

Chapter B-6

House-to-house and bell ringing collection methods in Mumbai

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B-6.1 INTRODUCTION

This chapter describes two collection methods that were being practised in F North Ward - a largely residential area in the City of Mumbai.

The *house-to house* method serves an area of apartment buildings, and consists of removing waste stored in small vats or enclosures which are located inside the property boundaries. The *bell ringing* method is basically a block collection method, in which the presence of the collection vehicle is announced by a labourer walking ahead of the truck, ringing a bell. (In practice, much of the waste reaches the truck in other ways.)

For the purposes of this study each method was observed by a small team on only one occasion. More observations would have provided more representative data and allowed for the improvement of the data collection methods; nevertheless some comparisons can be made and some suggestions proposed for more detailed studies and possible variations. In each case the team followed the truck in a car except during the collecting phase, when the observers followed on foot, pacing the distance, counting the numbers of containers used to fill the truck, and recording other observations. When loaded the vehicle was diverted to a public weighbridge so that the load could be weighed.

Both systems made use of hired vehicles, which were old non-tipping open trucks with the sides raised, and a separate compartment made for the crew in the front of the body, just behind the cab. The contracts were of two years' duration, and were negotiated and administered centrally by the MCGM, though penalties were administered by the wards, and the wards were responsible for reporting on the contractors' performance to the MCGM head office. The Ward where the study was undertaken - F North - was divided into two sections, each with a supervisor. The Ward was further sub-divided into ten parts, each with a chowki under the supervision of a Junior Overseer. Two shifts were operated - 6.30 am to 1.30 pm and 2 pm to 9 pm. The general terms and conditions relating to the hire of trucks for refuse collection are reproduced in appendix BB-6.3.

The generation of waste was said to be less in the period November to April, perhaps because more waste was burned, and more between May and August, perhaps because of the greater availability of fruit such as mangoes, and the larger amounts of garden waste because of the high rainfall. Contractors could be requested to provide extra vehicles at a day's notice to cope with increases in generation.

Eight MCGM labourers were allocated to each truck, together with a mukadam. Generally, two would stay on the back of the truck to receive the containers of waste and load the vehicle, starting at the front. The normal allocation of tools was

- * three black plastic bowls, each with two rope handles and with a diameter of 590 mm and a depth of 290 mm;
- * a bunch broom with a broomstick, (known locally as a *zeaf*) as shown in figure A-1.1;
- * one spade (with the handle at right angles to the blade to pull waste towards the user), and
- * one rake, having two long prongs at right angles to the handle, also for pulling waste into the bowls.

With these tools one or two people could fill the bowls, and two or three pairs could ferry the waste to the truck. The bowls were always carried by two men working together.

Not all of the labourers were needed for unloading the truck, and the truck could not accommodate nine people in addition to the driver, with any degree of comfort or safety. Therefore most of the labourers would go off duty after loading the trucks, leaving two to continue with the truck to the disposal site.

B-6.2 HOUSE-TO-HOUSE COLLECTION METHOD

In 1995 there were 23 routes for house-to-house collection in F North Ward, collecting on alternate days - 13 in the morning and 10 in the afternoon shift. Most of the plots had 20 to 30 apartments in them, in buildings of four or five storeys.

Observations and recommendations

The full record sheet of observations is reproduced in appendix BB-6.1, and results calculated from the data are also shown. The truck stopped at 12 places and collected waste from one community enclosure, a park, and sixteen apartment buildings.

Some of the storage facilities were located at the rear of the properties, so that the loaders were obliged to walk an extra distance carrying the waste, sometimes through narrow passages. Presumably the rear location is preferred so that residents do not see the waste every time they enter or leave their building. Such locations add to the work of the loaders, so it might be considered whether there should be a regulation to require that storage facilities be within a certain distance of the entrance to the property. A lightweight two-wheeled trolley might be helpful in transporting the waste to the truck; in this way one loader could carry the waste from the storage point to the truck, but two loaders would still be needed on the ground to lift the waste to give it to the pair in the vehicle.

The waste was generally stored in small masonry enclosures, though in some cases it was simply heaped in a pile. Loading the waste from the ground like this is inefficient and insanitary. It would be helpful if the waste were kept in bins or portable containers such that they could be lifted directly up to the pair in the truck for emptying. In this way the waste would not touch the ground. The difficulties with requiring residents to provide their own containers are:

- some of the containers may not be of a suitable type, or may be damaged so that they cannot be lifted or carried conveniently, and
- residents may fear that their containers would be stolen, even though they are kept within the property boundary.

If containers were provided by the MCGM, this would be a great expense for the Corporation, unless an effective way were found of recovering the cost from the residents, and such containers would still be at risk of damage and theft. Another alternative would be to require that waste be kept in plastic bags, but residents might object to the cost of purchasing the bags, and this would add to the quantity of plastic in the waste - and many solid waste managers are trying to find ways of reducing the amount of plastic film that is found in solid waste. Enveloping the waste in plastic bags would also have an impact on recycling.

The truck driver experienced difficulty in negotiating his way between parked cars, and on some occasions he obstructed the traffic. At least once he was prevented from getting close to the storage points, so that the loaders were obliged to carry the waste an extra distance. The areas that are suited to this type of collection, and the times when collection can be carried out, must be identified taking traffic problems into consideration. Sometimes smaller vehicles are needed.

Rat burrows were obvious near some of the storage points. Storing waste on the ground encourages rats, since the waste is an easily accessible source of food. Waste should be stored in closed containers and action should be taken to kill the rats and prevent burrowing.

Some of the storage bunkers opened onto the streets, and were in a state of disrepair so that the waste fell onto the street. Such facilities should be repaired.

Large quantities of waste were produced by restaurants and other commercial premises. Some of these wastes were especially difficult to handle - for example wet food remains and coconut shells - which were handled individually. Such businesses should be charged a fee for solid waste management that reflects the quantities of waste that they produce and the difficulties experienced in handling it.

B-6.3 BELL RINGING COLLECTION METHOD

There were three bell ringing routes in F North Ward; each route was served daily, seven days a week. One loader walked ahead of the truck, ringing a bell to invite residents to bring their waste out to the truck. The waste was lifted into the truck by two labourers, being given to two others who emptied the residents' containers in the truck. In this way the waste did not touch the ground and did not require double handling.

