

The Construction Waste Disposal Charging Scheme in Hong Kong

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Abstract

Construction and demolition waste generated by construction activities in Hong Kong has increased in recent years. To tackle the problem, the Hong Kong Government introduced the Construction Waste Disposal Charging Scheme (CWDCS) in December 2005 to ensure that landfill construction waste disposal is properly priced to reduce construction waste. The charging scheme is not only intended to provide an economic incentive for contractors and developers to reduce waste but also to facilitate waste reusing and recycling, thereby to help slowing down the depletion of limited landfill capacity. This research aims to examine the effectiveness of the charging scheme after one year of implementation in particular 'polluter pays principle'. The study also identifies possible ways to fine-tune the scheme and to further improve its effectiveness.

Keywords

Public fill, construction waste, charging scheme, reducing, Hong Kong.

1 Introduction

The Polluter Pays Principle (PPP) used in international environmental law where the polluting party pays for the damage to the natural environment. It is regarded as regional custom because of the strong support it has received in most Organisation for Economic Co-operation and Development (OECD) and European Community (EC) countries (Wikipedia 2006). Since then, the PPP has been implemented in many developed and developing countries.

While environmental problems arising from construction waste is not unique in Hong Kong, there is an urgent need to introduce and to implement effective measures to reduce construction waste as there is only limited space for building new landfills. Experience in European countries has shown that waste disposal charging is a very effective way not only to reduce waste but also to further reuse and recycle waste materials (Andersen 1998, Glazyrina *et al.* 2006, Magrinho *et al.* 2006). Countries in South-Eastern Asia have also shown that landfill charging scheme provides positive initiatives to reduce and to recycle waste. For example, South Korea has reduced its total waste by about 30% since implementing a landfill charging scheme in 1995, and Taipei did even better, reducing its waste by about 40% after introducing a charging scheme in 2002 (Environmental Protection Department 2007, Tsai and Chou 2004).

It has also been advocated and realised that the implementation of a construction and demolition waste disposal charging scheme in Hong Kong would also lead to a reduction of construction and demolition waste and further promotes recycling and reuse (Chung and Lo 2003, Hao *et al.* 2005, Hao and Zhang 2005, Poon *et al.* 2001, Shen *et al.* 2004, Tam *et al.* 2002, Tam and Tam 2006, Tse 2001). In response to these, the CWDCS was implemented on 1st December 2005.

However, the application and implementation of the PPP to identify liable parties to cleanup waste are difficult (Cai and Sun 2000, Dainty and Brooke 2004, Teo and Loosemore 2001). Given the fragmented nature of the construction waste chain from its generation to its disposal and so many embedded parties and factors throughout the process, the implementation of the CWDCS is usually very difficult. Therefore, it is important for the involved parties during the first year's experiences to know the effects of the scheme. By examining these effects, a better understanding on problematic areas can be gained, which in turn can help the CWDCS implementation.

The overall aim of this paper is to examine the effectiveness of the CWDCS in Hong Kong via the following objectives:

- To identify and to investigate critical factors for effective implementation of the CWDCS in Hong Kong;
- To review and to compare differences in terms of construction waste quantity and waste management before and after the scheme's implementation;
- To identify and to examine problematic areas during the implementation of the scheme, and how these can be compared with international experience;
- To develop guidelines from looking into the strengths and limitations of the scheme; and
- To make suggestions to the Hong Kong Government and its construction industry based on the guidelines to help improving the implementation of the scheme.

