Sustainable Transportation Systems
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Lecture 32
Sustainable Transport Planning and Approaches III
Management Strategies for Transportation Systems

Hello friends. So in the series of sustainable transportation planning today we will discuss several other measures, which are known as strategies, very simple strategies for the transportation system management. So, different planning and approaches which we are discussing today in that series this is the last lecture regarding planning, but this will give you an idea that what different kind of measures can really help us to better plan the traffic system.

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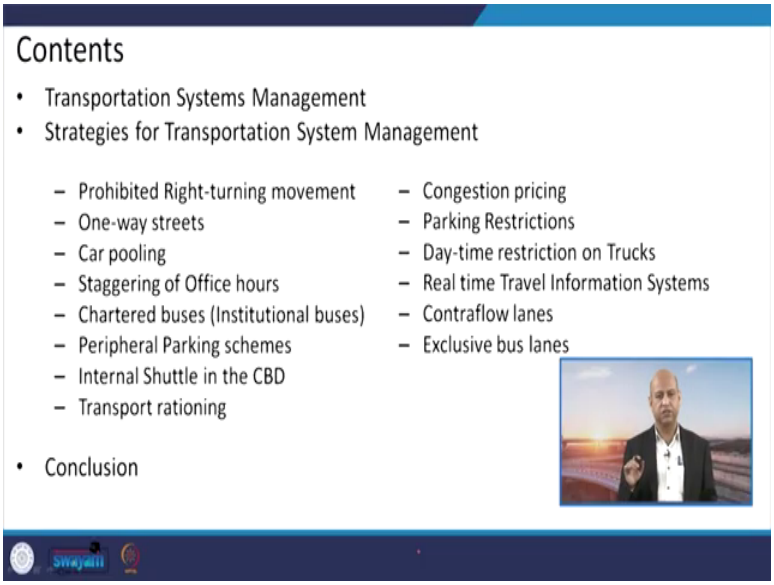

So we will see like transportation systems management. So the planning is nothing but to manage the system basically to plan for management of the transportation system, and then we will look around strategies. Strategies for transportation system management, maybe one or mixture of these strategies which are listed here, like it can prohibit right turning movement, means because after all we want to reduce congestion, we want to have the movement or mobility, very smooth and very efficient.

So for that purpose we can apply one or more measures which are listed here. One way street sometimes we can do, because looking at traffic volume if on one side if it is not going in a good number then the whole street can be on one way, because otherwise on other side will be a lot of traffic. So that will create congestion and traffic jam.

Then carpooling means policies which can enhance or improve or encourage the people to carpooling then it will improve the traffic situation. Staggering of office hours so that different office hours can be assigned to different activities so that all people do not go at the same time, otherwise volume of the traffic will be high at a particular time slot.

Then chartered buses, some institutions have chartered buses so that people come together and that way the number of cars will be reduced, otherwise they will need to drive their own car and that will create a situation of traffic jam. Peripheral parking schemes, different parking schemes maybe there so that people have to park at a particular place and we have to pay for that. So that again they can use some public transport system after that or something like that.

Internal shuttle in the Central Business District or central point of the commercial centers, transport rationing, again, different ways of, kind of like odd-even, etc., so that we can restrict traffic from flowing just like anything. Congestion pricing again to reduce the congestion or a traffic jam. So at a particular place where you find that a lot of people come there, then you can give some sort of ticket and ask people to pay for that.

So that only those who really wants to come there, they come and they do not create any crowd through vehicles, etc. Parking restrictions, so in terms of time, et cetera that can also help. Day time restriction of heavy trucks so that noise and pollution reduces significantly in the daytime. Real-time travel information system, which can help us to know when, which bus is coming to that we are ready to ride that bus or we can plan our journey accordingly, if that system is properly working.

Then we can subscribe those apps and we know at which time the bus will come so that we can go to the bus station. Then contraflow lanes, some lanes can be used for again to adjust the traffic, sometimes in a particular lane a lot of traffic is there and in other lane very less traffic is

there. So the traffic which is in the lane where a lot of traffic is there, which can be diverted in other lane also.

So in opposite direction can also traffic flow and that way we can save this situation of congestion. Exclusive bus lanes which we have seen in BRTS system, so those kind of measures can also be adopted, and ultimately we will conclude how this can help us to manage the transportation system in best way.

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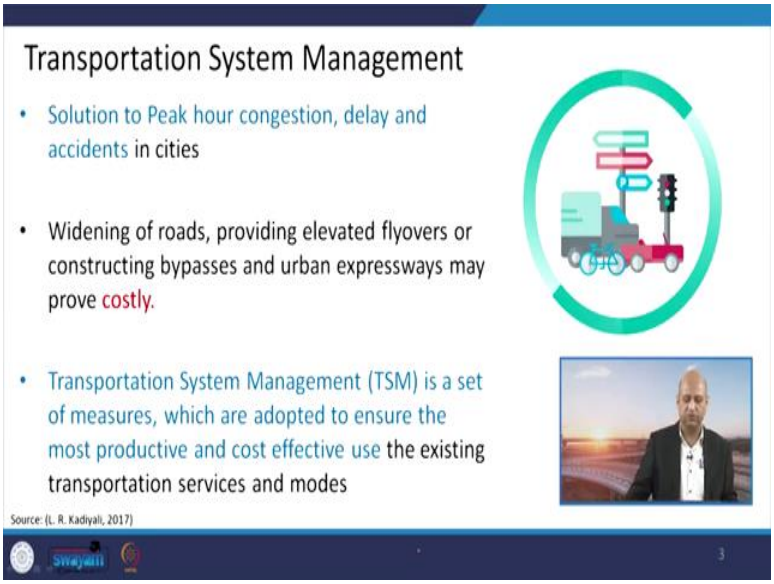

So you see, why do we need the transportation system management? Very simple, because if we keep on widening the roads or providing elevated fly overs and bypasses, urban expressways, etc., these are very costly affairs, and again they are for temporary situations, kind of more traffic comes then again space is less.

So that means we also need to address this kind of situation to reduce the congestion, etc., by other means and those means are in the form of transportation system management tools or measures or policies and these are the set of measures, a kind of pool of the measures and which are adopted to ensure that most of the productive and cost effective usage of the existing transportation infrastructure and services and modes take place.

So, that means we design some policies and we implement those policies on the ground within the given infrastructure facilities or services. We manage the traffic flow in such a way that we

can avoid the situation of traffic jams and congestion, at certain locations where a lot of traffic moves.

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So what we do? These are the kind of things, for example we can prohibit right turn, we can prohibit left turn, we can prohibit U turn so that traffic smoothly flows in a particular direction and those situations which could be because of this turning, which could be like traffic jam situation that can be avoided. So where saturation happens those kind of capacity at the intersection there these kind of situations help to avoid the congestion.

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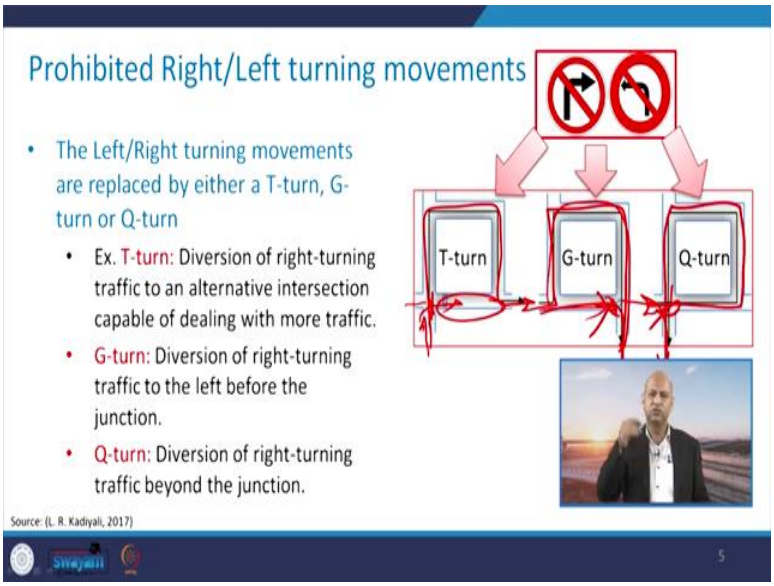

You can see like T turn, G turn, Q turn, depending upon the situation. For example you can see here the person could go like this, when it coming from this side, it can go from this side, but it has been blocked, so this is a kind of T. So the T turn means the person will go and come from that way and go like this. So this has been blocked.

Otherwise maybe because the traffic is coming from this side also, traffic may be coming from local sides also and that can create situation of traffic jam. But when you are taking the longer route that situation will dilute in the number of vehicles. G turn is like, for example here again this particular road has been blocked so straight you do not go and this is also blocked here so nobody can turn on this direction.

So the person will come here, it will be taking this route, so that means again this is blocked, so directly you cannot go and take this turn. It is here, blocked, you have to take this turn, this is called G turn. Similarly Q turn means the person who is coming from this side he could go like this, so this is blocked here, that means you have to go directly, then come on that way and this is a kind of Q turn.

So these kind of T turn, G turn, Q turn, all these kind of geometrical flow patterns are used to mitigate the situation of traffic jam and congestion. So traffic is diverted in a particular fashion, that is why the nomenclature is coming in that way like T turn or G turn like those.