Only part of the waste loaded into the truck was received in this way. Street sweepers brought their containers for emptying, and there were roadside piles. Much of the waste was loaded from vats or enclosures, or from other storage facilities, that belonged to businesses, so the crew needed to have the tools mentioned earlier in this chapter in order to pick up waste from the ground.

The area from which the waste was collected was known as the Parsee Colony. The Parsees, descendants of Zoroastrians from Iran, were reputed to be very clean and orderly, and so it may be that some of the behaviour recorded here could not be expected amongst other social groups.

Observations and recommendations

Appendix BB-6.2 shows the work study record and some analysis of the data collected.

One of the most striking observations is that very little waste was collected during the first 25 stops. The reason for this is not clear. It may have been that the time was too early, but this is unlikely, unless servants come later and they are given the duty of carrying out the waste. It may have been because most of the waste had been collected the previous day, or it may have been because the residents were not yet accustomed to the system, and they or their servants were still throwing the waste onto piles beside the street. It would be worthwhile to conduct a social survey in the area to find out why the residents were not using the service, and how such a service could be modified to make it more acceptable. The graph in figure B-6.1 illustrates this slow start; each bar represents a 30 minute period, and it can be seen that the number of containers of waste received in the first half hour is much less than for any subsequent period. The number of residents bringing their waste increased by a very significant extent towards the end of the route.

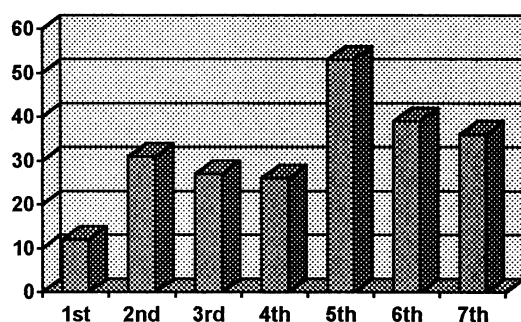


Figure B-6.1 Number of containers emptied into the truck for successive 30 minute periods

The number of containers of waste received in each half hour period is shown on the vertical axis.

Each bar represents one period of 30 minutes:

“1st” represents the interval 7.43 am to 8.13 am;

“2nd” represents the interval from 8.13 am to 8.43 am

and so on up till the end of the 7th period which is 11.13 am.

As has already been mentioned, waste was coming to the truck in three ways - brought by residents, brought by street sweepers, and collected by the MCGM loaders. An approximate analysis of the proportions brought in each way was made, based on the assumption that each resident brought only one container and that each sweeper brought an average of two, and that the rest was picked up by the loaders. The data were not collected with this analysis in mind, and this is why such assumptions must be made. (This illustrates the point that work study data collection should be planned according to the type of information that is needed, so that the method of collecting data can be developed and practised according to the information that is needed.) The lack of time allowed only one opportunity for following a truck on this type of duty, so the information was not complete, and, for some purposes, not in the best form. Figure B-6.2 shows an approximate breakdown of the collected

waste, according to how it was brought to the truck. It can be seen that, in spite of the slow start, more than one third of the waste was brought by the residents in answer to the bell.

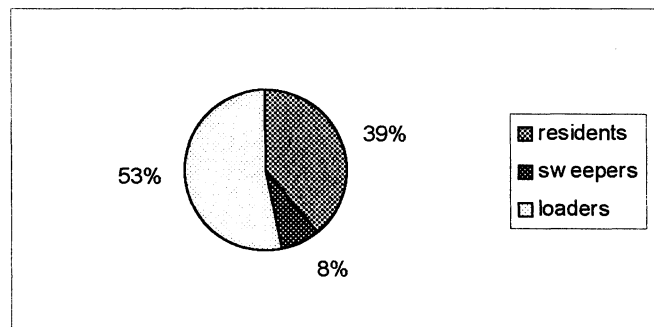


Figure B-6.2 Proportions of waste brought by residents, MCGM sweepers and loaders

Some of the residents brought their containers to the main road at the end of their lane, and left them there until the truck came. This was a very helpful action since it saved the loaders from walking up the lane and it enables the waste to be unloaded directly from the residents' containers into the truck, thereby saving picking the waste up from the ground. If more residents would do this, the task of refuse collection would be simplified. It would be worth talking to the residents who do this, asking them if they have experienced any difficulties and how they overcame them, and perhaps making a short video interview as part of a public education exercise.

It is always useful to consider a range of alternatives, and in this case it would be advisable to consider whether other types of vehicle and a smaller workforce would be appropriate for the bell ringing collection, and whether the two types of collection should be kept separate.

- ◇ If the same vehicle were used only for the bell ringing collection, only three labourers would be needed - one to ring the bell, one to pass the waste up to the loader in the truck, and one to place the load within the truck body. If the truck were fitted with a distinctive signal, perhaps the driver could announce his arrival, without the need for the labourer with the bell.
- ◇ Alternatively, the collection service could be operated by labourers with handcarts, joining the street sweeping and refuse collection functions into one. In this case a transfer point would be needed - perhaps a hook lift container.
- ◇ A small motorised vehicle is another alternative - perhaps a tricycle rickshaw as used in Ahmedabad, or a pickup. One loader would be sufficient, since the body would be low enough to be loaded from the ground. Ideally the driver should also do the work of the loader.

B-6.4 COMPARISONS AND GENERAL COMMENTS

There are several advantages in requiring the residents to make their own arrangements for storage. Not only is the cost of providing community storage avoided, but the residents assume responsibility for the maintenance and condition of their containers, and there is little chance of rag-pickers sorting through and scattering the waste if it is stored on private property. Complaints about the location of waste containers will be less if the residents themselves take responsibility for this issue. Sometimes residents take no care of their own storage facilities (particularly if they are shared by a large number of tenants in an apartment building), and so some of these advantages can be lost.

A wide range of containers were used, but all seemed to serve their purpose reasonably well.

The weights of waste put into the black bowls by the loaders were measured in a few isolated cases, and weights of 11, 18 and 54 kg were recorded. These figures illustrate the wide range of densities that are encountered in Mumbai's waste. It is likely that using these bowls to carry 50 kg of waste will quickly damage the bowls. It is interesting that a load of 54 kg can be handled by two loaders and lifted high enough to be loaded into the truck. The average weight of waste in such a bowl was estimated in appendix BB-6.1 to be just under 16 kg.