2 Hong Kong Waste Disposal Facilities

For decades, landfills have provided a convenient and cost-effective solution to waste treatment of the industry (Mills *et al.* 1999). Wong and Tanner's study pointed out that the landfills, originally expected to approximately last 40 to 50 years, would be filled up by 2010, even if there were adequate outlets for construction and demolition materials (Wong and Tanner 1997). All these investigations signal the seriousness of construction solid waste generation. A forecast of the generation of construction and demolition waste was carried out in 2005 by the Environmental Protection Department (EPD) of the Hong Kong Special Administrative Region (SAR). The estimated quantities of construction and demolition waste are based on the assumption that about 80% of the total construction and demolition materials will be delivered to public filling areas and the remaining 20% to landfills (EPD, 2004). Landfills are designed to receive non-inert solid waste while public filling areas for land reclamation and site formation only accept inert materials such as rubble, stone, brick, concrete from construction and demolition works. With about 24% annual increase in construction and demolition waste to be disposed to landfills and public filling areas from 1991 to 2016, it is necessary to reduce the consumption of these waste disposal facilities; otherwise, they will be full in the next ten years (Environmental Protection Department 2007).

2.1 Strategic Landfill Areas

The three main landfill areas for non-inert waste of South East New Territories (SENT) landfill, North East New Territories (NENT) landfill and West East New Territories (WENT) landfill, will be exhausted in the next 8 to 10 years (Waste Reduction Framework Plan 1998).

There are about 86.29 million tons available in the three landfill areas, of which SENT, NENT and WENT share about 66%, 80% and 85% respectively (see Table 1). It is expected that all the landfill areas

will be running out in 2008, if further waste reduction measures are not implemented. The approved reclamation projects will only provide outlets for the public fills until 2004. If there are insufficient public filling areas and no waste reduction measures, more public filling will be diverted to landfills.

**Table 1: Breakdown information of the three landfills
(Environmental Protection Department 2007)**

Landfills	Void space consumption (end 2000)			Landfill life expectancy		
	Design capacity (million cubic metres) (Mm ³)	Percentage consumption	Remaining capacity (Mm ³)	Optimistic scenario	Pessimistic scenario	Worst scenario
SENT	43.1	34%	28.6	2012	2010	2005
NENT	35.0	20%	28.1	2016	2013	2007
WENT	61.9	15%	52.8	2018	2013	2008
Notes: Optimistic scenarios are represented with low waste growth, waste reduction targets and sufficient public fill outlets are achieved; Pessimistic scenarios are represented with high waste growth, waste reduction targets are not achieved, but sufficient public fill outlets; and Worst scenarios are represented with high waste growth, waste reduction targets are not achieved and insufficient public fill outlets.						

2.2 Public Filling Areas

Public filling services are provided to the public for disposal of inert waste. Public filling for construction consist of excavated earth, asphalt, building debris, broken rock and concrete (Civil Engineering Department 2004). Public fillings are economical sources for filling materials for reclamation and earth-filling projects and also help preserve the precious landfill space in Hong Kong. Existing public filling facilities available to the public are: (1) public filling area at Tuen Mun Area 38; (2) public filling barging point at Quarry Bay and Sai Ying Pun; (3) stockpiling area at Mui Wo on Lantau Island; and (4) the filling bank at Tseung Kwan O Area 137.

There are about 5.53 million cubic metres available in the two public filling programmes, of which about 5.35 and 0.18 are at Tseung Kwan O Area 137 and Tuen Mun Area 38 Stage 2 respectively (see Table 2). To cope with a large amount of waste generated from the industry, four public filling areas, namely, Central reclamation Phase III, Penny's Bay reclamation Stage 2, Wanchai development Phase II and South East Kowloon development, are under planning to fulfill further needs in Hong Kong.

Table 2: Public filling programme (Civil Engineering Department 2004)

Project name	Void space consumption (April 2003)			Landfill life	
	Design capacity (million cubic metres) (Mm ³)	Percentage consumption	Remaining capacity (Mm ³)	Open date	Expected closure date
Tseung Kwan O Area 137	5.66	5%	5.35	Oct 2002	Dec 2004
Tuen Mun Area 38 Stage 2	5.01	96%	0.18	Sep 2001	Jun 2003
Central reclamation Phase III	3.67	Under planning		Apr 2003	Mid 2007
Penny's Bay reclamation Stage 2	18.10			Mid 2003	Mid 2007
Wanchai development Phase II	3.70			Jan 2004	Dec 2007
South East Kowloon development	21.80			Jul 2004	Dec 2010

