1 INTRODUCTION

1.1 Definitions

Construction and Demolition (C&D) Material is defined by the Environmental Protection Department (EPD, 1998) as:

A mixture of surplus materials arising from any excavation, civil/building construction, site clearance, demolition activities, road works and building renovation. Over 80% of C&D materials are **inert** and are further defined as **public fill**. Public fill includes debris, rubble, earth and concrete which are suitable for land reclamation and site formation. When sorted properly, materials such as clean concrete and asphalt can be recycled for use in construction. The remaining **non-inert** substances in C&D material are called **C&D waste** which includes bamboo, timber, vegetation, packaging waste and other organic materials. In contrast to public fill, C&D waste is not suitable for land reclamation and is disposed of at landfills.

1.2 The Problem and the Need to Reduce Waste

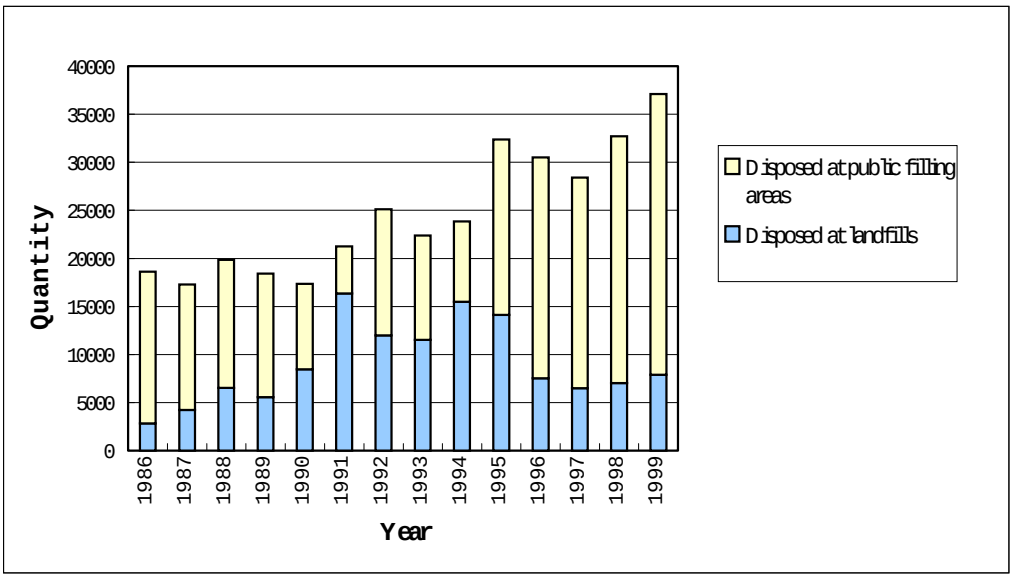


Figure 1.1 Quantities of C& D material generated from 1986 to 1999
(Source: Yuen 1999 and EPD 2000)

The construction industry is the major solid waste generator in Hong Kong. The extensive building and infrastructure development projects as well as redevelopment of old districts has led to an increase in C&D material generation in the last decade. Figure 1.1 shows the quantities of C&D material generated from 1986 to 1999.

According to the Environmental Protection Department (EPD, 2000), a daily average of about 37,110 tonnes of C&D material was generated in 1999, which was 4 times as much as that of municipal solid waste. Of this total amount, 7890 tonnes (21%) was disposed of at landfills while the remainder was disposed to public filling areas (Figure 1.2). The latest statistics on C&D waste arising can be found in EPD's web site at http://www.info.gov.hk/wrc/cdm.

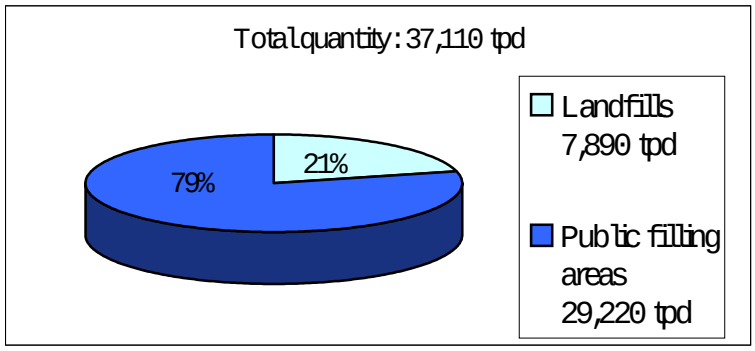


Figure 1.2 Quantity of C&D waste delivered to public filling areas and landfills in 1999
(Source: EPD 2000)