Table B-6.1 summarises some of the key data found during this brief study. It must be remembered that the data were based on the observation of only one trip in each case, and that the observers did

not have time to develop the best recording methodology nor to practise the collection of these data, so the results must be regarded as a tentative indication, and nothing more.

Table B-6.1 Summary of some basic indicators for the house-to-house and bell ringing systems

Indicators		House-to-house	Bell ringing
Weight collected	[tons]	3.60	2.16
Time to load one ton	[minutes]	44	93
Time to load 1 m ³	[minutes]	17	23
As-loaded density	[kg/m ³]	380	243
Cost per ton	[Rs/ton]	537	895

It can be seen that the weights collected were very different, largely because of the big differences in density. Since the costs for the labour and vehicle are the same, the cost per ton depends on the weight collected, and so is very much more in the second case. The time needed to load a ton of waste is twice as much for the bell ringing case, but there is much less difference in the time required to load a unit volume. It is not possible to say from these results that the bell ringing method is more expensive as currently practised, since the basic costs are the same, and if the density difference is due to socio-economic factors (and therefore independent of the loading method) the cost difference is a geographical variable. The unit costs appear high in comparison with some other methods (for example the compactors investigated in chapter B-2), but it must be remembered the methods discussed here include primary collection to a certain extent, whereas some of the others are purely secondary collection.

Since the labour costs are 80% of the total costs, any method of reducing the requirement of labour is likely to have a significant effect on the unit collection costs.

The frequent stopping and starting required in these collection methods should be expected to shorten the lives of transmission components of the trucks, especially clutch plates. Under the present arrangement the cost of such repairs is borne by the contractor who supplies the vehicle, and so is of no concern to the Municipal Corporation.

These systems have some interesting advantages, and should be studied in more detail. If modifications to the arrangements would be accepted by the labour unions, there is scope for reducing the cost. These methods require more co-operation and participation from residents and so consideration should be given to public education campaigns.

APPENDIX BB-6 HOUSE-TO-HOUSE AND BELL RINGING COLLECTION IN MUMBAI

BB-6.1 HOUSE-TO HOUSE COLLECTION

Work study observations, F North Ward, Route No. 21, 8 December 1995

Station	Plot No.	Distance from previous site (m)	Time of arrival	Travel time to site (min' s")	Loading time (min' s")	Distance to carry waste (m)	Number of bowls / equivalent	Type of waste, comments
Note 1	Note 2					Note 3	Note 4	
								Leaving muster chowki
1	-	15	7.32'00"	28"	15'40"	3	28	Bunker, street waste
2	292	730	7.51'30"	3'50"	42'30"	30	41 / 44	Heavy restaurant waste
3	305	22	8.34'48"	48"	9'21"	8	13 / 24	Apartment, leaves, paper
4	294	10	8.44'27"	18"	8'40"	5	11 / 17	
5	304	19	8.53'50"	43"	6'05"	6	7 / 10	
6	295	34	9.00'00"	40"	5'55"	34	5 / 9	Storage at back, passage 950 mm wide
7	303	15	9.07'10"	40"	9'35"	7	10 / 17	Loaded through hole in wall
8	302	17	9.17'15"	30"	4'45"	14	5 / 9	Dump without walls
9	297	53	9.23'00"	1'00"	24'05"	14	4 / 6	Parked car prevented truck
	299					42	3 / 5	stopping nearer, waste from
	300					67	5 / 9	four plots brought to truck at
	301					67	5 / 8	same place
10	park	N.R.	9.47'05"	N.R.	1'45"	N.R.	6 / 7	Street & park waste
11	318	183	9.53'15"	3'25"	10'45"	33	3 / 6	Also debris
12	317A	40	10.04'50"	50"	18'54"	56	3 / 5	Storage behind building
	317					8	4 / 7	
	298					5	4 / 6	
	315					18	9 / 12	Storage just inside gate
	km reading	time	location, activity					
	881	10.23'44"	Loading completed, load covered, truck departs					
	882	10.27'00"	Arrive check post					
		10.43'28"	Depart checkpost					
	890	11.11'50"	Arrive weighbridge					
		11.14'20"	Depart weighbridge					
	894	11.28'30"	Arrive Deonar disposal site gatehouse					
	896	11.38'20"	Unloading started					
		12.22'35"	Unloading completed					
	898	12.30'50"	Arrive gatehouse					
		12.35'00"	Depart gatehouse					
	902	12.48'00"	Arrive weighbridge					

Notes: N.R. means not recorded

- 1) A "station" here means each place where the vehicle stopped to load
- 2) The distance was measured by pacing, and is accurate to +/- 10%.
- 3) The distance that the labourers were carrying the waste in bowls was also paced.
- 4) Much of the waste was loaded into the truck by means of the specially designed black plastic bowls. One of these bowls can be seen in photograph 5. The bowls had a diameter of 590 mm and were 210 mm deep. Waste was also brought in other types of container - for example sweepers would bring waste in cane or bamboo baskets, and shopkeepers or domestic servants might use buckets. The number of black bowl loads was counted, but an attempt was made to estimate the volume of the waste coming in other containers, and make allowances for bowls that were only partly full or overloaded by estimating the equivalent

number of bowls - i.e. the number of bowl loads that there would have been if all the waste had been brought in well-filled bowls. An entry in this column of 13 / 24 means that loaders brought 13 bowls full of waste, but the total waste brought to the truck at this station could be reasonably carried in 24 bowls.

Data from table	Distance travelled within collecting area	1.1 km.
	Time travelling within collection area	13'12"
	Average speed within collection area = $1.1/[13.2/60]$	= 5.2 km/h
	Total loading time	158 minutes
	Time to load 1 ton of waste with 8 labourers = $158/3.6$	= 43.9 minutes
	Total number of estimated equivalent bowls of waste	229
	Average weight of one bowl of waste = $3600 / 229$	15.7 kg
	Average volume of waste in one bowl = $9400 / 229$	= 41 litres

It is possible to estimate the distance walked by the labourers, by taking the actual number of bowl loads to indicate the number of times that the labourers walked into and out of a property. It is assumed that two labourers stayed on the vehicle so that six were walking to and fro into the properties.