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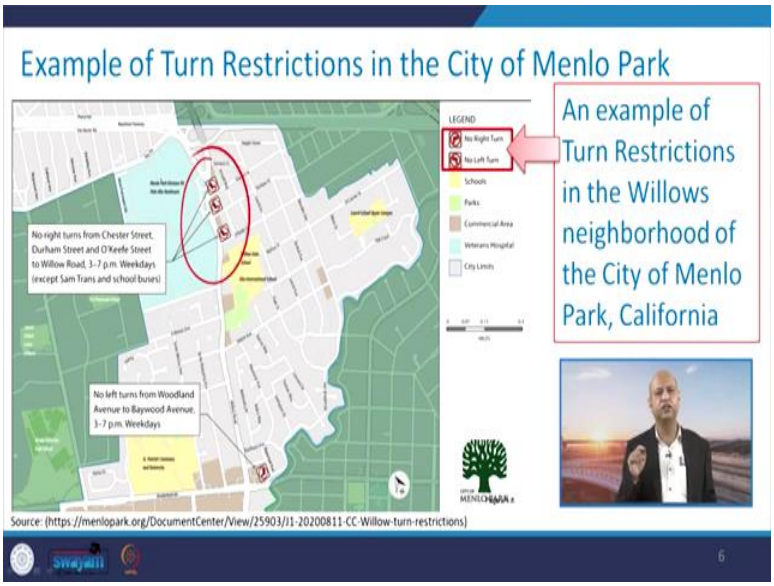

Well this is one example of turn restrictions in the city, Menlo Park, so at certain locations you can see these kind of turn restrictions are applied and that really helped.

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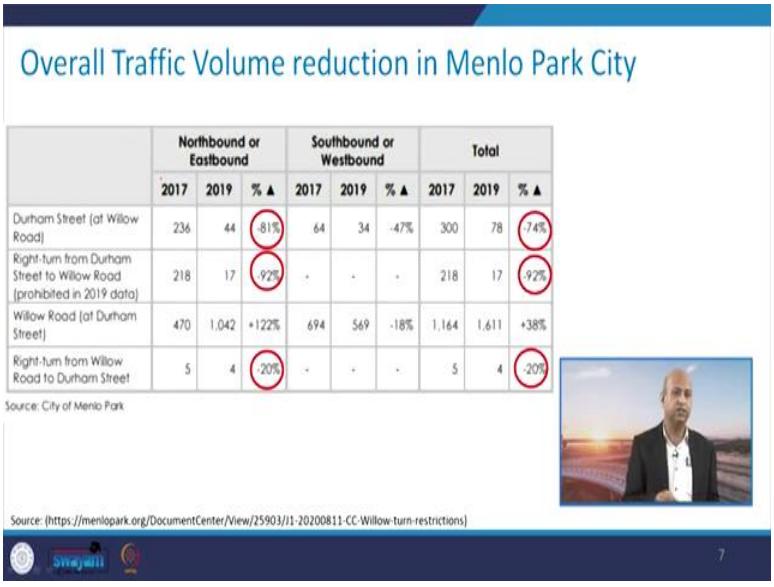

	Northbound or Eastbound			Southbound or Westbound			Total		
	2017	2019	% ▲	2017	2019	% ▲	2017	2019	% ▲
Durham Street (at Willow Road)	236	44	-81%	64	34	-47%	300	78	-74%
Right-turn from Durham Street to Willow Road (prohibited in 2019 data)	218	17	-92%	-	-	-	218	17	-92%
Willow Road (at Durham Street)	470	1,042	+122%	694	569	-18%	1,164	1,611	+38%
Right-turn from Willow Road to Durham Street	5	4	-20%	-	-	-	5	4	-20%

Means the data says that because of these measures or U turn restrictions or prohibiting left turn, right turn or encouraging people to take the T turn or G turn or Q turn, those kind of traffic slowing patterns, they have benefited these 81 %, 92 % of volume reduction on those particular locations where a lot of traffic used to be there and congestion used to happen.

So the total overall traffic volume reduction happened by those kind of measures, like 81 %, 92 %. At certain locations it has also increased, but overall reduction of the volume is observed on those particular areas.

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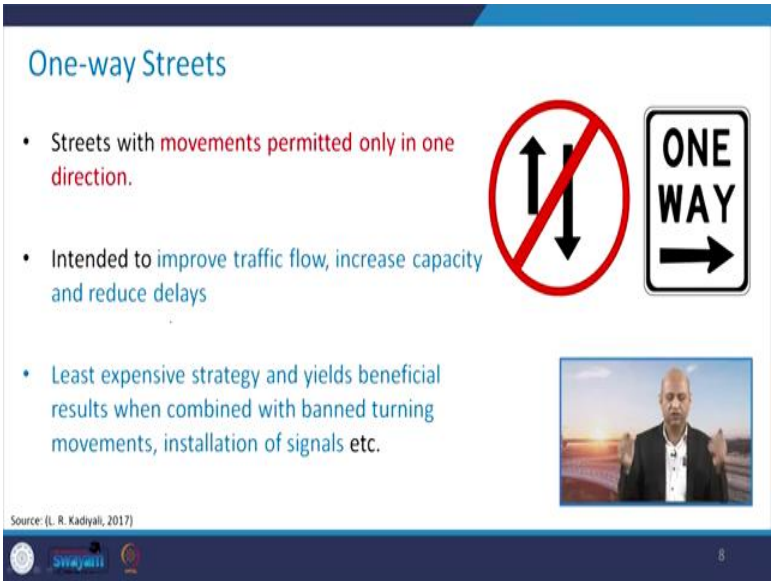

One way streets, so again when in a certain direction a lot of traffic is there then better to make it one lane only, so that only the few vehicles which were coming from opposite direction can take other route. So that way we can again help a lot of traffic to go in one direction. So these are intended to improve the traffic flow and to also increase the capacity of a particular lane and to reduce the delays.

Otherwise traffic will move very slowly when a lot of volume of the traffic is there, and a lot of fuel will be burned, emissions will be there, air quality will deteriorate and time will also be taken a lot of for diverging. Least expensive strategies these are. We do not need to create flyovers, etc., at that particular location or the point. You can just have this kind of one way traffic and reduce the congestion phenomenally.

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So these are the examples of this Karol Bagh in New Delhi. So at certain locations they have, by virtue or observation as well as survey and the date of the traffic volume they have decided certain roads to go for one way only. That way the traffic volume or traffic flow is smoother.

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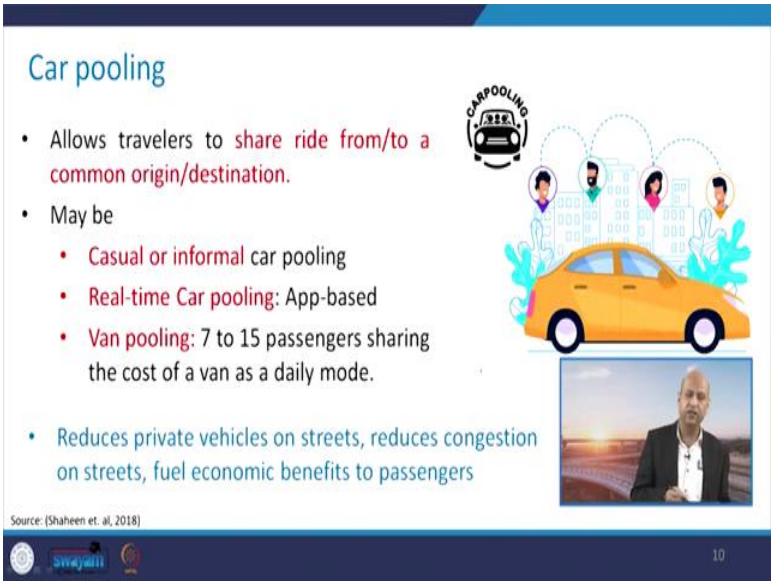

Then another way would be like car pooling, because if let us say 10 people are driving their own car so 10 cars will be on the road, but if three or four people decided to pool in a car that

means two or three car is needed for those 10 people. So that way we have saved like six to seven cars, we have taken off from the road.

So that makes sense, because it will reduce the changes of traffic jam and congestion and also will help people to save the money, to save the time. That way this informal car pooling can be encouraged, plus app based car pooling also be there, you might have seen in these Uber and those kind of apps. You are allowed to share the ride.

So those kind of things can happen through apps also. Then van pooling can be there, because if 7 or 15 people, if they are going to a school or industry or factory every day, they can hire a van and they can pool it. So the total expenses for the travel will be less and also the fuel burning reduction will be achieved, so air pollution related problem will be reduced.

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Well then car pooling social benefits are there, because it will reduce the total miles traveled when we calculate, so carbon footprints are also reduced, green house gas emissions are also reduced, and then cost saving is there for the public so it is a win-win situation.

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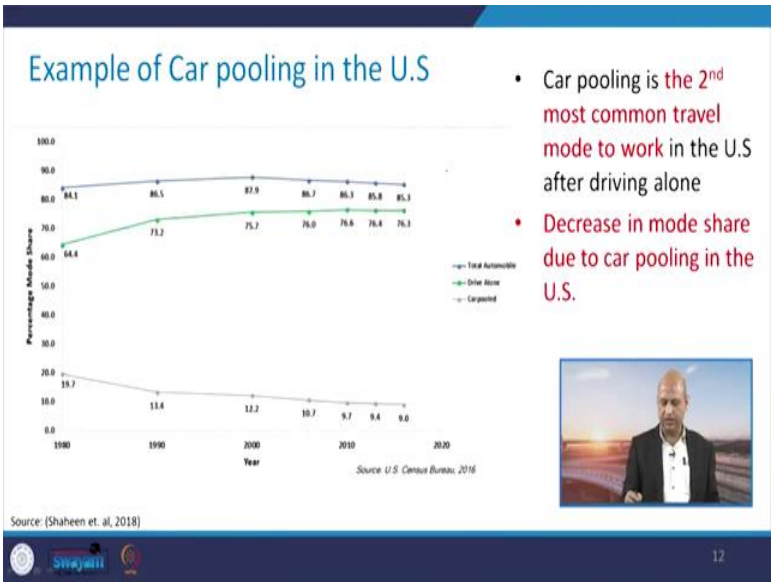

This is one example of car pooling in the U.S. So you can see this car pooling is also there, this is the second favored way of traveling means people drive their own, alone, people drive alone. So this kind of thing is increasing and car pooling is decreasing that is not a good situation but there is the way of car pooling means that should be encouraged in the U.S.

