2 MINIMISING AND MANAGING DEMOLITION WASTE

2.1 Demolition Waste

The Planning and Lands Bureau of Hong Kong made an assessment in 1999 of the condition of buildings in urban areas. The result revealed that there were 8,500 buildings over 30 years old and of these, 2,200 buildings required redevelopment.

In a building demolition project, almost the whole building structure including the substructure, superstructure and external landscape will become demolition waste. This is 10-20 times by weight of the waste generated from the construction of a new building. The waste usually consists of high percentages of inert materials such as bricks, sand and concrete. If this huge quantity of demolition debris is not properly managed for reuse or recycling, it would surely further aggravate the landfill shortage problem or severely shorten the life of the public filling areas.

The characteristics of the demolition waste may vary depending on the types of structures demolished and the demolition technique used. For instance, a large quantity of reusable materials such as timber and ferrous metal can be recovered by using selective demolition techniques, whereas an intermingled pile of mixed demolition waste will result when implosion or heavy mechanical demolition is used. The success of waste separation is highly dependent on the demolition method used.

2.2 Demolition Methods

Hammering - a top down method by which building components are broken down by repeated hammering caused by either machine mounted or hand held percussive breakers. This method is commonly used in Hong Kong. It is easy for waste separation.

Hitting - a wrecking or steel ball of weight 0.5-2 tones suspended from a crawler type crane repeatedly pounds the building. Much noise, dust and vibration are generated. An intermingled pile of demolition waste results. It is difficult for waste separation.

Crushing - a top down method by which the building components are broken into pieces by Jaw type or C-shaped crushers. It is easy for waste separation.

Bursting – the principle is to induce tensile stresses to crack the structure by filling with a chemical agent. Calcium oxide is commonly used since it expands after mixing with water. It is easy for waste separation.

Blasting - similar in principle to modern rock blasting. Small confined explosives changes are placed in designated drilled holes at the base of a concrete structure. However, for safety and environmental reasons, this method is restricted in congested areas. An intermingled pile of mixed demolition waste results, and it is

difficult for waste separation.

In Hong Kong, demolition sites are usually located in congested areas and space is not available for large machinery such as cranes. In view of this, the top-down method is the most commonly used demolition method. As its name implies, the conventional top-down method proceeds from the roof of the building to the ground in a floor by floor downward sequence. A typical demolition work statement is as follows:

1) To provide hoardings, covered walkways and temporary supporting structures along the demolition site.

2) To disconnect all services including drainage, electricity, water, gas, telephones and to seal up existing drainage routes to prevent the entering of debris.

3) To remove all non-inert waste such as loose household furniture, etc. left behind by tenants before the commencement of demolition.

4) To cover the whole building by a protective screen such as a double layer of tarpaulin sheet, catch fans, heavy duty nets and double layers of bamboo scaffolding.

5) To cut out a floor strip along the demolition line before large scale demolition work commences.

6) To remove all the existing building structure floor by floor down to ground floor level from roof level.

7) To break up a debris canyon (3m x 3m) in each floor.

8) To hoist a hydraulic percussion breaker to the top floor.

9) To demolish the building in sequence:
   (a) Slab demolition
   (b) R.C. beam/external wall demolition
   (c) Internal wall demolition

10) To grub up pile caps, ground beams, unused drains and gulleys.

11) To collect old materials and rubbish on the ground floor through the debris canyon.

12) To deliver demolished materials with a maximum size of 250x250mm to the ground floor for sorting. The sorting process and removal of demolished materials shall separate:
    (i) steel;
    (ii) concrete fragments;
    (iii) timber, rubbish and other decomposable materials.

13) To store the above three groups of materials into separate stocking areas for subsequent removal.

14) To cart away debris.

The acceptability of the material at public filling areas is largely dependent on the size and cleanliness of the materials. The current public dumping licence conditions only allow lorries containing rock or broken concrete up to 250mm in size, well mixed with earth, to enter public filling areas. Unacceptable materials, therefore, must be delivered to landfills.

