

amt of hydrogen =  $01.435 \times \frac{2}{18} = 0.380 \text{ kg}$

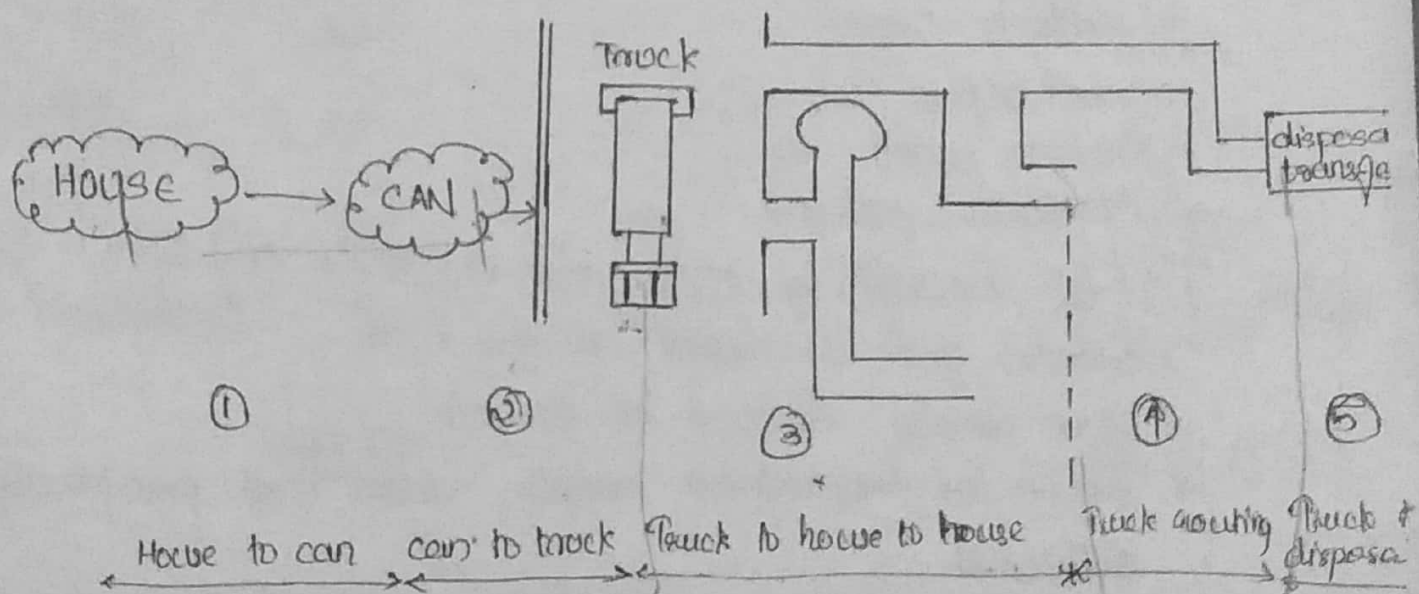
amt of  $O_2$  present =  $01.435 \times \frac{16}{18} = 1.273 \text{ kg}$

## MODULE - 3

### Collection of MSW:

- \* Collection services
- \* Collection systems
- \* Collection routes
- \* Need for transfer operations
- \* Resource conservation and recovery

### Five phases of MSW collection:



## Collection components:

- \* Collection parts
- \* Collection frequency
- \* Storage containers
- \* Collection crew
- \* Collection routes
- \* Transfer station

## Collection of MSW:

The functional element of MSW collection include gathering of solid waste and recyclable materials and their transport to the location where the collection vehicle is emptied. The collection programs in different communities vary greatly depending on:

- 1) Type of waste collected
- 2) Community characteristics
- 3) Economics
- 4) Waste collection facilities (transportation, recycling)
- 5) Attitude of public
- 6) Data concerning the waste sources, waste composition and total volume are critical for the proper planning of a collection program.

Q. Suppose a crew of people require 3 minutes per stop at which they can service 4 customers. If each customer generates 56 kg of refuse per week. Then how many customers can they service if they did not have to go to the land fill?

ans. The working time is 8 hours, assume 30 seconds for break and also for the travel from and to the garage. So, the productive hours become 6 hours (= 360 min). Given, 3 min/stop.

