Integrated Waste Management for a Smart City
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Module-04 Lecture-19
MSW Collection System

Okay. So we will get started from where we left in the previous module. We will, we were talking about the collection, we kind of left just before the collection. We said how the waste has to be stored in the places where it is being generated. So today we will, so once the waste is generated, we need to collect it. So today we will talk about what are the different collection equipment that is typically used and we will also see the examples, some photographs of different collection equipment in action. And that will give you some ideas about what type of collection equipment, again it depends on what type of waste we are producing, what type of like a city we have.

Sometimes you may have to go for a place where narrow street, so you cannot have a big truck going around. So there are different ways it can be done and you will see some examples on in this particular module. And when we look at some of the, we will, as I said there will be three specific case studies, at least three for the first, among the first 20 smart cities that have been identified in India. So you will see some of the other examples there as well.

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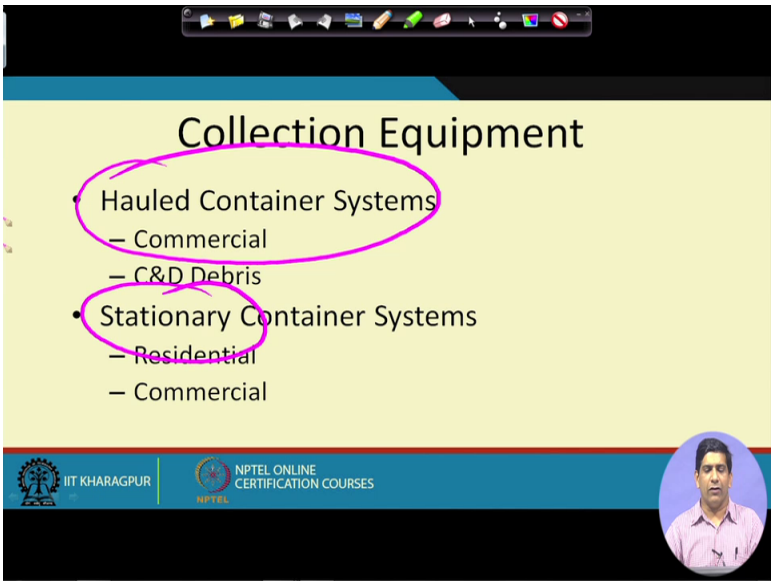

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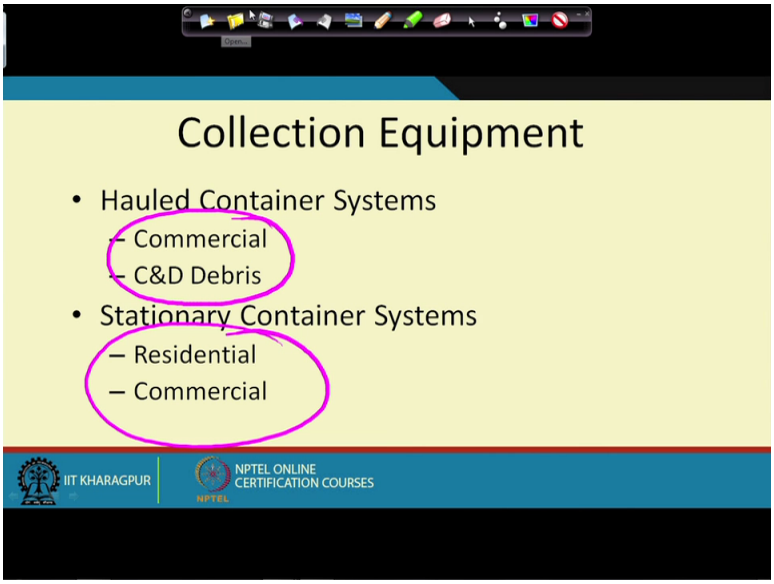

So let us get started. So in terms of the collection equipment, there are in broadly, so broadly we have two types. One is the hauled container and one is the stationary container. As the name suggest, it is based on like a hauled container or the stationary container. For the hauled container system, it is the, hauled means it is you have the trash can, you have a big trash can as you saw in the previous module and then you have a truck coming in and it is taking the whole trash can with it. So that is the hauled container. It is hauling it away. So it is not a stationary, it is hauling it away.

And the other part, when we say stationary, stationary is when the trash can stays where it is, a truck comes in, unloads the material from this trash can into the truck itself and the truck moves away. So empty truck comes in, (take) unloads the material from the trash can, the truck gets filled and then the truck goes away with that garbage. So there is a hauled means when the trash can itself gets taken away and then the new trash can, new empty trash can is put there.

So when we use it? Depending on, as you can see over here, depending on the different types of location, different types of waste, either you will use for a hauled container or the stationary container. So for the hauled container system, we will typically use it in a commercial setting or C&D debris. Commercial, where you have lot of waste being produced in a big institutional area, big mall area where you have a huge trash can, so all the garbage is getting filled in there.

So this trash can becomes so heavy that now the truck, you cannot really unload it either mechanically or using physical means. So what, either you have to kind of go in and try to dig it out and put it in the truck. So that requires lot of manpower. So rather than doing that, we take this whole container with it and put empty container there.

Same thing with construction and demolition debris. When we say construction and demolition waste, which we will talk more in detail towards the end of this course, C&D waste is, construction waste is what we have? We have concrete, we have brick, we could have wood pieces, so those are heavy stuff. So they are really heavy stuff, so we cannot really unload them from one container to another container. So we basically take the whole container away and that is why it is said hauling when the container itself is hauled away.

So you should not have difficulty remembering these two because hauled means where things have been, the trash can itself is taken away. Stationary means where the trash can stays as it is. When I am talking about trash can, I am talking about the huge trash can, not the small ones that we use at home. So for the stationary container system, usually in the residential and commercial area. Some commercial area will also will have, for the residential area as you will see lots of pictures here.

As a residential area, you have the small trash can on the side of the road. This truck will come in and it will unload it and then the trash can stays right there and your waste is taken away. So those are the two different types of collection equipment potentially used and this will be typically our primary collection center or the secondary collection center as we call it in Indian context. If you look at any DPR of any ULB in India, you will see a primary collection and a secondary collection.