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Well these are the promotion of car pooling because certain roads like this is dedicated for buses or cars which have minimum three riders, that means it make sense, it will take less time because

this road is completely vacant, the people who are driving on that road will have, they can attain good speed and they can save a lot of time, whereas this people who are driving alone or two people are there those kind of, for auto this particular lane is there.

So, dedicated lane for encouraging the car pool and buses, etc., can be there. So that is one policy to encourage the car pooling and to reduce the number of cars on the roads.

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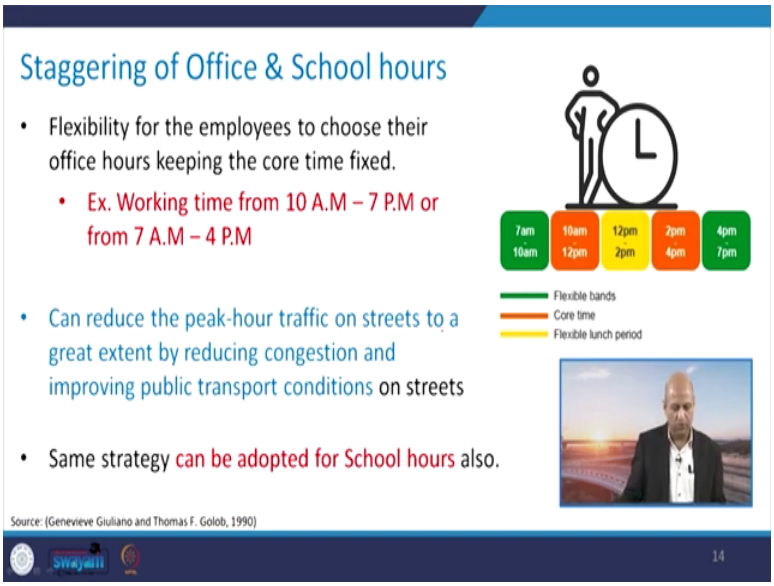

Well staggering of office and school hours, that makes very practical and very simple decision. It does not take much kind of technological interventions, et cetera. Only you have to just change the office hours, for example in a particular school or in a particular factor if you can divide the classes or some set of people whose work is not dependent on each other.

So, you can say that those many people will come like 7:00 a.m. or 8:00 a.m. other people will come 10:00 a.m. or you can decide according to the different service industries. Like when office hours are open at 10:00 a.m. or 9:00 a.m. then you can ask certain kind of offices, that one category of office will open at 7:00 a.m. other category of office will open at 8:00 a.m. so those kind of differentiation in time, that staggering of time really help to reduce the traffic on the road. So this is a very simple example of reducing the traffic and improving the environment.

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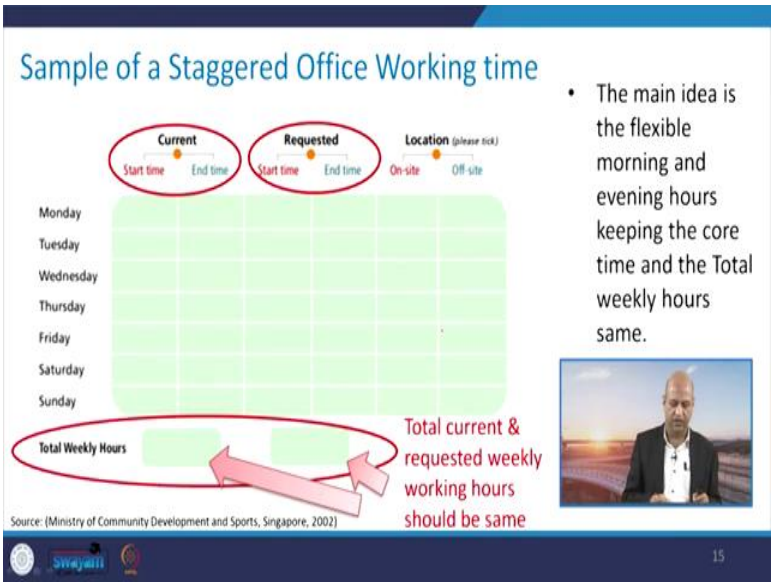

So, how to achieve that? For that purpose simple survey can be done with the employees that which time is okay for that particular person, start time and the end time, but the total time of the office remains same. Eight hours working will remain same.

So, if somebody is coming at 7:00 a.m. so that will go at 4:00 p.m. including one hour of lunch, similarly if somebody is coming at 10:00 a.m. then that fellow will be there up to 6:00 p.m. like that. So those kind of office hours can be there.

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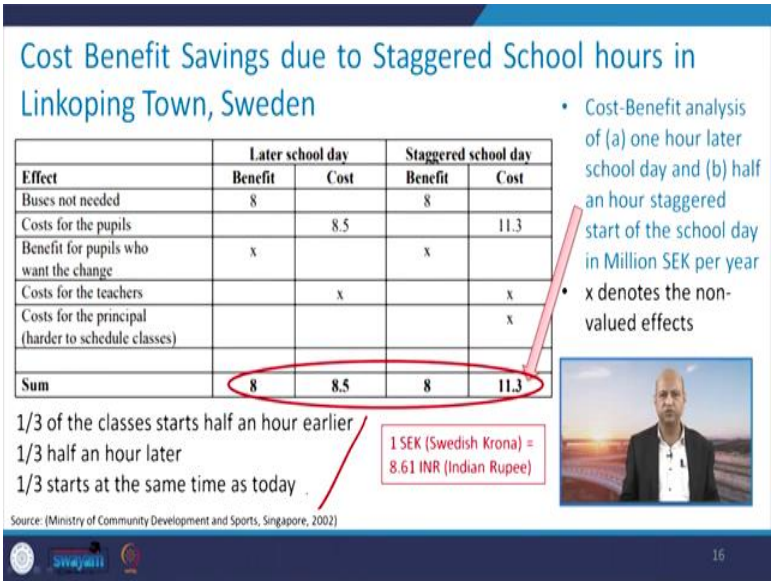

So there is one very good example of this staggering of the time. Like one school in in the Linkoping Town in Sweden, they have implement this particular policy of different timings for one third of the classes half an hour before of the designated time, one third half and hour later and one third on the same timing of the school. So that way you see, suppose 100 buses were needed for example if time was not there for three segments, so 100 buses will be required.

But if time is staggered so the requirement of the number of buses will be less. So that means investment is less and the one bus can go in the half an hour before and that bus can again root for the second stage. That way the investment is reduced and timings are also same for the teachers and the students but because of this differential timings they can save a lot of time in terms of investment, of transportation cost.

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Plus peripheral parking schemes can be there. This is one way. So the park and ride facilities, because at certain places like bus stops or railway stations we have seen these examples in earlier slides also that if there is a very good public transportation system then you can park and parking system should also be there.

You can park your vehicle at the bus station and if you want to go for your work or shopping you take the public transportation system, you come back, take your vehicle again, so that way again

you can save a lot of cost of the fuel and others, because the public transportation is always cheaper than the private vehicle.

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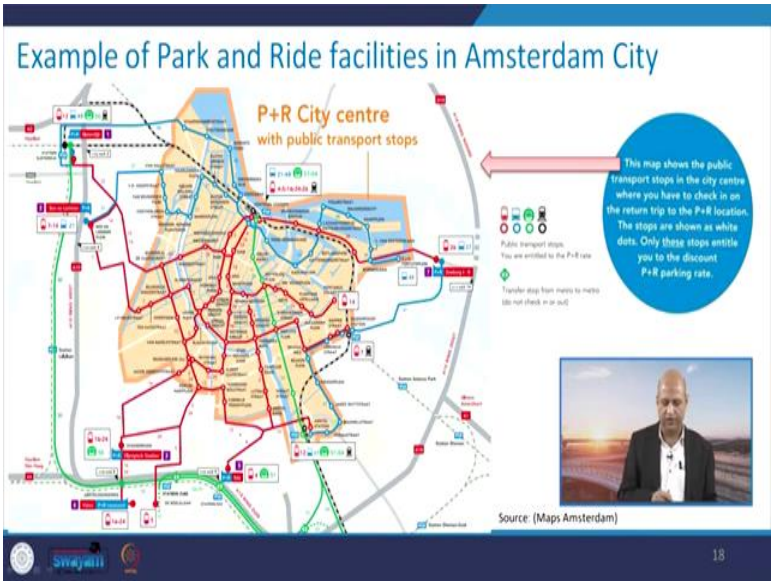

When you see this park and ride facility, so that way this is one example of Amsterdam city of the Netherlands, so at certain places, means all those places are particularly marked where you can get this kind of parking system. So people know already and whatever nearer point is there they go there, park their vehicle and use the public transportation system and that way they enjoy good ride of the public transportation system as well community kind of gathering also, benefits are also there.

