

CHAPTER 11

STREET CLEANSING

11.1 INTRODUCTION

The sweeping of streets is such a simple and humble occupation that it rarely attracts technical interest of the managers responsible for such activities. However, many cities spend between 30 to 50 percent of their solid waste budgets on street cleansing. It is a service for which a wide variety of tools, equipment and methods, both manual and mechanical, are available, and it is one in which there is often great scope for financial saving by the introduction of more efficient methods.

This is an area in which public relations are very important. Much of the work arises directly from shortcomings in public behaviour, such as throwing litter on the streets and open spaces. In some cities, however, a high proportion of street wastes arise from deficiencies in the refuse collection service as a result of which residents dispose of domestic and shop-wastes in the streets. The cost of removing wastes which have been scattered on the streets is very much higher than the cost of collecting similar wastes which have been placed in containers such as domestic wastes bins or litter containers.

Thus street cleansing policies should have the following objectives:

- the provision of services for the collection of wastes from source, i.e., efficient refuse collection,
- reduction of street litter by public education and awareness,
- the use of systems which achieve high labour productivity,
- the design and use of effective tools and equipment.

11.2 SOURCES

For the purpose of solid waste management all street wastes fall into three main categories:

11.2.1 Natural Wastes

These include dust blown from unpaved areas, sometimes from within the city and sometimes from a great distance, and decaying vegetation such as fallen leaves, blossoms and seeds which originate from trees and plants in the city. Natural wastes cannot be avoided, but may be controlled by such measures as the careful selection of the types of tree planted in the city.

11.2.2 Road Traffic Wastes

Motor vehicles deposit oil, rubber and mud; in addition, there is sometimes accidental spillage of a vehicle's load. Animals drawing vehicles deposit excrement on the road surface. At large construction sites mud is often carried out by motor vehicles and deposited on adjacent roads; in wet weather this can cause danger to other traffic by skidding. Traffic wastes are largely unavoidable but some legislative control is possible in the cases of load spillage and construction sites.

11.2.3 Behavioural Wastes

The main source of wastes is litter thrown by pedestrians and house or shop-wastes swept or thrown out of private premises instead of being placed in the suitable container meant for the purpose. Human spittle and the excrement of domestic pets also fall into this category and together provide health risk, which arises from street wastes due to inhalation of dust contaminated by dried spittle and excrement.

Behavioural wastes are largely avoidable provided an efficient refuse collection service is in operation and litter bins are provided for the use of pedestrians. But success requires a continuing programme of **public education and awareness** backed up by **legislation** and rapidly **operating enforcement** procedures.

11.3 MANUAL CLEANSING OF STREET AND PUBLIC PLACES

A street normally comprises three distinct paved surfaces: a highway for motor traffic, and footway on both sides for pedestrians. The footways are slightly elevated and are separated from the highway by a kerb and channel. The channel is the lowest part of the road structure and serves as a drainage channel during rainfall; at regular intervals it is provided with outlets for the surface water to the main drainage system.

It is rarely necessary to sweep the surface of the highway because motor traffic creates a turbulence, which carries dust and litter away from the crown of the road and concentrates it in the channels at the sides. Thus, street sweeping usually has two components: footways and channels.

Footway wastes are mainly light litter and a little dust; in the channels the proportion of dust and heavy wastes is usually greater. Therefore, the tasks tend to be different. Footways are large areas with a low concentration of wastes; channels are narrow strips with a high concentration of wastes, which tend to be heavy.

Although these principles apply to most streets of a city, the amount of wastes generated varies in proportion to the level of human activity; thus the necessary frequency of sweeping can range from several times a day to once or twice a week.

11.3.1 Frequency of Street Cleansing

Daily sweeping of public streets is essential where there is habitation close by. Isolated pockets or roads with little or no habitation around do not require daily cleansing but at the same time they cannot be ignored. A schedule of street cleaning should be prepared, prioritizing the roads requiring daily cleansing and the ones which are need to be cleansed periodically.