Primary collection is the collection from the each and every households and which is done predominantly I would say like almost every day. Most of these big cities now which has lot of high rise apartment complexes, they basically have, they have hired somebody, a private party who comes and collect the garbage from each and every house. And then that garbage is taken away to a, outside of that.

Some places actually, I have seen in Coimbatore or in Bangalore where they, just on the outskirts of that gated community, they will have a place where this waste will be dumped and then the

municipality truck will collect it from that particular location and then it will take it to either to a transfer station or to a landfill or to maybe a secondary processing facility. So there are different ways things get managed.

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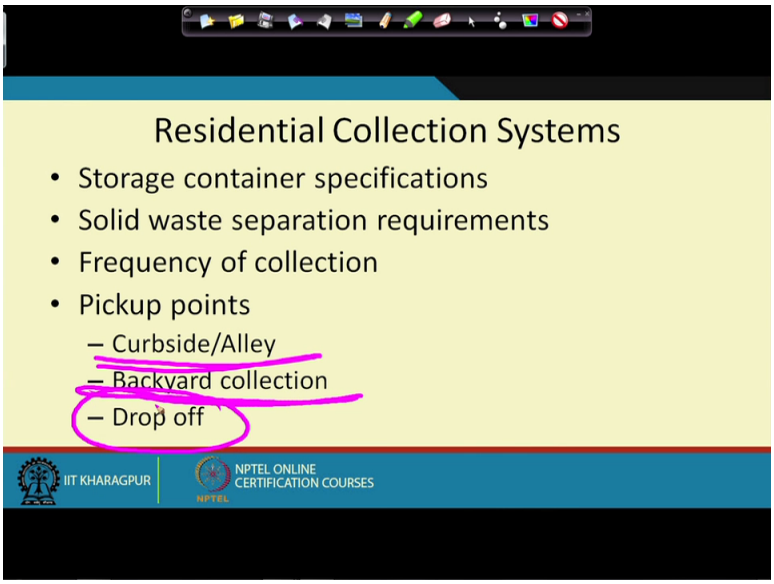

So in the residential collection system, when we have the residential collection system, you need to have storage container specification. Again, these things are part of the municipal solid waste management rules as well. So like what kind of storage container it can be and that depends on what kind of truck will come to collect it. Whether you want it mechanized, whether you want it semi-mechanized, whether you want it totally manual, so based on that you will have different types containers.

And you will, again you will see lots of pictures of that. And whether there is a separation requirement, whether you are doing source separated or you are collecting everything together and taking it to a like material recycling facility where you will do that like when the ULB will have a separate waste sorting happening over there. And frequency of collection, so frequency of collection is also more, say if it is once a week, we need a bigger container. If it is once in every two days, once every day, it is like a daily collection, you need different types of containers.

And then where it will be picked up? Whether curbside, when we say curbside basically it is on the, just in front of the house. And typically we are talking about the individual houses. So there the curbside is on the just in front of the house. There could be backyard collection which many

places, especially initially when they started collecting the garbage from each houses, some people do not like to keep the garbage out upfront, so they want the garbage on the back of the house. So things have been collected from the back as well.

And if you are living in a semi-urban area or in rural areas, since the houses are so much apart, it is, many times it is difficult to have a collection truck going around and collecting the garbage. So what arrangement made there is there will be a drop-off location. So it will be the waste generator's responsibility like somebody like our like as a citizen's responsibility, they will be allocated a designated drop-off center.

So people living in area A will go to a location Y where there is a drop-off center. All the different like a source separation or whatever the ULB has planned for, whether they want it wet and dry, whether they want even wet and even within dry, they want paper separate, plastic separate, glass separate, that depends on what the municipal council has come up with, what the councilor has, what the ward commissioners has come up with.

And that is usually happens in consultation with the normal people whether like the people, public in general and then you go and drop off your waste there and there will be a person who will be overseeing the whole operation. And typically in where this kind of location you will go to, they will look at your driver license or some sort of ID which tells you that you are from that area because you cannot come from some other area and drop off your waste in this. If you do that, they will charge you more. If you are from that local area, you already kind of pay for that as part of the property tax or you could, there could be some basic charges. So you need to show your ID when you come and drop off at these drop-off centers.

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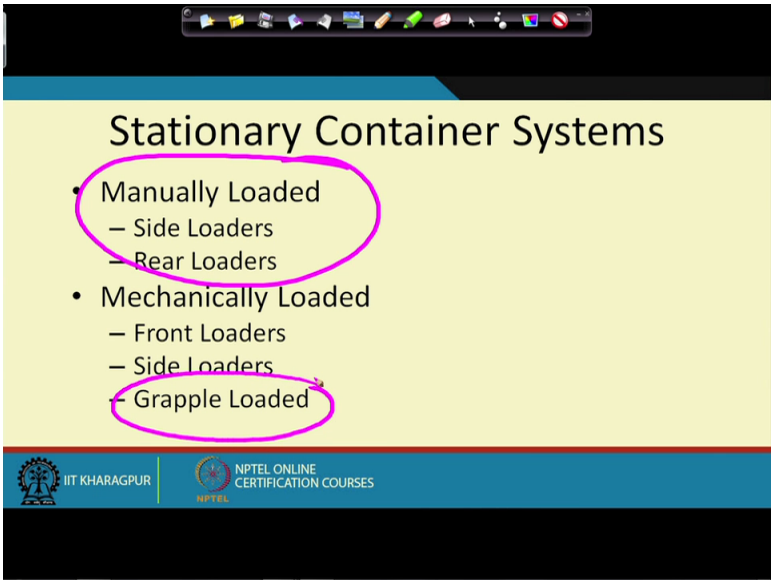

Then, stationary container system, when we have, talking about the stationary container, it could be manually loaded. When we talk about manually load, it could be side loader or rear loader. If you just, these are the different ones. If you do not, if you are not able to kind of understand this differentiation between these two, do not worry too much. In few minutes from now, you will see lots of pictures, with explaining each and every one again I will show you the picture and explain that. But it could be manually or mechanically. So there could be either a manual system or a mechanical system.

If it is a manual system, it could be side loaded or rear loaded. Side loaded means in the truck you have the garbage being loaded from the side or it could be on the back of the truck, the garbage is loaded from the back of the truck. Same thing with mechanically loaded. Mechanically loaded means you will have hydraulic arm where things will get lifted up. It could be front loader, especially for the big trash can, things will go in there and hold the trash can and lift it and dump it on the back of the truck and then put the trash can back there.