Currently, inert C&D materials (e.g. sand, bricks and concrete) suitable for reclamation and land formation works is disposed of at the public filling areas and the non-inert portion (e.g. plastics, wood and paper) at municipal solid waste landfills. The strategy aims at reusing the inert C&D materials and minimizing the amount requiring landfill disposal so that the life span of the landfills in Hong Kong can be extended. However, in recent years, public concerns and objections have often delayed, stopped or reduced the scale of the implementation of planned reclamation projects, particularly those within Victoria Harbour and there has been a shortfall in reclamation sites. Approved reclamation projects will only provide outlet for inert materials until 2004. For a sustainable waste management strategy, we can no longer rely solely on

reclamations to accept most of the C&D material.

On the other hand, of the 18,040 tonnes of all solid waste disposed of daily at the three municipal waste landfill sites, 44% is C&D materials (EPD, 2000). This C&D materials has been taking up valuable landfill space at a rate of more than 3,500m^3 per day. If we do nothing to reverse this trend, the landfills in Hong Kong will be exhausted in 10 to 15 years (Waste Reduction Framework Plan 1998-2007). As land in Hong Kong is valuable, it is important for Hong Kong to adopt a strategy to reduce and recycle C&D materials and to handle the problem in a more environmentally responsible way.

1.3 Sources of Construction and Demolition Waste

Construction and demolition waste can be classified according to its source, or type of works from which it is generated. Five broad waste materials source categories were identified in an earlier study commissioned by the Environmental Protection Department (EPD 1995):

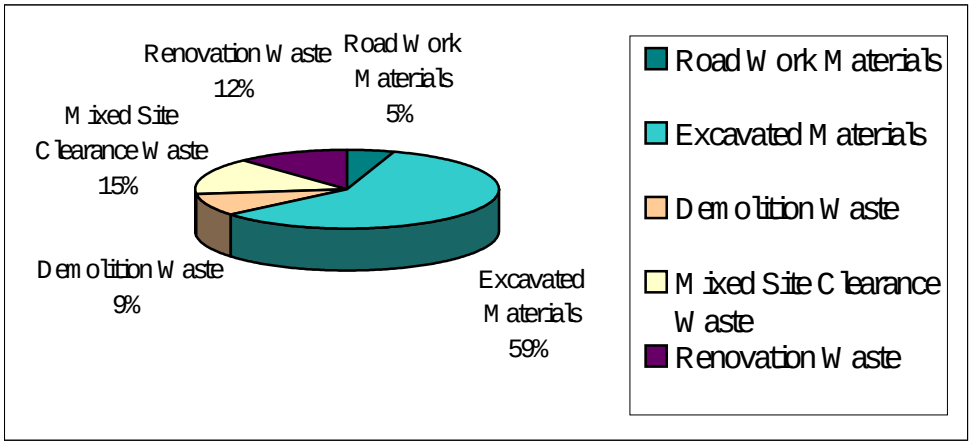


Figure 1.3 Analysis of Source of C&D Waste Received at Landfills
(Source: EPD 1995)

A joint survey by the Civil Engineering Department and the Environmental Protection Department on the source, nature and proportions of C&D material delivered to Public Filling Areas and Landfills from September 1999 to January 2000 classified C&D material according to its source (Table 1.1).

	C&D Material 100%			
	C&D Waste 16.5%		Public Fill 83.5%	
	Private Projects 8.7%	Public Projects 7.8%	Private Projects 44.6%	Public Projects 38.8%
Civil works	0.4%	1.5%	31.9%	26.9%
Fitting out new buildings	0.6%	0.2%	1.4%	1.5%
Renovating old buildings	2.9%	0.7%	2.1%	1.2%
Constructing new buildings	4.3%	5.1%	9.2%	9.2%
Demolishing old buildings	0.6%	0.3%		

Table 1.1 Summary of Survey Results on C&D Material Generation
(Source: EPD, 2000)

Each of these categories of material (waste) requires a different set of criteria for its management. For example, waste material generated from civil engineering works such as site formation, is mainly soil, sand, and rubble. This source of waste is usually minimized by balancing cutting and filling on a project basis. A set of engineering standards is already available to govern the use of excavated materials for filling (refer to General Specifications of Civil Engineering Works). Therefore, this guidebook is mainly concerned with measures for the reduction of waste generated from the other building works categories.