The following measures may be taken to ensure regular sweeping of streets and public places:

11.3.1.1 Cleansing of Street on a daily basis including Sundays and Public Holidays

Cleansing of the public roads, streets, lanes, by-lanes should be done daily if there is habitation or commercial activity on one or both sides of the street. A list of such roads and streets together with their length and width should be prepared and a program for their daily cleaning should be worked out by the local body keeping in view the work norms (yardsticks) prescribed. Roads and streets with no cluster habitation which do not require daily cleaning may be put in a separate group and may be taken up for need-based cleaning on alternate days, twice a week, once a week or occasionally, as considered appropriate by the urban local body. Similarly a timetable should be prepared for cleaning of open public spaces daily or periodically to ensure that they do not become dump yards and remain clean.

(a) Working on Sundays:

The generation of waste is a continuous process. As waste is produced each day, collection, transportation and disposal of waste is required to be done daily. There can therefore be no holiday in street sweeping, primary collection, transportation, processing and disposal of waste. All local bodies should therefore re-organize their work schedule and ensure that the Sanitation Department functions on all days in the year irrespective of Sundays and public holidays. This does not mean that Sanitation Department staff shall have no weekly off or holidays. The sweepers and other staff engaged in collection, transportation and disposal of waste as well as supervision of sanitation services should be given their statutory weekly off by rotation instead of giving them off on Sunday, by dividing the staff into seven groups and each group getting a weekly off on one of the days of the week. Thus one-seventh of the staff should be enjoying their weekly off on each day of the week. This will necessitate staff consolidation or creation of additional posts to the extent of one-seventh of the total strength of the staff in the cities where no cleaning is presently done on Sundays.

Alternatively, the staff may be given two half days (afternoon) off in a week in lieu of one full day weekly off if the sweepers agree to such an arrangement. Here the sweepers may leave work after working for 4 hours on two days out of seven days of the week to make up their weekly off. Perhaps they may be happy to have two half holidays instead of one weekly off in a week as they will have more time for themselves and the family twice a week. However, since this has legal implications, such arrangements will have to be worked out by mutual consent.

This arrangement of giving two half days' leave in lieu of one full day weekly off, may be made applicable to street sweepers and drain cleaners and their supervisors only and not to the transportation workers or workers engaged in the disposal of waste as these activities have to continue for full shifts of the day. One-seventh additional staff may be engaged in these sections of the SWM department to make up the requirement of working on all the days, or overtime may be given as per the need to complete the day's work.

(b) Review of Holidays given to the staff working in essential services such as Collection, Transportation, Processing and Disposal of Waste:

The list of public holidays being given to staff engaged in essential services vis-a-vis general category staff should be reviewed by the local body. Normally the number of holidays given to essential services staff are less than half the number of holidays given to general category staff. After review, the local body

may finalize the number of holidays to be given to the sweepers and other staff in SWM and thereafter may make necessary arrangements for the collection, transportation and disposal of waste on all public holidays by either suitably compensating existing workers for holiday or by creating additional mechanisms to carry out the work on public holidays. The staff can also be compensated by giving additional earned leave in lieu of a public holiday, or additional salary/allowance as deemed proper. This suggestion does not preclude continuance of existing arrangements, if any, made by the local body to provide SWM services on public holidays.

(c) Substitution of Sanitation Workers:

When any sanitation worker remains absent or proceeds on leave, alternate arrangements must be made to ensure that cleaning is done as usual. Badli workers or leave reserve could be used for this purpose. Any other satisfactory arrangements, which are currently in use for this purpose, may continue. Work must not suffer on account of absenteeism.

(d) Prevent open Burning of Waste by Sweepers and the Public:

All Urban Local Bodies should take measures to prevent burning of tree leaves and other waste by sweepers on the roadside and direct sweepers to take all waste to the communal waste storage bins/sites only. Action may be taken against the erring employees. Where open spaces are available nearby, the leaves could be rapid-composted and used locally as organic manure for roadside plantations.

11.4 CLASSIFICATION OF STREETS

For the effective planning of manual sweeping it is necessary to classify streets, or sections of streets, according to the required frequency of sweeping. The following **Table 11.1**, shows a typical method of classification with the frequency of sweepings.