That is your, those kind of elements are also there in terms of the front loader. It could be a side loader and it could be a grapple loader. Grapple loader, I will show you picture of that too. Grapple loader, essentially what you do is you have your truck right here, this is your kind of arm, it goes there, collects the garbage, picks it up and bring it and drop it over there. So that is called a grapple loader. So those kind of things are also used.

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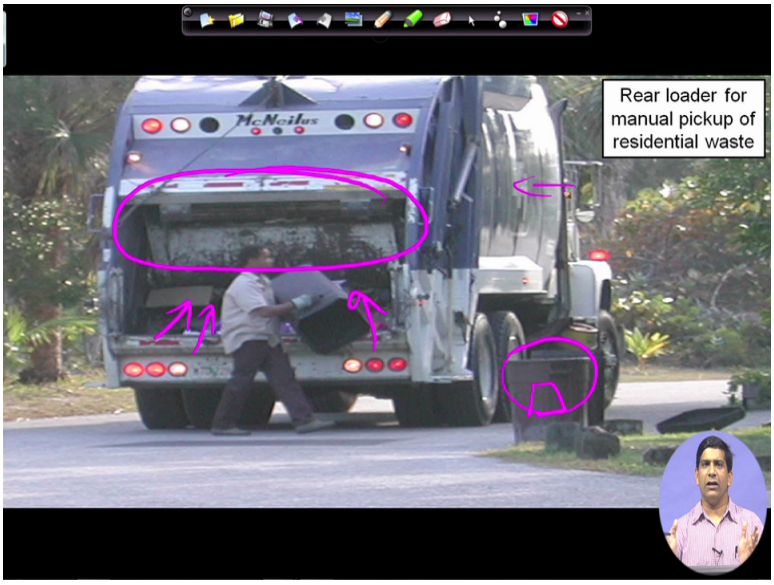

So let us see some picture now. So this is a rear loader truck, it is a rear loader manual pickup as you can see. So this people have say residences. Just outskirts of their house, on the side of the road, they have put their garbage can. And usually people will do that in the morning time when they go for work, they will take this. Every, in most of the western world, this as I said earlier, it is once in a week collection. So you will know, say your area will be collected on a Wednesday or a Friday or a Saturday.

So you know which days, usually Sunday there is no collection, it is a holiday for all. So you will have this collection happening on a particular day of the week. So in the morning by 7, 7:30, you are supposed to bring your garbage can and put it on the (outs) just next to the road. And when this truck will come in, this is a manual, rear loader manual pickup. So as you can see this gentleman, this, he is taking this garbage can, he emptied it.

Now, he will go there and pick up the another one and then empty it. So he will basically bring it here and it will get emptied into this truck. And the other thing that you see in this truck is this part where you see this particular part, it actually is a compactor. So when the garbage, as you can see over here, the garbage will actually move into the truck from here and it will get compacted. So it is does get, so these trucks are, it is getting compacted into the truck.

So what is the benefit of having this compaction there? Because that means that more and more houses can be served with one truck. So you are not doing a super-compaction but you are doing little bit of compaction because many times you have a very fluffy kind of material. You have a cardboard, you may have some thermocol and all those material which takes a lot of volume but their weight is very less. So this compactor helps in compacting those garbage into the truck and that way you can service more houses in one run.

These trucks are highly sophisticated trucks. Some of these like a good truck these days, usually they will, this is a manual one, so here he can even have a look at the garbage, what is in there. If there is something wrong, he will not pick it up and he will put a sticker on here saying that this was, because of this reason your garbage was not picked up.

So but in the automated ones, as you will see some of the automated ones, usually they will have a, it is a driver who is sitting here has a camera and usually it is one person vehicle. So there has a camera. Once the garbage is loaded, he can even see in the camera what is going into the truck. And if he see there is some problem like recyclables are coming in regular trash, he will know, based on the GPS location he will, he knows the address of the house, so he will make a note of that.

He will let the office people know. If there is like a violation that waste was not separated properly, the people will get SMS or it will get one email coming to them like automated email that your waste was not sorted properly today and look at the sticker that was left on your door.

And they have to fix it. If they do not fix it, if they see that problem happening frequently, even the house maybe told that we will not service your house anymore.

So those are the things are there and some of those even started, in India, recently we visited (()) (13:36) and I will show you (())(13:37) which is in Andhra Pradesh. And we have, there is some, if you do not do source separation properly, there is a fine and they are trying to enforce that fine. Sometimes it is difficult to do that but things are picking up there where there are some of the towns, they are actually forcing people that you need to separate. And that as a responsible citizen, we need to follow the rules too.

Municipal Solid Waste Management Rules 2016, it is not for the ULBs or the people working in ULB or the industries who are in waste management sector, they are, they have to follow the rule but we as a common citizen, we also have the responsibility of follow the rule. It requires, as a waste generator, our requirement is we need to keep it source separated. So if you do not do it, the ULB has every right to do a fine within the rule and that in some ULBs, they have started doing that.

And it is happening other places in the world too. It is nothing, we cannot complain in India because this is pretty much common. It is international practice these days that of course, we have to follow the rule. If you do not follow traffic rule, you get the traffic ticket. So if you do not follow waste rule, you will get a waste ticket. So it is kind of similar concept here. So this is one type of truck.

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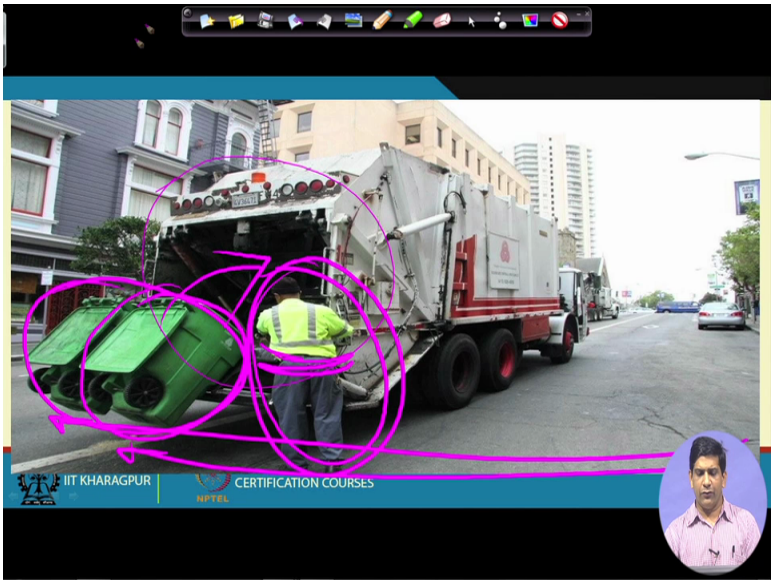

Then, you see this is a semi-automated. And this is, this picture is actually near, it is San Francisco. And this is a truck here. San Francisco, they have a, they do a three-way collection actually. This is a green one, so this is a green bin. So green bin has only the food waste and the organics in here. Then they have a black bin which is for the landfill and then they have a blue bin which is for the recyclable.