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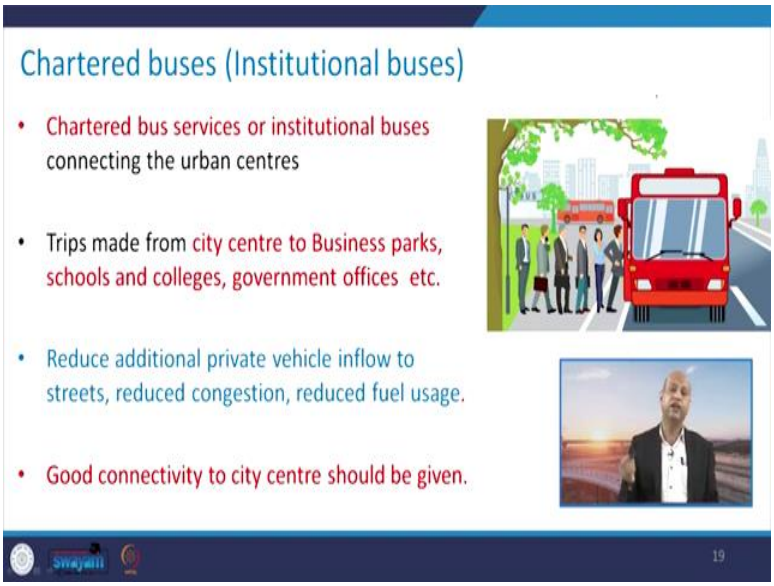

Chartered buses, as I said because for a particular factory, if let us say from a particular locality if 10 people are coming from other locality, 15 people are coming so within city if we know different locations, the people, employees are coming from those locations, so we can have a chartered bus, dedicated bus for those employees, group of employees. So they are taken by that bus and then after office hours they are dropped at their particular places, so that way they do not need their own private vehicle to take, to go to the office.

So this makes sense again. It saves a lot of fuel emissions or prices which are required or cost which is required to meet the travel demand, because if we go through our car, with the help of our car, then a lot of money will be spent on petrol or diesel depending upon which kind of car it is. So this makes sense, institutional buses or chartered buses for colleges, for government offices, even private corporate offices provide chartered buses, so this is a very good practice in that sense.

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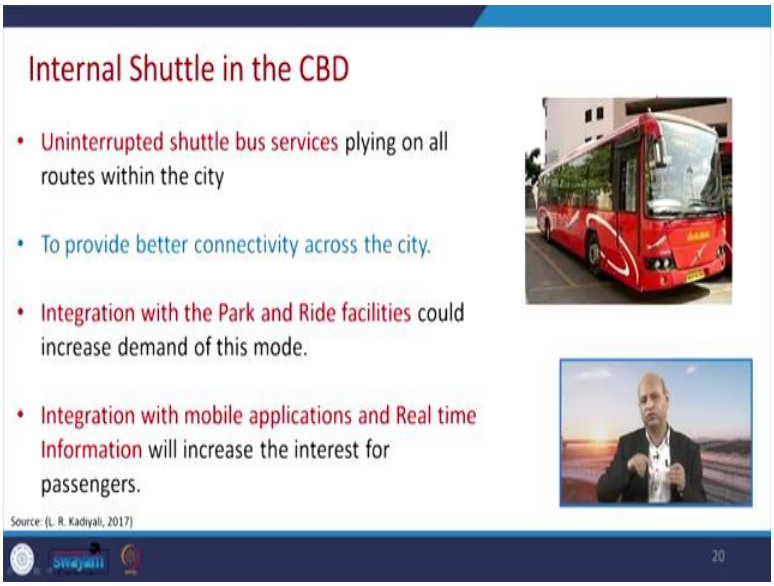

Then there may be some internal shuttles, in central business districts or central business and commercial centers, for example if you know that at a particular shopping center a lot of people comes so you know within the periphery of 3 kilometers or 4 kilometers one, if shuttle bus goes and frequency is quite high so people will not like to bring their own cars or scooters.

They will park 3 kilometers away and that shuttle they will take because the frequency is good and ride is also comfortable. So that way they can just, there may be ways of like weekly ticket or monthly ticket or those kind of multiple modes tickets, so they just use those tickets and there is no other cost involved, so that way again you can use those kind of facilities to reduce the traffic jam or congestion.

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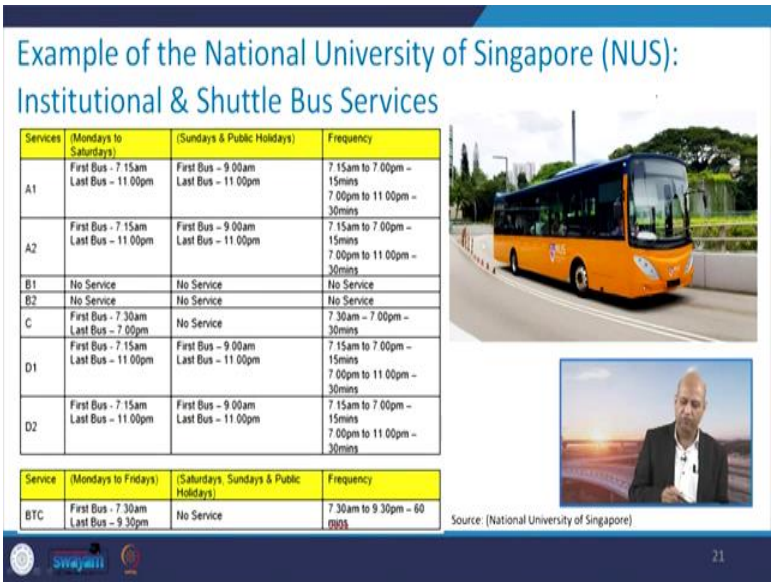

Well this is the example of National University of Singapore, where these institutional buses, those chartered buses or shuttle buses, services are there, so this kind of time table is available. So you know, first bus starts at 7:15 a.m. and the last bus is 11:00 p.m. so you know that before 7:00 a.m. you need not to go and after 11:00 p.m. it will be difficult. So accordingly you can plan your working hours.

So that way at different points and for different days timings are already decided so that information can help you to plan your attending classes or visiting your laboratories or those kind of things, pre-planning can be done by this kind of system, and that way again a lot traffic is saved, means the roads are just empty and you enjoy a good ride, a smooth ride.

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Congestion pricing, which I think we have discussed in a particular example like this example of London where in city center if you want to go then you have to pay a lot of tax, so that tax has discouraged people to bring their privately owned vehicles and they take public transportation system. So the demand based strategy can be implemented.

If you know by some survey ground, where they survey that at this particular location a lot of traffic comes and accordingly in a particular timings like evening hours or at the lunch hours or which time a lot of traffic comes. So that window of the time you can charge for some price for congestion, that if some people will go in this street or stretch, between this hour to this hour, they will be charged a particular amount.

So that will discourage people just who are habitual of going through just like that. Otherwise only those people who are needing to go that particular place only they will come. So this will encourage private vehicles to shift away and from the congested routes and they will go to another route where they will not have to pay some price, and these routes which are fined heavily they have been seen that those situations greatly improved after those congestion prices.

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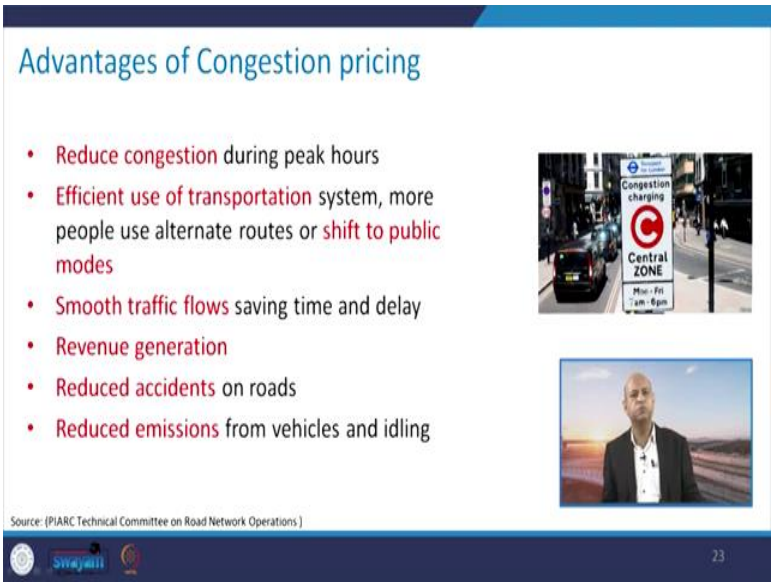

So the congestion prices, the benefits are like, simple benefit is that you reduce the congestion, there is no traffic jam and then efficient use of the transportation system, more people use alternate routes, because otherwise people used to go through way then they will take another route, maybe 1 kilometer longer, but they do not want to pay that much of price which is more than burning the fuel, then they will take that longer route, no problem.

Smooth traffic flows, saving time and delay, because in traffic jam always we waste our lot of time. Revenue generation for that locality, revenue will be there, so that can be used for other purposes, then reduced accidents because whenever traffic jam is there and sometimes some accidents happen or even uncomfortable or unpleasant situations happen, road rage and those kind of issues may also happen there. Reduced emissions from vehicles, that is again an additional benefit.