2.3 Selective Demolition

To ensure all demolition waste is acceptable at public filling areas or for recycling, it may be necessary to alter the traditional demolition method and introduce “selective demolition”. The method requires that before and during the demolition process a concise sorting of different material categories is carried out to prevent any contamination of inert or recyclable parts with wood, paper, cardboard, plastics and metals etc (Lauritzen and Hahn 1992).

Selective demolition is principally carried out in reverse order to the construction process according to the following procedures:

1) removal of remains and non-fixtures;

2) stripping, comprising internal clearing, removal of doors, windows, roof components, installation, water, air conditioning, electricity etc. leaving only the building bearing structure.
3) demolition of the building structure.

Figure 2.1 illustrates the sequence of selective demolition. The demolition process is separated into phases in which one type of material is carefully dismantled at one time and salvaged for reuse and recycling. The wastes generated in each dismantling stage are of similar types and nature such that contamination of non-recyclable items can be significantly reduced.

Since the work involved in the removal of non-fixtures and other internal services/remains is primarily carried out by hand, the above procedure is more labour and time demanding. However, the demolition waste would be largely free from contaminants and non-recyclable materials and saving can be realised by reduced transport and disposal costs. It has been estimated that the overall cost of the demolition work would be increased by 10-20% (Lauritzen and Hahn 1992).

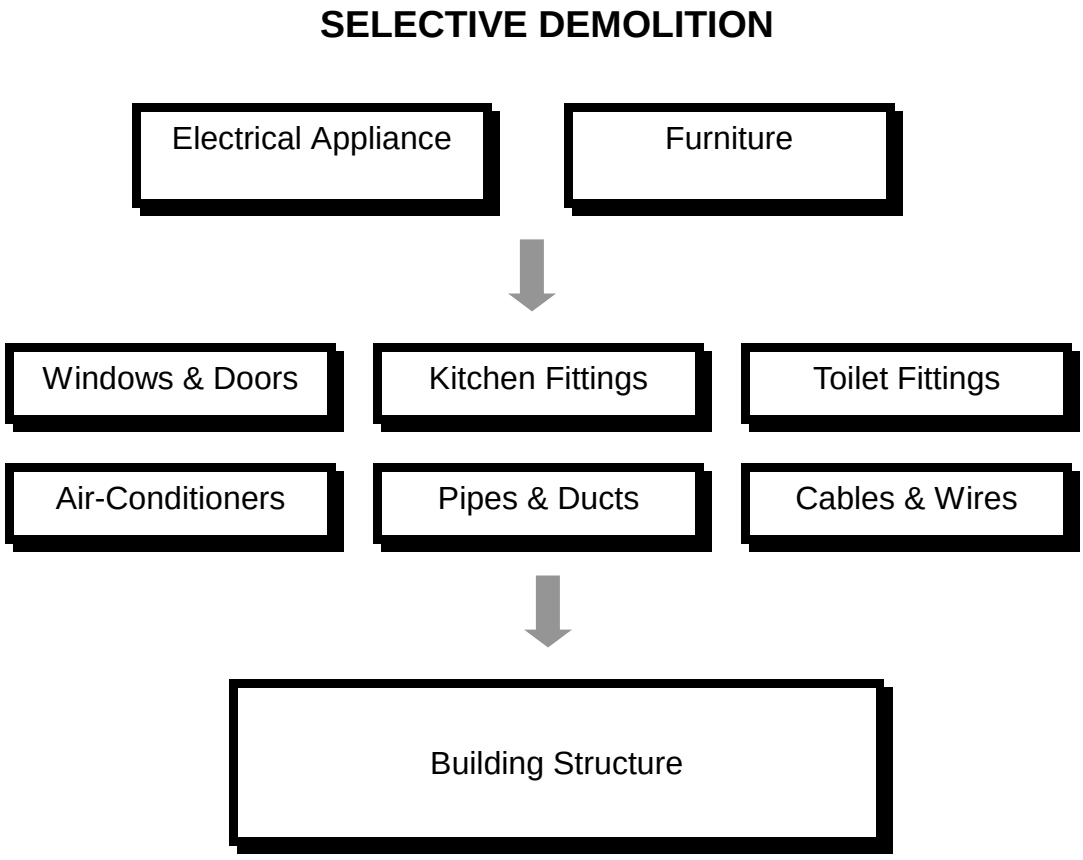

Figure 2.1 Sequence of Selective Demolition

2.4 On-site Sorting of Demolition Waste

The HKSAR government has also realised the importance of source separation and has published technical circular WBTC no. 5/98 on on-site sorting of C&D material on demolition sites. It stated that " as from 1st April 1998 all tenders for contracts which comprise solely (i.e. 100%) demolition works shall include a requirement for on-site sorting of all C&D material prior to disposal and a particular specification clause shall be included in the tender documents for mandatory on-site sorting, processing and disposal of the same".

