Urban Transportation Systems Planning
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Lecture-11
Introduction and Basic Considerations of Trip Generation

Welcome to module C, lecture 1. In this module, we shall talk about the trip generation. In today's lecture will give you an introduction to trip generation and also identify various basic aspects which are important in the context of trip generation.

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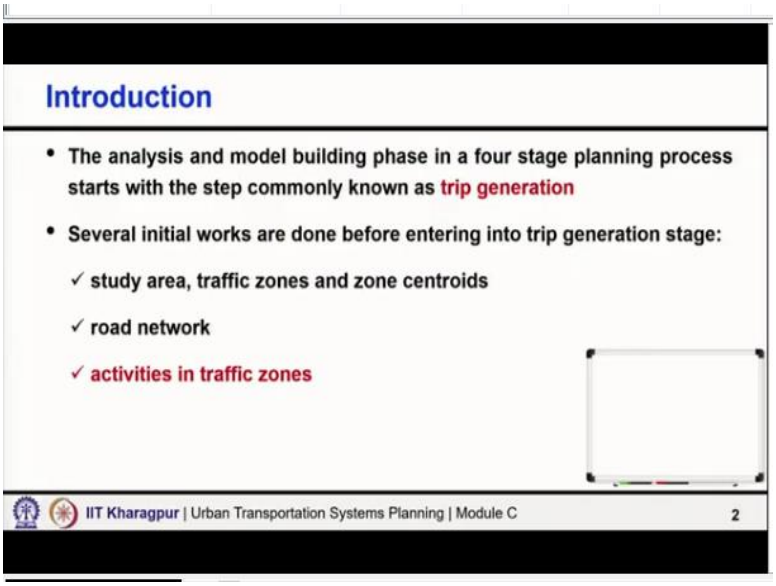

The analysis and model building phase in a 4 stage transportation planning process starts with trip generation, that is the phase 1. We have already discussed an overview of the 4 stage planning process and you know the stages are trip generation, trip distribution, mode choice and traffic assignment. But before we start this model building phase and start the trip generation modeling, several initial works are done before we enter into the stage.

Say for example, we need to identify the study area, we need to divide the study area into suitable number of traffic zones, identify zones centroid, build the road network or develop the map of the road network, connect the centroids to this road network, we identify various activities that are there in different traffic zones, identify traffic zones. So, all these ground works I would say the base works are done before we actually enter into trip generation stage.

In fact, as you know, the urban activities or the distribution of activities in different zones are the basic inputs to the trip generation process.

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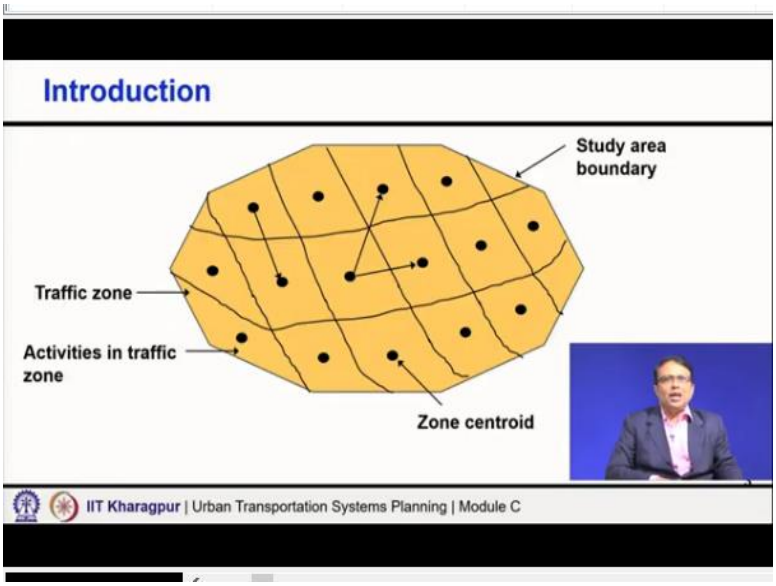

Now, it looks like this. So, we have identified the study area, you know demarcated the boundary to do to say that that is within that demarcated boundary or cordon line is our study area, then divided them into suitable number of smaller zones and then identified the zone centroids connected it to the basic network. So, all these zone works are ready.