Plot no.	Distance to walk [m]	Number of bowls	Distance walked to and from storage [m]
-	3	28	168
292	30	41	2460
305	8	13	208
294	5	11	110
304	6	7	84
295	34	5	340
303	7	10	140
302	14	5	140
297	14	4	112
299	42	3	252
300	67	5	670
301	67	5	670
park		6	
318	33	3	198
317A	56	3	336
317	8	4	64
298	5	4	40
315	18	9	324
average 24.5		sum 166	sum 6316

Assuming that the walking is done by six labourers, working in pairs, the total distance covered by each person between the truck and the storage points, if the same labourers stay on the truck, is
 $6316 / 3 = 2105$ m.

If the loaders take equal turns at working on the truck, then the average distance becomes
 $3/4 \times 2105 = 1580$ m

Half of this distance is covered carrying full bowls. To this walking distance should be added the distance between collection points, which is 1.1 km, but if it is assumed that each pair rides on the truck for one quarter of this distance, the distance walked between collecting points is

$$3/4 \times 1100 = 830 \text{ m}$$

The estimate of the total distance walked by each loader is therefore
 $1580 + 830 = 2410$ m.

Further data:

Truck provided by contractor, registration no. BMQ 8617, with 8 MCGM labourers

Truck body: length 3.78 m; width 2.17 m; height of sides 1.3 m; height of tailgate 1.14 m.

Estimate of volume of waste: [See figure BB-6.1]

If loaded to full height, volume is $(3.78 \times 1.3) \times 2.17 = 10.7 \text{ m}^3$.

Since waste does not reach top at front and back, subtract triangles (in vertical section)
 So estimated volume just after loading is

$$(3.78 \times 1.3 - [0.5 \times 1.5 \times \{1.3 - 0.62\}] - [0.5 \times 0.15 \times 1.0]) \times 2.17 = 9.4 \text{ m}^3$$

Estimated volume at weighbridge is $9.4 - [3.78 \times 0.3 \times 2.17] = 6.9 \text{ m}^3$

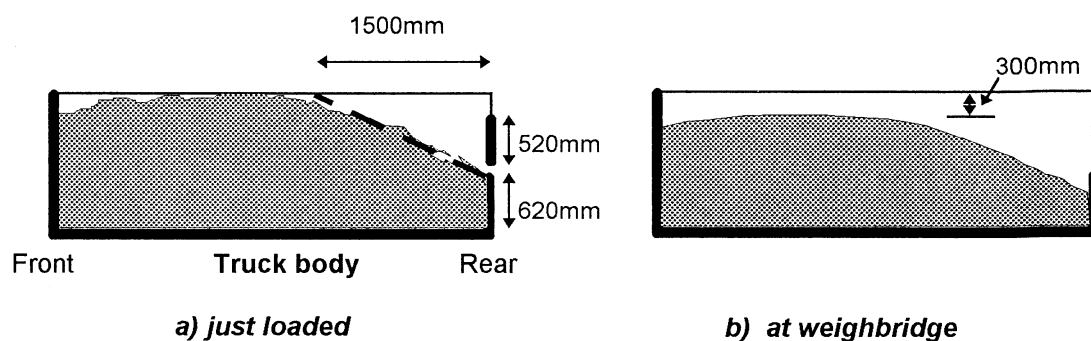


Figure BB-6.1 Observations used to estimate volume of waste

Time to load one cubic metre = $158 / 9.4 = 16.8$ minutes

Weighbridge results

Weight of loaded vehicle	8060 kg	(c.f. RLW 10772 kg)
Weight of empty vehicle	4460 kg	
Weight of load	3600 kg	

Estimated density of waste:

Just after loading	$3600 / 9.4 = 380 \text{ kg/m}^3$
At weighbridge	$3600 / 6.9 = 520 \text{ kg/m}^3$

Unit cost of collection

		Rs	
Hire of truck and driver (including fuel and maintenance)		384	(1995)
Employment costs for 8 loaders (appendix AA-2.1.2)	8 x 170	1360	
Employment cost for one mukadam (appendix AA-2.1.2)		190	
Total cost per shift		1934	
Cost per ton	$1934 / 3.60$	537	
Percentage of cost that is labour charges	$1550 / 1934$	80%	

APPENDIX BB-6.2 STUDY OF BELL RINGING COLLECTION SYSTEM

Route 15, Parsee Colony, F North Ward, Mumbai, 18 December 1995

Station	Distance meter [km]	Distance from previous station [m]	Time of arrival	Time spent at station [min' s"]	No. of residents bringing waste	No. of containers brought to truck	Comments
	516		7.40'00"				Depart muster chowki
1	518		7.43'35"	3'00"	1	1	Resident came after 2 minutes
2		210	7.47'37"	5'10"	0	5	
3		140	7.54'10"	1'14"	0	0	
4		110	7.56'25"	56"	0	0	
5		70	7.57'52"	1'01"	0	0	
6		80	8.00'00"	49"	0	0	
7		40	8.01'15"	1'00"	0	0	
8		65	8.03'05"	56"	0	0	
9		25	8.04'25"	25"	0	2	sweeper's containers
10		50	8.05'35"	37"	0	0	
11		60	8.07'00"	48"	1	1	plastic bag
12		60	8.08'34"	31"	1	1	cane basket
13		55	8.09'35"	1'31"	1	1	v. large bowl, palm branches
14		55	8.11'48"	33"	1	1	cane basket
15		15	8.12'34"	33"	0	0	
16		50	8.13'51"	21"	1	1	
17		40	8.14'45"	34"	0	0	
18		45	8.15'55"	19"	0	0	
19		105	8.18'00"	35"	0	0	
20		25	8.19'00"	9"	0	0	
21		30	8.19'29"	43"	2	2	
22		25	8.20'35"	55"	0	1	twigs and branches
23		15	8.21'40"	15"	0	1	1 sweeper's basket
24		200	8.23'25"	1'04"	1	1	large plastic bin
25		100	8.25'25"	1'33"	0	0	
26		40	8.27'35"	17"	0	1	tree branches
27		45	8.28'20"	2'05"	0	4	street waste from sweepers
28		175	8.32'15"	6'47"	11	15	bags, buckets, bowls, branches
29		50	8.39'30"	3'58"	5	6	containers and garden waste
30		125	8.45'15"	1'10"	2	5	
31		60	8.47'14"	26"	0	0	
32		50	8.48'26"	16"	0	0	
33		100	8.49'28"	3'26"	1	12	street wastes from sweepers
34		75	8.53'40"	1'30"	1	1	
35		110	8.55'25"	1'10"	0	0	
36		60	8.57'12"	27"	0	0	
37		125	8.59'15"	5'10"	0	1	pile cleared by loaders
38		55	9.05'18"	17"	0	0	
39		45	9.06'08"	20"	1	1	small plastic bin
40	519	65	9.07'27"	14'03"	0	N.R.	2 sweepers' carts and roadside pile
41	521	N.R.	9.24'07"	4'48"	2	4	oil drum emptied using bowls
42		70	9.30'43"	5'10"	2	4	largely garden waste
43		45	9.36'21"	6'08"	3	9	restaurant waste carried 75m
44		160	9.43'24"	2'31"	3	4	
45		55	9.46'47"	4'03"	4	12	