1.4 Constituents of Construction and Demolition Waste

According to a study conducted by EPD in 1995, 12 sub-categories of waste constitute the bulk of C&D waste received at landfills (EPD 1995). Table 1.2 indicates the composition of each category.

Component	Composition of each category of construction & demolition waste received at landfill sites (% by weight)				
	Road work material	Excavated soil	Demolition waste	Site Clearance	Renovation Waste
Soil/Sand*	23.0	73.8	21.5	33.0	19.4
Concrete/Mortar*	16.9	1.2	10.8	4.6	7.4
Rock/Rubble*	14.4	12.5	27.7	15.0	38.8
Reinforced concrete*	14.2	0.4	5.8	0.9	7.0
Bricks/Tiles*	0.8	0.4	12.1	1.4	9.6
Slurry & mud	1.8	9.7	1.5	1.0	3.1
Asphalt	24.7	0.0	0.0	0.2	0.0
Cement contaminated	1.7	0.4	3.2	15.6	3.3
Wood	0.6	0.9	10.5	13.3	7.1
Ferrous metals	0.5	0.0	0.6	1.0	1.3
Non-ferrous metals	0.0	0.0	0.7	0.2	0.1
Others (include bamboo, trees, glass, plastics, bulky waste/fixtures, organics & garbage	1.4	0.7	5.6	13.8	2.9
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Percentage of total quantity of C&D waste landfilled	5.2	59.4	8.5	14.6	12.3

Note:

* Inert materials which are considered suitable for public filling area
The above figures are estimated by visual inspection of 3060 trucks loads delivering construction & demolition waste in 1995. They should be regarded as indicative only rather than actual composition of construction & demolition waste during the year.

Table 1.2 Composition of construction & demolition waste disposed of at landfills in 1995
(Source: EPD 1995)

1.5 Forecast of Construction and Demolition Waste Arising

Since 1998, a forecast of the generation of construction & demolition (C&D) material has been carried out by the Civil Engineering Department (CED) which oversees the management of public fills (i.e. inert C&D materials) through its Fill Management Committee. The public fill planning model, one of the key elements of the public filling strategy set out by the Committee, has been

developed by CED. The planning model, amongst other things, forecasts the quantity C&D material arising. Based on the information generated from the planning model, the forecast quantities of C&D material arising in 2001, 2006 and 2011 and 2016 have been estimated. The forecast quantities of C&D waste to be disposed of at landfills are based on the assumption that about 80% of the total C&D material arising will be delivered to public filling areas and the remaining 20% to landfills. The actual and estimated quantities of public fill and C&D waste to be disposed of at public filling areas and landfills respectively since 1986 are shown in Figure 1.4.

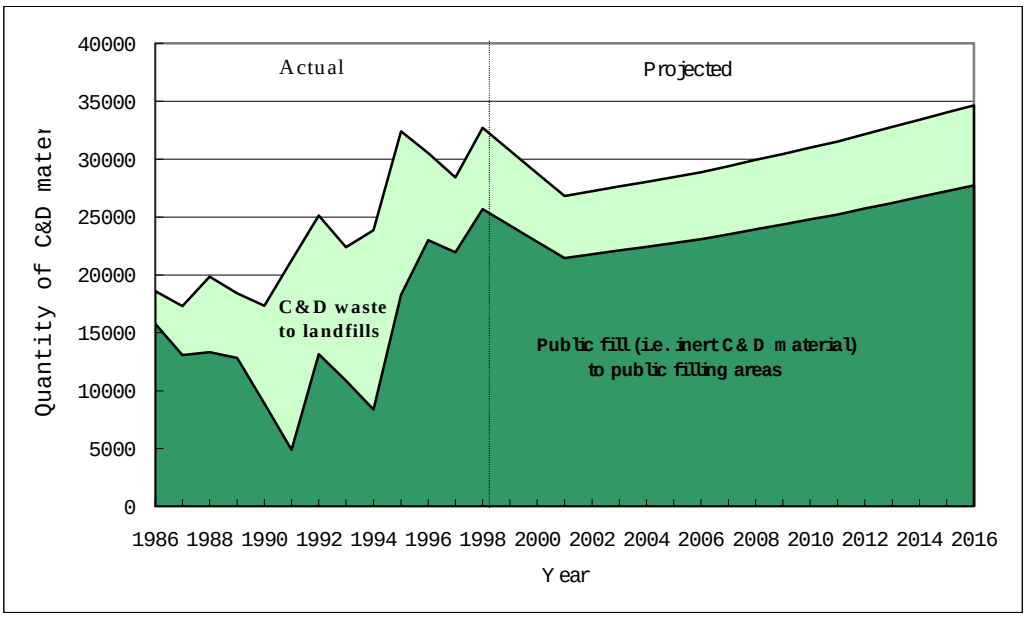


Figure 1.4 Quantity of construction and demolition waste disposed of at public filling areas and landfills 1986 – 2011
(Source: Mouchel, 1998)