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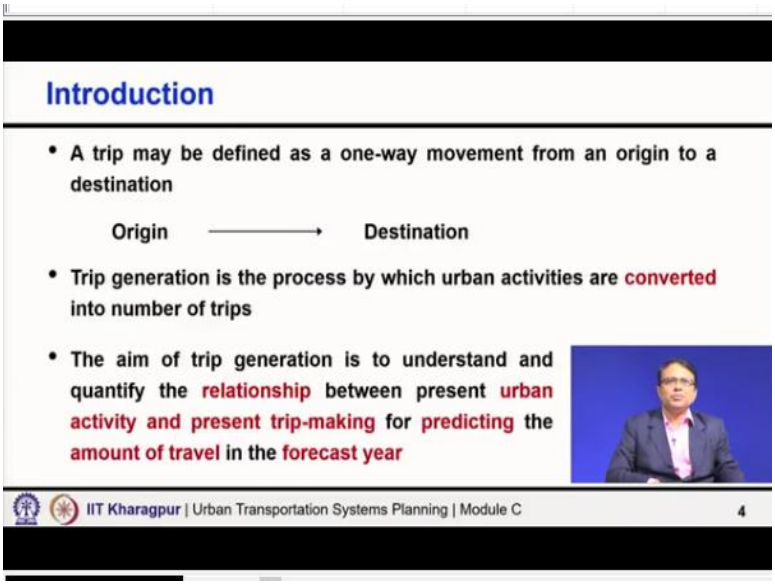

Now, we are talking about trip generation. So, the very first thing is to understand what is a trip? How we define it trip? A trip may be defined as a one way movement from an origin to a destination, people move for different reasons, we stay in home, but then we need to go to

college. So, we traveled to college, we need to go for buying vegetables we go to market. So, every one way movement is called a trip.

So, every movement has an origin it starts from a point it goes to a destination. So, for example, if I am traveling from home to shop, then my starting point origin is home and my destination is shop. Now, what we are doing in trip generation as we said that inputs to the trip generation what is the basic input? Basic input is the activities in different zones. So, we can say that trip generation is the process by which we are trying to convert activities into number of trips.

Because the activities the trips are happening. So, what is or what are the levels of activities and then correspondingly what are the levels of trip generation? So, we can say that trip generation is a process by which we are converting activities into number of trips. And the aim of trip generation is to understand and also quantify the relationship between what between urban activity, that is the input.

And the present trip making that output. So, you want to understand and quantify this relationship. What level of urban activity means what level of expected trip generation and that is what why we are doing this because we want to predict the amount of travel in the forecast year. Say 2021 we are doing the work. So, 2021 we know the activities in different zones, we know the present trip making also in different zone.

We try to understand and captured this relationship or quantify this relationship. So, that future we know what kind of activities are planned or what kind of activities are likely to happen in these zones. So, if the future activities are like that, then using this relation, we would be able to say that what kind of travel or trip generation can happen in the forecast year.

So, it is all for all this module building, including the trip generation modeling is basically to capture the relationship, so that we are able to predict it in the forecast year or horizon year, we also call it as horizon year.

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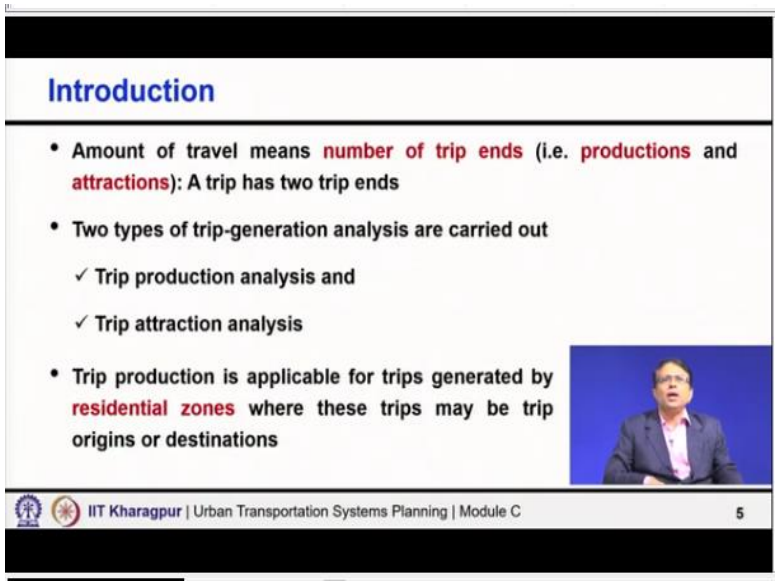

Then, since we say amount of travel, what we mean by amount of travel? Amount of travel means the number of trips, every trip has got to ends somewhere it is an origin, there is an origin, there is also a destination. So, we want to predict how many trip ends are going to happen. That is the amount. Amount of travel means how many trip ends? This is in the context of trip generation.

