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A Review on Construction Waste Minimization and Management

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ABSTRACT: Construction industry has been developing rapidly around the world. The development has led to serious problem in generation of construction wastes in many developing countries and expectation of the natural resources to large extend. The construction wastes clustered into physical and non-physical waste and it has greater impact to environment, economy and social of each country. Before it can be managed well, it is important to understand the root cause of the generation. This paper identifies and detects factors contributed to the generation of construction waste. Mapping technique was applied for identification works and interview was conducted to detect the physical and non-physical waste. These factors were grouped into seven categories: Design, Handling, Worker, Management, Site condition, Procurement and External factor. The significant factors of each category of waste were determined. The findings will help construction players to avoid, reduce and recycling the physical and non-physical wastes. Furthermore, the paper has put forward some recommendations for better improvements in construction. Key Words: Construction Wastes, Reduce Waste

I. INTRODUCTION

The construction industry is the second largest industry in India after agriculture. It makes significant contribution to the national economy and provides employment to large number of people. This project consists of an investigation on the incidence of residential construction waste in Pune. Construction waste has proved to have a negative effect on the economic health of construction companies and on the environment.

1.1 Background

To evaluate the current methods to waste diagnostic questionnaires will be developed to identify the most frequent waste categories present in the job site affecting the final cost of the residential projects, the types of waste and their possible causes. The questionnaires will be sent to thirty construction companies. First, construction activities that produced highest amount of waste would be chosen. Second, predominant causes and types of waste will be identified by second questionnaire for top three activities. Third, implementation and recommendation will be chosen according to the previous study and it is given to the five construction companies out of thirty companies which will help them to minimize the waste in terms of cost, material and quality. Owners, in the recent years, are facing serious difficulties. Over the past few Years, they have habitually been in a position that did not require a rigorous pursuit for lower prices since they were enjoying record closings and excited buyers. However, as the market slowdown and inventories rise, builders now find themselves in a situation that they have to reduce costs to have a place in this new competitive market.

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1.2 Motivation

Construction and demolition waste management has become one of the major environmental problems in many municipalities. It has been a pressing issue in India since the late nineties due to the running out of disposal sites to manage the huge amount of waste generated. The building industry is consuming a considerable amount of resources, from the most common material sand to the valuable natural assets like timber. If the life cycle of the material on site, from its transportation and delivery to the end fate, is closely examined, it is generally known that there is a relatively large portion of the materials being wasted because of poor material control on building sites. There are two main kinds of building construction waste, structure waste and finishing waste. Concrete fragment, reinforcement bars, abandoned timber plate and pieces are generated as structure waste during the course of construction. Finishing waste (including a wide range of waste materials) is generated during the finishing stage of a building. For instance, surplus cement mortar arising from screed scatters over the floors inside the building. Broken raw materials like mosaic, tiles, ceramics, paints and plastering materials are wasted because of careless use. The packaging of public and household facilities such as gas cookers, bathtubs, washtubs and window frames are also parts of the finishing wastes. Bossink and Brouwers (1996) estimated from a Dutch study that about 1–10% by weight of the purchased construction materials leave the sites of residential projects as waste. Many resources can be conserved and the amount of C&D waste required to be disposed of should be greatly reduced if better management of materials is practiced on building sites. The strategy to manage C&D materials comprises three major tasks: reduce, reuse and recycle. In this paper, it will concentrate on reducing building waste through better materials control.

1.3 Objectives

1. To study the types of construction wastes.
2. Thorough data collection regarding construction waste minimization.
3. To study the most frequent waste categories affecting the final project cost.
4. To determine the possible causes of wastes.
5. Find solutions to be put into effect at residential construction sites to reduce waste productions.

1.4 Scope of the Study

This study focus on the zero waste management at construction site which are through interview and questionnaire to the contactor and project manager at construction site. This study also By the result analysis the waste minimization, reuse and recycling will be found and the mitigation measures will be provided and to gets more information about method used in zero waste management construction.