Each city should determine its own frequency requirements and develop an appropriate classification system. Time studies should then be carried out for each class of street and the results of these will indicate the length of street that a man can sweep at the required frequency. For example, time studies may show that for Class A streets one man can be allocated between 250 and 300 metres, while for Class F the length may be as great as 1.0 km. In measuring work content, sub-classification may be necessary to take account of variation in wastes generation within a given class.

Table 11.1 : A Typical Classification of Streets and the Frequency of Sweeping

Class	Character of Street	Frequency of Sweeping
A	City centre shopping	Daily
B	Market areas	Daily
C	City centre and minor streets	Daily
D	Sub-urban shopping streets	Daily
E	Residential streets (high & low income)	Daily
F	Roads and streets having no households/establishments on either sides	Once a week
G	Sub-urban main streets	Twice a week
H	Open space	Occasionally, when required. (minimum once in a fortnight)

On the basis of this information a city can be divided into sweepers' beats which contain fairly uniform workloads, despite great differences in the lengths to be covered.

11.4.1 Sweeping Methods

In the normal sweeping situation of footway and channel there is an established work method for a single operator which has been designed to minimize unproductive walking:

1. Park receptacle (normally a handcart) at commencement of section to be swept.
2. Using wide broom, sweep wastes off footway into channel for a convenient distance, say 20-50 metres.
3. Sweep channel in reverse direction, ending at parked receptacle; make intermediate heaps if quantity so required; *do not sweep across drainage grids.*
4. Move receptacle up to next section to be swept, picking up heaps on the way.

11.4.2 Work-norms for Street Sweepers

Work-norms for street cleansing depends on various factors e.g. city size,

types of residential, institutional and commercial areas, quality and quantity of refuse generated etc. Suggested work-norms have been given at **Para 19.6 in Chapter 19 on “Institutional and Capacity Building Aspects”**.

11.4.3 Working Hours

Different cities have adopted different working hours depending on local conditions and age-old traditions. It is desirable to start work as early as possible in the morning so that the city looks clean before the roads and streets get busy in the morning.

Normally the labour force is required to work for 8 hours and is given half an hour's recess. Considering the type of work, it is desirable to split the 8 hours of duty of sweepers into two spells, 4 to 5 hours in the morning and 3 to 4 hours in the afternoon and the work force should be fully utilized in both the spells of duties. Quite often the work force is utilized in a group in the afternoon hours, which is highly unproductive. Individual work needs to be allotted to each person in both spells to ensure full output and accountability. The local body may decide the duty hours on the above lines and the total hours of work to be taken from the sweepers, subject to government policy, court orders and union agreements.

11.5 EQUIPMENT USED FOR STREET SWEEPING

Use of appropriate tool play an important role in improving the efficiency of the work force. Presently most of the tools utilized by the sanitation workers are inefficient and outdated and need to be replaced by efficient tools and equipment. Traditionally the work force resists any change, even if it is for their good. Persuasion and awareness efforts will, therefore, be necessary to convince the workforce to adopt improved tools and equipment. Equipment used for manual street sweepings are; brooms, shovels, and containers. These are described in the following sections:

11.5.1 Brooms

Instead of using short handled brooms which require bending of the body while at work, causes fatigue to the workforce and causes back pain in the long run, the workforce may be advised to use long handled brooms, which will not require bending, reduce fatigue and increase their productivity. In cities where a broom allowance is given, or only broom sticks are provided to sweepers, they may be persuaded that long handled brooms may be used or made by them for street sweeping. While making such brooms, a metal blade which can scrape the

material sticking on the street should be fixed on the top of the broom, or a separate metal scraper may be given to the sweepers, to remove sticky material from the street while sweeping.

There is no yardstick about the number of brooms to be given to sweepers per month. In some cities three brooms per month are given, whereas in other cities only one broom is given per quarter of a year. One long handled broom per month is considered to be adequate for street sweeping. The bamboo (long handle) to which the broom is attached need not be given once a month as it has a long life. The same bamboo should be reused while making the broom. The bamboo may be replaced as and when required. It could be once in six months or once a year depending upon the local conditions of the city.

