

Construction Waste Management Techniques: Merits And Challenges For Recycling And Reusing

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Abstract

Waste production is an unavoidable problem and currently is a bulging issue. Several studies have been conducted to identify solutions to this problem. Many of these solutions are case specific and area based. Further, these studies have described waste management very briefly and covered only a few of the waste management areas. **Methods:** Critical review of the previous research works related to construction management has been done. It involved the reviewing papers which are already published in well reputed research journals. **Novelty:** The studies have highlighted various recommendations and techniques for management of construction waste with their implementation. **Objective:** This paper is focusing on highlighting various perspectives of several waste management techniques. **Findings:** From the study, it is pointed out that 5R principles are most commonly adopted hierarchy for managing waste worldwide. This includes reduce, reuse, recycle, recover and remove. Removal is the last step when no other option is there to treat. Also, various benefits and challenges faced in adopting waste management on construction sites are identified and discussed. Based on this study, it is suggested that for effective waste management, all stakeholders including clients, contractors, government and suppliers be actively engaged in the process of waste management.

Keywords: Waste Management Techniques, construction Waste, 5R, Recycling, Reusing

Introduction:

Construction waste is becoming one of the challenging problems across the globe specially in developing regions¹. This problem might rise to an uncontrollable extent if no proper action is taken. It is estimated that more than 40% of the total solid waste generated comprises of construction and demolition waste². This amount is expected to increase further by 2025 and by that time huge monetary resources will be required to come out of this problem³. Research work conducted in Pakistan revealed that approximate amount of solid waste is 48 million tons which are increasing

at the rate of 2% annually⁴. This massive amount of waste puts a burden on the government to manage this waste and also requires financial resources which can never be recovered.

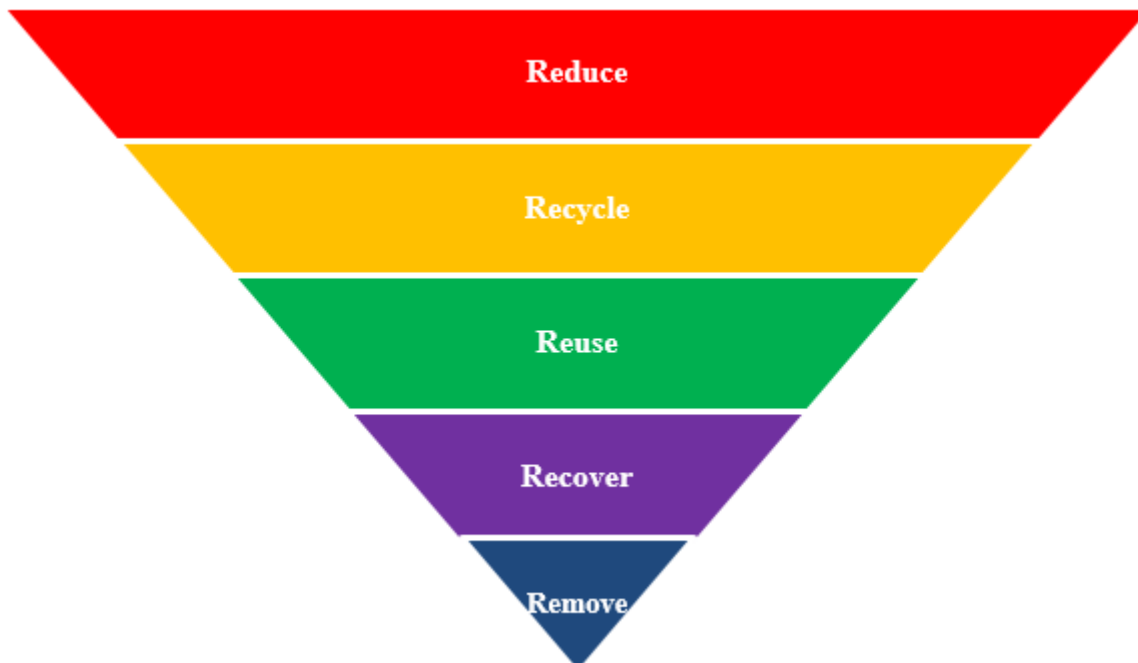
Construction and demolition waste is the largest constituent of the solid waste⁵⁻⁷ which is surplus material produced from renovation, rebuilt, building and demolition activities⁸. It also includes debris generated at the site by road works, site clearance, and other demolition activities. This waste may contain concrete, brick pieces, asphalt, wood, plastics, and packaging⁹⁻¹¹.

Usually, this waste contains non-hazardous materials but sometime it might contain a small fraction of hazardous materials which impart adverse negative impacts on the environment¹². Though debris and waste generated by construction, demolition and renovation activities is not harmful to human being but it deteriorates the environment.

The environment is severely affected due to several other factors including urbanization, which is also a cause of increased C&D waste¹³. Every year more than 10 billion tons of construction and demolition waste is produced across the globe among which developed and urbanized countries have a significant contribution. Like 700 million tons of construction and demolition is just produced by United States¹⁴. Similarly, European Union produces over 800 million tons¹⁵, China generates 2300 million tons¹⁶ and Pakistan produces over 48 million tons each year¹⁷. Thus, there is a strong need to minimize and properly treat and manage this waste and reduce its impacts on the environment.

For minimizing C&D waste, several remedial techniques have been adopted worldwide⁶¹. Several researchers proposed different management hierarchy. Normally concept of 5R methods is observed in construction projects. 5R methods include five waste management elements as schematically presented in figure 1.