∴ The truck should be able to make 180 stops at each stop they can service 4 customers.

∴ Total service =  $4 \times 180 = 720$  customers.

1. a) classify solid waste based on source and define each  
 b) what are the physical charac. of MSW?

2. Using the data for a MSW sample provided below, find the avg. moisture content of the sample. Base your calculations on a 100kg sample size.

a) Component	Moisture content (%)	wght (%)
Paper waste	7	15
Yard waste	55	18
Food waste	65	20
Plastic	2	5
wood	20	8
Glass	3	7
Metals	3	9
Textiles	12	8

b) what are the advantages of estimating the quantity of waste generated?

c) write the impact of industrial waste on environment.

3. Estimate the energy content on dry and ash free dry basis of a solid waste sample with the following

a) composition. Assume the overall ash content of solid waste is 21% & 5% susp. Assume a mass of 100kg.

Component	Food waste	Paper	Card board	Plastics	Garden trimming	wood	in case
% by wght.	15	45	10	10	10	5	5
energy KJ/Kg	4650	16750	16300	32600	6500	18600	700

b) What are the impact of C and D waste on environment?

Answers:

Q. a) Source	Typical facilities, activities/ locations where waste is generated.	Characteristics
* Residential	Single family or multi-family buildings, apartments.	Food wastes, plastics, glass & ceramics, yard wastes, batteries.
* Commercial	Office buildings, stores, hotels, restaurants, service stations etc.	Food waste, paper, cardboard, glass plastics, wood, metal & wastes.
* Institutional	Schools, hospitals, prison	Food waste, paper, cardboard, glass, plastics, wood, metal wastes.
* Industrial	Fabrication, construction, demolition, light & heavy demolition manufacturing process, refineries, power plants.	Hazardous waste, metal waste, ash.

# 11/2/20 Collection Services:

- \* Residential →
  - \* Curb
  - \* Alley
  - \* Setout - setback
  - \* Setout
  - \* Backyard curbs.

\* Industrial → Large movable & stationary containers & compactors.

## 1. Curb:

When curb service is used the house owner is responsible for placing the containers to be emptied at the curb on collection day and for returning the empty containers to their storage location until the next collection.

### Advantages:

- It is less costly, because it requires less time and fewer crew members.
- As the crew members do not enter the private property fewer issues will be the result of passing complaints.
- It is adaptable to automated and semi-automated collection equipment.

### Disadvantages:

- The residence owner is responsible for placing the containers at the proper collection point.

- Collection days must be scheduled
- On collection days the containers are visible from the street which is not aesthetically appealing.

2. Alleys: It is a narrow passage way b/w or behind the buildings and are part of the basic lay out of a city and the containers used for storing solid waste are placed in alleys.

3. Set out - set back:

In this the containers are set out from the house owners properly and set back after being emptied by additional crew members that works with collection crew responsible for loading the collection vehicle.

Advantages:

- Collection days need not be scheduled.
- Waste containers are not usually visible from the street.
- Use of additional crew members reduces the loading time.

Disadvantages:

- \* As the crew members enter the private property the ~~less~~ passing complaints are likely to occur.
- \* As the residence are not involved more crew members are required, hence it is more costly than others.

4) Set back: The set back service is essentially same as that of set out set back except that the house owner is responsible for returning the storage containers to the storage location.

5) Back yard entry: In this service the collection crew is responsible for entering the house owners property and removing the wastes from their storage location.

### Advantages:

- \* It gives requires fewer crew members than set out set back method.
- \* Collection dates may be not be scheduled.
- \* Waste containers are not usually visible from the street.

Q A truck is found to service customers at a rate of 1.25 customers/min. If actual time they spend on collection is 4hrs. how many customers can be serviced?

ans

~~$N = \frac{Q}{X}$~~

~~Total no. of customers serviced~~

~~Collection frequency no. of collection~~

1.25 cust/min.