So in the here as you can see it is a semi-automated and it is a rear loader. So rear means from the back. So that is why it is loading is done from the backside. So that is why it is called rear loader. So sorry, so it is loading is done from the back. So that is why you see, so that is in the back of the truck. So this gentleman who is, there will be at least one driver there and this gentleman he will bring, he will, so these trash cans probably will be on the side of the road and then he will bring it over here. So these trash cans will get, bring it over here.

Then he just puts it, kind of he puts it along the rear of the truck. And there is arm coming from the truck which lifts this container and then it unloads it over here. So what is the benefit of having this semi-automated? Because what it does, it is actually a big help for this gentleman right here because trying to lift this garbage can filled with entirely filled with the food waste, you can think about so much of a weight.

Food waste has lot of moisture, it is, it gets really heavy. So think about the back of this gentleman over here, he will have a big problem in the back if in his, so if he does not, if we do

not have a semi-automated. Like it is we have to look at the worker's health and safety as well. So here this gets semi-automated, so it gets unloaded into the truck. And that is how it goes into the truck. And then again you have a compactor here and that compactor will compact the garbage so that you can service more houses.

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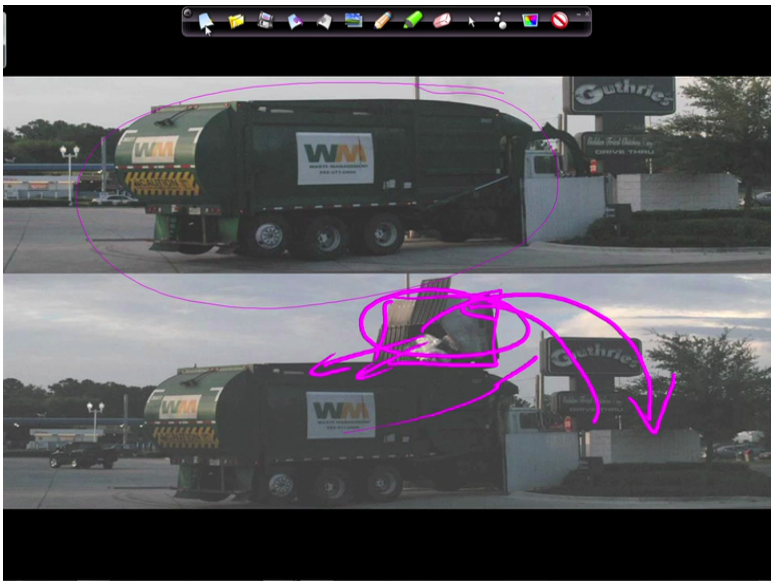

This one in a commercial area, as you can see over here, this is not a very like it is the picture is not very like a great ones. But I think you can see this is a, again this one is waste management truck. Waste management you might be knowing that is almost, that is a Fortune 500 company and they are using, they use this. Like, they have been very active in the waste management sector. So here this waste management, this truck is there and then there is arm upfront.

As you can, this, there is actually trash can right there behind the sign which does not show up very well. But here you can see the trash can being lifted. So this truck has a arm upfront, so trash can was over here, it was lifted all the way to the top. And you are seeing in the, this trash can that you see on top, that is the trash can which is lifted up. So it is in terms of, it took a arm and lift it and it is putting it back into the truck. So the garbage is coming into the truck over here. So that is why it is done.

Usually, they will have some cameras there where driver can also see. If there is some problematic substances, he will find out. And there is a compactor there again. So here and then he will put, this trash can will go back to its location over there. So this is a stationary container

system. So it is not a hauled. So all the pictures that we have seen is the stationary container system. The waste container stays in place, waste is unloaded into the truck and the truck is carrying the waste away.

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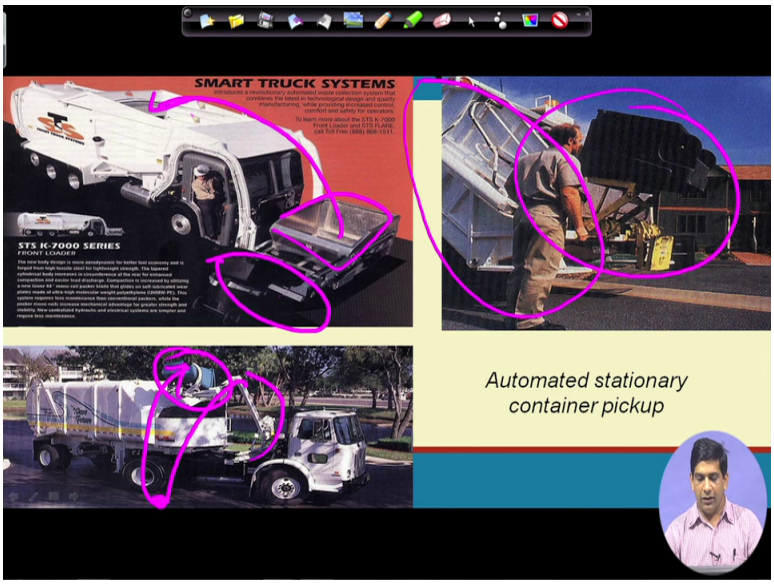

So there are lot of automated stationary container pickup is there. There are different types of pickup. So here you can see, this is the arm. Here like a nice picture of this, so here you have this arm coming out. This arm, similar arm is there on the opposite side. And this is the trash can which has been lifted up and then it will be taken over here. You can see the hole on top and then it will get dumped into the waste over there. So this is how this one, this thing is done.