So, every trip has an origin and has a destination it starts from one place, it goes to another place. So, every trip is also produced somewhere and attracted somewhere. So, there cannot be any trip which is there in that urban network, which is produced but not attracted, that is impossible. Every trip which is produced must be getting attracted somewhere otherwise it is not a trip.

Same way, if we know that some trips are getting attracted, it must be getting produced somewhere as well, is not it? So, every trip has got a production point where it is getting produced. And it is getting attracted also to some other point. That is the point of attraction. So, when we say now, origin and destination and production and attractions are the similar, they are some cases may be similar, some cases they are different as well.

Not that origin means always the point of productions or destination means always the points of attraction, that may not be so, that we shall or I shall explain you further as we move forward, I have discussed it also when I talked about the overview of urban transportation planning process, but again, shall come back to this. The basic idea is if home is one end, either origin or destination.

Then the trip is always produced at home end and attracted at the other end. Do you remember I discussed this in the previous module? So, if there is any end either origin or destination, it may be origin, it may be destination, one end is home. So, if there is a home in one and then the trip is always produced at home end and attracted to the other end and if none of this ends include home.

Then trip is produced at the origin point, trip is getting attracted at the distribution point, that is as simple as that. So, because there are both trip gen productions and trip attractions. So, when we are talking about trip generation analysis, we also mean that trip production analysis and trip attraction analysis. So, both are to be understood clearly. And we need to module both not just one.

Now, trip production is applicable for trips generated by residential zones where these trips, maybe origins or destinations. That is what I explained. If there is a home end residential area is there, if there is an home end then trip is always produced at the home end, irrespective of whether that is origin or that is destination, maybe from if I origin destination is very relative, because if somebody is going from home to office.

And you ask him where from you are coming, he will say I am coming from home, where you are going, he will say, okay, I am going to office. But the same person, if you ask him in the afternoon when he is going back home from office, he will say where from you are coming, he will say, okay, I am coming from office, where you are going I am going home, but that does not mean trip is produced in the office, trip always gets attracted in the office.

So, if there is a home end trip is always produced in home end because people stay there finally. So, that is what he said that trip production is applicable for trips which are generated by residential zones, where these trips maybe origin or maybe also destination depending on at what time whether the person is leaving the home or coming back home, when you are intercepting him depending on that the residential zones maybe origin, maybe destination. But always the residential zone is the point of production.

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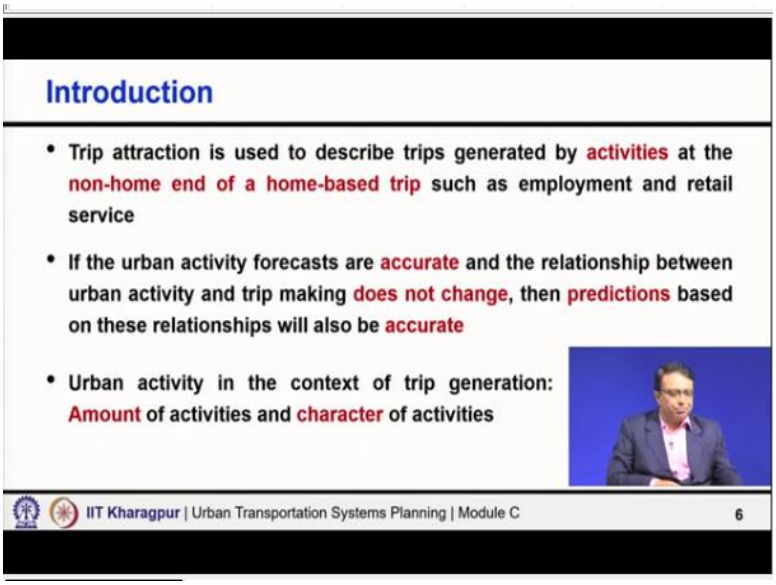

Then trip attraction is used to describe trip generated by activities at the non home end of the home based trip. So, if there is homemade trips, one end is homes obviously trip is produced there, then why trip gets attracted? Trip gets attracted to the other end, which is then the non home end of the home based trip, what kind of attraction it could be? It could be maybe employment, people are going to office, it will be retail service, it may be shopping, it may be recreational facility anything is possible other than residential activities.

