of high magnitude, the waste occurs in construction projects also contains a huge part of the total waste.

Many research efforts (A. Nikakhtar at al, 2015; Carlos T. Formoso at al, 1999; Carlos T. Formoso at al, 2002; S. A. Abbasian Hosseini at al, 2011) in the construction industry over the past several years have concentrated on waste generated during the life cycle of a construction project. These research efforts were aimed at identification of construction waste and improving construction processes through construction waste reduction.

According to Koskela (1992), Project managers may consider waste as only physical construction waste i.e. material losses. But there are other types of resource wastes related to the execution of unnecessary activities that results in additional costs but do not add value to the final product.

Formoso et al. (2002) recommended a broader definition of waste to include material waste as well as waste related to other resources involved in the execution of the construction process.

2 Categorization of Waste

Concept of waste: Waste should be understood as any inefficiency that results in the use of equipment, materials, labour, or capital in excess quantities than that of considered as necessary in the construction of a building. Construction waste is classified according to different attributes such as type, quantity etc. In spite of different classifications, a majority of them follow the same basic concept. The common points among these categorizations are material loss, debris and design. (A. Nikakhtar et al, 2015).

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. (Carlos T. Formoso, 1999).

Waste can be categorized mainly in two categories: value added waste and non-value added waste.

Value added waste: Value added waste can be explained as the waste for which extras pay is required and leads the project to cost overrun. i.e. material waste.

Non-value added waste: It can be explained as the waste which consumes extra resources but does not add any value to the final product. I.e. waste of time.

The figure 1 shows the categorization of waste which includes value added and non value added waste and main causes of occurrence of the waste. The example of value added wastes are: Material waste, waste due to defect, excessive stock, rework, frequent changes in design etc. The example of non value added wastes are: Transportation, time waste, motion waste, over processing waste, excess inventory waste etc.

Value added wastes:

Material waste:

Material waste contains a huge portion of construction waste. Waste of sand due to rain, Waste of cement bags in rainy season, Waste of steel bars are some of the major reasons of material waste. The material waste makes the contractor to pay extra amount for material and that leads the project to cost overrun.

Waste due to defect:

The waste occurs due to defects is also a major cause of construction waste. Sometimes the material received, may be found defective which needs to be replaced or needs to purchase new material, which adds extra cost to the project.

The construction work, which is not constructed as per design, needs to be reconstructed, which needs extra material and adds extra cost and time to the project.

Some times during the construction, the equipments get defected due to wear and tear or rough handling or any other reason. These equipments need to get repaired or replaced by new equipments. This factor also adds extra amount of money and leads the project to cost overrun.

Waste due to excessive stock of material:

The excessive stock of material sometimes leads to material waste. Excessive stock of cement bags, steel bars than needed becomes waste after the completion of the project. The studies show that in the projects of higher magnitudes, a considerably huge amount of material gets wasted after the completion of the project.

Waste due to rework:

The rework of any component consumes extra materials and time which doesn't add any value to the project. Change in design is a cause of rework. Sometimes the design may be changed due to customer's requirement or any other unavoidable reason which leads to rework. The defective work is also an important reason for rework. If any component found to be defectively constructed, it needs to be re-constructed. This consumes extra materials and time to the project but doesn't add any value to the project.

Sometimes unskilled labors fail to carry out the construction as per the design. This type of construction needs to be re constructed.

Waste due to frequent changes in design:

Sometimes the structural engineer or architect makes changes in the designs as per the customer's needs and requirements. If the customer changes his mind after the construction of any component the design may be changed and requires rework of that component which consumes extra materials, time and other resources.

Non-value added waste:Transportation waste:

The time waste occurs due to delay and times consumed for transportation are the main waste on the construction site, which add no value to the project.

When the material gets stock out, time waste occurs until the new ordered material gets delivered to the site.

The waste of time occurs due to the time taken to bring up the equipment to the construction site from the other site.

If the equipment needed, is occupied on other site, it needs to wait until the equipment gets free.

Waste of time:

The waste of time due to several causes is also an important effect of time overrun of the project. In the rainy season, when the rainfall occurs, the work is stopped until the rain gets stopped. The waste of time due to this waiting period is a considerable reason.

After the material is ordered, it takes time to deliver the material to the site. This time period is also the reason of the waste of time.

Sometimes an activity cannot be started until its preceding activity is not completed. The time wasted due to not starting of the activity is also affects on time overrun.

The time gets wasted in obtaining the land for the project due to encroachment. This is also a reason of time waste.