~~No. of customers a single truck can service per day~~

$4 \times 60 = 240$

~~no. of working days/week~~

$240 \times 1.25 = 300$  customers/day

No of collection vehicles model (N) needed:

$$N = \frac{SF}{XW}$$

S = Total no. of customers serviced

F = collection frequency

(no. of collection/week)

X = no. of customers a single truck can service per day.

W = no. of working days/week.

Q. Calculate the no. of collection vehicles a community council need if it has a total of 5000 customer services that are to be collected once per week.

ans. S = 5000

F = once per week.

Assume a single truck can serve 300 customer per day and the collection occurs on mon, tue, thurs, fri and leaving out for truck maintenance.

W = 4, X = 300

$$N = \frac{SF}{XW} = \frac{5000 \times 1}{300 \times 4} = 4.2 \approx \underline{\underline{5 \text{ trucks}}}$$

Imp Collection Systems:

\* Handled container s/m (HCS)

- conventional mode
- Exchange container s/m.



\* Stationary container s/m (SCS)

(s/m with self loading compactors)

(s/m with manual loaded vehicles)

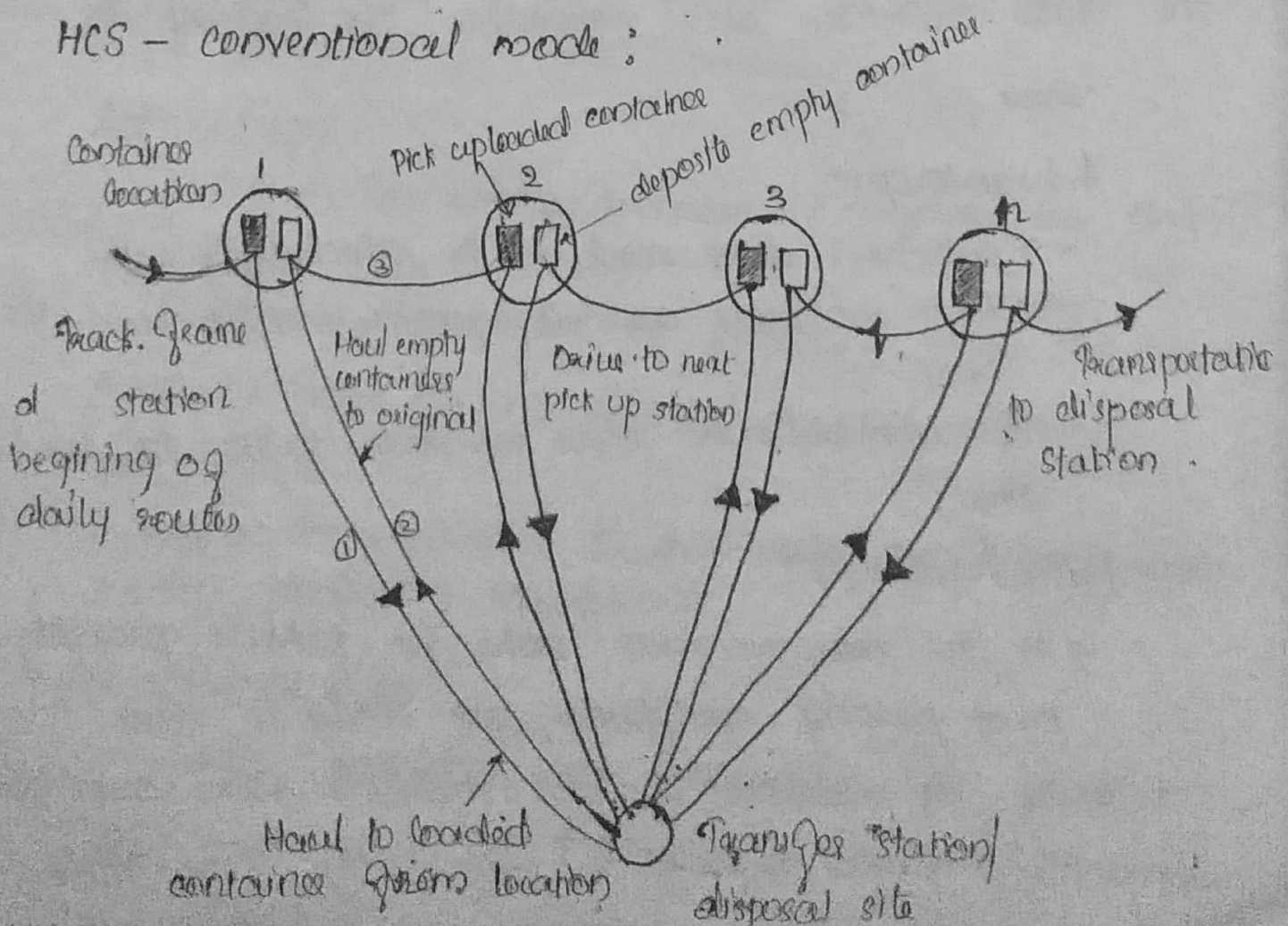
Hauled container s/m (HCS):

