Topic 8
Solid Waste Disposal System

Introduction

- Often the last building distribution system considered is the one involving the bulkiest items, the flow of supplies in and solid waste out.
- This system is usually not seen as consuming building energy or requiring specialized equipment, therefore it ordinarily becomes a lower priority system in the design process.
- In actuality, the provisions for delivery of supplies and the collection and storage of solid wastes can be more consuming than water/ waste systems, can present a fire danger and can create local environmental problems.
- The separation of solid waste for resource recovery involves significant energy and environmental consequences.
- Mechanical equipment associated with solid waste is now more commonly installed.

SIX ELEMENTS OF SWM

- Generation
- Storage
- Collection,
- Transportation and transfer,
- Processing and Treatment
- Disposal

Develop a sustainable waste management strategy

A sustainable waste management strategy for tower blocks should consider the following issues and opportunities:

- increasing residents awareness of waste as an environmental issue
- reducing volume of waste through the refuse chute
- sorting of waste for recycling
- composting of organic household waste
- provision of storage area in each flat to store recyclable waste
- Ensuring a clean and tidy environment particularly around storage areas

Refuse Collection Systems

Bins

- Cheapest methods of refuse collection in buildings
- Adequate ventilation
- Use of rubber and plastic bins to avoid noise
- Special vehicles with larger containers required to handle and empty the bins daily.

For Office Buildings, The manual managed refuse disposal system

- Refuse from each floor is collected by a worker using a bigger bin pushed on a cart
- The collection is the responsibility of the building management
- The refuse is taken down to a bin center by a service lift located nearby
- Trolleys in the bin centre are provided by the local authority by rentals
- Provision of a disposal bay which allows the access of a rubbish truck
- The refuse chamber can be located on the ground floor or sub-basement , with a water source for washing and cleaning purposes.

Types of Solid Wastes

- The resources within solid wastes can be divided into high grade resources represented by recyclable materials and the low-grade resources of heat and by-products obtainable from the burning or decomposing of combustible solid wastes.

High Grade Resources

- These include metals such as aluminum and steel, paper and paperboard, wood, and some plastics. For buildings they pose the problem of storage while awaiting collection. For many of these materials, reuse in their present form is desirable, which eliminates compaction as a storage strategy.

Low Grade Resources

- Include material for which recycling is impractical but that are combustible, including gaseous wastes, liquid and semi-liquid wastes, and solid wastes.
- Incinerators must meet increasingly strict regulations and as a result are rarely installed in buildings.
- A better option is to compost them in landfills.
- The methane generated in landfills can then

- In general, the more thoroughly the different types of solid wastes are mixed, the harder it is to recover their high and low grade resources.
- From an energy conservation viewpoint, solid wastes should be kept locally as separate as possible.
- However there are two disadvantages to local solid waste separation.
  - Keeping solid waste separate requires more time and effort on the part of the consumer.
  - The floor or cabinet space taken up by so many separate containers.

WASTE GENERATION IN MALAYSIA

Bil.	Negeri	Tahun 2000		Tahun 2001		Tahun 2002	
		Angg. Penduduk dalam kaw. PBT	Angg. Sisa Yang Dihasilkan (tan/hari)	Angg. Penduduk dalam kaw. PBT	Angg. Sisa Yang Dihasilkan (tan/hari)	Angg. Penduduk dalam kaw. PBT	Angg. Sisa Yang Dihasilkan (tan/hari)
1.	JOHOR	2,252,882	1,915	2,309,204	2,002	2,366,934	2,093
2.	KEDAH	1,557,259	1,324	1,596,190	1,384	1,636,095	1,447
3.	KELANTAN	1,216,769	1,034	1,247,188	1,081	1,278,368	1,131
4.	MELAKA	605,361	515	620,495	538	636,007	562
5.	NEG. SEMBILAN	890,597	757	912,862	791	935,683	827
6.	PAHANG	1,126,000	957	1,154,150	1,001	1,183,004	1,046
7.	PERAK	1,796,575	1,527	1,841,489	1,597	1,887,527	1,669
8.	PERLIS	230,000	196	235,750	204	241,644	214
9.	PULAU PINANG	1,279,470	1,088	1,311,457	1,137	1,344,243	1,189
10.	SELANGOR	3,325,261	2,826	3,408,393	2,955	3,493,602	3,090
11.	TERENGGANU	1,038,436	883	1,064,397	923	1,091,007	965
12.	KUALA LUMPUR	1,400,000	2,520	1,435,000	2,635	1,470,875	2,755
	JUMLAH	**16,718,610**	**15,541**	**17,136,575**	**16,248**	**17,564,989**	**16,987**