1.5 Construction Waste Construction

Waste can be defined as any materials by product of human and industrial activity that has no residual value. Waste is a product or material that is unwanted. Construction waste clustered into two groups namely the physical and non-physical waste. 1.4 Waste Minimization & Recycling Goals Starting with a goal will help guide the decision-making process, as well as provide direction for subcontractors and suppliers. It is also provides a baseline for measuring how well the project succeeded with waste minimization and recycling. This provides you with “boasting rights.” As will be discussed in the final section of this document, in addition to the cost savings and environmental good that is achieved through waste minimization and recycling, it positions your business in a unique niche that can benefit your overall business development. Being able to prove that you have succeeded in the past is therefore essential. Having a goal and measuring your results provides that proof.

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II. LITERATURE & REVIEW

Researchers across the world give special attention to the construction waste minimization techniques. It is necessary to mention focus of their papers towards the construction waste and their approach towards understanding of construction wastes. The objective of literature review was,

1. Optimization of construction activities using Lean thinking approach
2. Quantification of construction waste
3. Study of various approaches adopted for construction waste minimization
4. Source evaluation of construction waste
5. Study of factors contributing to physical and non-physical waste
6. Identifying main causes and prevention construction waste

Keeping in mind this objectives, literature review is done to study various approaches given by following researchers:

3.1 Abbasian Hosseini, A. Nikakhtar, K.Y. Wong, A. Zavichi studied “Implementing Lean Construction theory to construction processes’ waste management.” (1)

Purpose – This paper focuses on lean thinking approach towards executing construction activities. It also suggests that we can achieve high optimization of construction activities and can use discrete simulation method for executing construction activities.

Findings – This paper conducted a case study to reveal the results of lean thinking application in the real manner. The research content in this paper presents systematic approach for the application of lean production principle. Results of study shows that the construction processes has a high potential of optimization by implementing lean construction principles. Lean construction thinking through considering integrated view of production, attains to show the importance of neglected concepts in designing.

3.2 Said Jalali studied “Quantification of construction waste amount” (6)

Purpose – This paper outlines the importance of quantification of waste for a sound and adequate management of waste in the construction of building. It is noted that such quantifications provide a necessary tool for evaluating the true size of the wastes and hence making the adequate decisions for their minimization and sustainable management. Furthermore, quantification of wastes enables a more adequate planning of the construction site.

Findings – This paper helps to find construction wastes classification by source and type. Method for quantification of construction waste:

Global index Approach – This approach is based on the global data from similar construction types that provides the amount of waste per square meter of construction. The global data is gathered from previous construction work and register on data files are used as global index for given construction. This index can be used for the quantification of waste from region or even from whole country.

Component index approach – This approach provides the amount of waste generated from each construction component that compose a project. The construction component has a specific function in the building and is usually performed by a given professional on the site. Furthermore, it has a unit of its own.

3.3 B.A.G. Bossink and H.J.H. Brouwers studied “Construction Waste:

Quantification and source Evaluation” (2)

Purpose - This paper focus on prevention of generation of construction waste. Prevention on site is an important issue in the integrated chain management policy in the sustainable construction appendix. Integrated chain management in the construction industry involves closing the cycle of resource used to the greatest possible extent.

Findings – This paper mainly indicates that the main amount of solid waste in the construction project is caused by the use of small variety of construction material. Eighty percent of construction used by use of stone tablets, piles, Concrete, Sand-Lime elements. This list shows that a great amount of causes of generation of construction waste can be related to both design activities and operation activities.

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Construction community pointed out the need the use of conceptualization of waste based on idea that is necessary to remove activities that do not add value from perspective of the client. In fact, some papers have claimed the need for separating unavoidable and avoidable non value adding activities, based on the assumption that it is uncomfortable to consider all of them as a waste.

