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Identification of Waste Materials in Construction Site and Practice of 3R in Construction Projects

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Key words: Identification of waste materials, 3R practices, questionnaire survey, analysis of questionnaire survey, solid disposal, emphasized

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Abstract: The effectiveness of the achievement of construction waste reduction through 3R reflects the sustainability in construction waste management. Weak achievement of construction waste reduction through 3R among contractors will lead to unsustainable construction waste management. Increase in construction waste on landfills is dangerous where land is very limited for solid was to disposal. This aim of this study is to investigate current practice of construction waste materials in site conditions and reduction through 3R practice among contractors. The results reported herein are based on feedbacks from 56 constructions. Interviews and questionnaire surveys have been originate that 3R practice is not mandatory in construction waste management. Only 65% construction contractors practiced 3R in managing their waste. Therefore, 3R practices should be emphasized in construction industry. Reducing wastes through 3R practices in construction industry is a way forward towards sustainable construction waste management, especially in expanding the lifetime of landfill.

INTRODUCTION

Construction industry consumes a high amount of natural resources and generates more quantities of construction waste. Construction waste is defined as waste generated from construction industry during construction activities, civil construction and building, road construction and demolition activities, construction site cleaning, building reconstruction including soil excavation. Some of construction wastes are recyclable and reusable; however, most of the wastes are usually dumped on landfill. According to construction waste management is a tool to control the cost of construction waste disposal and to facilitate other alternative than disposal method such as reuse and recycling to reduce construction waste disposed at landfills at the last stage. Construction waste should be recognized as a valuable resource because many types of construction waste can be reused or recycled.

The construction industry is conscientious for the formation of incredible achievements but unfortunately it can also be responsible for generating inefficiency. Studies show that >50% of the time spent on construction in the United States is wasted on unproductive activities. Anything that can be eliminated without diminishing the value of work for the customer can be defined as waste and it can often go unnoticed by many professionals. Here are the 7 basic types of waste commonly found on construction projects.

Defects: Anything that wasn't done correctly the first time and must be repaired, replaced or redone. This includes damaged material, rework or punch list items. A flooring material not installed per the specifications or a finished wall damaged by the electrical contractor would fall under that category.

Over production: Fabricating material too soon or ordering extra material because of poor quality as opposed to "Just-in-time" thinking which consists of producing and delivering the right amount of material at the time it is needed for production. While it's easy to label excess material as waste, material being delivered too soon is also wasteful since, it results in excess inventory which may then need to be discarded should the design change.

Inventory: Being burdened by excess materials, often caused by overproduction. This includes material stored on-site or at the fabrication yard work in progress and unused tools and parts. While having some inventory on hand is necessary to keep the project going, these materials should be minimized as much as possible as they tend to require a fair bit of handling and storage space.

Extra processing: Unnecessary steps in the project value chain such as transforming or double-handling material. There are also a lot of coordination and administrative workflows on a construction project that can lead to double data entry: multiple signatures on forms organizing field notes into a report, redundant daily logs and forwarding emails with drawings and RFIs to the field to name a few.

Motion: Extra steps taken by people to accomplish their work as results of inefficient processes. This includes time spent looking for a tool or file as well as walking extra yards due to poor layout of the work area.

Transportation: Unnecessary movement of materials or equipment, this can involve movement from one jobsite to another or from a yard to a material lay down area and then again to the actual work area. While this type of waste cannot be eliminated 100%, transportation should be minimized as it not only adds time to the whole construction process but also exposes the material to handling damage.

Waiting: Crews waiting for the delivery of material or equipments or the completion of preceding activities. This also applies to anyone on the project waiting for information such as field personnel waiting for a plan or an RFI, a scheduler waiting for progress updates or mpayroll waiting for time sheets.