In this the wastes can be hauled to the disposal site emptied and return to the original location. This is suitable for areas with high waste generation.

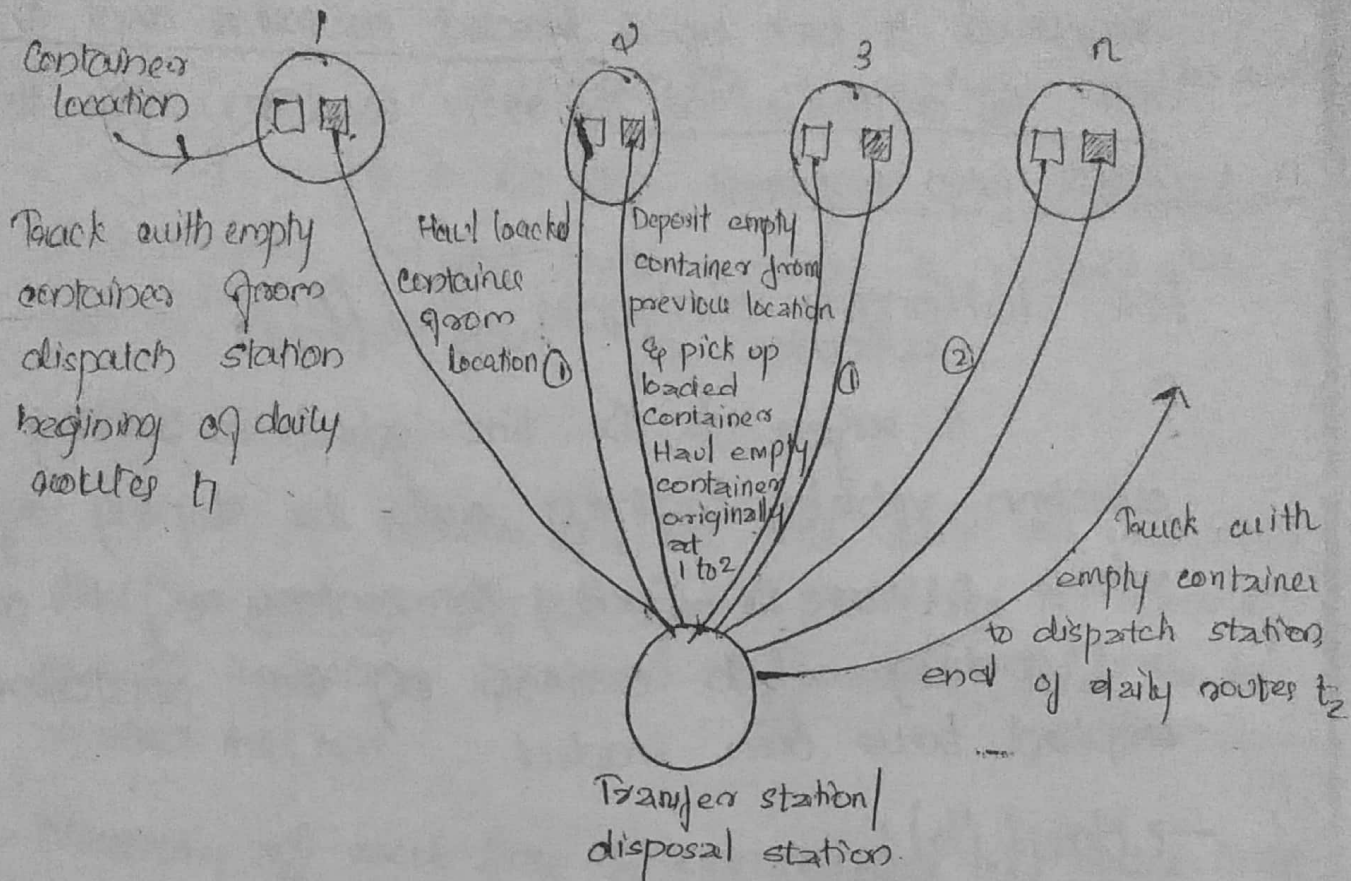
It can be

- \* Hoist truck
- \* Pilt frame container.
- \* Trash trailer.

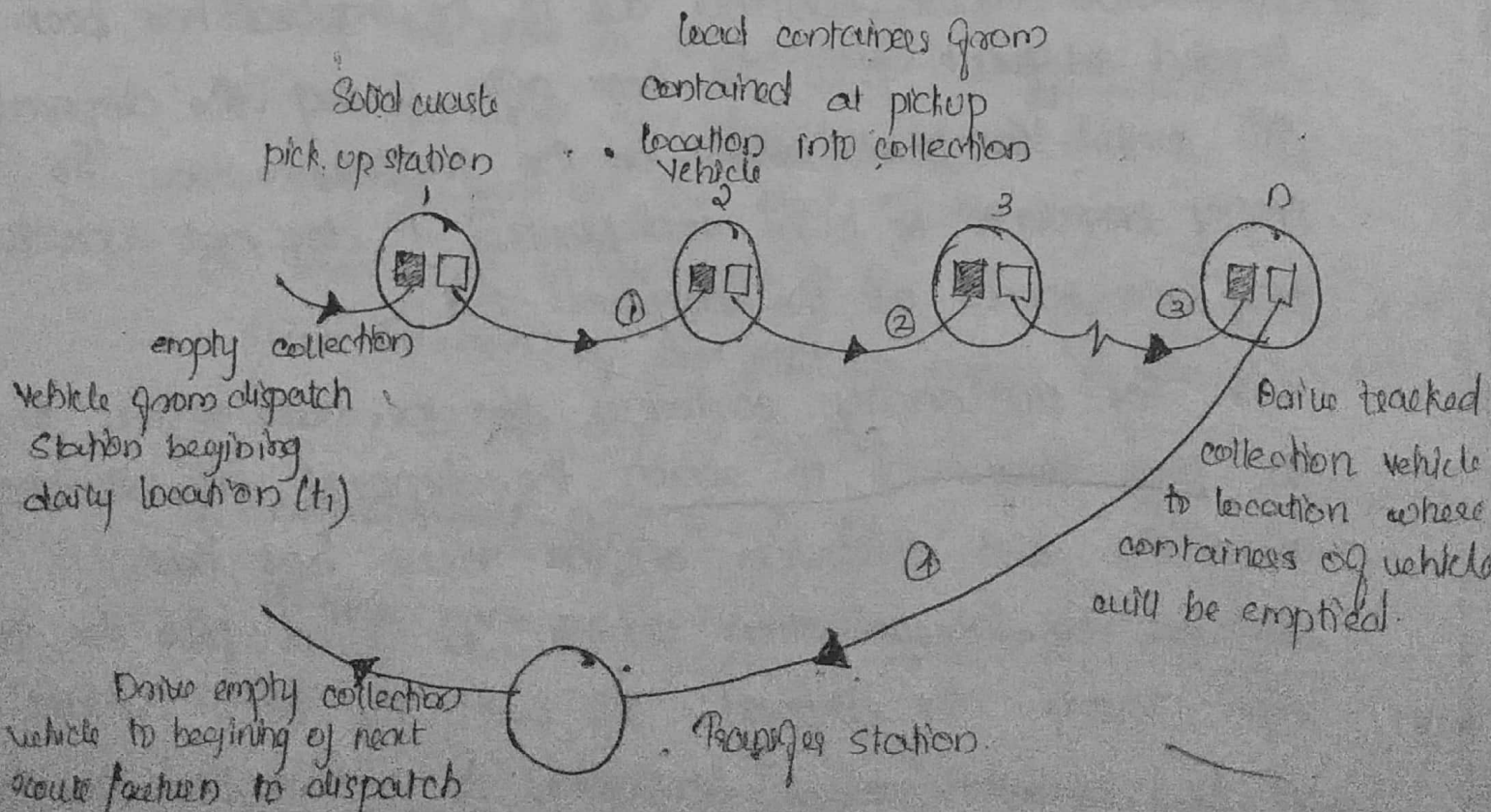
HCS - conventional mode :