Station	Distance meter [km]	Distance from previous station [m]	Time of arrival	Time spent at station [min' s"]	No. of residents bringing waste	No. of containers brought to truck	Comments
46		105	9.51'40"	5'10"	7	10	sweeper, bins and bags
47		70	9.58'35"	22"	0	0	
48		90	9.59'48"	2'14"	3	9	traffic obstructed by truck
49		90	10.02'50"	2'16"	11	18	
				* 10'			delay - discussion with observers
50		N.R.	10.17'05"	2'05"	5	5	
51		70	10.19'35"	1'15"	3	6	
52		55	10.21'20"	2'52"	4	10	Bins waiting at end of lane.
53	521	70	10.25'30"	28"	0	0	
54			10.28'07"	24'11"	6	29	Coconuts taken from oil drum by hand, carried 15m. Restaurant waste carried 25m
55	521	N.R.	10.54'14"	9'01"	2	10	sugar cane and coconut carried 30 and 40 m.
56		50	11.04'09"	15'21"	2	25	food waste in box, bucket & bin. Also waste lifted from gutter.
			11.19'30"	30"			Tarpaulin spread over load
			11.20'00"	*22'30"			refreshment break
			11.42'30"	21'30"			depart for checkpoint
524			12.04'	* 25'30"			depart checkpoint for weighbridge
532			12.39'30"	* 1'55"			loaded vehicle weighed (R K Studio weighbridge)
			12.41'25"	9'55"			depart for disposal site
536			12.51'20"				arrive Deonar disposal site gatehouse
538			13.02'16"	25'44"			unloading at disposal site
539			13.35'53"	4'22"			check out at gatehouse
			13.40'15"	* 9'50"			travel to weighbridge
543			13.50'05"				arrive weighbridge

Notes: * Activities that were a result of the work study observation, and not a part of a normal trip, are marked with an asterisk.

Other data

Truck registration number MMT 3673; hire charge Rs 384 per trip

Operated with one mukadam and eight labourers from MCGM.

Dimensions of cargo body: Height of sides above ground 2.69 m;

Length 3.680 m, width 2.15 m, height of sides 1.4m, height of tailboard 0.52 m.

When the truck had just been loaded and covered with a tarpaulin, the top of the load was about 250 mm below the top of the sides, and it sloped down to the top of the tailboard over the last 600 mm, as shown in the figure BB-6.2

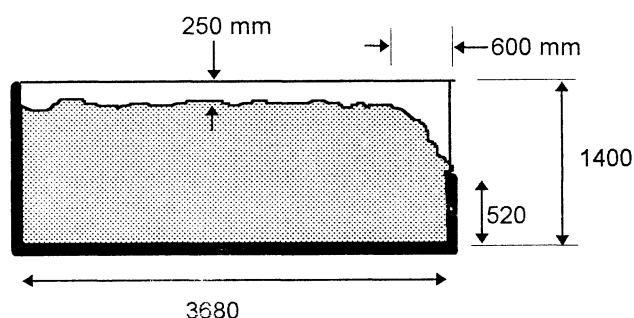


Figure BB-6.2 Extent of loading of truck 18.12.95

Volume of refuse in this case

$$\begin{aligned}
 &= 3.68 \times 2.15 \times [1.40 - 0.25] \\
 &\quad - 2.15 \times 0.5 [(1.15 - 0.52) \times 0.6] \\
 &= 8.9 \text{ m}^3
 \end{aligned}$$

At Deonar disposal site gatehouse the top of the waste was 400 mm below the top of the sides, so the height of the waste had reduced from 1.15 m to 1.00 m. At this stage the volume of the waste was

$$\begin{aligned}
 &8.9 \times [1.00 / 1.15] \\
 &= 7.7 \text{ m}^3
 \end{aligned}$$

Weight of truck loaded 7100 kg
 Weight of truck empty 4940 kg
 ⇨ weight of load 2160 kg

Density of waste = 2160 / 8.9 = 243 kg/m³ as loaded
 and 2160 / 7.7 = 280 kg/m³ after the waste has been compacted by the vibration of the journey to the disposal site

Unit cost

Cost per shift (vehicle hire, 8 loaders and mukadam from appendix BB-6.1) Rs 1934

Weight collected 2.16 tons, therefore cost per ton = 1934 / 2.16 = Rs 895

Time data

- Time to load truck 7.44 am to 11.20 am less 10 minutes delay at 10.02 206 minutes
- Time to load 1 ton 206 / 2.16 93 minutes/ton
- Time to load one cubic metre = 206 / 8.9 23 minutes/m³
- Total distance covered during collecting stage 3800 m walking, and approximately one kilometre in the vehicle.
- Time to unload vehicle 25'44"
- Total time on disposal site 44'30"
- Average speed between checkpoint, weighbridge and gatehouse 17 km in 55'15" 18.5 km/h, though it did travel at speeds of 50 km/h when conditions allowed.

Comparison with other days

On this particular trip the truck arrived at the check post at about 12 noon, having been delayed by a ten minute discussion and a 22 minute tea break. Excerpts from the check post records for the three bell ringing routes were used to determine whether such a finish time was typical. The records are shown below.