3 Existing Waste Management Methods

Although waste generation is serious in the construction industry, there are many possibilities in disposing construction and demolition waste, from recycling to incineration and landfilling. Five waste management actions have been recommended by the Waste Reduction Framework Plan (Waste Reduction

Framework Plan 1998): (1) Waste avoidance: waste should not be produced in the first place, for example, packaging should not be used unless essential; (2) Waste minimization: if waste production is unavoidable, it should be minimized. Essential packaging, for example, should be designed to minimize the materials used; (3) Waste recovery, recycling and reuse: the recovery, recycling and reuse of suitable waste materials should be maximized; for example, using a producer responsible scheme to recover waste packaging for reusing; (4) Waste bulk reduction: if it is not possible to recover, recycle or reuse the waste materials, the volume of residual waste should be reduced before the final disposal, this might involve incineration or composting; and (5) Waste disposal: wherever possible the residue left after bulk reduction should be used for construction purposes or reclamation instead of being dumped in landfills.

There are several measures in implementing waste management under government initiatives:

- The Waste Disposal Ordinance [Chapter (Cap.) 354], enacted in 1980, along with its subsidiary regulations, is the principal legal framework. The other ordinances include Waste Disposal (charges for disposal of waste) Regulation, Waste Disposal (designated waste disposal facility) Regulation, Town Planning Ordinance (Cap. 131), and Building Ordinance (Cap. 123) (Environmental Protection Department 2007);
- An environmental protection issue was initially addressed by the Hong Kong government in 1989, which laid down the framework for a comprehensive 10-year plan to reduce construction waste and other pollution problems, including commitments to review its progress every two years;
- In 1995, the Hong Kong government launched a green manager scheme, requiring every governmental department to appoint a green manager to manage the environmental performance of individual organizations (Environmental Protection Department 2007);
- The government drafted a Waste Reduction Framework Plan (WRFP), which was launched on 5 November 1998 (Waste Reduction Framework Plan 1998) attempting to change the waste treatment habits of the public, and acknowledging the low environmental awareness in Hong Kong;
- In February 2003, the Buildings Department (BD) of the Hong Kong SAR issued a practice note for authorized persons and registered structure engineers entitled “Use of recycled aggregates in concrete” (Buildings Department 2006). This technical guideline can be applied to prescribed mix concrete (20P) and designed mix concrete (25D to 35D) to adopt 100% and 20% recycled aggregate respectively;
- The Civil Engineering Department (CED) of the Hong Kong SAR is commissioning a pilot recycling plant at Tuen Mun Area 38 with a view to supply recycled aggregate to a number of public projects from 2004 to 2006 (Civil Engineering Department 2004);
- The Circular (Ref: 15/2003) (Environment Transport and Works Bureau 2004) on “Waste management on construction sites” issued by the Environment, Transport and Works Bureau of the Hong Kong SAR on 15 May 2003 strengthens the government's initiatives by stipulating the implementation of its “Waste management plan” and “Pay for safety and environment scheme” for public construction projects; and
- A landfill charging scheme has been implementing since December 2005 to charge polluting producers of waste dumped into the public landfill areas to encourage the recycling and reusing the construction waste (Environmental Protection Department 2007).

4 Research Methodology

To analyse the effectiveness of the CWDCS implementation in Hong Kong, a survey has been conducted at the Tseung Kwan O Area 137 and Tuen Mun Area 38. Daily waste records from January 2006 to December 2006 collected from landfills and public filling facilities are used.

5 Results

Table 3 shows the quantity received from sorting facilities in 2006. Figure 1 shows the trend of total waste sent to landfills and public fills from 1991 to 2006. It should be highlighted that construction waste disposal dramatically dropped from about 21,450,000 tons in 2005 to about 8,561,200 tons in 2006 after the implementation of landfill charging scheme.