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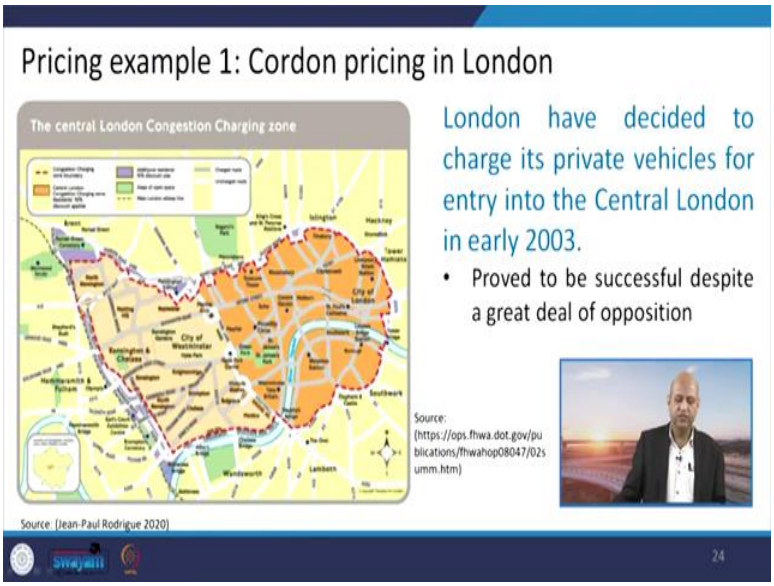

Pricing example, like in London, which I already gave you one example that even initially a lot of opposition was there, but later on it was found that this is a very successful policy measure, which reduced this traffic congestion situation in the city center where this cordon pricing was applied in the London City Center.

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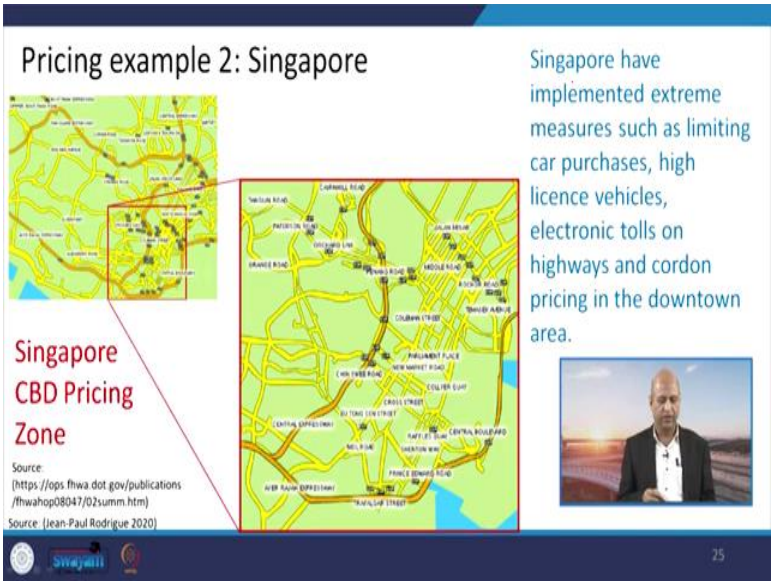

One another example is of the Singapore also, so they have very extreme measures like very high fines if somebody takes in a particular locality the vehicle and then some licensing or limiting the

car purchases even. Means we have to take permission before you buy a car. So a lot of fee you have to deposit. So that discourages people to buy, because it is then an expensive affair and only when you want to buy, because without that car you cannot do your business.

Only then you will buy, otherwise you will shift towards the public transportation system. So those kind of city governments, apply these command and control kind of policy measures. Sometimes it really helps. So these kind of pricing and the tax and licensing kind of situations or measures can help to reduce the number of privately owned cars.

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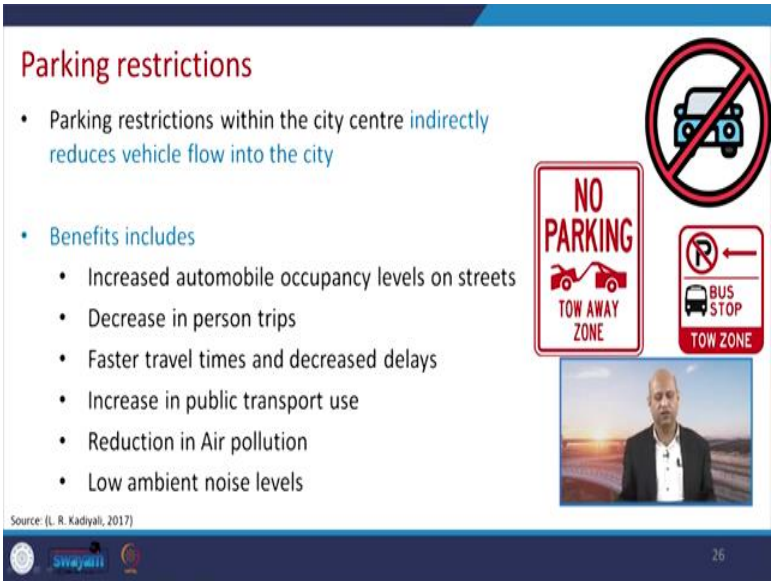

Parking restrictions, so you can restrict parking for a particular place that no parking is there, then for certain timings that only for this timing parking is allowed here, so that way again you will regulate and you will direct the people to behave in a certain way. You will discourage people to come when parking is not available there, so they will not come, and a lot of fine can be given by police, traffic police if they park on the wrong place.

So that way again those benefits are there, let the persons trip is reduced, a lot of benefit is there in terms of air quality improvement and the increased automobile occupancy levels in public transportation system, those kind of benefits are there.

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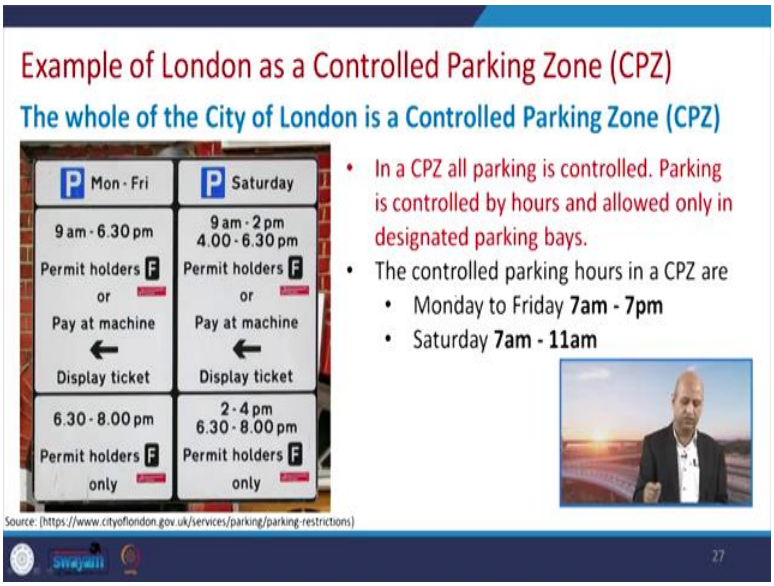

This is another example like controlled parking zones, like Monday to Friday 7:00 a.m. to 7:00 p.m. Saturday 7:00 a.m. to 11:00 a.m. only. So those kind of different timing windows are there. Before or after that particular time slot people will not be allowed to park there, and that way you know in advance that which timings a lot of traffic comes and parking is not allowed, then people will not come there to do purchasing with their own vehicle. They will take another kind public transportation system.

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Parking pricing worldwide different cities have different prices and the maximum is in London, so situation depends because if you cannot control people with lesser pricing then you have to increase the pricing, so that people feel discouraged to pay that much amount of money just like that.

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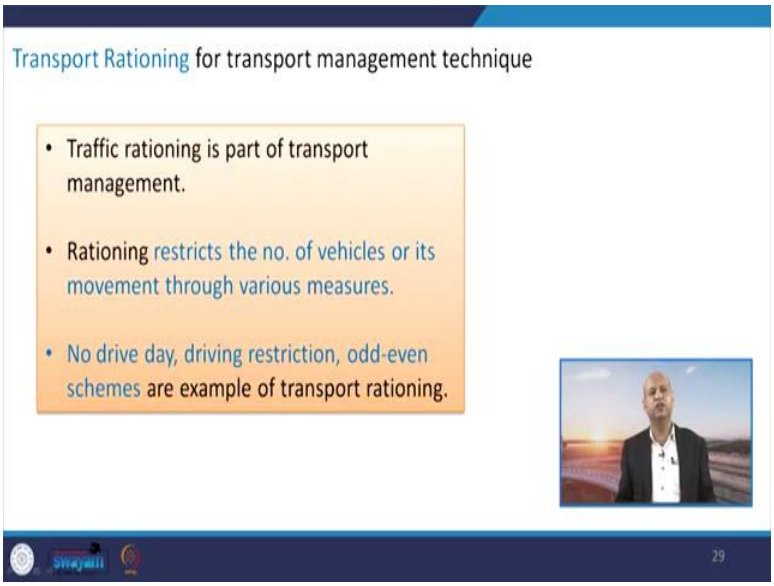

Then there is one another way of transportation rationing so that is, transportation rationing is done by odd-even or some restrictions in a particular day that Monday is not allowed or Sunday is not allowed, those kind of, no drive day, driving restrictions odd-even schemes, and these kind of things are known as traffic transportation rationing.