Demolition waste materials list:

- Asphaltic concrete paving
- Concrete
- Concrete reinforcing steel
- Bricks
- Concrete masonry units
- Wood studs
- Wood joists
- Plywood and oriented strand board
- Wood paneling
- Wood trim
- Structural and miscellaneous steel
- Rough hardware
- Roofing
- Insulation
- Doors and frames
- Doors hardware
- Windows
- Glasing
- Metal studs
- Gypsum boards
- Acoustical tile and panels
- Carpet
- Carpet pad
- Demountable partitions
- Equipment
- Cabinets
- Plumbing fixers
- Piping
- Supports and hangers
- Valves
- Spronklers
- Machanical equipment
- Refrigerants
- Electrical conduct
- Copper wirings
- Lighting fixtures
- Lamps
- Ballasts
- Electriczl devices
- Switchgear and panel boards

Construction waste reduction through 3R: Solid waste reduction through 3R is one of the thrusts of National Solid Waste Management (NSWM) policy. Construction waste is one of the controlled solid wastes. 3R practices represent the concept of reduce, reuse and recycle.

Reduce: Reduction is considered as the most effective and efficient method to manage construction waste. Reduction does not only reduce construction waste generation.

Reuse: Reuse is usually a favorite option because some construction waste can be reused in other construction project. Reuse is most beneficial and contractors can save money, since, disposal involved cost.

Recycle: When reduction and reuse become difficult, recycling is desired. Some new materials can be made out through recycling. Recycling construction waste can be categorized into on-site and off-site. On-site recycling is defined as segregation of construction waste for subsequent use as the raw materials in construction project. Meanwhile, off-site recycling is segregation of construction waste which are then transported to other organizations or locations and the waste is used as raw materials.

Objective:

- Identification of waste materials and reduction waste materials using 3R in construction
- Investigate current practice of construction waste materials in site conditions and reduction through 3R practice among contractors

MATERIALS AND METHODS

- Collection of data related to the waste materials in construction projects
- Identifying the basic type of waste material commonly found in construction practices
- Practices of 3R in construction projects
- Conduct the questionnaire survey related to waste materials and practices of 3R in construction
- Analysis the questionnaire survey
- Recommendation

RESULTS AND DISCUSSION

In this study, we are conducting questionnaire survey. Total 40 questions are in that survey 65 responses are given out of 70 members. The survey mainly focus on the waste materials in construction site, we have identified the high rating waste materials and low rating waste materials and also measure the causes of waste materials in construction site and to give the analysis which causes high priority to some questions related to the waste materials how they are used in construction site (Wang *et al*., 2010; Shen *et al*., 2004; McDonald and Smithers, 1998; Kofoworola and Gheewala, 2009; Treloar *et al*., 2003; Llatas, 2011; Lu and Yuan, 2011; Mastan Vali and Asadi, 2017; Sambaturu *et al*., 2017).

The above flowchart shows that concrete waste has got high rating compare to other materials. Pipes waste has got least rating (2.1) and remaining materials almost have same rating, the produced waste rating ranged between 2.5-3.2. In that total analysis the material waste can be mainly produced due to some causes of waste materials in construction site, table shows the ranking level of waste causes in ranking wise. The waste material in site mainly causes by improper planning of materials, usages and also many companies are not following the waste management techniques. In India 64% companies are not following the waste management rules, only 34% of companies follows the waste reuse and recycle process in construction (Table 1).

Table 1: The ranking level of waste causes in ranking wise

Basic types of waste commonly found on construction projects	Rating
Defects	4.3
Over productions	2.5
Inventory	3.5
Extra processing	4.5
Motion	3.1
Transportation	2.5
Waiting	2.0

Table 2: Factors influencing the construction waste management

Factors influencing the construction waste management	Rating
Project procurement cost reduction	8.8
Conditions of contract	8.4
Concern for the environment	8.0
Client requirement	7.6
Lake of awareness	7.3
Government incentive	7.1
Legislation	6.5
Weakness in legislation	6.4
Waste is a not problem in site	5.1

Table 3: 3 R is not mandatory and 23% of contractors not sure whether 3R is mandatory in construction