This one is the grapple loader. As you can see this is the arm where you can see the trash can over here as well. So this trash can was somewhere over here, so this arm actually came in, lifted this trash can up and then it is emptying it into this truck. So there are different types of truck. And this is another way of automated truck where things have been loaded up here. The truck body is also tilted a little bit. So there are variety of trucks out there depending on what kind of, based on what will work in your city, in your area. You choose ones which works best for you.

And these trucks, more and more automated trucks we have, we are getting some of these garbage truck like the self-compactor one. We are (get), I see, started seeing it in India, in Kharagpur municipality actually recently bought one. Just few weeks back, I was, I saw that in the Kharagpur town. So I am pretty sure it will be, must be coming into other towns and other

ULBs as well. So and these trucks are expensive, so that is the good ones. As I was telling you yesterday, I am sorry, in the previous module that if you look at the that particular, I think I mentioned to you about that video where secret life of garbage, they talk about these trucks as well.

And that truck, some of these trucks is up to 250,000 dollar. So 250,000 dollar, it is almost like 1 crore, is not it? Certainly, even more than that. Right now it is around 60, say 65 rupees. So even if for our calculation sake, let us say 60 rupees, so it is what? 1.2 and then another like 1.5 crore. So around 1.5 crore for one truck, so it is not cheap. That is why this waste routing which we will talk about becomes very important where if we can reduce the number of trucks, then it is always, and more the compartment you want for the source segregation waste, the cost will add up.

So that is why waste business, it is the collection and transportation of the garbage is the costliest component of the waste management. So it is, that is typically one question asked in many like I have seen in many of the like MTech exam or PhD exam, people were asked what is the costliest component of the waste management system. It is a collection, collecting the garbage. So collecting and transporting the garbage, it is very, very expensive part.

So if we can somehow like make it optimized, so there is an optimization solution, there is an operation research involved here. So garbage business is not very simple business. It is a very highly multidisciplinary area. And I will talk about that optimization thing as we make progress in this particular like topic.

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So here there are some other example. The tilt frame, we look for hauled containers. Here now the container itself has been brought in. So this is, this was the container, typically you see in a C&D landfill. That container was loaded up at the construction site. And then when it came to and then hauled to the landfill or the dumps like a landfill site and here at the landfill site what they have done, they with the hydraulic like a jack, like hydraulic arm, things, the whole frame it gets tilted. And then the waste will come out, based on gravity it will just slide out. So that is it will, waste will basically slide out because of the slope there. So that is also used for the hauled container.

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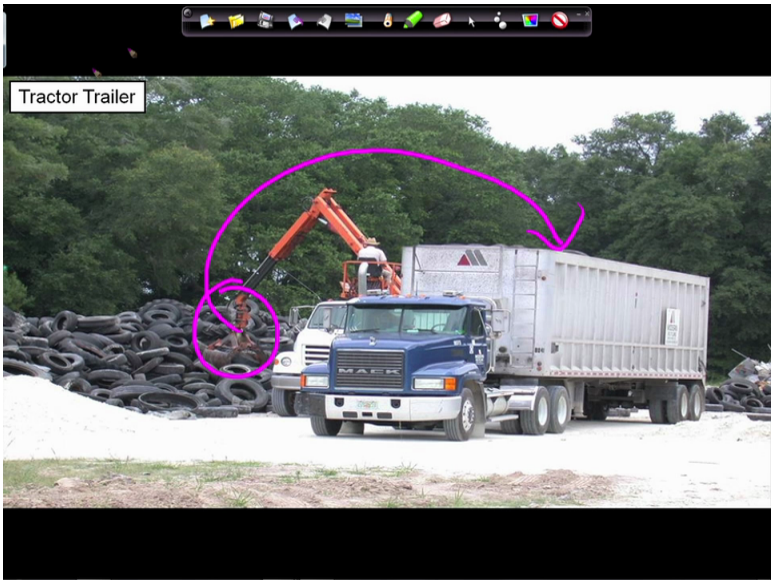

So now we are moving from stationary container to the hauled container system. This is a tractor trailer, here again you lift things up using this tractor and put it in here. So here as you can see, this has been lifted from there and then it will basically, it will be taken and put it in, into this truck and then it will be taken away for like a treatment or disposal.

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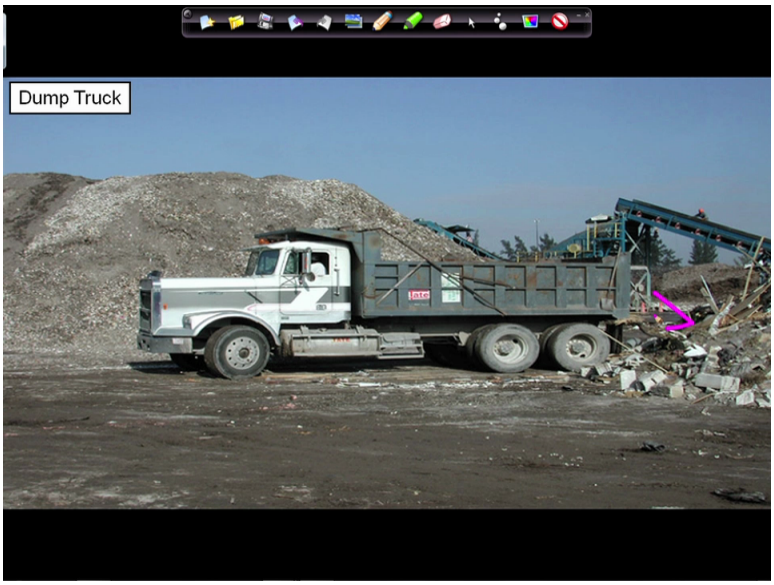

So this is another dump truck which is used. So if you can, this is a dump truck carrying all the waste and which goes to the, typical in a C&D landfill you see that. So it is bringing all the waste

which then you have to take this, you have to empty this waste from there. So this will be basically emptied from this side and it will come out and get dumped on, onto the landfill site.