Delhi Model Broom, as shown in Fig. 11.1 is being extensively used in large cities and towns. General specifications of Delhi model broom are:

Length of the broom	80-85 cm
Weight of the broom	1 kg
Binding material	20 gauge MS sheet ring having width of 1.5-2 cm
Handle of the broom	Bamboo of 135 cm length, 3-4 cm dia
Weight of the bamboo handle (approximately)	900 gm

The bamboo sticks should be free from ruts, insects and of good quality. The handle of the broom should be solid and smooth in texture and free from insects. The bamboo should have a pointed edge on one end for proper fixing with the broom.

11.5.2 Shovels

The function of the broom is to gather the street wastes into small heaps, which then have to be picked up completely, and placed in a receptacle. The conventional tool for this purpose is a large straight-blade shovel. However, when the wastes comprise large quantities of very light materials such as leaves, a shovel is ineffective because dried leaves fall off or are blown away during transfer. A good solution to this problem is to use a pair of flat boards, usually plywood, between which the wastes are retained by hand-pressure. A typical design of hand shovel with specification is given at Fig. 11.2.

11.5.3 Container for Transfer of Sweepings

Various types of containers are used by the sweepers engaged in street sweepings for facilitating easy transfer of street-sweepings from the streets into the handcarts. Containers, which are normally used, made up of Cane, Bamboo, Plastic, Low Density Plastic (LDP), Metal or Fibre Reinforced Plastic (FRP). While selecting a particular type of container, economic consideration must be given keeping in view the life of the container. A general description of alternative containers for sweepers is given in Table 11.2.

Table 11.2 : General Description of Alternative Containers for Sweepers

	Cane basket	Bamboo basket	Other material bin
Plan cross section shape	Circular	Circular	Square
Top dimension (diameter or side) (mm)	440	450	450
Bottom dimension (mm)	380	350	300
Height (mm)	360	350	500
Weight (kg)	4	1.5	4
Capacity (litres)	25-40	25-40	25-40

11.5.4 Vehicles and Transfer Facilities

The work of a sweeper falls into two main parts:

- (i) sweeping, and transferring wastes to receptacle, and
- (ii) transporting full receptacle to a transfer point where it can be emptied.

In terms of sweeping, while the first activity is productive, the second is unproductive because it represents loss of sweeping time. The aim, therefore, should be to reduce to the minimum the proportion of time spent on transport. This can be achieved in two ways:

- (i) minimizing the distance over which the collected wastes have to be transported, and
- (ii) providing the maximum size of receptacle for swept wastes.

Various activities involved in the first approach are described as under:

An essential feature of the organization for street sweeping is the provision of a transfer facility within reasonable distance of each beat. The ideal arrangement is for this to be located in the district depot where it is under continuous supervision. It can take many different forms, but it must not be a dump on the ground, which would be unhygienic and costly in manpower for re-loading. The following are systems in common use, and the capacities are based on 40 sweepers each of whom brings in $0.5 \text{ m}^3/\text{day}$, a total for the district of $20 \text{ m}^3/\text{day}$:

- (i) a side-loaded trailer of 7 m^3 , exchanged three times a day, and
- (ii) a steel skip of 4 m^3 exchanged five times/day by a skipoist vehicle.

There is an alternative to the provision of transfer facilities for sweepers: this is to arrange for every sweeper to be visited about four times a day by a vehicle into which his full bins are emptied. The system requires very careful routing and the observance of precise timetables by sweepers and vehicles to ensure rendezvous without tedious searches. It has the advantage that the sweeper is able to devote the whole of his time to sweeping, but it does not eliminate the need for the other depot facilities such as welfare and handcart parking.

The second one which has been seriously neglected in many cities and towns. Often sweepers are given baskets for the transport of street wastes, as a result of which they spend most of their day walking to empty the basket instead of sweeping. The best solution is a handcart, the gross weight of which may be as much as 50 to 60 kg in level areas and less in hilly areas.