Source: MHLG 2003

Waste Composition (K.L.)

No.	Source Of Waste	Residential	Commercial	Institutional
1.	Food waste & organic	63.1	76.8	40.6
2.	Mix paper	6.7	7.6	16.0
3.	Mix plastics	14.3	9.0	17.2
4.	Textiles	1.7	0.5	0.7
5.	Rubber & leather	0.6	0.3	0.1
6.	Yard waste	6.3	0.9	18.4
7.	Glass	2.1	0.9	1.5
8.	Ferrous	2.3	1.4	2.8
9.	Aluminum	0.1	0.1	1.3
10.	Others	2.8	2.5	1.4
	Total (2,3,7,8,9)	**25.5**	**19.0**	**38.8**

Source: Nazeri 2002

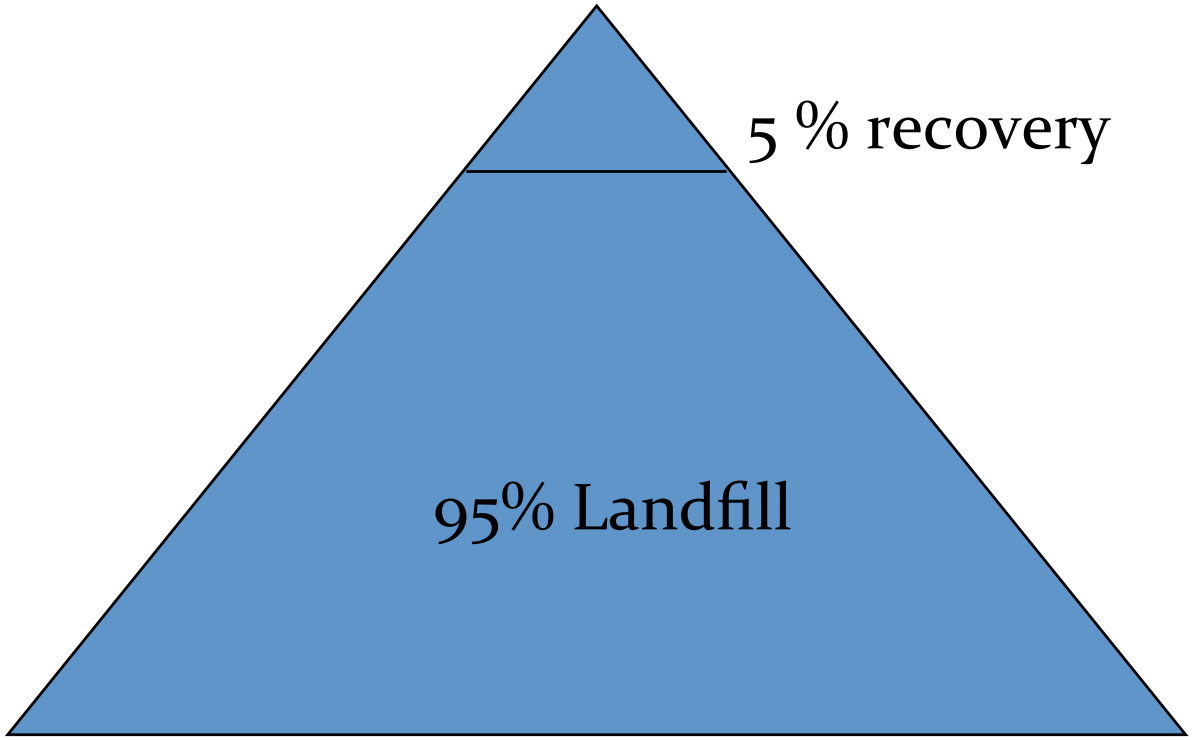
ROLE OF LOCAL GOVERNMENT

- Local Authorities are the implementing agencies and have direct responsibility over solid waste collection, treatment and disposal.