Reasons of contractors practiced 3R in managing waste	Rating
Environmental protection	4.0
High scrap valve of recycled waste materials	3.3
Profits	2.3
Contractor requirement	1.5
Others	0.5*

*Significant value

Waste production causes ratings: Table 2 shows that extra processing has got high rating compare to other causes. Waiting has got least rating 2 and remaining has same difference at one point. In that total analysis the material waste can be mainly produced due to some causes of waste materials in construction site, the waste material in site mainly causes by improper planning of materials, usages and also many companies are not following the waste management techniques. Current practice of construction waste reduction through 3R among contractors: dased on the questionnaire survey it has been found that 65% of contractors have the knowledge on 3R concept. Meanwhile, 10% of the contractors are not sure and 25% of contractors have no knowledge whatsoever on 3R concept. Majority of contractors get to know the about 3R through media, workshop and courses. Small portion of contractors

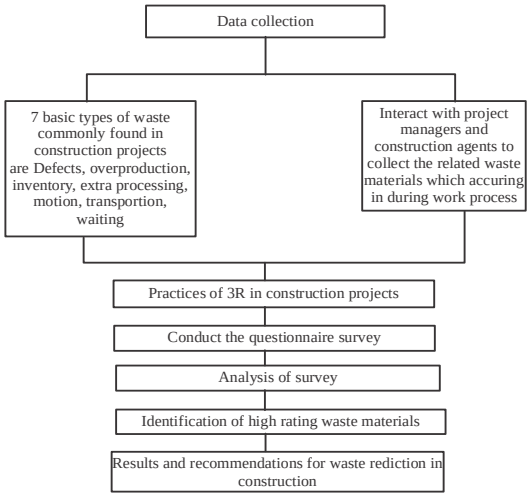

Fig. 1: Collection of data related to the waste materials in construction projects

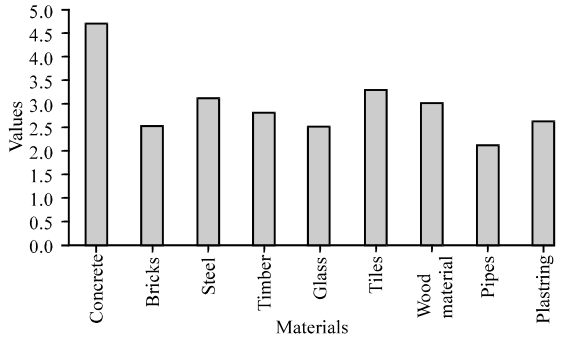

Fig. 2: Rank wise graphical representation of waste materials in construction site

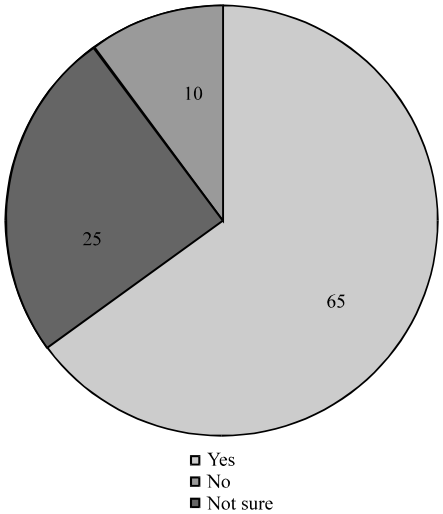

Fig. 3: Level of knowledge on 3R concept among contractors (sales)