1.6 The Waste Reduction Framework Plan

In November 1998, the government launched a ten-year Waste Reduction Framework Plan (WRFP) to reverse the rising trend of waste growth and to conserve the scarce landfill space. The Plan sets out programmes to:

- extend the useful life of our strategic landfills;

- minimise the amount of waste produced;
- help conserve the earth's non-renewable resources;
- increase the waste recycling rate;
- identify the true costs of waste management;
- improve institutional arrangements to manage and minimize waste.

For the management of C&D materials, the WRFP sets out the target that, in addition to 80% of the total C&D material arising already diverted to public filling areas, a further 20% reduction of the remaining C&D waste to be disposed of at landfills is targeted to be achieved by:

- introducing a landfill charging scheme;
- introducing on-site sorting of C&D waste in government works projects;
- exploring reuse and recycling of C&D waste; and
- avoiding and minimizing C&D waste through better design and construction management.

1.7 The Waste Management Hierarchy

A comprehensive waste minimisation plan should consist of the components "Avoidance", "Minimisation", "Reuse" and "Recycle". The first priority is waste avoidance, that is not producing wastes in the first place. If wastes must be produced, the quantities should be minimised. The next priority is to maximise recovery, reuse and recycling of suitable waste materials. When these possibilities have been exhausted, the next priority is to reduce the bulk volume of residual waste being passed on to the last option of is final disposal at landfill.

