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The evolution of construction waste sorting on-site

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ABSTRACT

Construction waste comprises inert (e.g., sand, bricks, and concrete) and non-inert materials (e.g., bamboo, plastics, glass, wood, and paper). In Hong Kong, the inert portion can be deposited at public filling areas for land reclamation while the non-inert portion is disposed of at landfills. However, construction waste is usually a mixture of both inert and non-inert materials and thus a segregation of the two portions is of paramount importance for effective waste minimization. Previous studies have revealed that construction contractors in Hong Kong were unwilling to carry out on-site construction waste sorting (CWS) even though it has numerous advantages. After a decade, the situation should have changed, particularly given the promulgation of a waste charging scheme in 2006 imposing levies on different methods of construction waste disposal. This study thus aims at ascertaining the state-of-the-art on-site CWS practices in Hong Kong, with a particular interest in its evolution over the past ten years. Data was collected through case studies of six construction sites where a hybrid research method included a literature review, non-participant observations, and interviews. It was found that construction waste management (CWM) regulations have significantly enhanced on-site CWS in Hong Kong. Site space and project stakeholders' attitudes are still regarded as the most critical factors but labor and cost are no longer of major concerns in undertaking on-site CWS. Instead, a market for recyclables and an awareness of the profound environmental benefits are now perceived as being of major importance in these practices. Findings from the study can be used to review the effectiveness of current on-site CWS in Hong Kong, and through benchmarking they can also be used to develop good CWS practices in other economies.

Contents

1. Introduction

Construction waste is a major concern in Hong Kong. Construction activities in the region unavoidably produce a great amount of construction waste. Latest statistics from the Hong Kong Environment Protection Department (HKEPD) [5] showed that in 2010 construction waste accounted for 25.9% of all the solid waste generated in Hong Kong, reaching 3584 t per day (tpd) disposal at landfills. However, burying the large amount of construction waste in landfills leads to an extensive volume of air, water, and soil pollution due to the production of CO_2 and methane from anaerobic degradation of the material. In addition

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to the adverse environmental impacts, construction waste also brings tremendous pressure to the limited landfill space in this extremely compact city. The [6] predicted that with an estimated 24% annual increase in construction waste disposal, the landfill facilities in Hong Kong would be full by 2017. Cheung [1] stated that landfill "should be treated as a precious asset and not for daily use". Therefore, there is an acute need to effectively manage construction waste in Hong Kong so as to reduce its negative impact on the environment.

In Hong Kong, construction waste is categorized into inert and non-inert, where the inert materials, comprising mainly sand, bricks and concrete, is deposited at public filling areas for land reclamation, while the non-inert portion, consisting of materials such as bamboo, plastics, glass, wood, paper, vegetation and other organic materials, is disposed of at landfills as solid waste. However, construction waste is usually a mixture of both inert and non-inert materials and although segregation of the two types of waste is of paramount importance [15], the nature of the materials makes them difficult to sort. Poon et al. [10] found out that construction contractors were reluctant to carry out on-site waste sorting owing to various difficulties in spite of the perceived advantages of doing so. Later, with the aid of a flow-free mapping presentation technique, Shen et al. [12] developed a construction waste management mapping model (WMMM). The WMMM was rather intuitive in facilitating descriptions of CWM procedures on-site with a view to comparing CWM practices between different construction sites, and thus identifying both good practices and weak areas. The two studies were both undertaken with an attempt to enhance the effectiveness of on-site CWS/CWM activities in the context of Hong Kong.

Over the past decade, a series of CWM regulations have been issued in Hong Kong. These primarily include adopting a waste disposal ordinance, launching an off-site CWS program, commissioning a pilot concrete recycling plant, implementing the waste management plan, promoting a waste disposal charging scheme, and implementing a trip-ticket system [4,13]. Among them, three regulations, namely, the waste disposal charging scheme, the off-site CWS program, and the trip-ticket system, are closely related to CWS practices. In this connection and taking the research by Poon et al. [10] as the point of departure, two questions that arose were (a) what is the status quo of on-site CWS in Hong Kong? and (b) to what extent have on-site CWS practices changed?