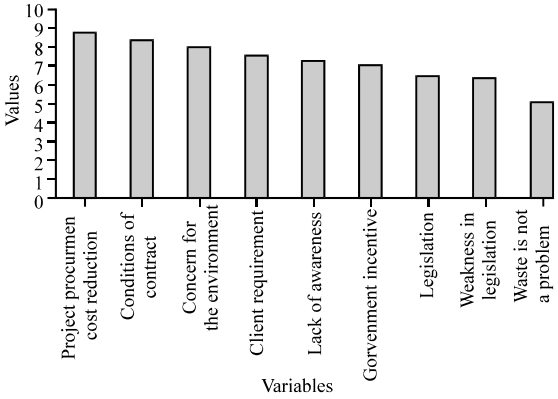

Fig. 4: Rating system

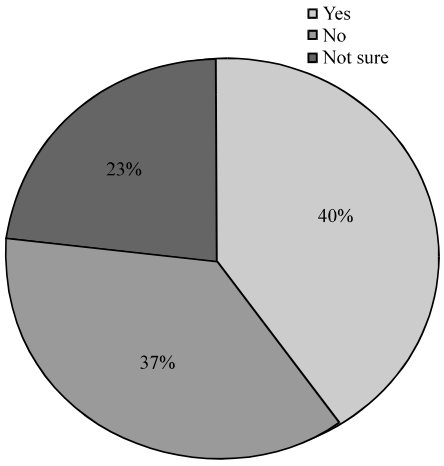

Fig. 5: Practice 3R is mandatory in construction waste management

obtained information on 3R through law and regulation and requirement of contract. Besides that, a few of the contractors also learn about 3R through university and reading materials.

Table 3 shows that factors influencing the construction waste management by conducting the survey and interview the responses manly shows into rating, project procurement cost reduction is top rating compare to other factors and waste is not a problem in site got the least rating. And figure show the rating system (Fig. 1-5).

Most of contractors do not practice 3R in managing construction waste which is unsustainable. It has been identified that weak implementation of 3R practice is due to constraint in time and cost, lack of space, lack of enforcement, lack of awareness and knowledge, lack of coordination and contractor's attitude and low participation. Therefore, governing bodies should put in efforts in encouraging, promoting and enforcing 3R

practices. 3R practice is an appropriate approach for contractors in managing construction waste because it is sustainable and beneficial.

Waste management practices 3R as shown in Fig. 2. Meanwhile, 40% contractors revealed that 3R is not mandatory and 23% of contractors not sure whether 3R is mandatory in construction waste management. However, based on the feedbacks provided by experts interviewed, one expert stated that 3R practice is mandatory to legal contractor because minimization and recycling construction waste are stated in planning permission plan.

Meanwhile, others experts stated that 3R practice are not mandated and not stated in project contract. However, some contractors do practice 3R in managing waste and stated in contract and in pursuing sustainable building rating like Green Building Index (GBI) and Malaysian Carbon Reduction and Environmental Sustainable Tool (MyCREST) where 3R practice is one of the criteria. Their agencies are in progress enforcing the law and regulation to mandatory 3R practices.

CONCLUSION

Overall, this study revealed that 3R practice currently is not mandatory in construction waste management and it depends on contractor's initiative and pursuing the sustainable building rating. But it will be mandatory when law and regulation has been enforced.

RECOMMENDATIONS

In order to improve the effectiveness of waste reduction through 3R in construction industry, there are important elements which should be emphasized, i.e., law and regulation, scheme and incentive. Awareness and knowledge on 3R, participation of contractors and available technology. Moreover, top-down approach with enforcement of legislation and policies and good governance concept should be implemented towards sustainable construction waste management.

The government can provide the strict conditions to follow the waste management and introduce specific legislation governing the handling and disposal of waste. To educate the sustainable construction in the curriculum of professionals in construction industry. Government can provide the rewards firms who embrace waste management wholly.

If a project manager or contractors forecast and record the type of construction materials waste which produced in a project, also aid in creating appropriate management action that reduces the amount of waste. Illegal dumping of construction waste materials will damage the environment, to reduce this problem a dumping site which separates the materials, based on inert and non-inert materials and it will be sent to their recycling factories to effective use of wastage.

Implementing reuse, recovery and recycling by construction waste management plan will help on project cost. Proper communication among all parties will reduce construction waste, who involved in a construction project including customer, contractor, engineer, planner, subcontractor, labor and even the suppliers. At the pre-planning stage of the project, proper material scheduling and material requirements at the right place and the right time will decrease the waste in constriction.

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