# A Perception on Waste Material Minimization in Construction Industry

[1]R.Shreena Shankari, [2]D.Ambika, [3]S.S.Kavithra

[1,3]Post Graduate Student, [2]Assistant Professor
Department of civil Engineering,
Kongu Engineering College, Perundurai, India.

***Abstract*— Material waste has been recognized as a major problem in the construction industry. Studies from various sites confirmed that even the materials that are least wasted like glass, tiles, paints etc..Represents a fairly certain percentage on construction cost. These materials also have an unhelpful affect on environment. Materials are very important on building sites, and all the materials that are delivered are not used for the purposes for which they had been ordered and disappearance of these materials constitute a part of waste and it has a negative effect on environment and also effects the contractors profitability. This paper mainly deals with the study of factors contributing to material that are least wasted. A questionnaire was prepared and survey was conducted among labors and supervisors. The data collected were analyzed through SPSS (Statistical package for social sciences), factor analysis and multiple regression were carried out to identify the significant factors contributing to material wastage.**

***Index Terms*—negative impact, material waste, waste management.**

---

## I. INTRODUCTION

Construction plays an significant role in developing the infrastructure of the country. But the difficulty faced by the industry is the construction material waste. Construction actions produce more waste materials compared to other industries. All the materials used in the construction tricks gets wasted, which consecutively increases the cost of the project, reduces the productivity and gives a negative impact to the environment. Building material waste is not easy to be recycled. Also there is no adequate space for the disposal of waste in cities . Generally the materials that gets wasted include concrete, timer, mortar, steel, bricks ,glass, paints, pvc pipes, electrical fixtures, steel formwork etc...among these materials the materials which gets minimum wasted but affects the profitability and are paints, pvc pipes, glass , electrical fixtures and tiles. These materials as they are least wasted are not given significance in reducing the waste generated. But these materials cannot be easily disposed as they are not bio-degradable and are sure to cause depressing impact to the environment.

## II. CONCEPT OF WASTE

Building material wastage is defined as the dissimilarity between the value of materials delivered and acknowledged on site and those correctly used as specified and precisely calculated in the work, after reducing the cost saving of substituted materials transferred elsewhere, in which needless cost and time may be annoyed by material wastage. Construction waste is any material, substance or thing which is generated as a outcome of construction work. It consists of unnecessary materials formed directly or indirectly by construction industries. Construction waste can also be explained as the bye-product together and detached from construction work places or sites and civil engineering structures.

## III. OBJECTIVES

- To identify the sources of waste in construction.
- To analyze the factors contributing to waste generation for materials which are minimum wasted in construction.
- To identify possible measures to minimize waste in construction site**.**

## IV. SCOPE OF THE STUDY

- Reduces the cost of the project
- Increases the overall quality of the project
- Reduces the negative impact on environment by reducing the need for disposal of waste generated.

## V. SIGNIFICANCE OF STUDY

Construction industry symbolizes one of the most noteworthy sectors in the economy of the country. Also it is well known that waste management in construction minimizes material wastage on construction site that accounts for cost over runs. For construction, more resourceful use of products means reduced costs of purchasing new materials. Waste management reduces

waste disposal costs and also improves site safety through better waste management. Also it improves work efficiencies through accurate detailed design, a focus on reducing rework, temporary works and mistakes.

## VI. LITERATURE REVIEW

**Ameh Oko John et al (2013)** study deals with the recognition of the majority wasteful materials in construction process and also they identified the peak factors that have most contribution to material wastage on construction site

.

**Muhwezi (2012)** studied to spot the attributes of construction wastes on building projects in Uganda and to advise the reasonable measures of minimizing their occurrences**.** A uncomplicated construction waste management system that can provide information on waste quantities, make out areas that are challenging in waste generation, and be able to analyze the causes of these wastes is recommended.

**Ali Asghar Najafpoor et al (2011)** identified the activities that generate the waste in design, transportation and storage. And by questionnaire survey the most causative factor for waste generation was found.

**Jia-Yuan Wang et al (2008) analyzed** the on-site production and sources of construction waste through data collected from a questionnaire survey and structured interviews conducted in shenzen. Key reasons for waste generation were found and and suggestions were given to lessen waste.

**Elizara B M et al (2005)** presents a new perception that aids project managers at construction site to improve the achievement level of a project in terms of construction waste management practice. It is based on the recognition of the construction waste management influencing factors that play an imperative role in lessening waste. The factors are found based on the literature and interview from practitioner on construction project.

