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A REVIEW ON UTILIZATION OF SITE WASTE MANAGEMENT PLAN FOR BETTERMENT OF CONSTRUCTION INDUSTRY

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Abstract: **Construction waste becomes a global issue facing by practitioners and researchers around the world. Waste can affects the success of construction project significantly. More specifically, it has major impact on construction cost, construction time, productivity and sustainability aspects. This paper aims to minimize the construction waste and develop the SWMP (Site Waste Management Plan).Study was carried out by focusing all the Stake Holders (i.e. clients, consultants and contractors) involved in construction project through preliminary questionnaire. Data was analyzed by RII, IMPI &MR methods with involving all factors of waste generation. Through identifying the causes and its correlation of the construction waste it gives better understanding to the construction community for future construction projects which benefit not only in term of economy but also the environment by implementing SWMP (Site Waste Management Plan) . This document sets out the basic structure of SWMPs and how companies can best use them to improve and manage their operations at all stages of site activity. It includes useful checklists and other guidance to help ensure the Plan is a practical tool.**

Keywords: Construction industry, Causes of waste, Construction waste, Sustainability

INTRODUCTION

In most parts of the world, construction industry consumes huge amount of natural resources and often generates large quantities of construction waste. A Construction waste consists of unwanted material produced directly or indirectly by the construction industries. This includes inert and non-biodegradable building materials such as concrete, plaster, wood, metal, broken tiles, bricks, masonry, insulation, nails, electrical wiring, and rebar, as well as waste originating from site. These wastes are heavy, having high density, very often occupy considerable storage space. This can have a negative impact on the profit margin of contractors. Reducing construction site waste reduces not only the cost of raw material purchase but also the cost of disposing of the waste created on site. It can also reduce wastage due to inefficiency on site e.g. source separation can reduce the amount of waste resulting from commingled disposal.

Construction site waste management and minimisation has a great potential to contribute to construction industry performance improvement as well as solve waste

management problems caused by the construction sector. A Site Waste Management Plan (SWMP) is simply a plan that details the amounts and types of wastes that will be produced on site and how they will be reused, recycled or disposed of. Site Waste Management Plans (SWMPs) are an important tool for construction companies and their clients, of all sizes, to improve their environmental performance, meet regulatory controls and reduce rising costs of disposing of waste.

OBJECTIVES OF STUDY

- To study the reason of waste and amount of Waste in Construction Industry.
- To check the requirement of SWMP in Construction Industries.
- Development of SWMP using various alternatives of reducing Waste in Construction.
- To check the feasibility of SWMP in Construction Industry for its betterment in terms of Ecology and Economy.

LITERATURE REVIEW

A number of studies have been carried out to determine the various waste generation factors in construction projects.

*Mansi Jain et al., suggest that main contributor of waste generation are as Contractor, Client, logistic, designer, supplier, procurement, manufacture and management. The various barriers for widespread adoption of waste management system are as lack of awareness in the industry, lack of interest from clients, lack of proper training and education, lack of skilled labour, lack of market competition, lack of government Interventions, lack of waste reduction approach by architects & the measures to stimulate a widespread adoption of waste minimization are as government initiative - Policy implications, create awareness among clients and contractors, training and education.

*Adewuyi,t.o & Otali, m. et al., find out the causes and factors affecting construction waste generation on building sites waste from uneconomical shapes. This study therefore recommended that construction stakeholders should consider the studied factors at every level of the construction processes and in their waste management plan. Due to least priority given to appropriate site waste minimization and management systems in Indian construction industry leads to generation of huge quantities of material waste. To mitigate problem of waste minimisation proper site waste management techniques,training&awareness programs should be organised.

* Job Thomas Wilson P. M. et al., study that Major Contributors of Construction & Demolition waste in a project are Site management, Manufacturer, Procurement, Supplier, Designer, Logistics, Owner, Contractor. Common Barriers to waste management in India are, Items recovered during construction is not sold at lower rate, Feasibility of recycling is not even considered seriously, Landfill tax is not imposed by municipality, the waste is disposed without segregation, No penal action is taken against violators. By adopting proper construction and deconstruction procedure& Resource efficient design will lead to effective minimisation of Construction waste. The unique concept of "5 R" named as " Refuse", "

Reduce", "Reuse", "Recycle", " Reinvent", act as essential tool in hand of Engineer to reduce & optimise construction waste. They concluded that it is possible to minimize the volume of C&D waste generated by identifying the potential waste early in the design.

*Abhijith Harikumar, *Sreejith M H, *Priya A.Jacob, *Aiswarya S studied that In India nearly 50% of Construction & Demolition waste is being re-used and recycled, while the remainder is mostly landfilled. General Waste Materials Originating from Construction are as Cement concrete, Bricks, Cement plaster , Steel (from RCC, door/window frames, roofing support, railings of staircase etc.) , Rubble , Stone (marble, granite, sand stone) , Timber (especially demolition of old buildings), Conduits (iron, plastic), Pipes (GI, iron, plastic). By adopting suitable recycling &reuse of waste materials it will not contribute to waste loads at dumping & disposal sites. It will also enhance betterment of ecofriendly environment & sustainability. Therefore Proper construction waste management can help in prioritizing reduction of building related waste through efficient jobsite practices.