Sometimes it may take longer than the usual time in excavation in case of hard rock or the tree roots under the ground level. This can also be a reason for the time waste.

Motion waste:

Motion waste can also be a reason for time waste on the construction site. The unnecessary movement of people and equipments on the site also leads to waste of time.

Over processing waste:

Over processing can also be a reason of time waste on the construction site. The time gets wasted on site due to re processing of a process. Double handling and double checking are also the reason of time waste on site.

Excess inventory waste:

Excess inventory can also be a reason for the waste of time on the construction site. Excess inventory needs extra handling time and space for the inventory management. This can be a cause of time waste on the site.

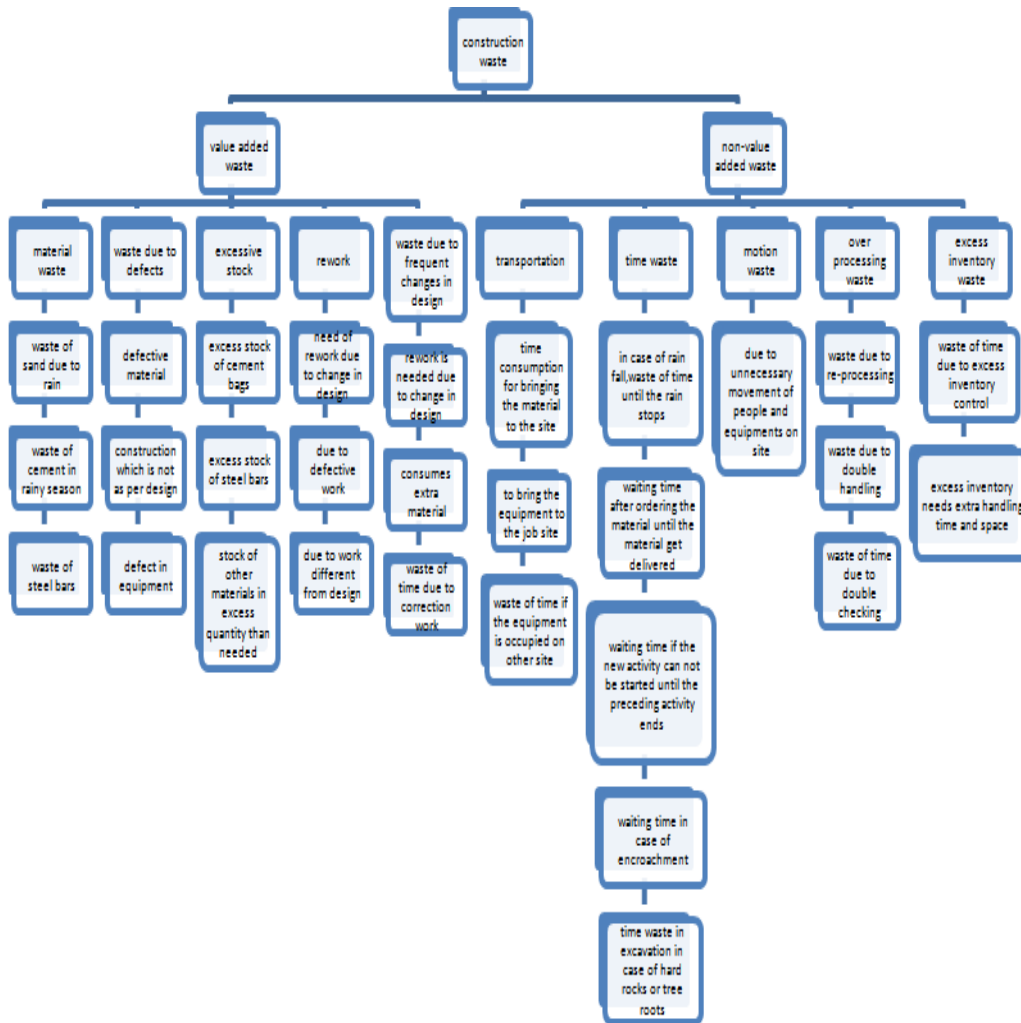


Fig. 1 Categorization of construction waste

CASE STUDY:

A study was carried out on a building construction project at Ahmedabad, Gujarat to get the idea about the percentage of waste occurs on a construction site.