If urban activity forecasts are accurate, once we have developed the model and then if we can predict this urban activity for the future or for the horizon years accurately and whatever relationships we are building now or capturing now in the base year, base year means, the year when we are doing this model building exercise and I have known activities, I have known trips and I am trying to build the relationship.

So, my X is also known my Y is also known, my dependent variables are known, my independent variables are also known. So, I have built the relationship. So, if I can predict the activities accurately for the future and the relationship what I have developed, if that relationship does not change, then prediction based on these relationships in the future will also be accurate.

So, if I can forecast Y a forecast X my independent variable accurately and if that Y as a function of X, that relationship remains valid for the future also, then using this relationship, whatever Y you will predict will be accurate. Now, urban activity in the context of trip generation, in this context, both amount of activities and character of activities, both are

equally important. What I mean by amount of activities and what I mean by character of activities that I'm going to discuss now, in my next slide.

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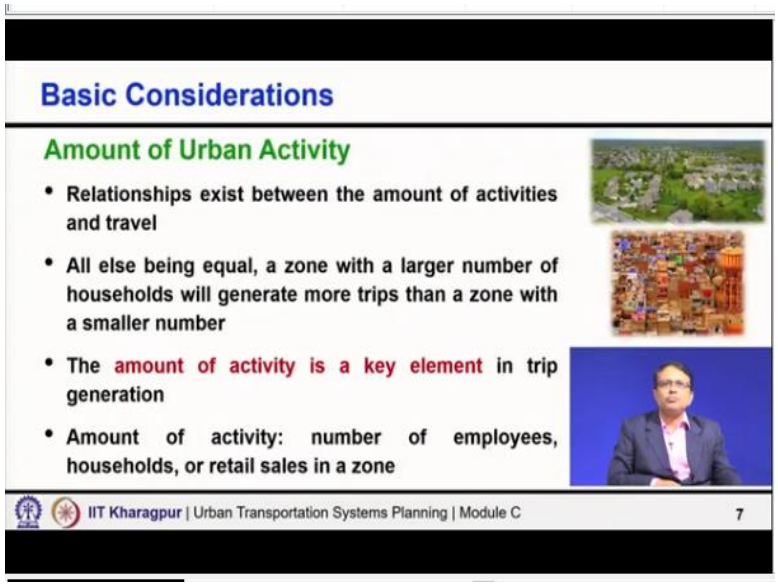

What is and why the amount of activity is important? Let us say that given everything else same, if there are 100 households in zone and if there are 200 households in zone given everything else is same nothing else is changing, then where you expect more production to happen? Obviously, where there are more households staying in that zone. So, 200 households will make even generate more trip than 100 households.

So, the amount of urban activity is important, how many households? number is important, how many households are there. So if there are more households, more activities, it means more activities and it means also more trip production. So, that is what I have said here that relationships exist between the amount of urban activities and the travel. Why, as I explained, I have mentioned it here the same thing.

All else being equal is shown with a larger number of households will obviously generate more trips than a zone with smaller number. So, the number matters, that means, the amount of urban activity matters. And in fact, the amount of activity is a key element intergeneration, we must know what amount of activity that is likely to generate or likely to be there in the future.

Now, how we express the amount of activities? I tell number of households, yes, that is one. It could also be number of employees, number of retail sales in a zone, all these are actually used to express the amount of urban activity in an urban area.