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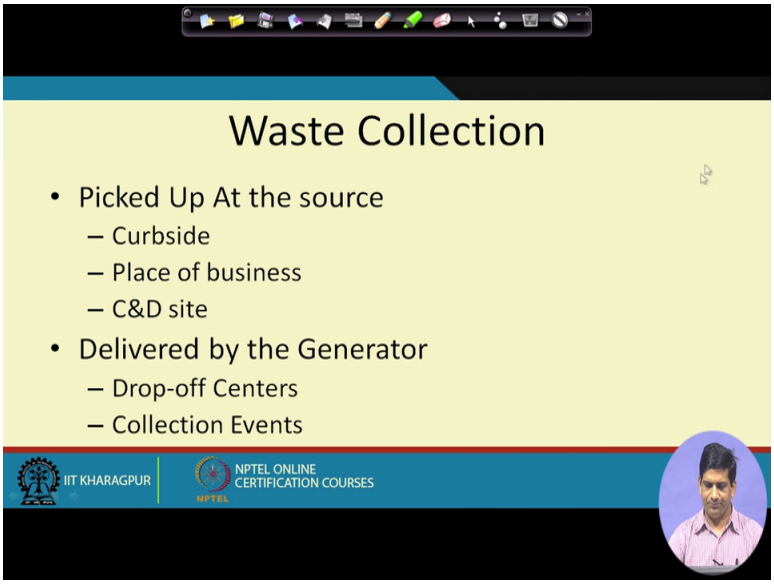

So in terms of waste collection, it can be picked up at source, we talked about that. From the houses you saw some pictures. It can be from place of business, that is also you saw a picture of that from the hauled container, from the stationary container system. It could be at C&D site, that also you saw an example of that. So this is, it can be picked up at the source. The other option is you can deliver it by the generator, you can take it to the drop-off center that we talked about or you can have a collection event. So we will try to see some example of that.

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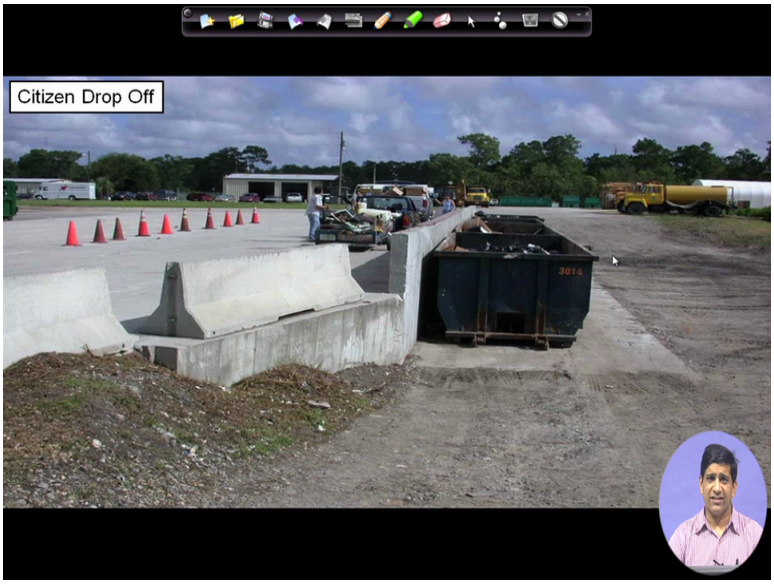

So this is a typical example of a citizen drop-off. You will see this happening mostly in a rural area or a semi-urban area where the houses are far apart. So houses are (little), they are not close to each other. So you have one house, then you travel several maybe meters, then you have another house, then you have another house. So if you have a truck going around, the truck will actually be traveling a lot without, and will not be able to serve lot of houses.

So those areas especially in the farm areas or the rural areas, what has been done, there is a citizen drop-off. They make a centralized citizen drop-off location where you as a citizen can drive in or you can usually you can drive in with your garbage in your truck or in your car and then you can drop off.

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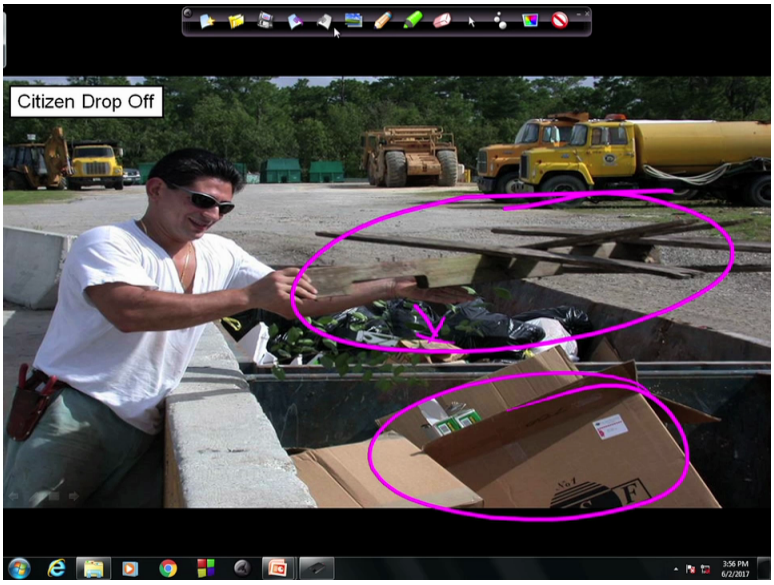

So here one example that you can see over here, that here citizen has come in and he is, probably their fence got broken, so he is just discharging, getting rid of this fence in this container which is for the organics kind of material. Here the cardboards have been put there for the recyclable. So you can have labels of different types of material and it will be dumped in different container.