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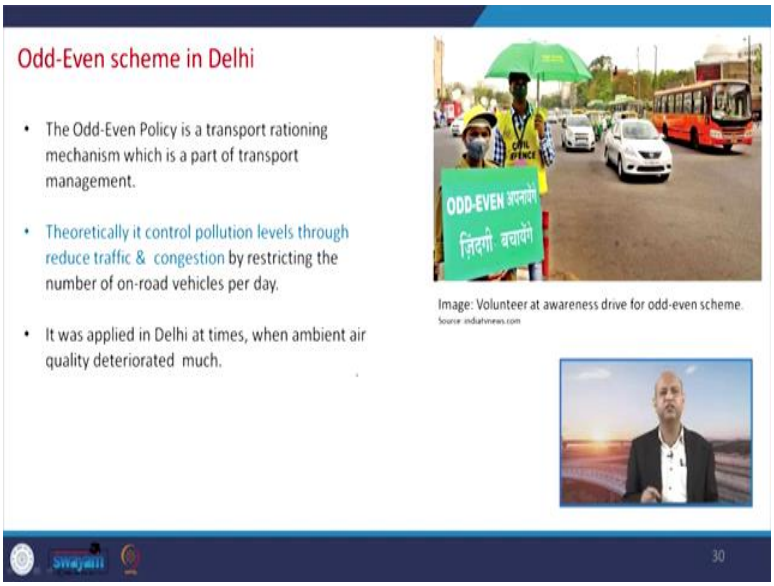

In Delhi it was implemented during, when a lot of pollution related issues were there. So this odd-even policy was started and some people have mixed opinion because some people say this was not a good option because then people bought old cars of the other number and then this was more polluting rather than an efficient car.

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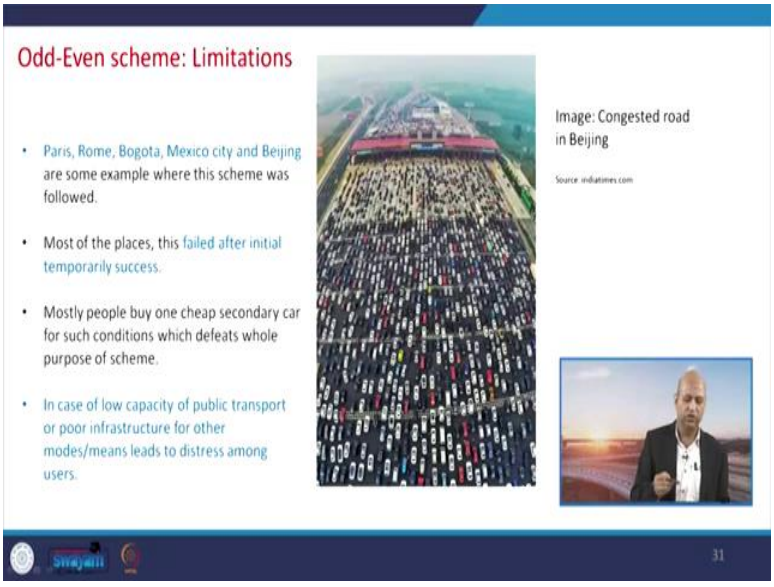

So odd-even schemes have certain limitations and everywhere, whether it is Paris, Rome, Bogota, Mexico City or Beijing, wherever it was implemented certain issues were there, and

mostly it is failed basically. It was a temporary success initially, but later on it was not a good option, because cheap secondary cars were bought by people who were having this kind of requirement.

They have to go, they cannot remain without traveling from one point to another and there is no public transportation system of good quality, then people have to have their own cars or vehicles. So in that case they were forced to buy more polluting cars or another number. Like if I have odd number car I will buy even number car, because then I can go every day. So this policy in that way, it failed.

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Only pedestrian movement on weekends, so those kind of situations or policies can be implemented, so that the traffic movement is zero on that particular day, that this street is only allowed for cyclist or for pedestrians on Sunday let us say. So the people will come, park their vehicle at certain point and they will roam around on foot or they will cycle there.

So those kind of situations are also there at certain markets. So even this New Delhi Municipal Corporation has planned these restrictions of vehicular movement on Saturdays and Sundays, in the inner circle of the city and it was protested by traders, because they thought that people will come less in number and their trading or business will be reduced, but when situation is better, rather more people may come there to visit.

Sometimes situations are not intuitive or they are counter intuitive when some people who did not come there because of traffic jam related situation, they will feel more incentive because then with kids they can come for on Sunday, for like picnic or those kind of sightseeing or just shopping. So that way it should be seen in a totality. Later on, but because of these protest, etc., this was rolled back. As I said we could experiment and see what is the situation and only then decision could be taken.

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There is no car Sundays like in Jakarta, in Singapore also and Copenhagen also thinking in that direction. So most of the days Central Jakarta is noisy polluted and very congested, but on Sundays the situation is quite opposite so people will motivated to go on those particular routes on Sundays, by public transportation system.

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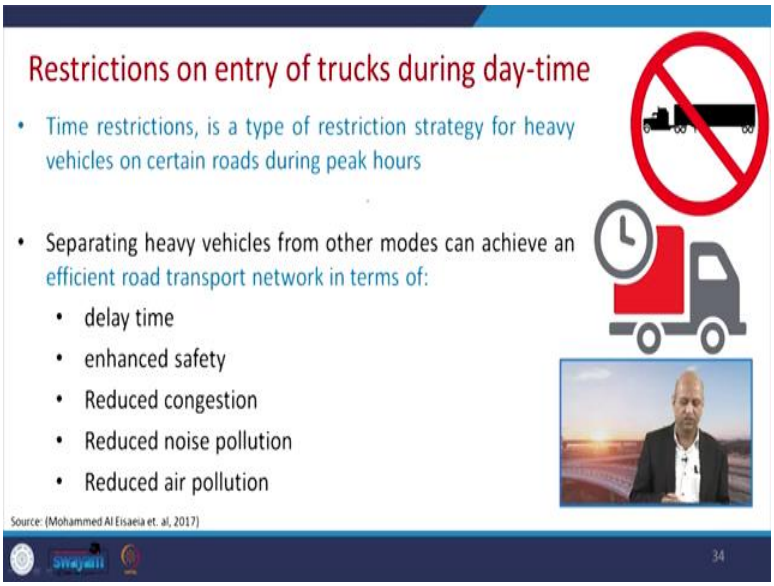

Restrictions on entry of trucks during daytime. Again you can reduce the noise or if traffic jam is there because of trucks, et cetera so all those benefits which are common are reaped there. So enhanced safety because of trucks and heavy vehicles, et cetera, it is difficult sometimes to control them, so accidents may happen, congestion related, noise related air pollution related issues can be addressed, so that they travel only during the night in that particular city.

In Delhi also it was a rule. Now peripheral highway is there so they do not need to cross Delhi. Otherwise earlier they used to cross Delhi in the night only. So those kind of situations may be in certain pockets of the city or in a whole city.

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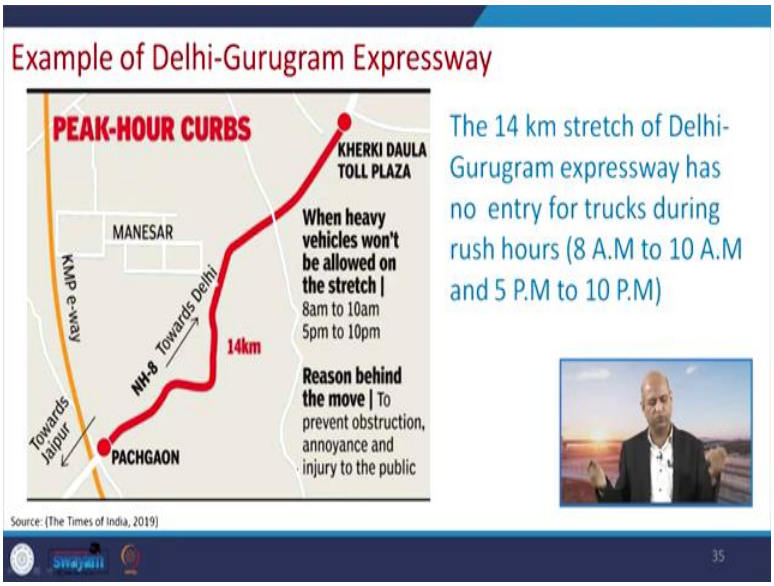

One example of Delhi-Gurugram Expressway, so 14 kilometer stretch from this 8:00 a.m. to 10:00 a.m. and 5:00 p.m. to 10:00 p.m. when office hours, means people are coming to office or going from the office, so these are the hours when a lot of traffic is there, so trucks are not allowed in these windows of time. So that way again traffic jam situation can be avoided.

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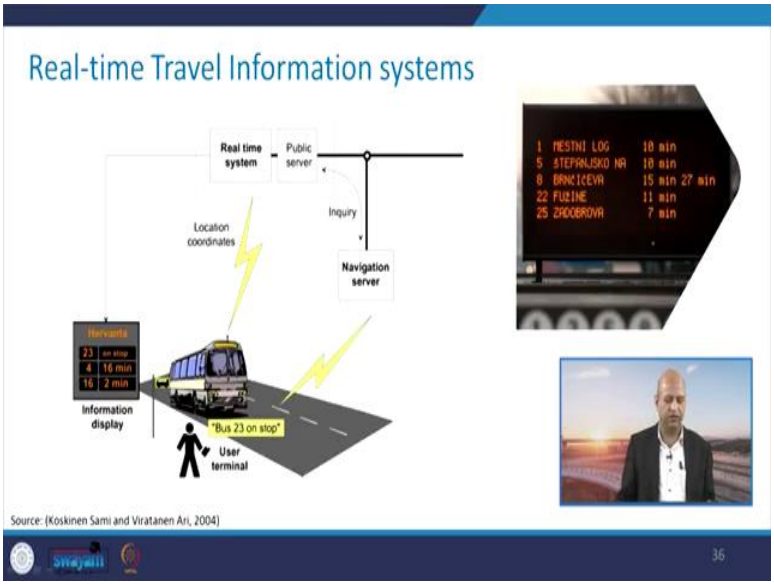

Then the function of real-time travel information system, basically as I said if you have the app you know when the bus will come, when the train will come, accordingly you plan your journey and that way it helps a lot in saving the time.