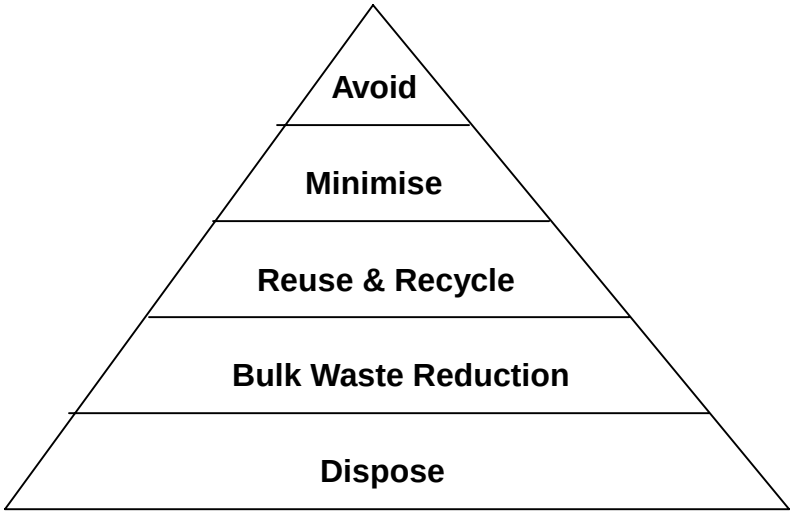


Figure 1.5 Waste Management Hierarchy

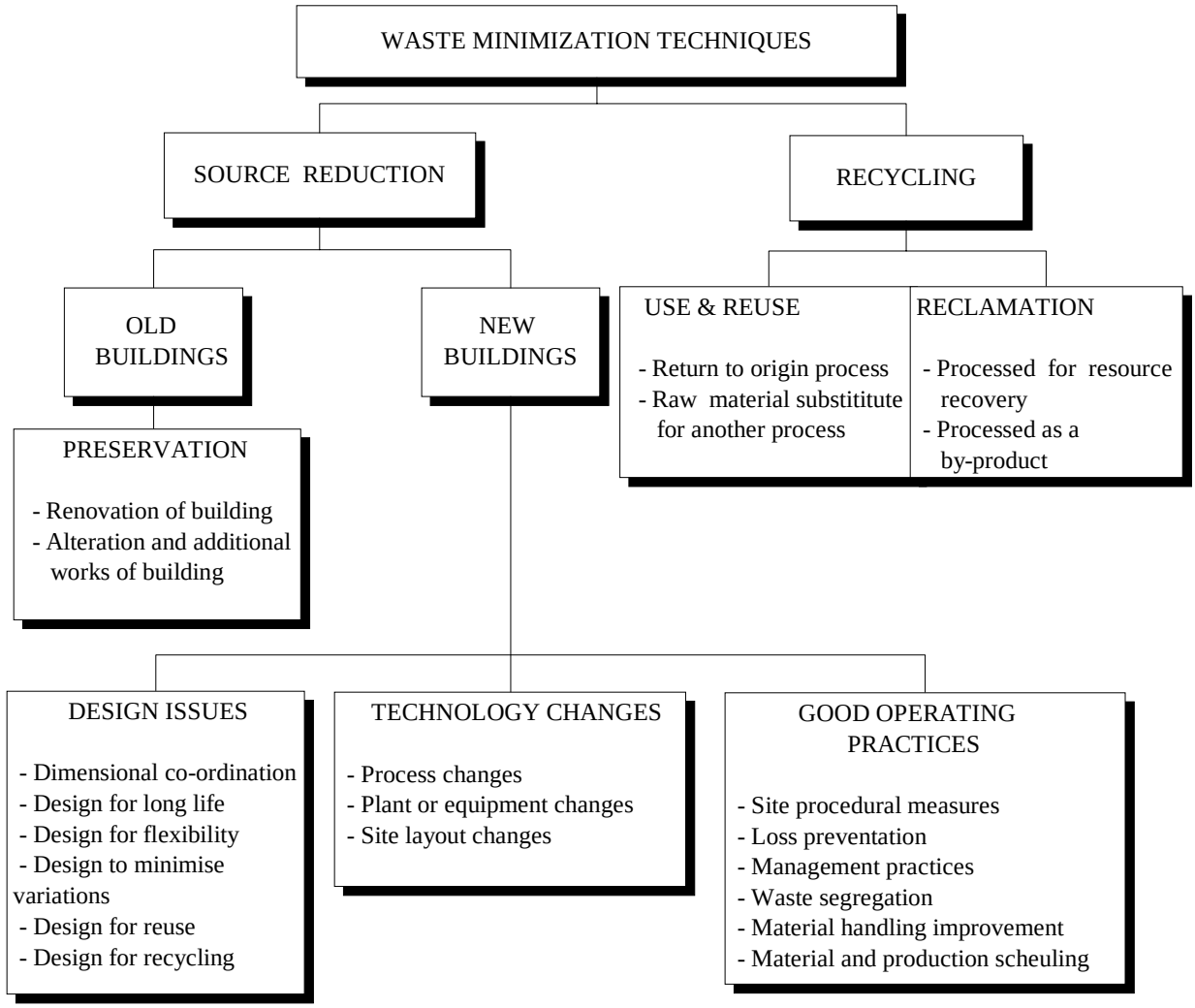
1.8 Waste Minimization Techniques

Source of the waste minimization techniques in construction are illustrated in Figure 1.6. The two basic techniques are source reduction and recycling (on-site and off-site). For example, steel and aluminium formwork can be reused over 100 times and are more sustainable alternatives to timber formwork; rubble and demolition waste may be processed and sorted to be free from contaminant for reclamation purposes.

As for source reduction, the retention of old buildings until the end of structural life is recommended. Older buildings should be renovated at 10-15 years depending on the state of the buildings. If a change of use is required, alteration and additional works should be considered first before any final decision to demolish the building.

While all of these issues are important, this guidebook will concentrate on source reduction for construction of new buildings i.e. design changes, technology changes and good operating practices for construction of new buildings. The issues for good operating practices are dealt with in Chapter 3 and low-waste technologies are recommended in Chapter 4. Finally, waste control in the design stage is dealt with in Chapter 5.

Figure 1.6 Waste Minimization Techniques in Construction
(modified from Ciambrone, 1996)



1.9 Objectives of this Guidebook

In recognition of the need to reduce waste, this guidebook is developed to provide practical guidance for the professionals in the building industry. It focuses on the following areas:

- Facilitating the reuse and recycling of demolition waste through selective demolition techniques and on-site sorting of waste. (Chapter 2)

- Avoiding and minimising building waste through better management and operating practices. (Chapter 3)

- Avoiding and minimising building waste through better construction technologies. (Chapter 4)

- Avoiding and minimising building waste through better design considerations. (Chapter 5)