## HCS - Exchange containers mode:



## SCS - stationary containers s/m:



15/2/20  
Q Write a note on construction and demolition waste management in India emphasizing the strategy for promoting processing of C and D waste generated at Maradu flat demolition.

ans. In generally adopting C and D waste management in India was;

- \* Items recovered during demolition are sold in the market at a discount cost price of new material.
- \* Items, that cannot be re-used are disposed to landfill site.
- \* Some municipal corporations allow C and D waste in their landfills, while others want to minimize it to prolong useful life of landfill sites.
- \* Different constituents of waste are not segregated prior to disposal.
- \* Though directives exist for disposal of waste to landfill areas, presently penal action against violators is practically not taken.

There can be use in this case also. Moreover,

- \* Recyclers and remanufacturers post consumer waste into new alternative waste products which are then marketed to the construction, manufacturing and energy industries. For various uses these products include animal bedding, shingle sand aggregate, shingle flake/plastic mix alternative fuel, sp. septic

and as well as other products.

\* The solid materials of concrete can be used for paving works of roads and many artistic works also can be done by it.

## 15/2/20 Analysis of collection s/m:

To establish vehicle and labour requirements for various collection s/m and for that unit time required activities involved:

→ Pick up (P)  $\begin{cases} \rightarrow P_{hes} \\ \rightarrow P_{ses} \end{cases}$

→ Haul (h)

→ At site (s)

→ off route (w)

## Definition of unit terms / operations

The activities involved in the collection of solid wastes can be resolved into 4 unit operations.

→ Pick up (P): For hauled container s/m ( $P_{hes}$ )

\* Conventional: (empty — loads)

In this mode  $P_{hes}$  refers to the time spent in driving to the next container after an empty container has been deposited, time spent in picking up the loaded container and the time required to redeposit the container after its

contents have been emptied

\* In exchange container mode Pcs refers to the time required to pick up a loaded container and to redeposit the container at the next location after its contents have been emptied.

For stationary containers s/m (P<sub>scs</sub>):

It refers to the time spent in loading the collection vehicles beginning with the stopping of the vehicle prior to loading the contents of 1<sup>st</sup> container and ending when contents of last container to be emptied have been loaded.

→ Haul (h):

\* For hauled containers s/m the haul represents the time required to reach the disposal site, starting after a container whose contents are to be emptied has been loaded on truck plus the time after leaving the disposal site until the truck arrives at the location where the empty container is to be redeposited. It does not include any time spent at the disposal site.

\* For stationary containers s/m the haul refers to the time required to reach the disposal site starting after the last container on the route has been emptied or the collection vehicle is filled plus the time after leaving the disposal site until the truck arrives at the location of 1<sup>st</sup> container to be emptied on the

near collection route. It does not include the time spent at disposal site.

\* At site (s): disposal site + waiting to unload

It refers to the time spent at the disposal site and includes the time spent waiting to unload as well as the time spent for unloading.

\* Off route (O):

It includes all the time spent on activities that are non-productive from the point of view of overall collection operation. Off route time can be divided into two

Necessary off route time & unnecessary off route time.