Name of the project- CASA VYOMA

Location - Vastrapur, Ahmedabad, Gujarat

Client - Joint venture of Ajmera builders and Sheetal construction

No. of towers - 8

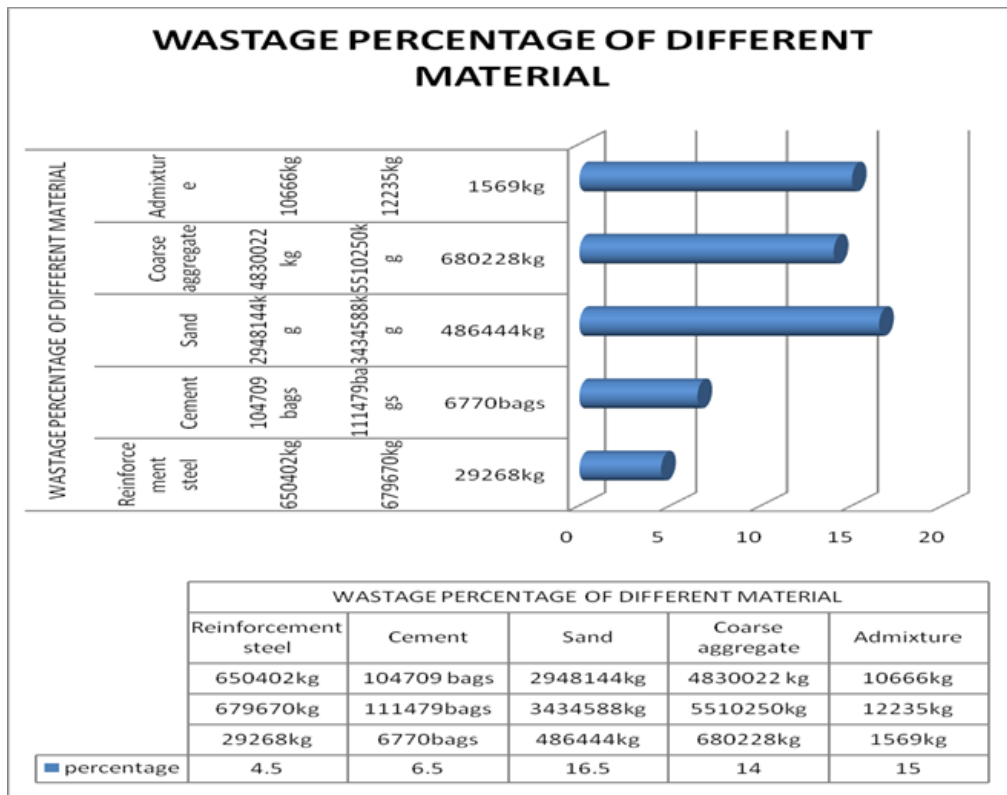
No. of floors - G + 12

Estimated total cost - Rs. 95 crores

The quantities of a building of each material were calculated and converted in to the floor wise quantities. From the quantity and the design mix of concrete, the actual consumption of cement, fine aggregate, coarse aggregate, steel on site was calculated and the difference of the required quantity

and the actual consumption of material was calculated and categorized as Value addition waste. The results of analyzed data are given below:

No.	Material	Theoretical Consumption(as per quantity)	Actually consumed	Wastage %
1	Reinforcement steel(foundation, beam, slab, column, pardi etc) including wastage (in kg)	650402	679670	29268kg (4.5%)
2	Cement (Bags)	104709	111479	6770 (6.5 %)
3	Sand (kg)	2948144	3434588	486444 (16.5%)
4	Coarse aggregate (kg)	4830022	5510250	680228 (14 %)
5	Admixture (kg)	10666	12235	1569 (15 %)



The figure shows generation of waste in various construction industry. The waste on the site considerably affects the total cost and estimated time period of the project.

Conclusion:

The case study shows the scenario of construction industry. Construction industry is very much affected by the value added and non-value added wastes. Fig 2 shows percentage of wastage of different material. The observed maximum wastage is of Sand and minimum wastage is for Reinforcement steel and cement. If cost of each item is correlated, it is observed that the cost of cement and steel is higher. It is preferable to more concentrate on controlling of wastage of cement and steel. These wastes considerably affect on overall cost of project. The value added wastes also lead the project to the cost overrun and ultimately loss to the customer and resources. The non-value added wastes also lead the project to the time overrun. Most of the projects in the construction industry in recent time suffer from time overrun but construction industry is not much conscious about the non value added wastes. It is much needed to reduce the value added as well as the non-value added wastes during the construction process to complete the project satisfactorily and to put the value to the final product, which the client is paying for. Study about the new construction techniques like lean construction and its implementation is desired to minimize the waste at the construction site. If wastages of materials are controlled or minimized, the resources available can be utilized optimally.

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