

Life-cycle Approach to Minimise Construction Waste



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Abstract

Waste generation by the construction industry is a significant issue for the industry and for the whole society. In recent years, economic, political and social pressures to adopt sustainable work practices have led to a renewed emphasis on developing effective waste minimisation measures for major construction projects. Hence, this article illustrates the best construction waste minimisation practices to adopt throughout the building lifecycle to minimise construction waste generation as per research findings.

Key words: construction waste, waste minimisation

Introduction

Many researchers have proved that the construction industry is a leading waste generator worldwide (Loosemore and Teo, 2001, McDonald and Smithers 1998, Dainty and Brooke, 2004). For decades, landfills have provided a convenient and cost-effective solution to construction waste. Due to increasing population and speed of development, it is anticipated that the quantity of waste generated through construction in the coming years will be considerable and thus requires waste prevention rather than relying on landfill sites. Moreover, it became a burden to clients, as they have to bear the costs of waste eventually. The cost of waste blunts the competitive edge of contractors, making their survival more difficult in a competitive environment (Macozoma, 2002). Waste creates loss of profit for contractors due to extra overhead costs, delays, lower productivity and extra work in cleaning and it is estimated that companies that produce a higher level of waste are at a 10 percent disadvantage in tendering (CIRIA, 1995). The above factors pertinent to the environment, economy and society lead the interest towards waste minimisation among construction industry practitioners.

Construction waste minimisation

Waste management is defined as the process involved in dealing with waste once it has arisen. The waste management hierarchy (Figure 1) is a guide to determine the best available practical preferences to address the waste issues in construction sites. It represents the best practicable environmental options within the chain of priority for waste management starting from prevention and reduction and extending to waste disposal, which is the least favourable option.

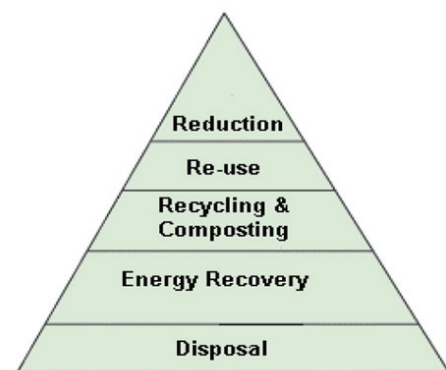


Figure 1: Waste management hierarchy

However, the most economically and environmentally preferable option to manage construction waste is 'waste minimisation', which is an in-plant process that reduces, eliminates or avoids the generation of waste. The next section of this article discusses the recommended best construction waste minimisation practices according to current and on-going research in the field of construction waste management, dividing them into project lifecycle phases: pre-design, design, procurement, and construction.

Pre-design Phase

Since past researchers have proven the fact that construction waste could occur as a result of incomplete briefing and clients' lack of interest towards waste minimisation, literature highlights the need of educating clients on waste minimisation benefits to develop attitudinal changes to encourage waste conscious designs and construction practices from the inception of projects. Additionally, more emphasis should be given by clients on conferring a complete brief to the design team to avoid later changes (including variations) during the construction phase, which was identified as one of the major sources for generating huge amounts of construction waste.

Design phase

The Design phase should play a major role in controlling waste in the construction industry. It has been estimated that 33% of on-site waste is due to the architect's failure to implement waste reduction measures during the design stages (Innes, 2004). There is a general consensus in the literature that design changes, incomplete designs, designers' lack of experience in evaluating construction methods and the sequence of construction operation, lack of design information, design complexities and over specification of materials are key origins of construction waste during the design phase. In order to minimise the adverse effects due to the above waste origins, past researchers suggested waste minimisation practices such as:

- *Design standardisation to improve buildability and to reduce the quantity of off-cuts*
Reduce substantial amount of off-cuts by designing room areas and ceiling heights in multiples of standard material sizes.
- *Design management to prevent the over-specification of materials*
Appoint a dedicated design manager with a brief to minimise waste due to over-specifications. Also, more time can be allowed for value engineering design solutions for more complex projects.
- *Increased use of off-site prefabrication to control waste and damage*
Increase the use of prefabricated elements to improve the quality work, to reduce the amount of on-site damage and to reduce re-works.

- *Environmental impact assessments of the scheme during the design phase*

Conduct regular design and production reviews where the waste minimisation strategies are considered a primary performance criterion. This can be incorporated as part of the design development process to ensure that the building met the client's criteria.

Procurement Phase

Past research findings accentuate a number of waste origins in the procurement stage of a construction project. Most of these waste origins relate to the responsibilities of project partners towards waste minimisation. Thus, researchers suggested the following practices to implant during the procurement phase.

- *Supply chain alliances with suppliers/recycling companies*
Arrange partnerships with suppliers to remove excess materials, to reprocess them and to reuse material where possible. Such practices could be supported with financial incentives for minimising waste
- *Dedicated specialist sub-contract package for on-site waste management*
Appoint a specialist firm to remove waste from a site while allocating some responsibility to trade contractors and maintaining good control over waste processes with the principle contractor.
- *Contractual clauses to penalise poor waste performance*
Include financial penalties for wasteful work practices in the contracts.
- *Additional tender premiums where waste initiatives are to be implemented*
Introduce financial subsidies for companies willing to invest on comprehensive waste minimisation systems at the tendering stage.
- *Supplier flexibility in providing smaller quantities of materials*
Encourage supplier to produce materials to project specifications and to provide smaller quantities of materials to reduce the need for on-site storage

Construction phase

The Construction phase could be termed the most critical stage when dealing with waste minimisation, because waste physically appears in this phase of a project. Over the decades, much research was conducted in different

parts of the world to identify on-site waste origins and waste minimisation measures. Many research findings concluded that waste origins in the construction stage were due to poor material storage and handling, negligence, material ordering errors, poor record keeping, poor workmanship and lack of site waste management plans. To facilitate waste reduction, researchers suggested the following practices to implement during the construction phase in a project.

- *Stock control measures to avoid the over-ordering of materials*
Tighter stock control measures coupled with the careful monitoring of on-site progress and raising awareness of site managers to eliminate over-ordering of materials.
- *Improved education of the workforce*
Increase attitudes of site operatives to minimise waste through education on the benefits of waste minimisation.
- *Provision of waste skips for specific materials*
Centrally control material skips through the principle contractor to help promote a culture of material segregation and recycling.
- *Just-in-time delivery strategy*
Adopt a just-in-time delivery strategy to reduce the potential damage from poor handling due to long-term site storage as well as reducing the potential for over-ordering materials.
- *Waste auditing to monitor and record environmental performance on-site*
Adopt waste auditing tools (SMARTWaste etc.) both to monitor the performance of on-site practices and to educate the workforce on the benefits of waste minimisation practices.

Other than the above-specified waste minimisation practices, it is essential to maintain effective and efficient communication and coordination systems and documents management systems throughout the project lifecycle to avoid confusion and miscommunications when handling project information among project partners.

Conclusion

Construction waste generation is a reality in the 21st century with the rapid developments in all parts of the world. Even though physical waste generates during the construction or demolition phase of a project, waste

origins emerge throughout the project life-cycle. Hence, waste minimisation practices should be implemented from the start of any construction project right through the design, procurement and construction phases to effectively reduce waste generation and to move towards sustainable construction targets.

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