Date	Reg. no.	Route 15		Reg. no.	Route 18		Reg. no.	Route 32	
		Loading	Time		Loading	Time		Loading	Time
10 (Sun)	3673	PL	10.45	6612	PL	11.00	1179 *	75%	9.40
11	3673	PL	11.20	6612	PL	11.50	8862	PL	11.05
12	3673	PL	10.50	6612	PL	11.30	8862	PL	10.45
13	3673	75%	11.10	6612	PL	11.50	8862	PL	10.35
14	3673	65%	11.10	6612	PL	11.45	4324	PL	10.45
15	3673	PL	11.30	6612	PL	11.30	8862	PL	10.50
16	3673	PL	11.20	6612	PL	11.40	8862	PL	10.15
17 (Sun)	801	70%	10.50	6612	PL	11.45	4324	PL	10.35
18	3673	PL	12.00		PL	11.50		PL	10.25

Notes: * MCGM compactor truck

PL means properly loaded - the junior overseer was satisfied that the truck was full. Otherwise the percentage indicates to extent to which the truck was loaded, as judged by the junior overseer.

If the 32 minutes unusual delay of the observed vehicle is taken from the time of arrival at the checkpost, the checking time of 11.30 am is obtained. The records show that, for route 15, a checking time that was the same or later only happened once in the nine days of records, but for the three routes (26 other recorded times) there were nine other occasions when a bell ringing route truck checked in at the same time or later - mostly for route 18. There were no cases when a truck on route 32 was as late as this. These differences between routes suggest that either route 32 was less demanding (that is, the truck could be filled more conveniently and quickly) or that the team of loaders on route 32 worked very hard on the nine days of the record.

The records also show that the trip to the disposal site took between 45 and 70 minutes, so if the time on the disposal site is 45 minutes, as it was for the observed case, the driver and loaders on route 18 cannot usually expect to be back at the checkpost for another 2 hours and 15 minutes, which could be as late as 2 pm, which is the start of the next shift.

APPENDIX BB-6.3 CONTRACT DETAILS FOR HIRE OF TRUCKS

The following clauses and table are taken directly from a MCGM contract document, prepared by the Solid Waste Management Department for the period 1994 to 1996. It is reproduced as faithfully as possible, without making editorial modifications. Words taken directly from the contract document are written in Times New Roman font, comments are in Arial font. Excerpts from the appendices mentioned in these clauses are reproduced at the end of this section.

Specifications, terms and conditions for supply of lorries without labourers, on hire for removal of refuse from wards in the City, Suburbs & Extended Suburbs for the period from _____ to _____

1) Lorries as per specifications at Page 20 & with carrying capacity exclusive of space provided for loaders and implements as indicated in Appendix 'B' at Page 30 shall be supplied to work in the wards during a shift of 8 hours.

Normally timings will be as under:

Lorry supply hours:-

6.00 A.M. to 2.00 P.M.

9.30 A.M. to 5.30 P.M.

2.00 P.M. to 10.00 P.M.

5.30 P.M. to 1.30 A.M. (Next day)

10.00 P.M. to 6.00 A.M. (Night shift as and when required)

S.W.M. Working hours:-

6.30 A.M. to 1.30 P.M.

10.00 A.M. to 5.00 P.M.

2.00 P.M. to 9.00 P.M.

6.00 P.M. to 1.00 A.M.

10.00 P.M. to 5.00 A.M.

Tenderers will note the approximate lorry shifts required in the above shifts, as indicated in Appendix 'I' at Page 31-32.

2) The Lorries shall reach the Ward Office not later than half an hour after the notified time. Lorries received thereafter are liable to be returned without use and the Municipal Corporation will not pay any charges whatsoever for the return of such lorries received late.

3) If the contractor is called upon to operate the vehicle beyond shift hours, he will be paid an extra rate of Rs. 20.00 per hour. However, less than 30 minutes additional operations will not be paid extra.

4a) The cubic capacity of the lorry excluding the space provided for loaders and implements as referred to in clause 5 shall be as indicated in appendix 'B' at Page 30 and the correct dimensions should always be made available with the driver of the lorry. In case the contractor supplies lorries of less capacity, then the rate to be paid shall be proportionately reduced to the actual capacity of vehicle supplied and the charges will be paid proportionately. Cubic capacity will be taken as the product of length, breadth and height of the body of the lorry. In case of vehicles of 10.58 cum. capacity the portion behind the driver's cabin provided for the space for the staff shall be of the same height as the said boards, if the rear board is not of full height as the side flaps, the vehicle will be treated as of less capacity.

b) In case dimension of the lorry is increased for raising the height by providing additional planks, there shall remain no gap which will cause to fall the refuse there from through the gap and litter on the road. However, the partition earmarked for accommodating the labourers and implements shall be kept at nominal height to permit free in the side and rear boards shall be rejected.

5) The vehicle of the make prior to 1980 will not be accepted for work as mentioned in tender.

5a) Every lorry supplied shall have (a) closing and opening type of tail board of permissible height at the back, (b) fixed strong partition of full height in front side of body as mentioned under condition 4(a), (c) a clear distance of not more than 0.457 mt. from driver's cabin. This shall be provided for use as standing place, for loaders and to keep implements, (d) seating arrangement for six loaders shall be provided in this compartment and this compartment shall be provided with temporary cover of canvas/hood, (e) leaving above space a clear loading space of approx. 5.66 cum. in respect of lorries of 5.66 cum. capacity and app. 10.58 cum. in respect of lorries of 10.58 cum. capacity shall be available for loading adequately with any of the items covered under condition 7. The contractor should take the advantages of length of the body and keep the height as minimum as possible to get the required volume of 10.58 cum or 5.66 cum.

6) The contractor shall supply full number of lorries indented for the day. The intimation would normally be given by previous day evening. Contractor's man should attend ward office daily to take the indent. In case of failure a fine of Rs. 25/- per day will be charged.

7) The lorries shall be used for the removal of refuse mixed with earth, debris, silt, any other waste materials including carcasses of animals.

8) Log sheets will be provided by the ward staff and countersigned by the officer in charge, on production of intimation slip from the contractors wherein it shall be mentioned the registration Nos. of lorries sent, their type whether Petrol or Diesel operated. The contractors shall ascertain that these details are incorporated in the log sheet issued.

9) Loading and unloading of refuse shall be done by the Municipal labour.