Table 3: Quantity received from sorting facilities in 2006

Facility	Destination	Area	Quantity (ton)	Sub-total quantity (ton)	Total quantity (ton)
Sorting Facilities	Public Fills	Tseung Kwan O Area 137	37,867	56,582 (29%)	196,730
		Tuen Mun Area 38	18,715		
	Landfills	Tseung Kwan O Area 137	112,919	140,148 (71%)	
		Tuen Mun Area 38	27,229		

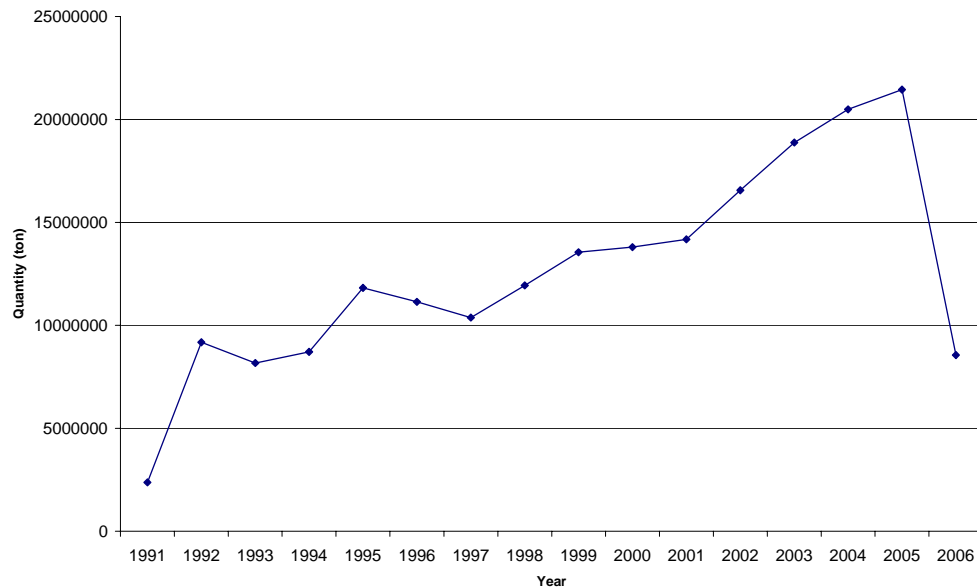


Figure 1: Construction and demolition waste received from 1991 to 2006

From the survey result shown in Table 4, construction waste disposal dramatically dropped from about 58,767 tons per day in 2005 to about 23,455 tons per day in 2006 after the implementation of landfill charging scheme. In comparing the results in 2005 and 2006, it should be noted that about 60% waste reduction in landfills, about 23% in public fills and about 65% in total waste.

Table 4: Approximate construction waste generated in 2005 and 2006

	Landfills (tons per day)	Public fills (tons per day)	Total construction waste (tons per day)
2005	6,556 (11%)	52,211 (89%)	58,767
2006	5,017 (21%)	18,438 (79%)	23,455

Table 5 and Figure 2 show the overall construction waste disposal to landfills and public fills. In 2006, the total quantity of waste sent to landfills and public fills was about 1,831,273 tons and 6,729,927 tons respectively. The total waste received from landfills and public fills was about 8,561,200 tons in 2006.

Table 5: Approximate construction waste disposal in 2006

Month	Landfills (ton)	Public fills (ton)	Total (ton)
January 2006	147,660	612,040	759,700
February 2006	124,538	581,662	706,200
March 2006	142,216	559,684	701,900
April 2006	113,847	435,253	549,100
May 2006	110,300	511,000	621,300
June 2006	128,509	529,091	657,600
July 2006	144,425	499,775	644,200
August 2006	177,688	573,412	751,100
September 2006	140,460	502,040	642,500
October 2006	219,221	550,479	769,700
November 2006	204,347	665,453	869,800
December 2006	178,062	710,038	888,100
Total	1,831,273	6,729,927	8,561,200