3.4 SasitharanNagapan, Ismail Abdul Rahman and Ade Asmistudied “Factors contributing to Physical and non-physical waste generation in construction industry”

Purpose – The purpose of this paper is to identify and detect the physical and non-physical waste factors in construction industry. This study will help researchers and construction industry players to understand main factors contributing to physical and non-physical waste generation. It gives clear idea about classification of construction waste.

Findings – The highest factors contributes to the waste generation is frequent design changes with twenty four researchers admit as contributory factor. This paper uses bar chart which shows there are nine factors contributing to physical waste while eight factors contributing to non-physical waste. On the other hand, only factors which contribute to non- physical waste are the wrong material storage. The physical waste generates from left over material on the site factors while non-physical waste arises because of factors related to poor site condition factors.

Method – Factors of waste generation are based on categories such as Design, Handling, Workers, Management, Site condition, Procurement, External factors etc.

3.5 Ramaswamy and K.P. studied “Incidence of Material Waste in Indian Building industry” NICMAR- Journal Of Construction Management, Vol. XXVIII, No.4, October-December. (4)

Purpose – This paper aims to investigate the material waste in Indian construction industry mainly on building projects. It concerned with waste measurement in Indian construction industry. The main objective was to investigate the causes of material waste and provide guidelines for preventing its incidence.

Findings - This paper aims to investigate the incidence of material waste in Indian construction industry. By conducting empirical studies across six building sites located in southern India. Data regarding material waste collected from six ongoing projects, two residential, four commercial. Causes of this waste can be minimized by use of prefabrication method.

Method - Data collected in the form of scrap waste for material and then scrap wastage as percentage of theoretical quantity of material was calculated. Then this wastage calculation compare with nominal value.

3.6 Daniela Dietz Viena, Carlos Torres Formoso and Bo TerjeKalsaas studied “Waste in construction : A systematic literature review on empirical studies”

Purpose – This paper presents a review on papers that have a systematic investigated the occurrence of waste in construction industry including concepts adopted, matrix and type of feedback provided. This study is a part of wider research that aims to conceptualize waste in production management theory. This study intends to make contribution towards understanding of the nature of waste particularly in the construction industry and how the construction management community can approach this theme so far.

Findings – After several refinements in the research fifty six papers are selected. The systematic literature review identified that the number of papers focused on how to avoid the waste in construction is relatively small, compare to what has been produced in the field of construction management.

3.7 Carlos T. Formoso, LucioSoibelmanM.ASCE, Claudia De Cesare and Eduardo L.Issato studied “Material waste in building industry : Main causes and prevention”

Purpose – This paper is concern with waste measurement in construction industry. The aim of this studies the main causes of waste in the industry as well as to indicate the order of magnitude of material waste.

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Findings – This paper gives the economic loss caused by material waste is smaller than the ones related to the insufficiency of human work. It also suggests that human work should be focused of waste prevention.

III. WASTE MINIMIZATION

Waste minimization means reducing the amount and environmental impact of waste generated, which can be achieved by reducing the quantity of materials used (and therefore potential for wastage) or by reusing existing materials. Ideally, prevention of waste is the target, but once it has been created recycling is the method of managing the waste. Prevention of the waste means the effective use of natural resources; energy needed to manufacture new materials as well as reducing pollution. The management of construction waste is important today. The scarcity in the availability of aggregate for the production of concrete is one of the important problems facing by the construction industry. Appropriate use of the construction waste is a solution to the fast degradation of virgin raw materials in the construction industry. Waste minimization in this context comprises two distinct stages. Firstly, the actual process of construction was monitored to assess the main areas where waste arose and to identify ways in which this waste could be reduced. Secondly, the construction method and the detailed choice of materials selected for the development were chosen with minimization of waste in mind. This included waste from extraction, processing, transport and building, as well as final disposal or recycling.