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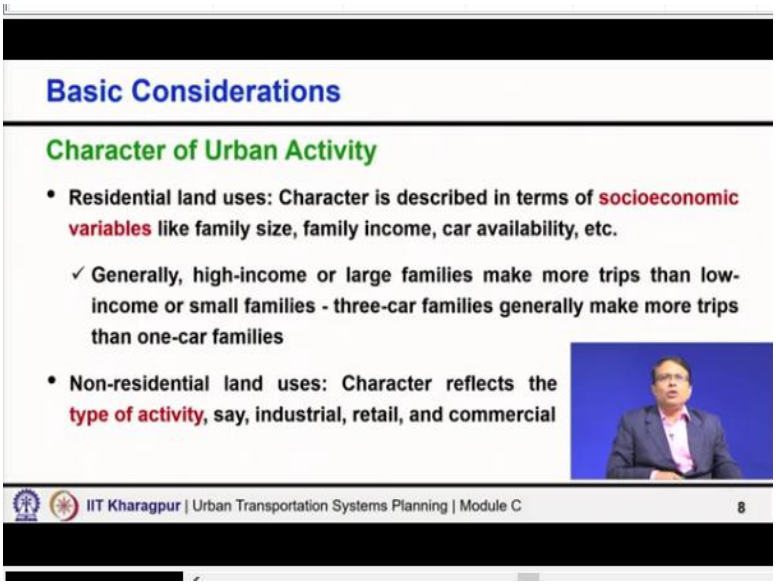

Now, as I said, the character is also important, not only the number or not only the amount, why the character is important? If I tell you in the context of residential land use, now you know that households could be of different types, if you go to a typical urban area, there are low income housing, there are medium income housing, medium income group housing, similarly high income group housing.

So, we know that LIG, MIG, HIG, all different types of housing said there. Now, if I asked you that same number say 1000 families are there, everything else is equal, everything else means all other except the size or the nature of house. But one area is basically LIG dominated housing and another area is HIG dominated housing. Where more trips will happen or will same number of trips will happen in both areas the answer is simply no.

So, you know that as income grows, so, more higher the income generally more travel will happen for various reasons. Because it is found actually that recreational trips, social trips, shopping trips, all this will be in more number once you go for high income housing. So, if I say the number of course 100 if I say number compared to 100, 200 will be higher.

So, the quantity or amount matters, but amount is not adequate, it is important, amount is important, but also the character. That is what I say in residential land uses character is

described in terms of socio economic variables like the family income, family size, car availability, all this. And just to give you an example, just to convince you as I said the same example is given here high income a large families make more trips than low income or small families even the family size.

So, everything else is same, but the family size one place only husband wife live mostly, maybe in those areas. And in another area, you have had more of the traditional Indian family with parents, with children. And with all uncle, aunt, everybody all are staying together. So, obviously, the households are more people are living, they make motor it may not be simply linear, that per person multiply it he will get the trip that may not happen, because not all types of trips will be proportional, how many person 2 persons are staying or even in traditional Indian family if 10 people are living together.

Even if 10 people lives together the uncle always goes to for shopping, shopping job is for uncle. Father will not go for that job. Uncle will go to the job, go for the shopping and not like the present situation that if in the same house, 3 brothers are staying in 3 different flats. All 3 will go for shopping in the morning to get vegetables and other things from the market.

So, the some of the trips, it depends what type of what purpose we are talking about trip, but generally larger family make more trip, high income more trip, households with who have cars will make more trips, higher number of cars will make more trips. So, you know the character is very, very important. In terms of non residential land use other than households the character reflects the type of activity. Say for what kind of activities? Is it industrial, is it retail, is it commercial? Now, why I say why this nature is also again important?

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Because you will see generally say for example, the number of trips generated by a shopping center is usually higher than the number of trips generated by a warehouse of the same size, size is same, but the number of trips attracted by a warehouse and by a shopping center will it be same? It cannot be, suppose the basic industry, some basic industries there and you have these typical call centers.

So, per unit area the employee or area per employee is not same. So, if the area I talk about the same area, my trip attraction is not going to because the kind of employment opportunity that is going to be generated per unit area will again not be same and if you go to a manufacturing industry a lot of area for storage of material, raw material, finished product, storage.

So, a lot of area but if you just compare it industries are people only need a place so, that they can keep the computer and sit and with the printer and maybe scanner and all those per person area is very small. So, the nature is important both at trip generation perspective and also for the trip attraction perspective. So, altogether we can say measure of amount of activity usually are not enough to develop a good relationship between travel and activities, the character of the activities is important too.