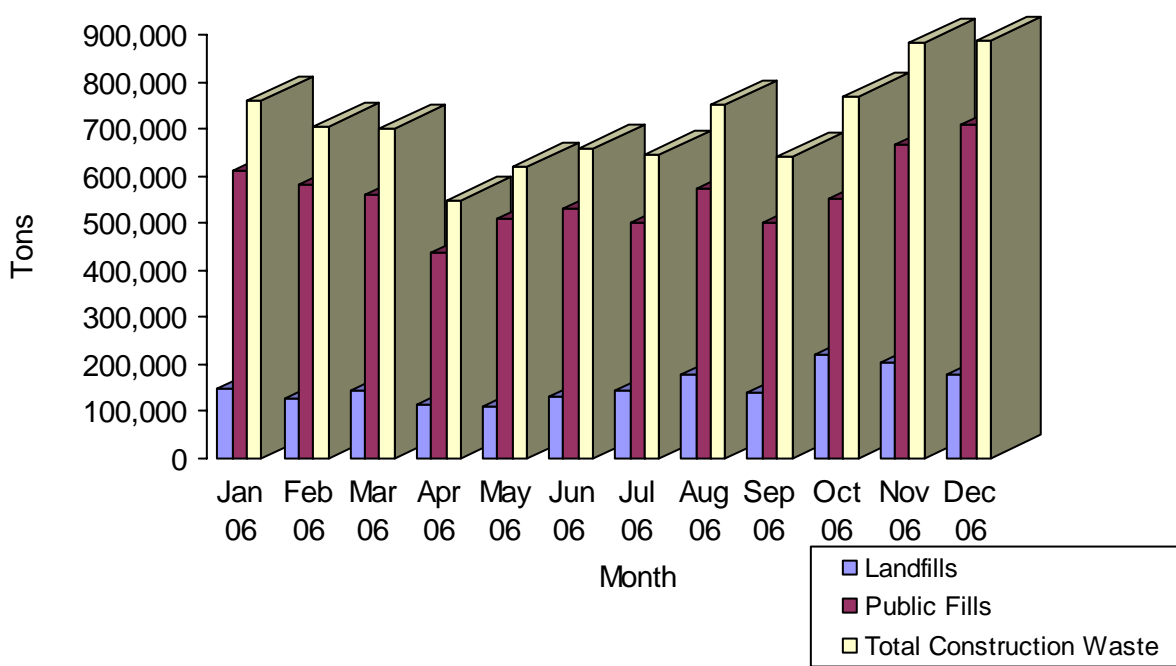


Figure 2: Approximate construction waste in 2006

From the results in this paper, the CWDCS implementation has significantly reduced the total waste generation. Suggestions to fine-tune the scheme and to improve waste recycling are as follows:

- Developing a waste reduction guideline on how to reuse, recycle and reduce different types of construction and demolition waste on site which in turn reduce waste sent to landfills and public fills;
- Providing a threshold waste sent to landfills or public fills and recycling to obtain a higher recycling rate;
- Revising the waste dumping charge, in which necessary charge increment may be implemented to obtain a higher recycling rate;
- Encouraging local recyclers to recycle different types of construction and demolition materials by providing financial support or land from the government; and
- Promoting the use of recycled materials among construction activities to balance the supply and demand markets.

6 Conclusion

Although reusing, recycling and reducing waste have been strongly encouraged by the Hong Kong government, landfilling, the last choice method in waste management hierarchy, is still the most common method used in the construction industry for waste treatment. The Hong Kong government has introduced the Construction Waste Disposal Charging Scheme (CWDCS) since December 2005 to help promoting construction waste reduction. This paper has examined waste in landfills before and after the CWDCS implementation. Detailed comparisons have been made. From that, it should be noted that waste dumped to landfills and public fills has been significantly reduced of about 65% after the implementation of CWDCS. It should be concluded that the implementation of CWDCS has effectively reduced construction and demolition waste, and thus help improving the environment. Recommendations to improve the CWDCS have also been provided to improve its effectiveness.

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