A suggested clause is set out as follows:

"All construction and demolition (C&D) materials arising from or in connection with the demolition work shall be sorted on-site and be separated into different groups for disposal at landfills, public filling areas, in filling areas provided by the Contractor, or recycling as appropriate. All public fills to be disposed of at public filling areas shall be sorted and broken down according to the Dumping Licence conditions.

Unless otherwise stated in the Contract, all C&D materials arising from or in connection with the demolition work shall become the property of the Contractor. The Contractor shall promptly remove all sorted and processed materials arising from or in connection with the demolition work from the Site on a regular basis as demolition work proceeds.

A method statement for the sorting, processing and disposal of C&D materials arising from or in connection with the demolition work shall be submitted to the Architect/Engineer or his representative for his approval [ ] days before the commencement of any sections of the Works."

It is suggested that contractors should separate at least inert from non-inert materials for reclamation and site formation use. Recent research indicated that 90% of demolition waste produced could be used for reclamation if waste sorting is performed. Higher grade use e.g. a road sub-base, of inert waste is also feasible provided that the relevant specifications are met.

2.5 Alternative Uses of Demolition Materials

Figure 2.2 shows that demolition materials can be separated into ferrous metals and concrete waste. The ferrous metal can be sent to a steel mill for producing recycled steel. The concrete waste can be reused for road building or sent to concrete processing station for making recycled aggregate.

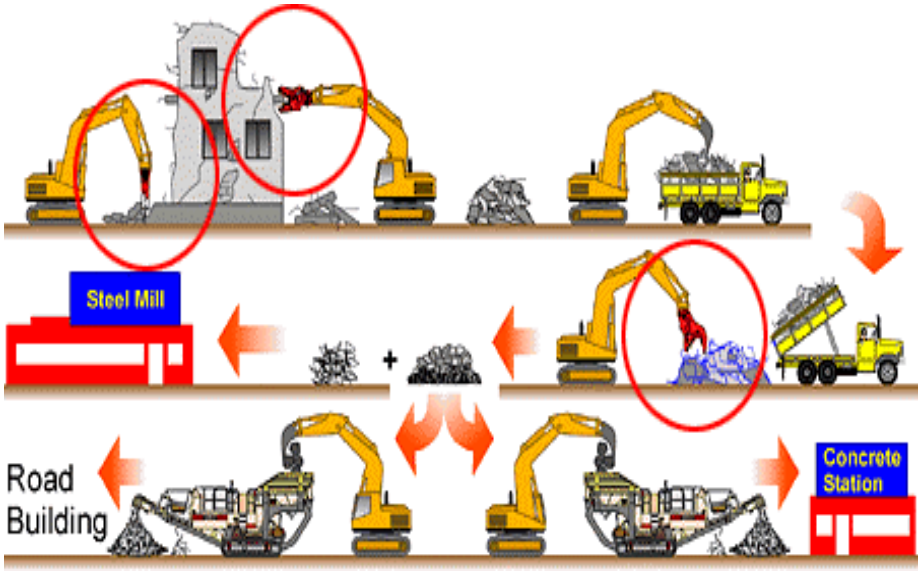

Figure 2.2 Alternative Uses of Demolition Materials

The suitability of the recycled aggregate for various applications is summarised in the following table (Kibert, 1993).

Recycled aggregate Category	General bulk fill	Fill in drainage project	Material for road construction	New concrete manufacture
Crushed demolition debris	●	●	※	※
Graded mixed debris	●	●	○	○
Clean graded brick	●	●	●	○
Clean graded concrete	●	●	●	●

● - Suitable ※ - Suitable in some cases ○ - Not suitable