So, we need both the amount of activities and also need to consider the character of activity to develop a good model or to build to develop the relationship in an appropriate manner.

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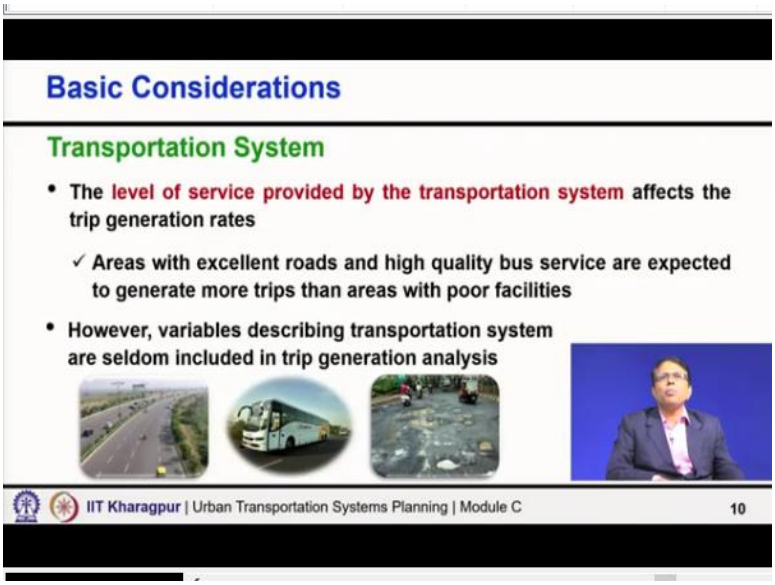

Now, there are certain basic considerations, which are again also important one we said we discussed that is the character of urban activity, amount of urban activity before that and hotels. The next is transportation system. All these things, the urban transportation is not so simple, the relationships that are really complex, but it is extremely interesting as well. And is one of the real problems all of us we are facing and a lot of challenges are there.

And a lot of opportunities are there as well I would say. So, again the basic considerations one of the basic consideration is basically the transportation system. Because whenever we are talking about trip generations, the level of service provided by the transportation systems also affect the trip generation rate. People want to travel, but how they will travel? They will travel using the available transportation system.

So, if the transportation system is good, more travel will occur. I mean this has got a different consequence as well, you build more roads, you develop the transportation system that will boost the travel, it happens and of course, because there is demand, you need to provide an improved transport system and because of improved transport system, it also influenced the demand it is always a two way relationship.

So, let us say and areas with excellent roads and high quality bus service are expected to generate more trips than areas with poor facilities. Normally what happens If the good transportation system is very good, it just come out of home and then buses are available regularly state way take you to the city center that will encourage people to travel more, but if it becomes extremely difficult then people will not travel so, easily.

They will accumulate all the work, 5 works accumulated together, then they will go. So, but these transportation systems we normally do not use as a variable in the trip generation analysis why? Because then it will make the trip generation elastic to the characteristics of the transportation system, the complexity will increase nothing else. So, we normally do not consider trip generation elastic to the transportation system, not a function of we do not consider it as a function of transportation system.

But we consider rather the trip distribution, mode choice, traffic assignment, all these acting. So, the loops are coming back to transportation system going back to mode choices, going back to distribution, but normally we do not go back to that trip generation. But of course, the impact of trip transportation system will be much higher on mode choice on route assignment, on distribution, trip distribution. Then the impact on the trip generation.

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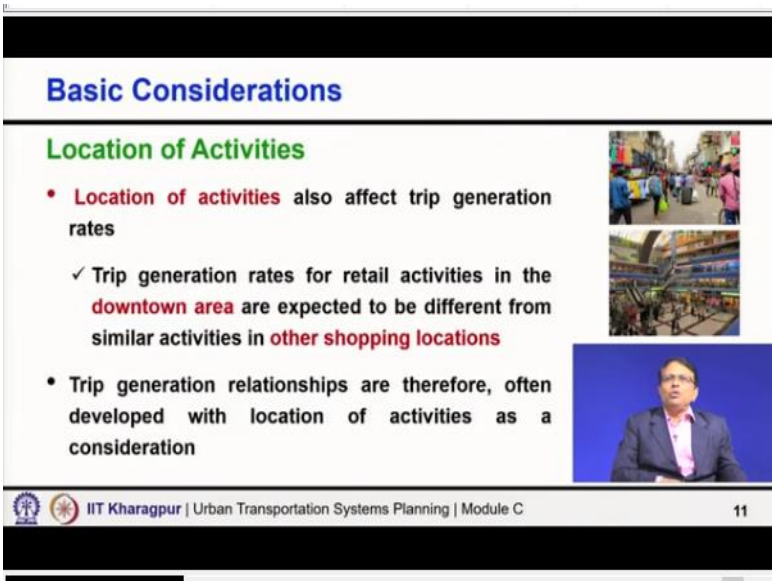