Figure 1. Hierarchy of Construction Waste Management Techniques



As seen from above figure 1, 5R includes reducing (minimizing) waste generation, recycling waste, reusing the waste materials, recovering the useful elements from waste and dumping of the waste¹⁸⁻¹⁹. Among these, reuse is the most recommended technique to minimize waste. According to²⁰, the term 'reuse' is described as using the same material more than once for the same function or for some other function at the same construction site. To reduce the construction waste, the material brought to the site must be shortlisted at the earlier stage. Also, frequent changes in

the project requirement should be avoided as a major cause of waste generation caused by last minutes' changes due to client requirements and design changes²¹. This will cause the increasing of waste material.

After reducing and re-using, recycling is the most recommended technique. According to²², many of the C&D wastes are recyclable. Recycling of construction waste means that the division of the waste and reproduce the waste to be new material. Recycling is of utmost importance in the waste management hierarchy for sustainable use of energy and resources²³. The recycling rate of C&D waste depends on a range of determinants such as waste management regulations²⁴⁻²⁵, employee training^{21,24} and economic concern²⁵⁻²⁶. In addition, the attitude and behavior of individuals towards recycling are important²⁷ and investigation of organizational variables on waste management by multilevel analysis²⁸.

It is requirement of industry and government as well to release pressure of landfill and enhance waste management practices by employing proper waste management technique like recycling, reusing and reducing²⁹.

In the current time, numerous studies have been conducted in developing countries to solve the issue of waste disposal and landfills. there are many factors that could help in adopting waste management practices. government support and friendly policies are some of the extrusive factors which could lead to minimizing landfills and save urban space³⁰.

Despite having many options of waste management waste is not well-practiced phenomenon on construction sites. Several hurdles do occur in this effort and need to be rectified. Communication gap, lack of coordination among parties³¹, outdated construction methodology²⁶, the involvement of more than one parties, inefficient management, and political interventions are the barriers in the implementation of waste management scheme.

Benefits of recycling and reusing C&D waste

Various researchers³²⁻³⁴ have conducted studies in highlighting the benefits of reusing and recycling the C&D waste. Major benefits of recycling and reusing waste material are summarized in table 1 below.

Table 1: Benefits of Recycling and Reusing

S. No.	Benefits of Recycling and Reusing	References
B ₁	Reusing of materials on-site	[5, 35, 36]
B ₂	Saving natural resources	[34, 37-40]
B ₃	Decreasing the needs of landfill spaces	[5, 33, 41]
B ₄	Saving energy	[33, 40]
B ₅	Reducing greenhouse gas emissions	[33, 40]
B ₆	Reducing health-related risks associated with landfilled C&D wastes	[33]
B ₇	Coping with the governmental strategy	[42, 33]
B ₈	Industry standard to achieve environmental sustainability	[32, 42]

It is argued that reuse and recycling of C&D waste could lead to economic, social and also environmental benefits. Using the recycling approach also leads to saving landfill charges and also can be helpful to develop a socially sustainable image⁴³. Additionally, construction companies could get benefit from reduced waste by lower costs to purchase virgin materials⁴⁴.

Difficulties and challenges in recycling and reusing

Though, recycling and using technique have been used for waste management for long time successfully. But, it also faces several difficulties and challenges in implementation. These challenges are summarized in table 2 below.

Table 2: Difficulties and Challenges of Recycling and Reusing

S. No.	Difficulties and Challenges of Recycling and Reusing	References
D ₁	Lack of waste-processing facilities or companies	[31, 45-46]
D ₂	Insufficient relevant policies	[42, 47]
D ₃	Poor regulations, and acts	[31, 35, 42]
D ₄	Poor communication among parties involved	[31]
D ₅	Poor coordination among parties involved	[31,60]
D ₆	Lack of economic feasibility in recycling and reusing C&D wastes	[37,48]
D ₇	Lack of viability in recycling and reusing C&D wastes	[37,48]
D ₈	Poor qualities of recycled products and their limited applications	[35, 38,48, 49, 50]
D ₉	Reluctance or cultural resistance to implement C&D waste diversion	[26,51]
D ₁₀	Illegal dumping	[45, 52-53]

Though, recycling and reusing have been proved very advantageous but they have certain demerits and limitation too. It is because same technique may suit for a specific case but not suits at all for some other case. Hence, one needs to be very clear and specific while suggesting a technique for waste management⁵⁴. On the other hand, reference³⁶ argued that recycling is a more practical option as compared to landfilling. Hence, there is still need of in depth study which considers the opportunities of various materials to be recycled and reused. Also, assess their impact from perspective of economic viability and environmental condition.

Recommendations on improving C&D waste recycling and reusing

The current state of implementing reusing and recycling techniques has shown positive results. For further improvements, the researchers have suggested several recommendations to enhance these techniques and manage C&D waste in a more particle and effective way. The important recommendations include:

- Penalizing the companies who do not treat waste and not properly manage the produced waste^{46, 55};
- Imposing Subsidy mechanism and tax incentives to the companies who responsibly handle all produced waste^{37, 48};
- Strict policy by the government and judicious punishments for the clients and contractors involved in illegal dumping^{33,45,48,51,56};
- Use of improved construction methodology and latest equipment which produces lesser waste ^{24, 26,51, 55, 57-58};
- Implementation of Applied research recommendations for the reduction of waste ^{38, 55, 59}.

Conclusion:

Waste management techniques and strategies may vary from country to country and location to location depending on mindset, literacy, and habits of people. Types of waste in that area also have an impact on adopting any particular

waste management practice. This study has revealed that reusing and recycling are major and common techniques which can play a key role in reducing construction waste on site. However, the adoption of any waste management technique is highly dependent on local management and available resources. Global studies revealed that reusing and recycling have exerted a positive effect in reducing the amount of construction waste amount. Also, it helps in financial control as well as environmental sustainability. Though there are several hurdles and challenges in adoption of these waste management techniques. But, these can be regularized by regularizing and imposing a penalty by the local government.

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