RESEARCH METHODOLOGY

The preliminary data for this research was collected through a literature review and the use of a questionnaire survey targeted all stake holders which are included in construction industries in India. The literature review was conducted through books, conference proceedings, the Internet, and international project management journals. Few experts were interviewed and their opinions were taken to identify factors which affect waste generation in construction projects. As the outcome, total 81 factors that affect contractor performance may be encountered in a construction project were identified. The factors which affects the waste generation are then classified into seven various phases of construction (Design, Handling, Workers, Management, Site Condition, Procurement, External Factor) depending on their nature and mode of occurrence. The groups of factors affecting waste generation are shown in following charts. List of 81 factors of waste generation in construction work are given in Table-1.

The next phase includes preparation of questionnaire based on Relative Importance Index (RII) technique, Importance index (IMPI) and Mean rank (MR) approach are used for giving ranking to factors affecting waste generation in construction projects. Survey questionnaire based on these techniques are given in Appendix 1.

A. Data Analysis Approach:

The Relative Importance Index (RII) will be used to rank (R) the different factors that affect the waste generation. These rankings make it possible to cross-compare the relative importance of the factors as perceived by groups of respondents (i.e. architect/engineer, contractors, and developer/owner, etc.). Each individual factor RII perceived by all respondents will be used to assess the general and overall rankings in order to give an overall picture of the factor of contractor performance in Indian construction industry. This RII technique is used by many researchers like, Desai Megha et al., Hany Abd Elshakour et al. (March 2012) to rank the various performance factors in construction projects. The formula to calculate RII given below:

$$RII = \frac{\Sigma w}{A * N}$$

Where,
W = Weighting given to each factor by the respondents (ranging from 1 to 4),
A = Highest weight (i.e. 4 in this case),
N = Total Number of respondents.

SUMMARY

Present study outlines the major factors affecting to waste generation in construction projects in Indian context. Based on literature study and from interview of experts, 81 factors were identified under 7 construction phases. Further methodology is suggested to work out critical factors by Relative importance index ,Important index and Mean rank methods. Survey Questionnaire is prepared based on these methods. It is proposed to carry out ranking of waste generation factor from Relative importance index ,Important index and Mean rank methods and find out most top ten factors which affects the waste generation.

REFERENCES

[01] Abhijith H., Sreejith M.H., Jacob P.A., Aiswarya S "Minimizing Construction Wastes by Efficient Site Practices". International Journal of Education and Applied Research, ISSN: 2348-0033 (Online), ISSN : 2249-4944 (Print), 2014.

[02] Alwi, S., Hampson, K., and Mohamed, S. Non Value-Adding Activities in Australian Construction.

[03] An evaluation of waste control measures in construction industry in Nigeria. African Journal of Environmental Science and Technology, Volume 5, (2011), pp. 246-254. Ekanayake, L. L., and Ofori, G. - An evaluation of waste control measures in construction industry in Nigeria- A. B. Wahab1* and A. F Lawal.

[04] Anantha R.V., Lokeshwari M. "Management of Construction and Demolition Waste". Journal of Environmental Research and Development, Vol. 5 No. 1, July-September 2010.

[05] Augustine S. MBA thesis "Managing Waste and Cost in the Construction Industry: A Case Study of the Road Construction Industry" to Institute of Distance Learning, Kwame Nkrumah University of Science and Technology, 2011.

[06] Baabereyir A. Ph. D Thesis "Urban Environmental Problems in Ghana: A Case Study of Social and Environmental Injustice in Solid Waste Management in Accra and Sekondi-Takoradi" to School of Geography, University of Nottingham.

[07] Construction and Demolition Waste Landfills-U.S. Environmental Protection Agency Office of Solid Waste.

[08] Construction material waste source evaluation. Proceedings of Construction site waste management and minimisation-International Council for Research and Innovation in Building and Construction (CIB).

[09] Construction waste management in India Job Thomas1, Wilson P. M.2 Division of Civil Engineering, School of Engineering, Cochin University of Science and Technology, Kochi, Kerala, India, PIN 682022.

[10] Construction Waste Quantification and Benchrnarking : A Study in Klang Valley, Malaysia-Alrmad Finaan Masudil*, Che Rosmani Che Hassan', Noo, ZalinaMahnood2, Siti Nazziera Moklrtar2.

[11] Evaluation Of Cause of Construction Material Waste -- Case Of Rivers State, Nigeria Adewuyi, T.O. and Otali, M.

[12] M. Lenzen and G.J.Treloar (2002) 'Embodied energy in buildings: wood versus concrete-reply to Börjesson and Gustavsson, Energy Policy, Vol 30, pp. 249–244.