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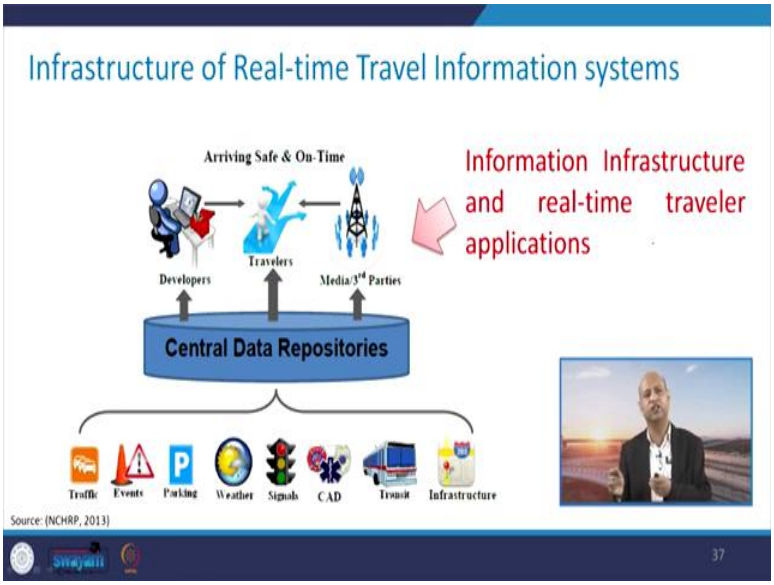

It also gives you information that which road is congested, which is not, so those kind of messages may come. Like FM radio you hear and they announce that okay this particular lane is busy these days, so that way you can have apps also, you can have FM or you can have other systems related to real-time information, which can help you to avoid the traffic jams on a particular locations or streets.

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These are the benefits, it enhances the mobility, because when traffic is flowing smoothly then mobility is better increased and efficiency and capacity of the transportation system increases, safety also increases, no doubt, reduced energy consumption and environmental cost is also reduced, because when pollution is there then you have to clean it.

So a lot of cost is involved in that, you can avoid. So prevention is better than the cure. That kind of thing happens here. Increased economic productivity: Because as you reduced the negative externalities, so productivity increases automatically.

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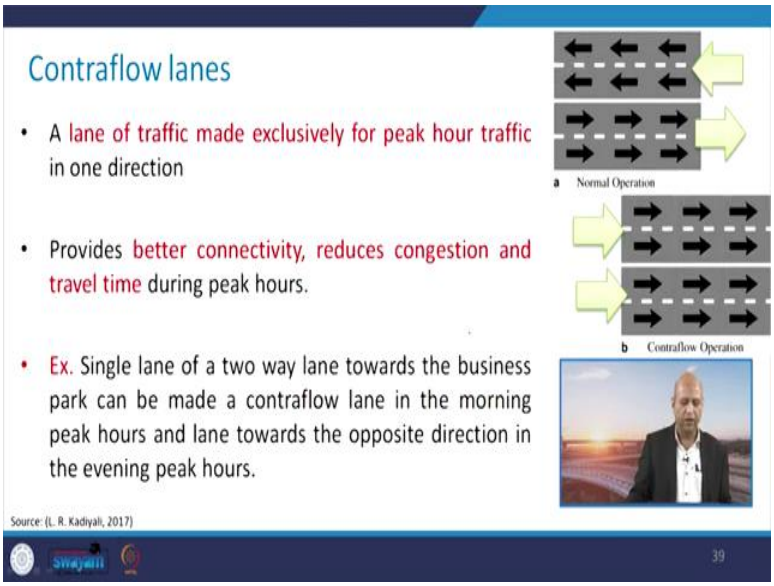

One example was of these contraflow lanes. You can see like this is the normal day. So, two lanes of this side, two lanes of that side, but when congestion is more in a particular time window so you can just allow one way only. So that way this particular lane has been used for going in that direction. Only one lane can also be used for this also. So that way you can play with depending upon how much traffic is there.

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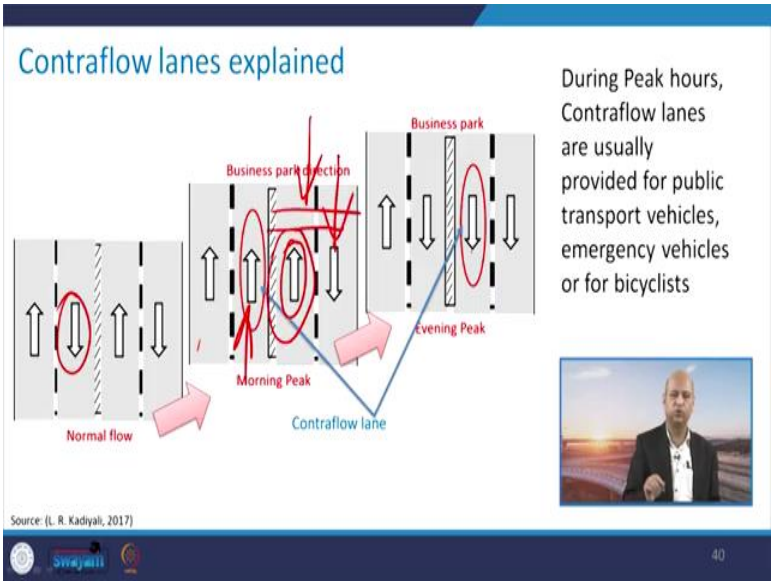

You can see these examples like normal flow in morning; again this has been used by going this particular, that way. The whole road is being used, and in the evening this particular lane has been used for coming. This was for going, so because a lot of traffic is coming from this side in the evening. So the whole lane is for coming only. There is no traffic to go on that side. So that way in the morning and evening hours, when looking at that traffic flow direction and the situation you can use this contraflow related scheme.

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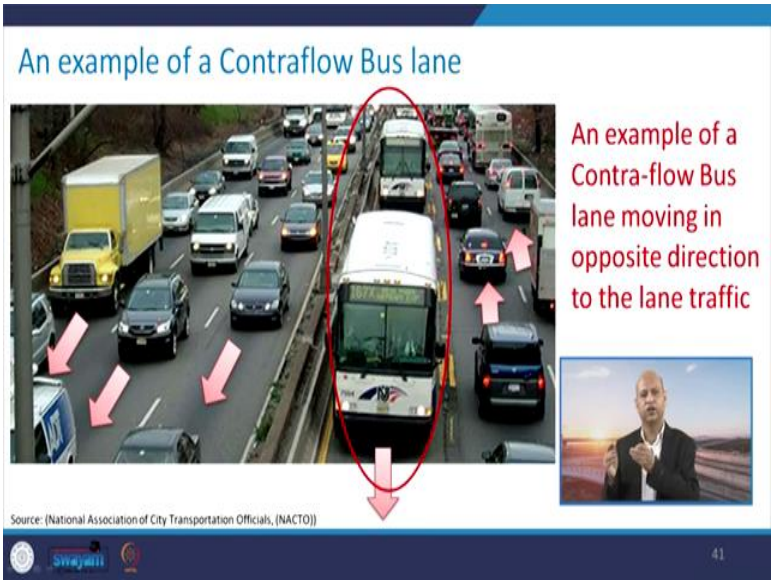

Contraflow bus lane can also be there like traffic is going there, but this bus is coming from that direction as we have seen in other examples also, because the traffic, most of the traffic is coming from this direction in a particular time period.

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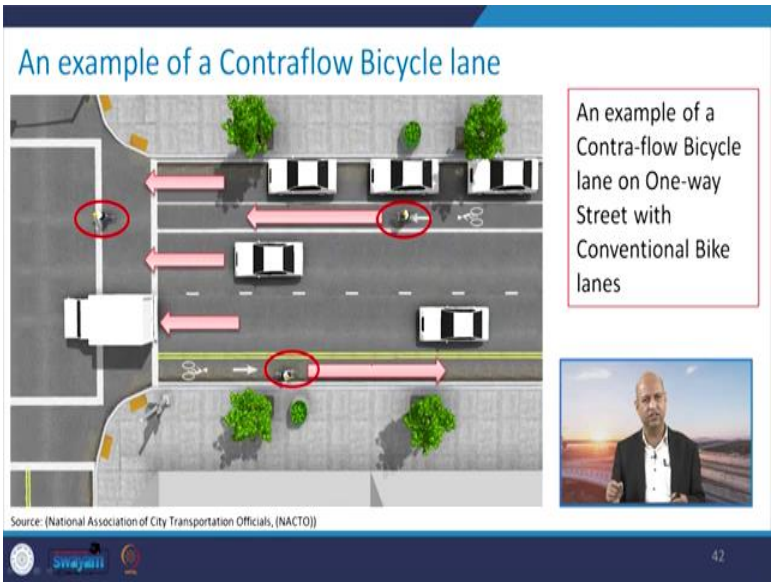

Similarly you can see some examples of bicycle lanes, so those are dedicated and even in opposite direction that can be occupied by bicycles.