9a) The Contractor shall make arrangement for unloading the garbage when asked to do so in case of unforeseen circumstances. In that case the contractor will be paid Rs. 60/- as unloading charges per trip of 10.58 cum. capacity & Rs. 30/- for one trip of 5.66 cum capacity.

10) Average number of lorries required daily in the ward will be shown in the Appendix 'I' & as mentioned in clause 3 of the agreement.

11a) At the unloading grounds, the drivers of the contractors' lorries shall obey the instructions of the dumping ground staff for proper entry of log sheets, for treatment by disinfection operations and for systematic parking at the site as shown by the municipal staff. The failure to comply this will be viewed seriously. The contractor shall depute a responsible person at the dumping ground from time to time to see that the lorry drivers are following the instructions of dumping ground staff.

b) The contractors shall be levied a penalty of Rs. 100/- per trip per lorry if he fails to unload the vehicle at appropriate place and as per instructions.

12) In case of emergency, the contractor shall be asked to work in any of the Wards A to G in the City and H/East, H/West, K/East, K/West, L, M/E, M/W, N, S, T, P/S, P/N, R/S, R/N, Wards in the suburb as and Extended suburbs other than that allotted to him and he shall be paid at the rate quoted by him in the Ward he is operating or the rate quoted by the successful tenderer for the Ward where he is directed to work whichever is higher. However, the vehicles for unloading shall be taken to the dumping ground shown against that ward in which he is directed to operate.

13) In case of breakdown of lorries the proportionate cost would be paid to the contractor according to the actual hours of working. Proportionate cost at Rs 5.00 per man hour of the entire gang of Municipal labour together with Mukadam, to the lorry will be deducted from the relevant bills of the contractor, based on the man hours of actual works.

13a) In case the contractors vehicle fails on the road due to the mechanical break-down etc. then the contractor will make necessary arrangement to transfer the refuse immediately to other vehicle and transport the same to the site of disposal. In case the contractor fails to make necessary arrangements within 3 hours to transport the refuse, necessary arrangements will be made by the Corporation through

its own staff and vehicles or through private agency and cost of the same alongwith 15% supervision charges will be recovered from the contractor in addition to penalty for non supply.

14) If the lorries are indented but not utilised for some reason or other and returned within half an hour from the commencement of conservancy working hours, no charges will be paid to the contractors, If the lorries are detained and returned within two hours thereafter 1/4 of the lorry shift charges shall be paid thereafter if the lorries are detained and not utilised for any period not exceeding 8 hours of the shift 1/2 of the lorry shift charges shall be paid.

15) In the event of non-supply of lorries, if the contractor fails to supply the number of lorries indented for the day, the cost of the labour and supervisory staff wasted due to short supply of lorries will be recorded as under:

a) In case the labour gang together with Mukadam is wasted Rs. 5.00 per man hour of gang will be recovered in proportion to number of hours wasted.

16a) In case the contractor fails to supply number of lorries indented for the day and number of lorries thus supplied less by the contractors shall be hired from any private agency or from open market of Municipal vehicle will be engaged at his risk and cost and the additional cost incurred if any plus 15% supervision charges will be recovered from the contractor in addition to usual penalties.

16b) Penalty equivalent to amount quoted per lorry will be recovered for each vehicle not supplied.

16c) If the lorry is indented for double shift and the contractor supplied only for one shift, the rate payable to him will be 50% of the accepted rate for a double shift and for non-supply for the other shift will attract penalties as mentioned above. Single shift will not be admissible.

17) The Contractor shall provide a board showing that the lorry is on Municipal duty (conservancy work) and the name of the Ward should exhibited on the front side of the lorry at a conspicuous place so long as the lorry is on Municipal Duty. Failure to display the board will render the contractor liable for penalty at Rs. 25/- per vehicle per shift.

18a) Lorries shall be sent to work in perfect working order having proper registration and fitness certificate for road worthiness from R.T.O. and with adequate supply of fuel oil. If the lorry goes for fuelling after it is received for work at the Ward Office the time wasted thereby will be taken into consideration at the time of payment of bills, in case the output of work is affected adversely. Similarly if the driver takes away the vehicles without allowing the vehicle to be loaded adequately proportionate deduction will be effected for the under-load. Mukadam of the loading gang shall be allowed to travel in the driver's cabin.

18b) If it is found that any vehicle has made an accident or is liable to make an accident due to the vehicle not being road worthy or due to mal-operation by the contractors driver or by rash driving by contractors staff such vehicles shall be debarred for use permanently anywhere in any of the wards and it will be contractors responsibility to make up the quota immediately.

19) The Contractor shall supply the lorries with tarpaulin cover as per municipal specification which should be in good condition and of a suitable size so as to cover the lorry completely. If the contractors fails to supply cover a fine of Rs. 50/- per trip per lorry will be levied and deducted from the bill. The tarpaulin will cover both side planks and the rear tail board completely from top to the floor of the vehicle and properly fixed by the hooks.

19a) In respect of 10.58 cum. lorries tarpaulin cover should be tied by putting the rope on side and on the back side as tide in the truck. [probably ...and tied to the truck.]

20) Lorry must go back to the Ward Office after unloading its last trip for relieving the Municipal Labour staff and depositing implements, failing compliance a penalty of Rs. 10/- per shift per lorry will be levied and deducted from the bill.

20a) For each trip lorry must report for inspection of M.L.J.O. [Motor Loader Junior Overseer] or their representatives at a fixed point for each Ward, as decided, for checking each trip before the lorry goes out of section to the dumping ground. Failure to route the lorry through check point will render the contractor liable for penalty at Rs. 25/- per trip per lorry.

21) The cost of any damage injury or death caused by the Contractor's lorry or any claim arising out of it, will be recovered from the contractor through his bill.

22) Commissioner shall terminate the contract for supply of lorries for a Ward or Wards after giving one calendar month's notice without assigning any reasons whatsoever.

23a) In case the contractors come forward with a request to allow them to withdraw from fulfilling their contractual obligations normally such a withdrawal is not allowed. However, if due to circumstances such a withdrawal is allowed, such firms may not be considered for award of work for a period of FIVE YEARS.

23b) The rates quoted should be firm for the entire contract period.