The primary aim of the study was twofold. First, to ascertain the current state-of-the-art on-site CWS practices in Hong Kong. Second, to conduct a comparison between the practices identified and the on-site CWS practices between 2002 and 2012. The institutional settings for on-site CWS was juxtaposed with those 10 years ago to allow a contrasting lens through which the evolution of on-site CWS practices in Hong Kong can be viewed. It was anticipated that the findings would be very useful for longitudinally analyzing on-site CWS practices in Hong Kong and may also be applicable to other economies that are committed to construction waste management. The paper is organized as follows. First, a literature review regarding on-site CWS is conducted to understand the rationale and major hurdles of carrying out on-site CWS by putting it into the Hong Kong context. Second, the research methodology adopted is introduced, which comprises a hybrid research strategy that involves a literature review, non-participant observations, and interviews with personnel employed on six construction projects. Third, a case study was carried out and detailed analyses and discussions presented. Finally the paper concludes by recommending institutional arrangements for encouraging better on-site CWS by connecting it with the whole waste management system in Hong Kong.

2. On-site construction waste sorting in Hong Kong

Construction waste is defined as "any substance, matter or thing which is generated as a result of construction work and abandoned whether or not it has been processed or stockpiled before being abandoned" [5]. It is a mixture of surplus materials arising from site clearance, excavation, construction, refurbishment, renovation, demolition and road works [5]. To understand the rationale of advocating on-site CWS, it is better to understand the character of construction waste first. Although it is often included as one of the forms of municipal solid waste (MSW), construction waste is considered as heterogeneous by comparison with general MSW (e.g., household waste) or other industrial waste (e.g., hospital waste and electrical waste) [8]. Construction waste comprises inert (e.g., sand, bricks, and concrete) and non-inert materials (e.g., bamboo, plastics, glass, wood, and paper). As mentioned previously, in Hong Kong, the inert portion of construction waste can be accepted by public fill reception facilities, while the non-inert part is dumped at landfills. It is thus sensible to sort the construction waste into inert and non-inert parts instead of burying them together in landfills. This is particularly important for compact areas such as Hong Kong where land reclamation is increasingly rare and existing landfills will be full in the very near future.

Over the last ten years, the Hong Kong government has made a considerable effort to manage the large amounts of construction waste. Three regulations have been issued to improve on-site CWS in Hong Kong. Notably, a waste disposal charging scheme (WDCS) was implemented based on the 'polluter pays principal' in 2006. According to the scheme, a construction contractor will have a levy of HK$125 (US$1 = HK$7.76) imposed for every tonne of construction waste containing not more than 50% by weight of inert substances it disposes of at landfills; it will be levied HK$100 per tonne if the generated construction waste containing more than 50% by weight of inert substances is accepted by off-site sorting facilities; while it will be charged only HK$27 per tonne if the construction waste consisting entirely of inert materials is accepted by public fill reception facilities. The discriminative prices are set up based on the premise that different forms of construction waste will have different degrees of impacts on the environment and society, and thus should be charged differently to encourage the minimization of construction waste.

Another significant endeavor is an off-site CWS program launched in 2006. Meanwhile, two off-site CWS facilities were set up in line with the implementation of the WDCS. According to the statistics provided by the Hong Kong Civil Engineering and Development Department (CEDD), the off-site CWS facilities have successfully handled a total of 5.11 million tonnes of construction waste by February 2012. A recent study also revealed that the off-site CWS programs is effective in that it not only separates construction waste off-site but also encourages construction contractors to do on-site CWS [9].

It seems that a rigid definition of on-site waste sorting is absent in the literature. Generally, people treat it as a good practice whereby construction waste is separated on construction sites and sorted into different groups in line with its characteristics and components. Through this, some valuable components can be picked up for reuse and recycle. For example, Poon et al. [10] and Wang et al. [15] found that on-site CWS could increase the rates of construction waste reuse and recycling, and reduce the costs for construction waste transportation and disposal. However, Poon et al. [10] reported that construction contractors in Hong Kong were mostly unwilling to conduct on-site CWS for a variety of reasons. Through investigating the feasibility of three on-site CWS alternatives, it was revealed that factors such as limited site space, management efforts, labor and cost, and interference with normal site activities were the main constraints of on-site CWS in Hong Kong (Poon, 2001). The unpopularity of