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Construction Waste Minimization in the UK: Current Pressures for Change and Approaches

M.Osmani

Associate Professor in Architecture and Sustainable Construction,
School of Civil and Building Engineering, Loughborough University, UK

Abstract

Recent figures published by the UK Government reveal that construction and demolition waste in the UK is around 120 million tonnes per annum, including an estimated 13 million tonnes of unused material. Furthermore, the introduction of new legislation, the emergence of new technologies and practices in both waste disposal and recovery, and the rising tide of public awareness are all conspiring to change the face of waste management. The opportunities and responsibilities to minimise construction waste rest with clients, contractors, suppliers and designers (architects/engineers). The paper evaluates construction waste minimization drivers and pressures for change in the UK; discusses construction waste source evaluation; and explores current thinking on construction waste research.

Keywords: Waste mangement; Construction; Design waste; UK.

1. Introduction

Achieving 'zero waste' will be a breakthrough strategy for a world in an environmental crisis, however, this is a highly challenging target in construction, but by involving and committing all stakeholders to reduce waste at source and developing efficient waste management strategies by reusing and recycling materials and components, can take the industry closer to the 'zero waste' vision, hence, moving from myth to reality. Minimization of construction waste can occur at various stages of a project life cycle; and opportunities and responsibilities lie with all supply chain stakeholders, particularly clients, designers, contractors and suppliers. The paper evaluates construction waste minimization drivers and pressures for change in the UK; discusses construction waste source evaluation; and explores current thinking on construction waste research.

2. Definitions

There is no generally accepted definition of construction waste. One common definition of construction waste, as issued by the European Council Directive 91/156/EEC, is "any substance or object which the holder discards or intends or is required to discard" (Directive 91/156/EEC [1], Article 1, Letter a). This definition applies to all waste irrespective of whether or not it is destined for disposal or recovery operations. However, Skoyles and Skoyles [2] defined construction waste as a material "which needed to be transported elsewhere from the construction site or used on the site itself other than the intended specific purpose of the project due to damage, excess or non-use or which

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cannot be used due to non-compliance with the specifications, or which is a by-product of the construction process"[11]. Similarly, the adopted definition of construction waste minimization for this research is "the reduction of waste at source, (i.e. designing out waste) by understanding its root causes and re-engineering current processes and practices to alleviate its generation" (Osmani, 2011[3]).

3. Construction waste management drivers

3.1. Legislative drivers

The UK Government has been using a combination of regulation, economic instruments and voluntary agreements to meet targets of ethical, social and environmental performance in driving the waste management agenda. The Government's Strategy for Sustainable Construction, published in June 2008, calls for a step change in the sustainability of procurement, design, and operation of all built assets, to be driven by innovation [4]. The aim of the Strategy is to improve the built environment performance with a focus on reducing carbon emissions and resource consumption in new buildings. In encouraging the construction industry to drive its own resource efficiency program, the Strategy calls for zero construction waste to landfill by 2020. It also set a target to halve the amount of construction, demolition and excavation wastes going to landfill by 2012 in comparison with 2008 levels, as a result of waste reduction, re-use and recycling. This is a significant challenge for the industry. Additionally, existing waste related legislation, especially the Landfill Tax (£56 per ton in 2011), which will make the current waste disposal methods too costly for construction firms), the Aggregates Levy (£2 per ton for on the extraction of aggregates); and Site Waste Management Plans Regulations 2008 (compulsory for all construction projects that exceed the value of £300,000) should contribute to a transition away from land-filling towards waste reduction, reuse and recycling. However, as yet this does not appear to have seriously reduced the amount of waste production, the UK Government is likely to introduce other fiscal measures and legislation in the future, which will push the construction industry towards a closed loop production system**.**

3.2. Financial drivers

The construction industry in the UK spends over £200 million on Landfill Tax each year. Waste typically costs companies 4% of turnover with potential savings of 1% through the implementation of a comprehensive waste minimization program. Furthermore, WRAP [5] estimates that £1.5 billion is wasted in materials that are delivered to the site but unused. Construction-related businesses can take advantage of government funding to implement waste minimization practices. Indeed, from April 2005 to March 2008, the government granted £284 million of Landfill Taxes to the Business Resource Efficiency and Waste (BREW) program. Over 65% of this funding was approved for waste management initiatives.

3.3. Business drivers

In order for construction to improve its performance in this competitive age, it has become essential that sustainable practices, including waste minimization, are adopted and implemented. Indeed, clients are increasingly demanding for enhanced sustainable project performance and are exerting more influence on the industry to reduce onsite waste and cut costs [12]. This is gradually becoming a necessary requirement for procurement across the entire supply chain. In response to such pressures, businesses are abandoning their narrow theory of value in favor of a broader approach, which not only seeks increased economic value, but considers corporate social responsibilities and stakeholders' engagement and commitment.