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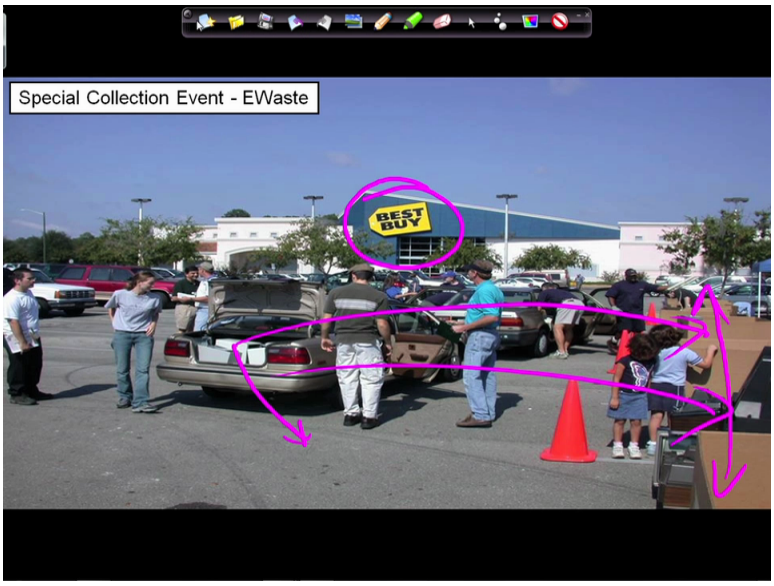

And then you can have a special event, special event usually for say for electronic waste or even these days for pharmaceuticals and personal care products. Pharmaceutical waste, we are, people

are eating lots of medicine these days. And these medicines earlier what we used to do that the regulation used to tell that you flush that medicine down the toilet.

So if you have an unused medication, if you go to the doctor, you go to the doctor, doctor gives you lot of, lots of medicine and then you consume only part of it. And so that medicine has to be still lying in your house, it is expired medicine now, you cannot use it anymore. So it has to be disposed. So earlier the thought was you put it in the toilet and flush it down.

But since it goes to the waste or a treatment plant, waste or a treatment plant is not designed to treat for it, so these pharmaceuticals are showing up either in the bio-solids or the affluent and from the affluent to the surface water. So nowadays the concept has changed that we should probably put it in a landfill environment. So it is, so there is, will be special collection event. From time to time, there will be a special collection event where this pharmaceutical waste will be taken away. So there is, similarly there used to be special collection event for e-waste. So this Best Buy as if some of you may have heard the name, it is one of the chain stores of for electronics in North America, also in Australia, New Zealand and other places.

So there they have, they facilitated, so this is the parking lot in front of them, they facilitated this waste collection where people come, people came in with their old electronics and they brought, these cardboard boxes were lined up here, big big cardboard boxes and they will basically put it in these cardboard boxes. So that is how and then it will be taken to e-waste like a recycler or e-waste treatment center.

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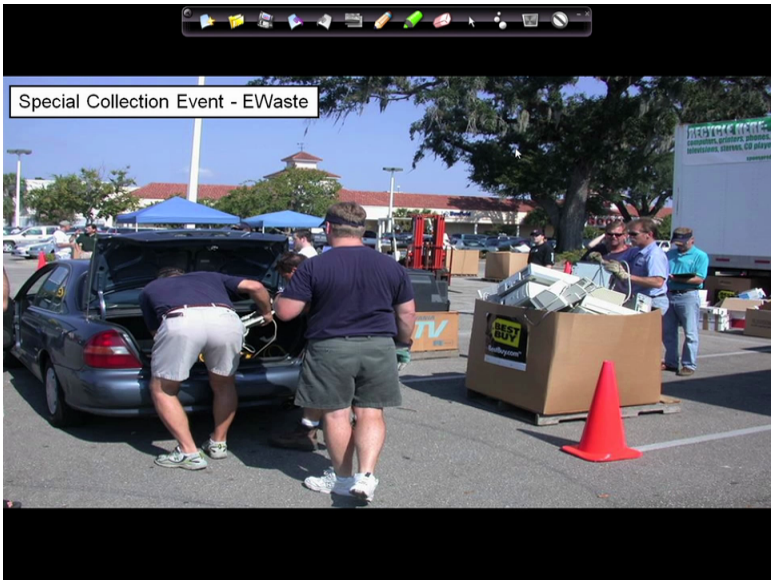

So you see there are some other pictures of the same thing, e-waste being taken away.

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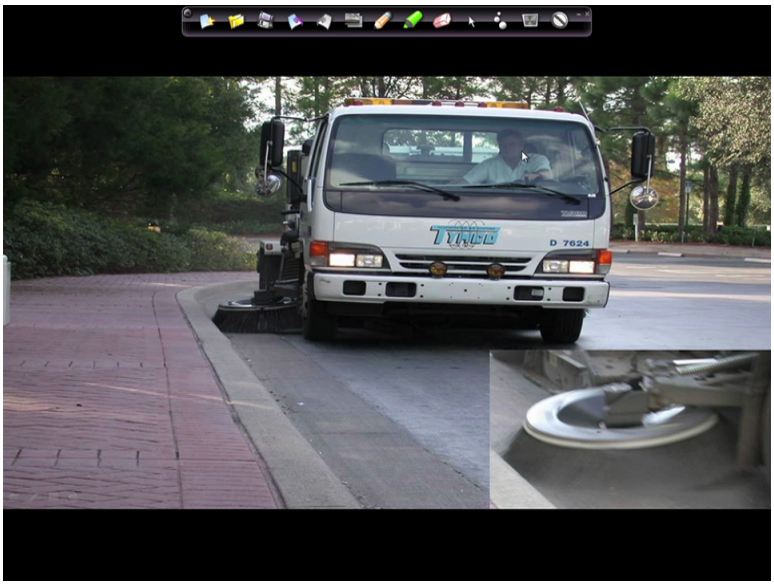

The other aspect is street sweeping. So if you, when you do the street sweeping, that waste has to go somewhere. So that waste also gets collected. That is a part of municipal solid waste.

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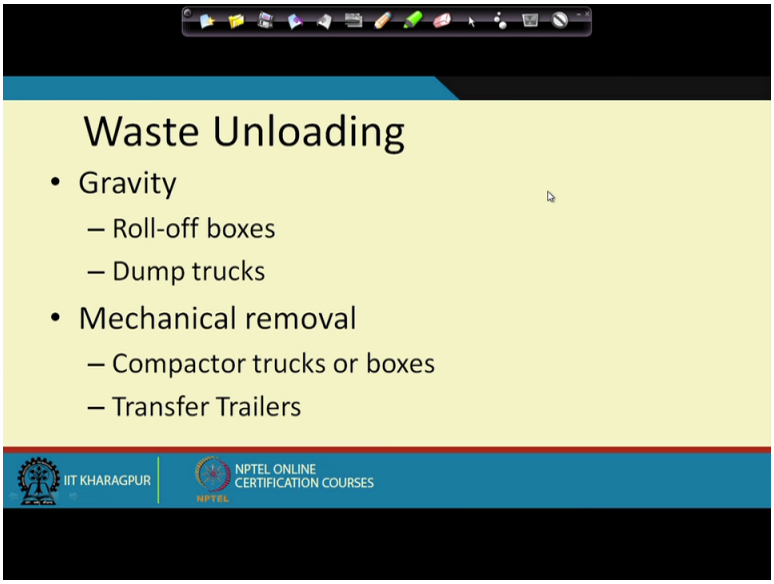

Then when you try to do the waste unloading, you can use gravity which is using the roll-off boxes or dump trucks. And you can also do a mechanical removal which is a compactor trucks or transfer trailer.