\* Necessary off route time includes:

- (i) Time spent on equipment repairs and maintenance
- (ii) Time loss due to unavoidable traffic congestion.
- (iii) Time spending for checking in and out in the morning and at the end of the day.
- (iv) Time spent in driving to the 1st pick up point and from location of last pick up point to the dispatch station at the end of the day.

\* Unnecessary off route time:

(i) Time spent on taking an unauthorised coffee breaks.

Talking to juveniles & also time spent for lunch.

	HCS	SCS
Time per trip (h/trip)	$T_{hes} = \frac{P_{hes} + s + b}{1 - w}$	$T_{scs} = \frac{P_{scs} + s + b}{1 - w}$
Pick up time per trip (h/trip)	$P_{hes} = p_c + u_c + d_{bc}$	$P_{scs} = c_t(u_c) + (np)^t$
No. of trips per vehicle per day	$N_d = \frac{(1-w)H}{P_{hes} + s + b}$	
No. of trips per day	$N_d = \frac{(1-w)H - (t_1 - t_2)}{T_{hes}}$	
No. of trips per week (trips/week)	$N_w = \frac{V_w}{cF}$	$N_w = \frac{V_w}{V_v}$
No. of trips per day (trips/day)	$N_d = \frac{V_d}{cF}$	$N_d = \frac{V_d}{V_v}$
No. of containers emptied per trip (containers/trip)		$c_t = \frac{V_v}{cF}$

$p_c$  = time required to pick up loaded containers (hrs/trip)

$u_c$  = time required to unload empty containers (hrs/trip)

$d_{bc}$  = time required to drive b/w container locations (hrs/trip)

$H$  = length of work day (hrs/day)

$V_w$  = weekly waste generation eqt. ( $m^3$ /week)

$V_d$  = daily waste generation eqt. ( $m^3$ /day)

$V$  = Vol of vehicle ( $m^3$ /trip)

$\alpha$  = compaction ratio

$C$  = avg. container size ( $m^3$ /trip)

$F$  = weighted avg. container utilisation factor

$n_p$  = no. of container pickup locations per trip.

$C_t$  = no. of containers emptied per trip.

8/3/20 collection routes:

\* Micro routing & macro routing

\* Routing pattern

- One way street collect<sup>n</sup>
- Three block configurat<sup>n</sup>
- Four block configurat<sup>n</sup>

Steps involved in establishing collect<sup>n</sup> route:

1. Preparat<sup>n</sup> of local<sup>n</sup> map showing data & informat<sup>n</sup> concerning the waste generat<sup>n</sup> sources.
2. Data analysis & preparat<sup>n</sup> of informat<sup>n</sup> summary tables.
3. Preliminary layout of routes.
4. Comparison of preliminary routes & the development of balanced routes by trial and error.

Factors affecting select<sup>n</sup> of route:

- (i) Do not fragment the routes.



(ii) collect<sup>n</sup> time and hauling time must be equal for each route.

(iii) Start collect<sup>n</sup> in the proximity of municipal sewage.

(iv) Do not collect heavy traffic streets during peak hrs / rush hrs.

(v) Start routes at higher elevat<sup>n</sup>.

(vi) Avoid dead end routes.

(vii) Routes must not be overbypassed.

(viii) make right turn as much as possible.

Advantages of proper planning of collect<sup>n</sup> routes :

\* It reduces the labour cost expended for collect<sup>n</sup>.

\* Reduces the cussking hrs.

\* Reduces the vehicle fuel consumption.