Construction waste once generated is difficult to recycle and reuse due to high level of contamination and heterogeneity. Hence its prevention and minimization gets an importance in project management scope. Depleting natural resources, increasing pollution, scarcity of dumping yards, destruction to the natural environment and habitat leading to ecological imbalance etc. are some of the negative impacts of construction waste. Failing to take immediate efforts in its reduction and management will lead to exhaust of the natural resources and land fill spaces. Though some amount of construction waste can't be avoided, the potential cost reduction by preventing generation of construction waste on site is substantial.

Waste leads to inefficiency that results in the excess use of equipment, materials, labor, capital or any tangible resource than those estimated as necessary in the production of an item. Researchers see waste as a non-value adding activity that always negatively affects project performance in the form of cost overruns and delays. Saving construction waste is considered as an important parameter in the cost equation. The economic and environmental benefits to be gained from waste minimization and recycling are enormous. It benefits the construction firms in terms of cost reduction and increased profit. Completing of project in or before scheduled time is the topmost priority of all the contractors. Hence their efforts automatically get diverted to time factor rather than prevention of negative impacts of project on surrounding environment.

Wastage may also lead to delays that cause idle time for other resources leading to loss of productivity. By appreciating the principles of handling and using materials onsite, attitudes to prevent waste can be developed and construction process can be managed more efficiently. To be able to reduce the amount of construction waste, it is essential to identify main causes of its generation. To capture the costs of nonconformance during the construction project and suggested that its reduction would improve profit margin, competitiveness and client satisfaction. Also researchers described non value adding activities as physical waste found on site and other waste that occurs during the construction process. Considerable amount of waste that is common on many projects suggests that there are systems, structures and processes leading generation of waste. It shall be understood that prevention of construction waste is preferable to recycling at the end of the pipeline.

Waste minimization provides financial benefits in terms of reduced transportation cost, less disposal cost, minimized purchase quantity and price of raw materials, reduced purchase price of new materials when considering reuse and recycling, increased returns achieved by selling waste materials etc. Environmental benefits consist of minimized amounts of waste disposed of at landfills, which therefore extend the lifespan of landfills, reduced environmental effects as a result of disposal, e.g. noise, pollution, and decreasing global warming. Other benefits include increased site safety, enhanced work efficiency and productivity and improved image of the company.

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IV. METHODOLOGY

- i. In this study, questionnaires will be used as a tool for collecting data for quantitative analysis. Questionnaire is the most common method used to acquire the opinions of the respondents in a structured manner. Although designing a questionnaire appears to be relatively simple, it is a complex process. The questions must be formulated and selected carefully and the aim of the research must continuously be borne in mind. Due to the nature of the research, it is important to ensure respondents of confidentiality with which answer would be treated as it could drastically influence the accuracy of results. This aspect therefore enjoyed a high priority during the instruction phase.
- ii. At this phase, two questionnaires will be designed to collect data. The questions will be created based on the concepts acquired on the literature review. They will be also designed in such a way that companies did not have to spend much time to answer.
- iii. The first questionnaire will be designed to identify and rank the most frequent waste categories (such as excavation, foundation, brickwork, plastering, tiling and so on) present in the job site affecting the final cost of the residential projects. General activities on construction sites were mentioned and site engineers will be asked to rank them according to their capability of waste generation and also their effect on final cost.

V. CONCLUSION

Applying waste management theories will reduce issues related to environment, social and also gives economic benefits for the firm. Systematic analysis of waste generation is helpful for identification of major causes of waste. Once it is identified, it can be avoided or minimized resulting in major financial benefits for the firm. Construction waste management is required for a country to develop in a sustainable manner. It helps to address issues related to environment, social and economy. Once the root causes of waste generation are notified, it can either be avoided or minimized to benefit the world for better future. This study has identified significant factors contributing to waste in construction projects. By identifying the significant factors in construction process, construction players are able to notice the best ways to apply new practice for reducing material waste, time delay and cost overrun in any project. Based on the results and findings of this study, the following recommendations are made to reduce the construction waste generation in any construction projects. The aim of this study is to investigate the waste recycling and reuse in the construction industry. It can be concluded that generally the construction personnel are Zero waste of the construction waste.

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