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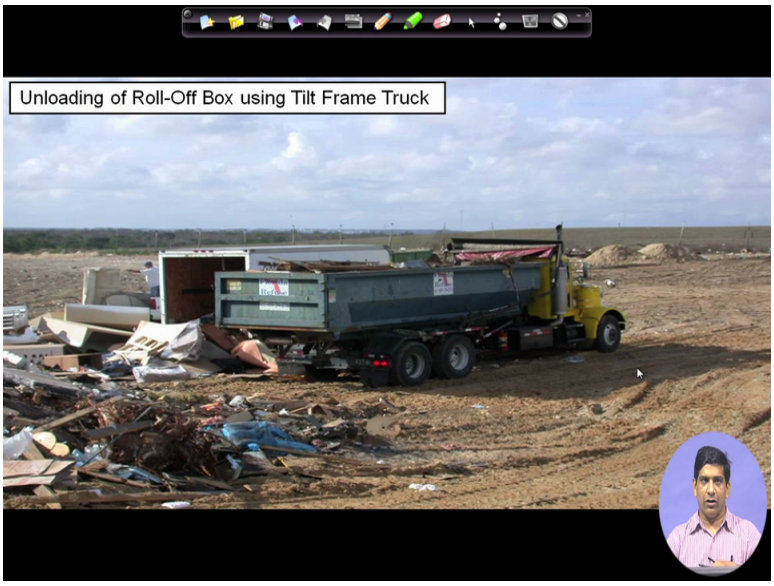

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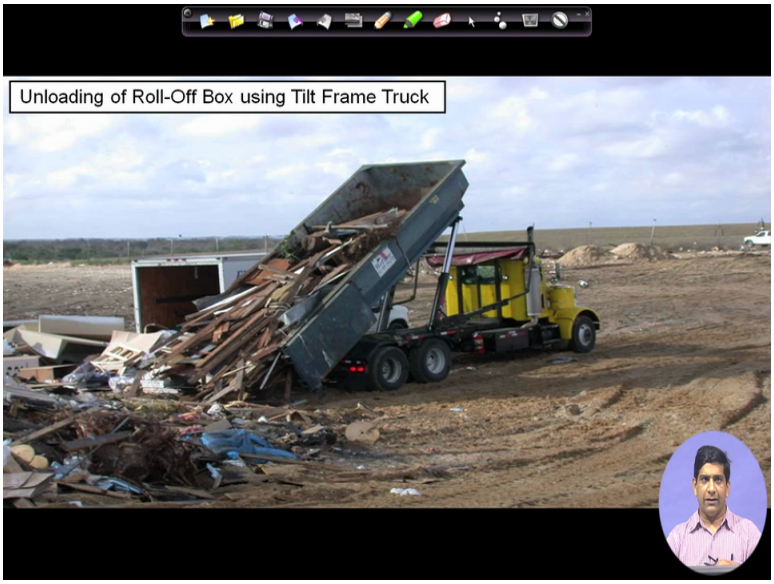

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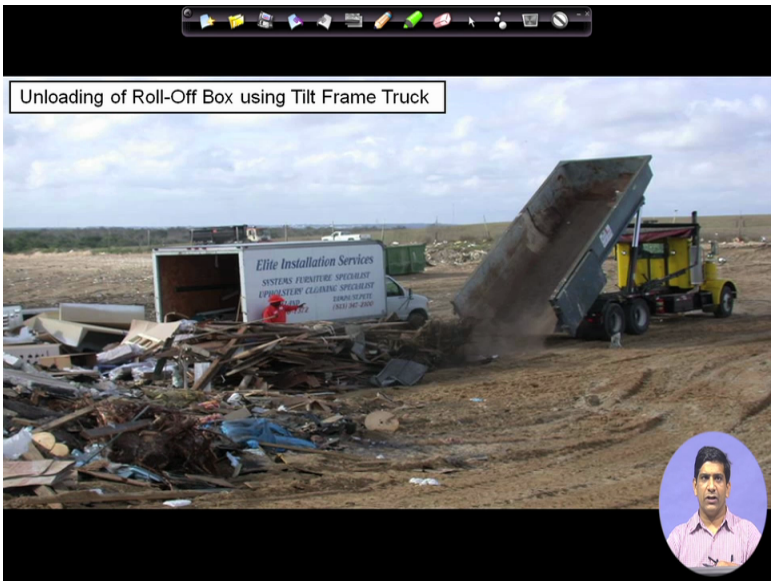

So let us look at some examples of that and then, so this is unloading of a roll-off box using tilt frame. So this one is, this is a roll-off box, it has a tilt frame as you can, if you can watch the pictures, watch the picture carefully. So this is a truck came in to the disposal site, then got open on the back and then it is lifted up. And then as you can see, it dumped all the garbage whatever it was there onto the disposal site. So this is how it is used in terms of unloading of roll-off box from there.

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Similarly here unloading of a compactor truck, remember these trucks we looked at it earlier where the waste got collected and it was compacted. Now, we have to take this waste out. So how it is done? Plate which moves along the truck, so that it moves along the truck and then takes this garbage out from the truck. So that is how it works, all these compactor trucks. So we will continue this discussion in our next module. And I will show you some more pictures of this collection.

As I said, it is pictures helps you understand it better. That is how I think that showing these pictures will really help in terms of understanding of how things is working. And from a smart city perspective, at some point of time we need to get these fancy equipments to our ULBs as well because we want to manage it properly, we want to do the source separation.

If you want to do the collection properly, this is the typical global practice today. So those things needs to be brought in into the Indian context and so that we can improve our waste management system. So with that, let us like close this particular video and then we will continue our discussion in the next video. Thank you.