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Similarly like the traffic is moving in certain directions, but it is not allowed, like traffic is not allowed to this direction, only bicycles are allowed. So this is the example of Dublin city. So these kind of examples can help us to reduce the congestion and improve the traffic flow.

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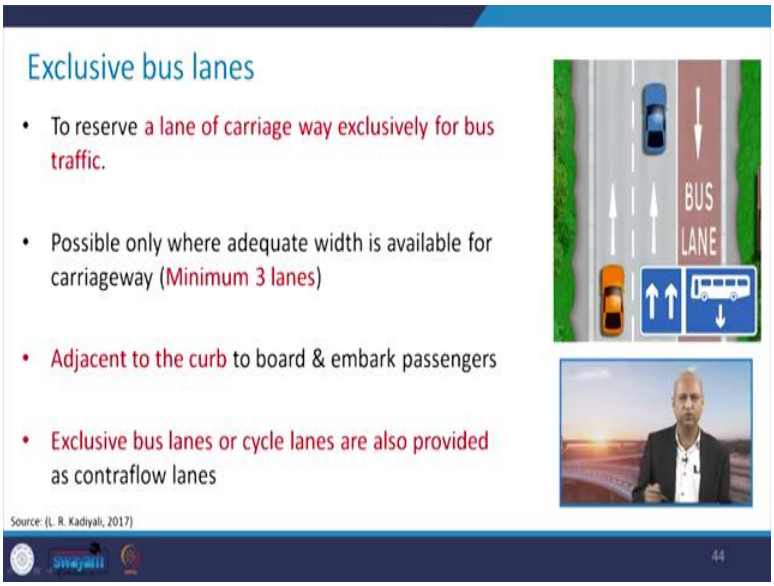

Exclusive bus lanes which we have seen in detail in case of BRTS system, so those kind of things are there, like bus lane is there. No car or scooter will be there, so bus will have a through way, it will have a good speed. So again it will save a lot of time. So people will feel that it is better to ride in the bus, rather than driving our own vehicle, because a lot of time will be saved, cost will be saved.

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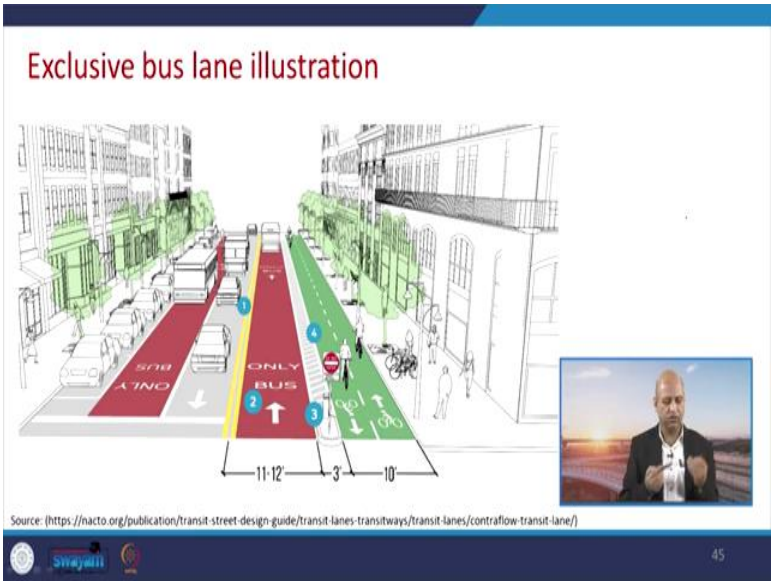

So these are the dedicated bus lanes which can be used for those purposes.

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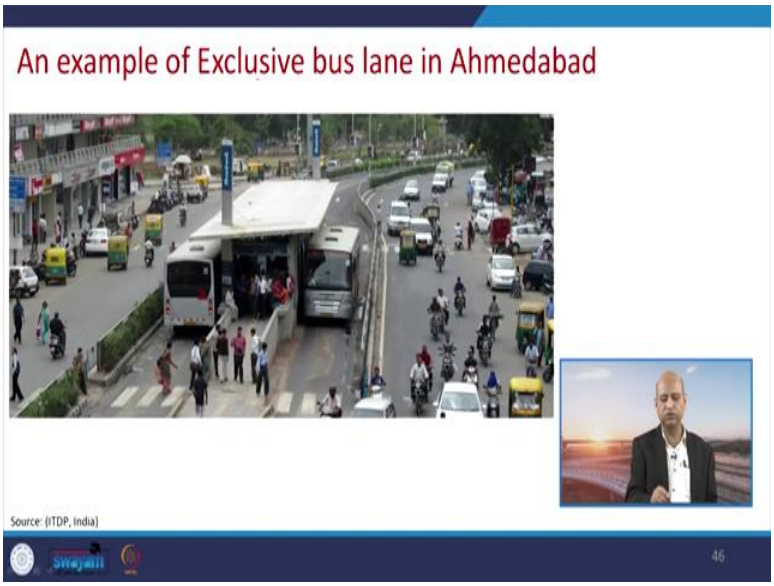

Example of exclusive bus lane in Ahmadabad, which we have discussed in earlier lecture also, so these again dedicated lanes for the buses so that they can move with the speed and in time. When we talk about the sustainable transportation, when we talk about the whole transportation system and it is a complex phenomenon in the sense because it is associated with different components and dimensions.

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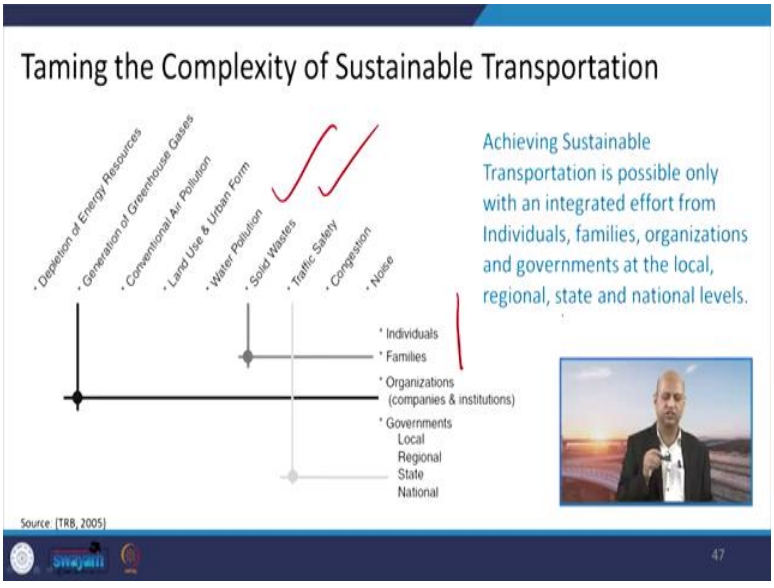

For example depletion of energy resources or the solid waste generation, water pollution, et cetera, but if we are responsible from individual to national level, at family level, organization level, different responsibilities if we honor then we can solve these problems. For example solid waste related issues, at family and individual level we can solve.

Traffic safety, congestion related issues, national and state policy measures can be adopted in that way. So in an integrated or holistic way only we can address these issues. So we have to tame this complex sustainable transportation system in a holistic way.

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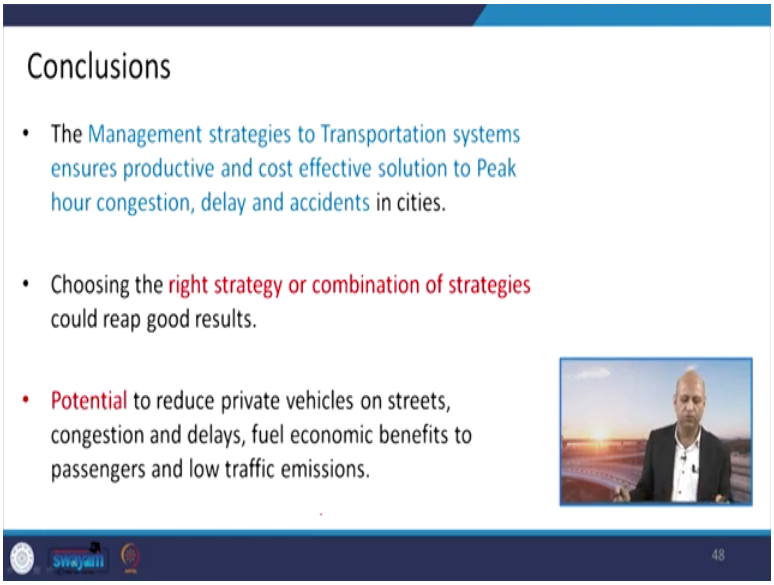

When we conclude about these strategies for managing the transportation system through better planning then we can see that that peak hour congestions in a particular city or in a city at a particular location, that can be addressed by several measure which we have seen. Very simple measures, very simple tools, from congestion pricing to one lane or T turn or Q turn, those kind of issues, and then choosing the right strategy and combination of right strategies, we can reap the good results so that smooth traffic flow is there.

Then we can reduce the number of private vehicles on the streets or roads and we can shift the population from privately owned vehicle to public transportation vehicle, whether it is chartered buses or good car pooling, those kind of issues, and that way we can reduce a lot of emissions and we can even save a lot of cost also. So this is all for today. So that way we have finished

planning related lectures. Now in next lecture we will discuss about life cycle assessment related issues.

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And before that if you want to know more about transportation planning, so this is the exhaustive list of references, which you can go through. So thank you for your kind attention. See you again in the next lecture. Thanks again.