[13] Management of Construction Waste in India: A Case of Green Technology-Nitish Bagdi, Vipin Aggarwal and Neetu Sherwal.

[14] Material Waste in the UAE Construction Industry: Main Causes and Minimisation Practices Al-Hajj, Assem; Hamani, Karima Acceptability in Sri Lanka. Lean Construction Journal, (2008), pp. 34-48. Projects. Presented on the 3rd workshop on lean construction, Albuquerque, (1995), pp. 67-77 Projects.

[15] Proceeding of International Conference on Advancement in Design, Construction, Construction Management and Maintenance of Building Structure, Bali, (2002). Said S. Al-M. MSC Thesis "Managing and Minimizing Construction Waste in Gaza Strip" to Faculty of Engineering, the Islamic University of Gaza, Palestine, 2006.

[16] Senaratne, S., and Wijesiri, D. Lean Construction as a Strategic Option: Testing its Suitability and Wahab, A. B., and Lawal, A. F.

[17] Serpell, A., Venturi, A., and Contreras, J. Characterization of waste in building construction.

[18] Tam V. W. Y., Tam C.M. "Waste Levels Reduction by using Stepwise Incentive System: A Hong Kong Study", Building Research and Information, 2006.

APPENDIX-I

Table-1 Factors affecting waste generation

Various Phases	No	*Factors affect waste generation of construction*
Design	1	Frequent design changes
	2	Design errors
	3	Lack of design information
	4	Poor design quality
	5	Slow drawing distribution
	6	Incomplete contract document
	7	Complicated design
	8	Inexperience designer
	9	Error in contract documentation
	10	Interaction between various specialists
	11	Poor coordination of parties during design stage
	12	Last minute client requirements
Handling	13	Wrong material storage

	14	Poor material handling
	15	Damage during transportation
	16	Poor quality of materials
	17	Equipment failure
	18	Delay during delivery
	19	Tools not suitable used
	20	Inefficient methods of unloading
	21	Materials supplied in loose form
Workers	22	Workers' mistakes during construction
	23	Incompetent worker
	24	Poor attitudes of workers
	25	Damage caused by workers
	26	Insufficient training for workers
	27	Lack of experience
	28	Shortage of skilled workers
	29	Inappropriate use of materials
	30	Poor workmanship
	31	Worker's no enthusiasm
	32	Inventory of materials not well documented
	33	Abnormal wear of equipment
	34	Lack of awareness among the workers
	35	Too much overtime for workers
Management	36	Poor planning
	37	Poor controlling
	38	Poor site management
	39	Poor supervision
	40	Inappropriate construction methods
	41	Lack of coordination among parties
	42	Poor information quality
	43	Late information flow among parties
	44	Scarcity of equipment
	45	Lack of waste management plans
	46	Resources problem
	47	Rework
	48	Waiting periods
	49	Communication problems
	50	Outdated equipment
	51	Non availability of equipment
	52	Lack of knowledge about construction
	53	Long project duration
	54	Lack of influence of contractors
	55	Lack of environmental awareness
Site	56	Leftover materials on site

Condition	57	Waste resulting from packaging
	58	Poor site condition
	59	Congestion of the site
	60	Lighting problem
	61	Difficulties accessing construction sites
	62	Unforeseen ground conditions
	63	Interference of others crews at site
Procurement	64	Ordering errors
	65	Items not in compliance with specification
	66	Error in shipping
	67	Mistakes in quantity surveys
	68	Supplier errors
	69	Wrong material delivery procedures
	70	Over allowances
	71	Frequent variation orders
	72	Different methods used for estimation
	73	Waiting for replacement
External Factor	74	Effect of weather
	75	Accidents
	76	Pilferage
	77	Lack of legislative enforcement
	78	Vandalism
	79	damages caused by third parties
	80	Festival celebration
	81	Unpredictable local conditions

APPENDIX-II

Section A

(Quantity of Wastage)

Sr. No.	Material	Quantity Of Wastage	Estimated Quantity	Unit Cost	Cost of Wastage
1.	Steel				
2.	Concrete				
3.	Bricks				
4.	Cement				
5.	AAC blocks (Autoclave unaerated cement block)				
6.	Cement Bags				
7.	Sand				
8.	Mortar				
9.	Coarse Aggregate				
10.	Nails				
11.	Binding Wire				

12.	Wood (formwork)				
13.	Granite Stone				
14.	Tiles				
Total Wastage Cost =					

Section D

How you utilize waste material on your side

Sr. No.	Material	Reuse	Recycle	Salvage	Dumping
1.	Steel				
2.	Concrete				
3.	Bricks				
4.	Cement				
5.	AAC blocks (Autoclave unaerated cement block)				
6.	Cement Bags				
7.	Sand				
8.	Mortar				
9.	Coarse Aggregate				
10.	Nails				
11.	Binding Wire				
12.	Wood (formwork)				
13.	Granite Stone				
14.	Tiles				