**Junli Yang et al (2005)** considered the rigorous literature review in relation to waste generation and management system, identification approaches to reduce, reuse and recycle waste construction materials for the future.

**Bon-Gang Hwang et al (2004)** investigated how different project individuality affect perception on advantages, from construction waste management, based on the survey results. A questionnaire was formulated to add perception and judgment on the selection of project characteristics and particular advantages of construction waste management.

**Andrew R F Dainty et al (2004)** explored the competence of measures used for minimizing waste generation in high profile UK based construction projects. The case studies exposed a wide range of waste strategies, the broader applicability of which was then studied via questionnaire survey from waste minimization specialists. The most helpful measures were given to be those that fostered waste minimization partnership throughout the supply chain.

## VII. RESEARCH METHODOLOGY

Data required for the research are collected by analyzing the documents of previous studies, interviews and questionnaire. The data collected are analyzed using factor analyze technique.

***Scope***

The scope of this study is confined only to construction workers and supervisors.

***Questionnaire preparation***

Questionnaire is prepared with five point scale. It is prepared such that it is easy and simple to understand. It consists of two sections section A consists of demographic profile and the second section B consists of questions to be filled by the workers.

***Data collection method***

The factors contributing to materials that are minimum wasted are identified from literature reviews and structured interviews from supervisors and workers at construction site. From the reviews and interviews questionnaire was formulated and survey is conducted.

***Data analyzing method***

The data collected are analyzed through SPSS (Statistical package for social sciences). The statistical tests are conducted to ensure that the sample can be used for further analysis.

***Descriptive statistics***

Questionnaire were distributed to sample of construction workers and supervisors.118 valid responses were collected. The majority of respondents were male 64.4 percent and percent of female response were 35.4. In terms of type of building 70.3 percent of response were collected from supervisors/workers working in residential building and 29.7 percent of response were collected from supervisors/workers working in commercial building.

## VIII. ANALYSIS AND DISCUSSIONS

### *Reliability statistics*

There are copious methods towards evaluating reliability of a scale. In this study, the method utilized for evaluating is cronbach"s reliability. Cronbach"s α is the frequently used practice to estimate reliability. It is highly specific and has the benefit of only requiring a single application of the scale. For the data to be reliable the value should be between 0.6 to 1. Hence the data is reliable.

Table 1 Reliability Statistics

| Cronbach"s Alpha | N of Items |
|---|---|
| 0.819 | 31 |

### *Ranking of factors*

From the response collected mean was found for each factor .Following factors ranked high and was to found be the main reason for waste generation of following materials.

Table 2 Top Factors

| Sources of waste generation at construction site | Main reasons for waste generation |
|---|---|
| Factors leading to wastage of PVC pipes | Unused pipes |
| Factors leading to wastage of paints | Wrong estimate |
| Factors leading to wastage of electrical fixtures | Lack of attention on materials |
| Factors leading to wastage of glass | Damage during transhipment |
| Factors leading to wastage of tiles | Change in dimension |
| General Factors contributing to wastage | Lack of waste management plan |
| | Changes in specifications |

### *Exploratory factor analysis*

The researchers studied the measured waste generation components by using exploratory factor analysis by means of principal component analysis. Factor analysis is capable of consolidating and data reduction in summarizing the data, factor analysis derives fundamental dimensions that describe the data in much smaller number of items than the original individual variables. Before performing factor analysis various statistical tests mainly Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Barlatt"s test of sphericity were carried out to examine whether the original data was appropriate for factor analysis. Table 3 KMO and Bartlett"s test

Table 3 KMO and Bartlett"s test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | 0.751 |
| Bartlett"s Test of Sphericity | Approx. Chi-Square | 2781.06 |
| | Df | 435 |
| | Sig. | 0.000 |

To verify if the data was suitable for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy value has to be equal to or greater than, 0.6 and that the Barlett"s test of sphericity value is important, and the value should be 0.05 or smaller. For this study, the value of KMO measure of sampling adequacy is 0.751 implying sample is in accordance with the fundamental requirements of factor analysis and Bartlett"s test is significant. The results of two statistical tests confirmed that the data obtained in the survey was suitable for factor analysis.