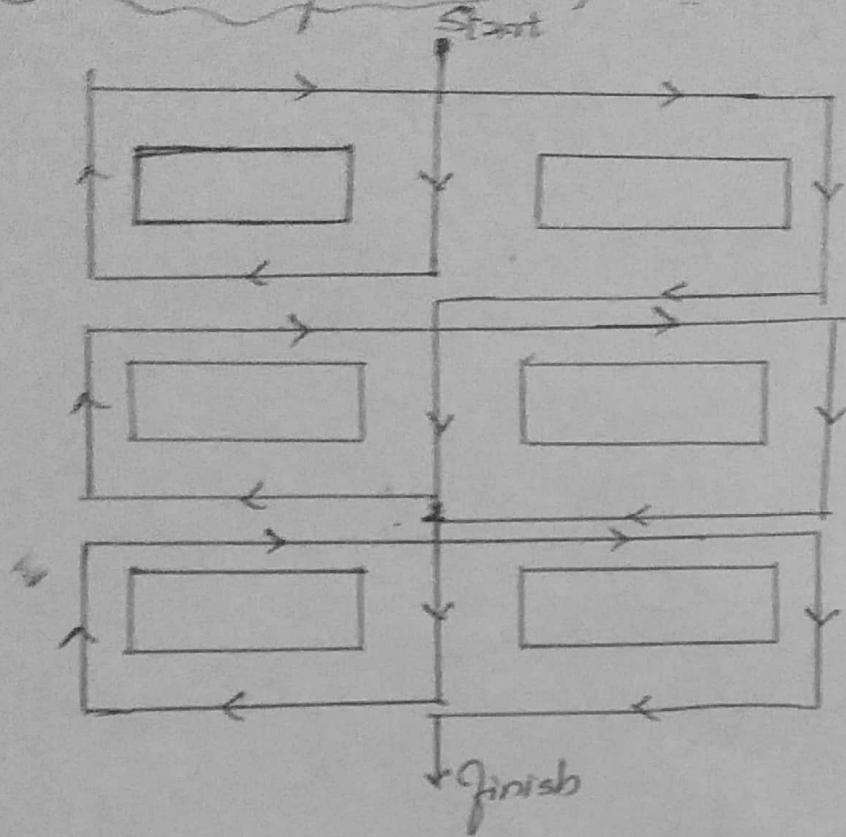
→ The size of the route depends upon,

(i) Amount of waste collected / stop.

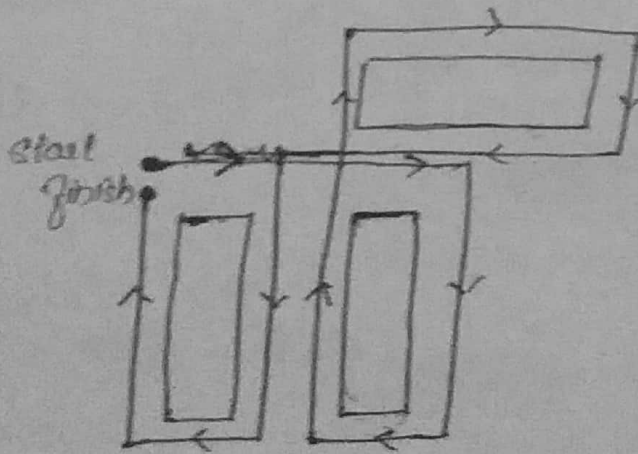
(ii) Direct Distance b/w stops.

(iii) Loading time by traffic cond<sup>n</sup>s.

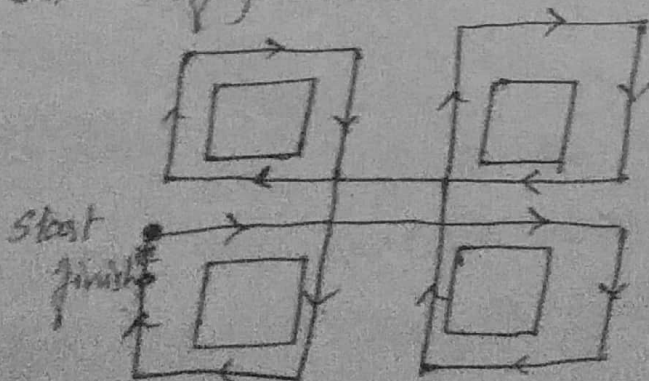
Routing pattern for one way street collect:



These block configuration:



Two block configuration:





It is a controlled facility and acts as a pre processing unit - wastes are dewatered, sorted and recyclable materials are recovered back.