The handcart design should avoid the need to empty the cart on to the ground at the transfer place, because this would create the unnecessary task of shovelling wastes into another vehicle at the time when the wastes is to be delivered to the disposal site. A better method is to equip the handcart with a number of portable receptacles that can be lifted off and emptied by one man into a transfer facility serving a number of sweepers.

The desirable features of a handcart for use by a single sweeper are as follows:

- (i) frame of light tubular steel, or angle, supporting a platform on which are placed two or more portable bins,
- (ii) wheels of large diameter, with rubber tyres, preferably pneumatic, ball or roller bearings,

- (iii) the portable bins should have a capacity of 30-40 litres each, according to the density of the wastes,
- (iv) brackets should be mounted on the frame of the handcart to carry three brooms and a shovel.

11.5.5 Hand-Carts/Tricycles

Each sweeper engaged in street sweeping should be given a handcart having 4 to 6 containers or a tricycle having 8 or more containers of 30 to 40 liters capacity each as illustrated below, for ease of handling. These containers should be detachable to facilitate the direct transfer of street sweepings and household waste from the container into the communal waste storage bins. Such containers should lockable with a chain arrangement. The handcart should have at least 3 wheels ball bearings so that it can be used efficiently. A typical sketch of six-bin handcart arrangement is shown in Fig. 11.3.

A detailed drawing of a new Handcart (M.S. Wheel Barrow) is shown in Fig. 11.4 and their specifications are given in Table 11.3.

A detailed sketch of Polyethylene Container to be used in the Handcart (M.S. Wheel Barrow) for collection and transportation is shown in Fig. 11.5.

Table 11.3 : Specification of New Design Hand Wheel Barrow

Sl. No.	Material	Size	Details for	No.	Quantity	Remarks
1.	M.S. Angle	25x25x5 mm	Top frame	-	332 cm	
2.	M.S. Angle	25x25x5 mm	Bottom frame	-	330 cm	
3.	M.S. Angle	25x25x5 mm	Standing support	4	100 cm	
4.	M.S. Angle	25x25x5 mm	Bottom frame Section angle	1+2	230 cm	
5.	M.S. Tec	40x40x6 mm	Bending wheel	2	314 cm	Each wheel
6.	M.S. Flat	40 x 6 mm	Support wheel & hub	12	240 cm	Dia 500 mm each
7.	M.S. Flat	20 x 5 mm	For axle bracket	2	70 cm	Wheel need
8.	M.S. Flat	20 x 5 mm	Barrow Section Flat	-	710 cm	6 supports
9.	M.S. Square bar	25 x 25 mm	Axle	1	100 cm	
10.	Round head rivet	32 x 10 mm	Riveting	2 wheels	12 No.	
11.	Round head rivet	25 x 8 mm	Riveting	2 wheels	12 No.	
12.	Hexagonal bolt	40 x 10 mm	Axle & Bracket	2 side	4 Nos.	
13.	M.S. Washer	25x50 mm- 16G thick		2 side	4 Nos.	
14.	Cotter pin	6 x 50 mm length	TO joint	2 side	2 No.	
15.	C.I. Hub	Complete with axie hole 20 mm support hole 6 no. with turning etc. The weight of the hub 3.5 kg.	Each side.	2 side	2 No.	
16.	HDPE Wheel	8"x3"x1" HDPE Wheel Red colour	Front side of the Barrow	1	1 No.	HDPE Material
17.	Bearing	6204 ZZ	For wheels	2 sides	4 Nos.	Standard quality.
18.	Galvanise tube	20 mm B grade	For handle	-	127 cm	
19.	Black and corrosive paint		Barrow should be painted coats inside & outside.	With two		
20.	M.S. Bush	CD = 25 mm wall thickness-3 mm	For two sides of the wheel	2 sides	2 Nos.	
21.	M.S. Angle	25x25x5 mm	For handle	2 Nos.	114 cm	

Note: Every wheel barrow should be equipped with 1500 mm long 5 mm MS chain and 7 Lever Jalaram lock. For each wheel barrows MS chain should be provided with fitting arrangement.