Table 4 Total variance explained

| S.No. | Factors | Initial Eigen Values | Variance Explained | Cumulative Percent |
|---|---|---|---|---|
| 1 | Site management and practices | 2.984 | 9.524 | 9.524 |
| 2 | On site operations | 2.411 | 8.527 | 18.051 |
| 3 | Materials handling , storage and transportation. | 2.077 | 8.253 | 26.304 |
| 4 | Materials management | 1.727 | 8.001 | 34.304 |
| 5 | Materials procurement | 1.592 | 7.952 | 42.257 |
| 6 | Workers negligence | 1.422 | 7.524 | 49.781 |
| 7 | Design errors | 1.101 | 7.425 | 57.206 |
| 8 | Environmental conditions | 1.042 | 6.220 | 63.426 |

The 8 components accounts for 63.426 percent of total variance.

The principal factors were labelled as follows

Factor 1**:** Site management and practices- This consists of 5 items that represent 9.524 percent of variance. The items are all related to practices and management at site and it considered important.

Factor 2: On site operations -This includes 4 items that represent 8.527 percent of variance. The items are all related operations carried out at site.

Factor 3: Materials handling, storage and transportation - This consists of 5 items that represents 8.253 percent of variance. The items include all factors related to improper handling of materials.

Factor 4: Materials management- This take into account 5 items and represent a 8.001 percent of variance. The items concentrates on factors related to managing of materials on site.

Factor 5: Materials procurement- This includes 3 items and represents 7.952 percent of variance. the items are all related to purchase of materials.

Factor 6: Workers negligence- This consists of 4 items and 7.524 percent of variance. This considers factors related to workers carelessness.

Factor 7: Design errors- This take into account 3 items and represents 7.425 percent of variance. The items are all related to errors made during design stages.

Factor 8: Environmental conditions - This hold 2 items and represent 6.220 percent of variance. These consists of items that are related to weather conditions

.

***Multiple regression Analysis***

Table 5 Multiple regression Analysis

| S.No. | Independent variables | Beta | Sig | Collinearity Statistics | |
|---|---|---|---|---|---|
| | | | | Tolerance | VIF |
| | (constant) | | 0.888 | | |
| 1 | Site management and practices | 0.251 | 0.001** | 0.945 | 1.111 |
| 2 | On site operations | 0.162 | 0.132 | 0.954 | 1.021 |
| 3 | Materials handling , storage and transportation. | 0.121 | 0.012** | 0.975 | 1.056 |
| 4 | Materials management | 0.135 | 0.223 | 0.927 | 1.025 |
| 5 | Materials procurement | 0.191 | 0.123 | 0.912 | 1.133 |
| 6 | Workers negligence | 0.150 | 0.011** | 0.989 | 1.187 |
| 7 | Design errors | 0.281 | 0.248 | 0.944 | 1.055 |
| 8 | Environmental conditions | 0.262 | 0.240 | 0.960 | 1.121 |
| R Square | | | | | 0.562 |
| Adjusted R square | | | | | 0.542 |
| F Statistic | | | | | 14.256 |
| Significant | | | | | 0.000 |

** Significant level one percent.

From TABLE 5 it is shown that the most contributing factors include on site management and practices (β=0.251 and t=0.001) and it is followed by workers negligence and materials handling and storage with (β=0.150 and t=0.011) and (β=0.121 and t=0.012).

## IX. CONCLUSION

The purpose of this study was to identify the most important factor that contributes to the materials that are least wasted. For this SPSS were used. The top factor were identified by mean. And from factor analysis 8 components were identified. These are Site management and practices ,on site operations, materials handling ,storage and transportation, materials management, materials procurement, workers negligence, design errors and Environmental conditions. It is very important to focus on the waste management plan. Changes in specifications also contribute to material wastage. It is important for the site manager to focus on material minimization strategies.This result indicated the most significant factors contributing to material waste and that includes site management and practices and it is followed by workers negligence and materials handling and storage from multiple regression analysis.

This study may help the construction industries to minimize the waste generation in construction sites. Reducing the generation of waste materials can reduce cost overruns and improve the overall efficiency of the project.

## REFERENCES

[1] Adnan Enshassi1, Said El-Moghany, Peter E Mayer & Josef Zimmermann (2011), "Material wastage on construction sites in the gaza strip",International Journal of Construction Project Management ISSN: 1944-1436 Vol.3, No. 2.

[2] Ameh Oko John, Daniel Emmanuel Itodo (2013), "Professionals views of material wastage on construction sites and cost overrun" ,research paper.