4. Origins of construction waste

There are a variety of different approaches to the evaluation of the main origins, sources and causes of construction waste. The extant of literature reveals a number of construction waste generation sources, which can be broadly categorized into eleven clusters. Table 1 shows that construction waste is generated throughout the project from inception to completion and the pre-construction stage has its considerable share. A recent research on construction procurement systems'-related waste sources showed that these fall under four main themes: uncoordinated early involvement of project

stakeholders, ineffective project communication and coordination, unclear allocation of responsibilities, and inconsistent procurement documentation [6]. Furthermore, it has been estimated that 33% of wasted materials is due to architects failing to design-out waste [7]. However, construction waste minimization through design is complex because buildings embody a large number of materials and processes. Equally, Osmani et al [8] reported that 'waste accepted as inevitable'; poor defined responsibilities' and 'lack training' are major challenges facing architects to design in waste reduction measures in their projects. This is made more complex when further waste is created directly or indirectly by other projects' stakeholders, namely clients, contractors, sub-contractors and suppliers. Nonetheless, there is a general consensus that design changes during operation activities are key origins of construction waste [9; 10]. The main drivers for design variations during construction are mainly due to a lack of understanding the underlying origins and causes; design changes to meet client's changing requirements; complex designs; lack of communication between design and construction teams; lack of design information; unforeseen ground conditions; and long project duration**.**

5. Construction waste reduction approaches

Despite international governmental, industrial and academic efforts to develop waste reduction thinking in construction, uptake globally is piecemeal. The current and ongoing research in the field of construction waste management and minimisation can be broadly categorised into the following thirteen clusters.

1. Construction waste quantification and source evaluation.
2. Procurement waste minimization strategies.
3. Designing out waste.
4. On-site construction waste sorting methods and techniques.
5. Development of waste data collection models, including flows of wastes and waste management mapping, to help with the handling of on-site waste.
6. Development of on-site waste auditing and assessment tools.
7. Impact of legislation on waste management practices.
8. Improvements of on-site waste management practices.
9. Reuse and recycle in construction.
10. Benefits of waste minimization.
11. Waste minimization manuals, including guides for designers.
12. Attitudes towards construction waste minimisation.
13. Comparative waste management studies.

A number of recent reports aim to promote awareness in the building construction industry about the benefits of waste minimization, including cost savings, and environmental issues and use of recycled and reclaimed materials. The 'three Rs' principle of waste (reduction, re-use and recycle), otherwise known as the waste hierarchy, has been widely adopted. Similarly, the impact of legislation, particularly the Landfill Tax, and its effects on the behavior and practices of the construction industry has resulted in a number of research studies. Furthermore, the last few years many waste minimization and recycling guides have been produced such as WRAP [5]. These documents give broad guidance for designers to adopt a waste minimization approach in their projects; however, the recommendations in these guides do not realistically relate waste to all parameters of the designers' environment, including the complex design and construction process and the supply chain. Additionally, they do not specifically identify waste-stream components in relation to their occurrence during the architectural design stages. Additionally, tools, models and techniques, such as SMARTWaste in the UK and WasteSpec in the USA, have been developed to help handle and better manage on-site waste generation and assess the associated cost implications. These tools which facilitate on-site auditing, waste management, and cost analysis deal with waste that has already been produced. Consequently, there is insufficient effort and no structured approach to address waste at source, i.e. 'design waste', to prevent it from being generated at the first place.

6. Discussion and conclusions

At present, legislative and fiscal measures are undoubtedly the major drivers for construction waste reduction in the UK, which were directly related to the rising Landfill Tax, increasing cost for waste disposal, and compliance requirements with Site Waste Management Regulations 2008. However current legislation fails to impose responsibilities on architects to minimise waste, which is by far most practical way to reduce waste at the onset of a project through design, rather than implementing waste minimisation measures later on during construction.

Waste minimization can be viewed as a threat requiring ever-increasing expenditure on end-of-pipe technologies to meet ever-increasing legislation, or as an opportunity to cut costs and improve performance. The choice should be obvious, but there is a need for a culture change. This requires re-engineering current practice to contribute to a cleaner environment through efficient and cost effective sustainable waste minimisation strategies. However, for waste minimisation to be effective and self-sustaining, it is important that all stakeholders along the construction supply chain adopt a more proactive approach in dealing with waste, i.e. designing out waste. In recognition of the responsibility of the architectural profession, through its leading role in project management and a key player in the construction industry, architects should move beyond the concept of 'Eco-efficiency' through bolt-on environmental strategies and strive to adopt 'Eco-effective' practices by implementing a holistic approach to design.

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