11.5.5.1 Specifications for Polyethylene Container to be used in the Handcart (M.S. Wheel Barrow) for Collection and Transportation of Solid Waste

The polyethylene container having size of 325 mm X 325 mm at the top and 290 mm X 290 mm at bottom with overall height of 325 mm shall be designed for transferring solid waste to the communal waste storage sites. It shall be made from durable material. The moulded polyethylene container shall be made from one piece moulding process. It shall have top-rim outside and embossment as per requirement.

The bottom of container shall have four holes of 10 mm dia. It shall be drilled at the corners. Inbuilt suitable stiffener shall be provided in the bottom and 15 mm wide and 10 mm deep and suitable stiffener must be provided on both the side other than the handle fixed sides. Built-rim shall be provided at bottom for easy handling and tilting container.

A handle shall be provided at top of container. The handle shall be made from 8 mm MS bar and both ends of handle shall be fitted with rivets by placing inside and outside MS strips. The fixing arrangement shall be such that it can hold handle firmly and easily so also tilting and lifting can be done.

TOLERANCES: 1 or – 3 mm except wall thickness

THICKNESS: All side should be 3 mm thick.
Tolerances of +/- 5% will be allowed.
Bottom should be 4 mm thick.

11.5.5.2 Material of Manufacture

The material for the manufacture of moulded polyethylene garbage bins should be virgin and of the best quality. The material should also conform to the standards as indicated in Table 11.4.

11.6 CLEANSING OF SURFACE DRAINS

In many cities there are open surface drains beside the road, into which quite often the sweepers and the public dispose of waste unauthorisedly. These drains need to be cleaned on a regular basis to permit free flow of waste water. Action should be taken to ensure that sweepers and citizens do not dispose of any waste into drains.

Table 11.4 : Properties and Standards of the Material

Sl.No.	Property	Testing method	Unit	Value
1.	Density	IS-7328-1992	Gm/cm ²	> 0.930
2.	Melt Flow Index	IS-2540-19631	GMs/10 min	1.5 to 5
3.	Tensile strength	IS-8543-84 part-4/sec 7 1996	Kg/cm ²	120
4.	Flexural modulus	IS-13360 part-5/sec 7 1996	Kg/cm ²	3000
5.	Hardness (shore)	IS-13360 part-5/sec 1 1992	D scale	> D 50
6.	Vicat Softening Temp	IS-1336 part-6/sec 1 1992	C	> 90
7.	Impact strength (2.5 kg/1 mts)	IS-12701-1996	J/mm ²	No puncture or damage
8.	Weathering - Colour fastness	IS-22530-1963	-	No. 4 gray scale

- Accelerated Ultra Violet Test (Q.U.V.) - ASTM-G-53, (50°C) - should be tested with Q.U.V test type accelerated weatherometer for 200 hours. Tensile strength and flexural modulus should each be not less than 70% of the values before exposure.

- The internal form and surface of the container shall be such that it will not trap the contents.
- There shall be no sharp edges anywhere on the container
- The internal and external surfaces shall be smooth and non porous, free from cracks, splits, dents, distortion, blisters, voids, air bubbles and other surface blemishes or defects.
- The bins are expected to be used in outdoor conditions. They should be UV stabilized and should be able to withstand outdoor weather conditions in India.

Initially, drain cleaners reporting to the Solid Waste Management Department should be given the work of cleaning shallow surface drains (not more than 60 cms) upto 500 meter length per day and this length may be increased as soon as the discharge of solid waste into the drain is substantially reduced.

Necessary tools should be given to the drain cleaners. They should also be given suitable seamless handcart and shovels for transferring the silt to sites identified for depositing it. The periodicity of cleaning such drains should be worked out based on the conditions and frequency of clogging of drains. The Roster of Cleaning of such drains should be worked out and strictly followed.