THE WAY FORWARD

Waste Hierarchy (Current Status)

- Reduce
- Reuse
- Recycling
- Intermediate Processing
- Disposal



THE WAY FORWARD

Waste Hierarchy (Targeted 2020)

- Reduce
- Reuse
- Recycling
- Intermediate Processing
- Disposal

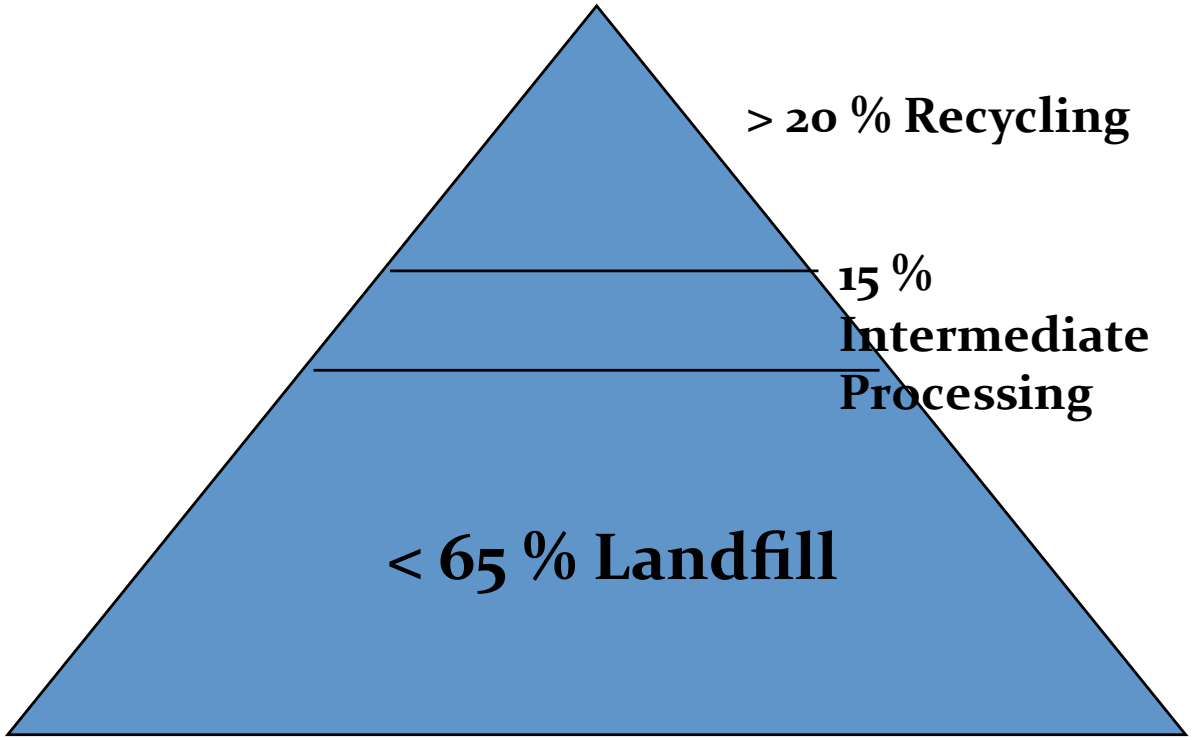


Table 8.2 **Solid Waste Sources in Building Operation**

Classification	Occupancy	Types of Waste Generated (percent, where available)	Quantities of Waste Generated I-P Units	Quantities of Waste Generated SI Units
Residential	Studio or 1-bedroom apartment	Newspaper (38/43)[a] Plastic (18/7)[a] Miscellaneous (13/18)[a]	1–1.5 yd^3/unit/month (200–250 lb) or 2.5 lb/person/day	0.8–1.1 m^3/unit/month (91–113 kg) or 1.1 kg/person/day
	2- or 3-bedroom apt. or single-family house	Metals (14/9)[a] Compost (10/15)[a] Glass (2/8)[a]	1.5–2 yd^3/unit/month (250–400 lb) or 2.5 lb/person/day	1.1–1.5 m^3/unit/month (113–181 kg) or 1.1 kg/person/day
Commercial	Office	Plastics, compost, used oil, metals, and glass (30)[b] High-grade paper (29)[b] Mixed papers (23)[b] Newspaper (10)[b] Corrugated cardboard (8)[b]	1.5 lb/employee/day or 1 yd^3/10,000 ft^2/day (includes 0.5 lb of high-grade paper/employee/day)	0.7 kg/employee/day, or 0.8 m^3/1,000 m^2/day (includes 0.2 kg of high-grade paper/employee/day)
	Department store Wholesale/retail Shopping center	Corrugated cardboard, compost, wood pallets, high-grade paper, and plastic film	1 yd^3/2,500 ft^2/day 70 lb/$1000 sales/day 2.5 lb/100 ft^2/day	0.8 m^3/250 m^2/day 32 kg/$1000 sales/day 1.1 kg/100 ft^2/day
	Supermarkets	Corrugated cardboard, compost, and wood pallets	1 yd^3/2,500 ft^2/day	0.8 m^3/250 m^2/day