[3] Andrew R J Dainty & Richard J Brooke (2004),"Towards improved construction waste minimisation: a need for improved supply chain integration", Structural Survey, Vol. 22, No 1, pp. 20 - 29.

[4] Begum, R.A., Siwar, C., Pereira, J.J. and Jaafar, A.H. (2007), "Implementation of waste management and minimization in the construction industry in Malaysia" Resources, Conservation and Recycling, Vol. 51 No. 1, pp. 190-202.

[5] Bon-Gang Hwang & Zong Bao Yeo (2011),"Perception on benefits of construction waste management in the Singapore construction industry",

[6] Carlous T F Ormosco ,Lucio Soibelman & Claudia de cesare (2002),"Material Waste Management in BuildingIindustry ".

[7] Chen. Z, Li. H. and Wong, T.C. (2000), "Environmental management of urban construction projects in China", Journal of Construction Engineering and Management, Vol. 126, pp. 320-4

[8] Elgizaw S M, El-Haggarb S M & Nassara K (2011), "Slum development using zero waste concepts: construction waste case study, " International Conference on Sustainable Design, Engineering and Construction Procedia Engineering .

[9] Elizara M, Agung Wibowoa & Pinardi Koestalama (2005), "Identification and analyze of influence level on waste construction management of performance" , The 5th International Conference of Euro Asia Civil Engineering Forum (EACEF-5).

[10] Engineering, Construction and Architectural Management, Vol. 18, No 4, pp. 394 - 40.

[11] Faniran, O.O. and Caban, G. (1998), "Minimising waste on construction project sites", Engineering Construction and Architectural Management 5

[12] Graham J Treloar, Hani Gupta, Peter E D & Love Binh Nguyen (2003),"An analysis of factors influencing waste minimisation and use of recycled materials for the construction of residential buildings", Management of Environmental Quality: An International Journal, Vol. 14, No 1, pp. 134 - 145.

[13] Hongping Yuan Liyin & Shen Jiayuan Wang (2011),"Major obstacles to improving the performance of waste management in China"s construction industry", Facilities, Vol. 29, No 5/6, pp. 224 - 242.

[14] Jia-Yuan Wang (2008),"An investigation of construction wastes: an empirical study in Shenzhen", Journal of Engineering, Design and Technology, Vol. 6, No 3, pp. 227 – 236.

[15] McGrath, C. and Anderson, M. (2000), "Waste minimisation on a construction site", Building Research Establishment Digest no. 447.

[16] Mohammed Arif & Deepthi Bendil (2012),"Construction waste management in India: an exploratory study", Construction Innovation, Vol. 12, No 2, pp. 133 – 155.

[17] Muhwezi L M, Chamuritho N M & Lema (2012) , "An investigation into Materials Wastes on building construction projects in Uganda" , journal of Engineering research Vol.1(1), pp 11-18.

[18] Nagapan, I.A. Rahman, A. Asmi, A.H. Memon, R.M. Zin, (2012), "Identifying Causes of Construction Waste - Case of Central Region of Peninsula Malaysia, International", Journal of Integrated Engineering, Malaysia, 4 (2) 22-28

[19] Nagapan, S., Rahman, I. A., and Asmi, A. Factors Contributing to Physical and Non-Physical Waste Generation in Construction Industry. International Journal of Advances in Applied Sciences , Volume1(1), (2012).

[20] Nayanthara De Silva S B & Vithana K H (2008),"Use of PC elements for waste minimization in the Sri Lankan construction industry", Structural Survey, Vol. 26, No 3, pp. 188 – 19

[21] Nigel Lawson, Ian Douglas Stephen, Garvin Clodagh ,McGrath David & Manning Jonathan Vetterlein (2001),"Recycling construction and demolition wastes – a UK perspective", Environmental Management and Health, Vol. 12, No 2, pp. 146 - 157.

[22] Oladiran & Olatunji Joseph (2008),"Causes And Minimization Techniques Of Material Waste In Nigerian Construction Process" Fifth international conference (CITC).

[22] Osmani, J. Glass, A.D.F. Price. 2008. Architects' perspectives on construction waste reduction by design. Waste Management 28:7, 1147-1158

[23] Ruichang Ma (2015), "Characterizing the generation and management of a new construction waste in China" The Tenth International Conference on Waste Management and Technology (ICWMT).