Whatever waste is removed from the drains should not be allowed to remain outside the drain for long for drying. It would be desirable to deposit the wet silt into a seamless handcart as soon as it is taken out from the drain. If that be not possible or found difficult, the silt may be allowed to dry for about 4 hours outside the drain before transporting the semi-solid silt for disposal.

In special situations a maximum of 24 hours should be allowed for removal of such waste. Seamless handcarts may be used for transfer of silt from the surface drain site to the waste storage depot. Shovels should be used for transferring the contents from the seamless handcart or tricycle to a larger container kept at the temporary storage depot or communal waste storage site.

If this work can be contracted out the contractor should ensure that the silt removed from the drain is similarly lifted promptly and taken to the disposal site as per the terms of contact.

11.7 REMOVAL OF SILT FROM UNDERGROUND DRAINS/ MANHOLES

The work of removal of silt from underground drains or manholes, storm water drains or surface drains deeper than 600 mm, should be done by the Engineering Division of the local body and this work should not be entrusted to the SWM department. The silt so removed should not be kept on the road/footpath for drying. This waste should be removed on the same line as suggested for silt removed from the surface drains. Wet waste only be removed immediately from the main roads and not less than in 4 hours and in other areas within 24 hours and taken to the disposal site to prevent nuisance and health hazards. This waste should not be taken to the compost plant, but may be used as landfill cover.

11.8 MECHANICAL SWEEPING

Most mechanical sweepers are suction machines, usually assisted by one or more revolving “scarifying” brushes for dislodging adhering matter. They range in size from small pedestrian-controlled pavement sweepers to large channel

sweepers, which often have an auxiliary engine to provide suction. The smallest machines operate at about 3 kmph, the largest at 8 kmph or faster. Some of the latter can be fitted with a wander-hose which can be controlled by an attendant and used to pick up refuse from inaccessible places; for example dry leaves from a drainage ditch.

Pavement sweepers are not usually practicable for cleaning normal footways because of obstructions such as lamp-columns, and the presence of pedestrians. Their main application is for very large paved areas such as central reservations and car parks. When they can be deployed effectively, they are very efficient for the removal of fine dust.

Channel sweepers have the same virtue, but they also have serious limitations, in particular:

- (i) no car parking can be allowed on mechanical sweeper routes,
- (ii) well-engineered roads are essential, particularly channel and kerb alignment,
- (iii) the serviceability of mechanical sweepers is low compared with most other vehicles,
- (iv) they are subject to damage by heavy objects lying on the road, or during travel over rough ground at disposal sites.

One function for which channel sweepers are supreme is the cleansing of heavy traffic roads on which the employment of manual sweepers may be dangerous. For this purpose, and also for one-way streets, the machine must be capable of working in either the left or the right-hand channel.

11.9 INSTITUTIONAL ARRANGEMENT FOR MANUAL SWEEPERS

For the effective management of sweepers, and for the transfer of their collected wastes, depots are required with the following facilities:

- (i) office for the district supervisor, where sweepers book on and off,
- (ii) parking area for handcarts with minor repairing facilities,
- (iii) tool and equipment store,
- (iv) transfer facility for sweepings,
- (v) toilet and welfare facilities.

Each depot should be located, as far as possible, at the centre of a sweeping district, the area of which will be determined by the number of sweepers and the lengths of their beats. In a city centre beats will be short and there may be more than 40 sweepers employed per square km; thus depots may be required on a grid of 1 km. In this case the average walking distance from beat to depot would be less than 500 metres. In a sub-urban residential area the number of sweepers per square km may be one or even less, and thus the depots would be more widely spaced. For example, a depot employing 20 sweepers may serve a district with an area of 25 km² equivalent to a grid of 5 km. In this case the average walking distance between depot and a beat could be 2 km and, therefore, the beats should be planned radially, to permit working on an outward and return basis each day.

11.10 LEGISLATION

Because of the behavioural origins of a large part of street wastes, legislation can often assist in achieving higher standards of cleanliness and reducing the total workload. Legislation on street cleansing has been incorporated in detail in **Chapter 24 on “*Legal Aspects*”**.