24) The contractor shall prepare separate monthly summaries of bills preferred by them against the various Municipal Departments during the month and send on or before the 5th of the next month these summaries to the respective units of the Accounts Department where the bills are admitted for payment. In case of discount bills, the contractor should submit fortnightly summaries say on 5th and 20th of the month to enable the Accounts Department to admit payment in time. The Corporation will not be responsible for delay in payment of their bills if summaries of bills as indicated herein are not submitted by them by due date as per the clause of the contract.

25) The contractor shall ensure that the payment of wheel tax for the lorries hired by the Corporation from them are cleared by their owners. If any such vehicle or vehicles supplied by the contractor are found to have run in arrears of such wheel taxes, the same shall be recovered from the contractor's bill or deposit after giving him the opportunity to clear the same.

25a) The requirement of the lorries are administrative [administered] wardwise, however for administrative convenience requirement is shown against conservancy wards in some wards. However, it shall be open for the Corporation to use any of the lorries in any of the conservancy wards in the same administrative ward without any extra cost.

26) For evaluation purposes rates as shown in Appendix 'B' at Page 30 will be taken into account.

27) In case the Refuse Vehicles are directed to dumping ground other than principal dumping ground and if the distance of other dumping ground is more than the principal dumping ground the Contractor will be paid at the rate of Rs. 5/- per k.m. for the additional distance in one direction irrespective of the capacity of the lorry. For example if the dumping ground of A/S Ward is changed from Deonar to Mulund then the contractor/s will be paid additional amount of Rs. 57.50 only.

28) In case the distance of other dumping ground where the Refuse lorries are directed, is less than the principal dumping ground then an amount of Rs. 5/- per k.m. will be deducted from the rate of Principal dumping ground for the distance less than principal dumping. The distance is as mentioned at Page 33-34 of the tender form.

29) The representation regarding dispute in distance at Page 33-34 will not be considered.

30) The contractor should display the registration No. of the vehicles and the name of the ward on the top portion of the cabin on the cleaner's side.

31) In the wards whose contractor/s vehicles, are supposed to make two trips per shift, but in case their vehicle does only one trip in a shift due to breakdown. In such cases 50% amount of the rate quoted per shift will be recovered from the contractor's bill as a penalty.

Other information from contract document

Specification of truck bodies on page 20

Specifications of loading space of lorries on 5.66 cum. capacity to be supplied by the prospective contractors.

The length shall be minimum three metre. The height should vary according to length to give required volume. Rear end tail gate shall be 0.915 mt. in height from the floor.

Specifications of loading space of lorries of 10.58 cum. capacity to be supplied by the prospective Contractors.

The length shall be 4.2 Mt. height 1.2 metres & width 2.1 metres. Rear end tail gate shall be 1.2 Mt. in two/three flaps.

Appendix B (page 30) lists the dumping grounds that should be used by each ward, the number of trips to be made per shift, and the cubic capacity of the trucks that are to be used. Two trips are required of vehicles that have a capacity of 5.66 m³ and the larger trucks are required to make only one. Appendix C (pages 33 and 34) shows the distances from the vehicle reporting chowkies in the wards to the entrance to the assigned or alternative disposal sites. The table below combines some of this information from appendices B and C for a few wards. (F North Ward is the subject of this chapter and K West Ward is the location of the study of chapter B-2.)

Ward	Principal dumping ground	Alternative unloading point	No. of trips / shift	Cubic capacity of lorries to be provided. [m ³]	Distance from ward chowki to disposal site [km]
A South	Deonar		1	10.58	24
		Mulund			35.5
		Refuse transfer station at LBS Marg, Kurla			17
F North	Deonar		1	10.58	11.5
K West	Chincholi		1	10.58	10
		Gorai			17.5
P South	Chincholi		2	5.66	2.5
S	Mulund		2	5.66	8.75

There is also a table (on pages 31 and 32 of the contract document) showing the vehicle requirements for each ward during the "peak season" when waste quantities are highest, and during the "lean season" when there is less waste to be collected. Some examples of the entries are reproduced below

	A South	F North	K West	P South
Peak season quota daily requirement (184 days)				
6.00 am to 2.00 pm	12	11	12	3
10.00 am to 6.00 pm	1	2	1	
2.00 pm to 10.00 pm	4	8	8	2
5.00 pm to 1.00 am	0	2	1	
TOTAL	17	23	22	5
Lean season quota daily requirement (181 days)				
6.00 am to 2.00 pm	11	9	10	2
10.00 am to 6.00 pm	1	1	1	
2.00 pm to 10.00 pm	3	7	6	2
5.00 pm to 1.00 am	0	1	1	
TOTAL	15	18	18	4

Comments

Administrators like to write strict conditions and demand a high specification, but consideration should also be given to how the regulations and standards will be enforced, and whether some of them are really necessary. For example, it is likely that many of the contractors' vehicles do not meet the requirements for age and some may not meet the requirements regarding the dimensions of the loading space. Since the unit cost of waste collection depends upon the volume of waste loaded, it is important to uphold the requirements for the loading space.

The terms and conditions clearly show the benefits of using contractors to supply vehicles. All concerns about availability and maintenance are taken care of by the contractor, and enforcement of discipline in terms of timing and deviation from required operational procedures can be achieved by reducing the fee that is paid at the end of the month, provided that the staff are not intimidated by the contractor.

Perhaps a major issue is the quality of the vehicles. Loading and unloading are slow and unhygienic, and a large area of the disposal site is required for large numbers of open trucks that require 25 minutes to be unloaded. The vehicles that the contractors supply are old and suitable for a wide variety of purposes, and if a contractor does not win a contract, he might use the vehicles for other purposes. Could contractors be persuaded to supply vehicles that are specially designed for handling solid waste? Modern and efficient solid waste collection vehicles are not well suited to transporting other types of materials, so before a contractor would consider investing in a specialised refuse collection truck, he would need to know that he had a contract for a long period (at least five years) and that the contract would pay. An alternative might be for contractors to lease the vehicles, but there is always the problem of how to ensure that the operator maintains the vehicle well and takes good care of it. A maintenance contract is another possible way of reducing the workload of municipal managers, but the municipal corporation must then find the capital required to purchase the vehicles.

The contractors trucks system in Mumbai may not be elegant or modern, and it may be more expensive than some alternatives, but it has provided a reliable service, and reliability is of great importance in solid waste management.