	Restaurants/entertainment	Compost (38)[b] Corrugated cardboard (11)[b] Newsprint (5)[b] High-grade paper (4)[b]	Cafeteria, 1 lb/meal Fast food, 200 lb/$1000 sales Restaurant, 1.5 lb/meal	Cafeteria, 0.45 kg/meal Fast food, 91 kg/$1000 sales Restaurant, 0.7 kg/meal
	Drug stores	Corrugated cardboard and high-grade paper	1 yd^3/2,000 ft^2/day	0.8 m^3/200 m^2/day
	Banks, insurance companies	High-grade paper, mixed paper, and corrugated cardboard	0.75 lb high-grade paper/person/day (survey required)	0.34 kg high-grade paper/person/day (survey required)
Hotels and Motels (not including restaurants)	High occupancy	Glass, aluminum, plastic, high-grade paper, newspaper, and corrugated cardboard	0.5 yd^3/room/week 3.2 lb/room/day	0.38 m^3/room/week 1.45 kg/room/day
	Average occupancy		0.17 yd^3/room/week 1.7 lb/room/day	0.13 m^3/room/week 0.8 kg/room/day
Institutional	Hospitals	Compost, high-grade paper, biomedical waste, corrugated cardboard, glass, and plastics	1 yd^3/5 occupied beds/day	0.8 m^3/5 occupied beds/day
	Nursing homes		1 yd^3/15 persons/day	0.8 m^3/15 persons/day
	Retirement homes		1 yd^3/20 persons/day	0.8 m^3/20 persons/day
Educational	Grade school	High-grade paper, mixed paper, newspaper, corrugated cardboard, compost, plastic, glass, and metals	1 yd^3/8 rooms/day	0.8 m^3/8 rooms/day
	High school		1 yd^3/10 rooms/day	0.8 m^3/10 rooms/day
	Universities		(Survey required)	(Survey required)

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[a]Percent by volume/percent by weight.

[b]Percent by volume.

- Approximate external storage areas are listed in Table 8.3. For groups of residences where storage compounds are provided, garbage cans should be fenced off to dogs and other marauders. Different bins for recyclable materials may be provided. A central compost pile could provide humus for the landscaping of the complex.

Table 8.3 **Space Planning for Solid Waste**

PART A. I-P UNITS			
		Exterior Area Required	
Occupancy	**Building Area ft²**	**For Trash ft²**	**For Recyclable Materials, ft²**
Nonresidential	0–5000	12	12
	5001–10,000	24	24
	10,001–25,000	48	48
	25,000+	Each additional 25,000 ft² require 48 ft² each, trash and recyclables	
Multifamily Residential	2–6 Units	12	12
	7–15 Units	24	24
	16–25 Units	48	48
	25+ Units	Each additional 25 dwelling units require 48 ft² each, trash and recyclables	
PART B. SI UNITS			
		Exterior Area Required	
Occupancy	**Building Area m²**	**For Trash m²**	**For Recyclable Materials, m²**
Nonresidential Buildings	0–465	1.1	1.1
	466–929	2.2	2.2
	930–2323	4.5	4.5
	2323+	Each additional 2323 m² require 4.5 m² each, trash and recyclables	
Multifamily Residential	2–6 Units	1.1	1.1
	7–15 Units	2.2	2.2
	16–25 Units	4.5	4.5
	25+ Units	Each additional 25 dwelling units require 4.5 m² each, trash and recyclables	

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Solid Waste Disposal for Large Buildings

2. begins as custodians disconnect these individual baskets and dump them in separate bins on a collection cart. At various special purpose stations, special wastebaskets can be supplied, white paper at the computer room and the copying machine, compostables and garbage at the employee lounge. Floor sweepings are added to the garbage. When the cart is full it is wheeled to the service closet, located at the core. There is a separate for each category of waste, along with a service sink and paper shredder.

3. begins at the ground floor of the service elevator, where white paper and other recyclables are shredded and stored until collection, compostables are stored or sent to a roof garden compost pile, and garbage is compacted and bagged. In the storage space, cool, dry and fresh air is desirable. A sprinkler fire protection system is required. The compactors and shredders are noisy and must be vibration-isolated from the floor. At the end of the 3rd stage, a truck or van from the recycling centre collects recyclables, and a garbage truck collects the garbage bags.

- First Stage:
  - On each floor central recycling points are gathered around four 508mm diameter steel chutes that run from top floor to sub-basement:
    - For white and computer paper – the opening in a vestibule for copy machines.
    - For organics (food wastes and soft soiled paper)
    - Returnable plastic bottles and aluminium cans
    - Mixed paper (coloured paper, file folders, paperboard)
  - In addition shelves in each pantry accept returnable glass bottles, coated papers, magazines and newspapers

- In the 2nd stage of collection,
  - custodians pick up the work baskets in the work areasand the collection from the pantry shelves.
  - These are taken to the sub-basement recycling depot and sorted.
- In the 3rd stage,
  - large movable bins await deposits at the bottom of the chutes.
  - Glass bottles, newspapers etc are collected and baled or boxed.
  - Recyclable materials and garbage are periodically taken up to the delivery docks to recycling and garbage collectors.
  - Organic compostable material is first refrigerated until enough material accumulates.
  - It is then screened and put into one of 4 composting reactors, each with an 18kg capacity.
  - After a 3 month decomposition period, the compost has turned to humus and is taken to the roof garden

Equipment for handling solid waste.

- As an alternative to the 4 chute system, an alternative is to use a single chute with a rotating receiving facility at the base. With up to 6 receiving bins on a carousel and a control panel at each floor's opening, considerable floor space is saved. The user sets the control panel setting, turning the carousel below to the appropriate bin. The access panel opens only one at a time and the garbage can be deposited. The receiving room at the bottom of the chute is about 3.7m square, with a minimum height of 2.4m.

- Most compactors can reduce the volume of solid waste to as little as 10% of the original volume.
- The different types depends on vertical or horizontal compaction;
  - automatic chute-fed or manual free-standing;
  - waste to be bagged or baled;
  - and the final size of each unit of compacted waste.
- Compactors can be noisy and be prone to fires as heat is generated during the compaction process.
- Many compactors have built-in sprays for fire control and disinfecting.
- Access to wash water and a floor drain are highly desirable.

Vacuum System

- A vacuum system has the following advantages:
- Reduce building volume consumed by waste chutes and storage cans on each floor
- Lines can be small
- Contents can move horizontally or even up
- Thus greater flexibility in design is possible
- A grinder plus evacuated tube system is similar to the one in figure

THE WAY FORWARD

Technical Aspect

- Integrated solid waste management facilities
- New Facilities with appropriate technology
  - Transfer Station
  - Thermal Treatment Plant
  - Composting Plant
  - Sanitary Landfill