Now, the location of activities is also important, where the shopping center is located? Is it located in the CBD area where in a wider roads are there and lot of parking facilities and the whole ambient is different or it is located in the savoir where there is a narrow streets is very difficult to go to move 2 cars side by side or 2 vehicles side by side. So, the location of the activity also affects the trip generation.

So, trip generation rates when you are borrowing from one location to another location, you can borrow, there is no problem. But please keep in mind that the location of activities is also important, whatever trip generation is happening maybe in bigger cities like in Bombay,

Delhi or Calcutta, a small town, if you are applying, you cannot apply the same rate, that does not happen in that way.

Even within a big cities also the major city area with better infrastructure facilities and everything and if you go to the downtown, go to the suburb area, it may not happen in the same way. So, the trip generation rates for retail activities in the downtown area are expected to be much different from similar activities in other shopping location. So, trip generation relationships are therefore often developed with location of activities as the considerations where they are located.

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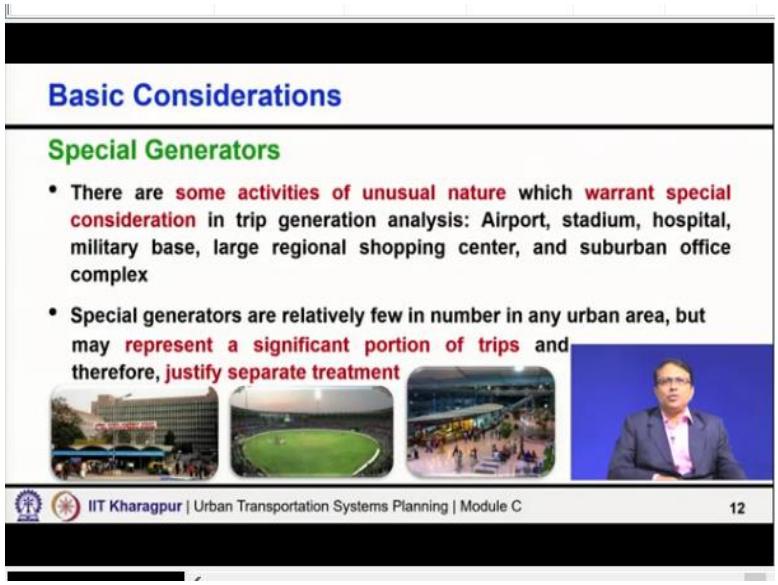

Then this is again interesting consideration special generators, what are special generators? These are some activities which are of unusual nature, not everywhere, every time, every study will encounter this. So, the number wise they may not be very high. There are some special activities of unusual nature which warrants special consideration in trip generation analysis.

For example, the normal land use or activities trained will not indicate if you are trying to develop any airport in that area. That is a very much special generator. If we are trying to build a new hospital, the normal activity forecast will not include such kind of generators or maybe military base or large regional shopping complex or developing maybe a stadium.

And it is a very, very different attraction, if there is a India Pakistan match in a stadium, the kind of trips what are expected, with kind of trip what will happen the whole thing, it is a

different event altogether. So similarly, if you have really, you are building an airport, that is again a completely different thing. So, the special generators are relatively few in number in any urban area may not be really large in number.

Not in every project or every city will find that but may represent a significant portion of the trips and therefore justify separate treatments. So, normal forecast, normal growth rate we are applying for activity forecasts. They may not include all such kind of special generator. So, you have to keep it in mind if there is a special generator like this, you must consider it separately and add it to the normal growth or normal base routine activity forecasts and based on that whatever trips will happen. So, you have to add it separately, consider it separately and we call it as special generator.

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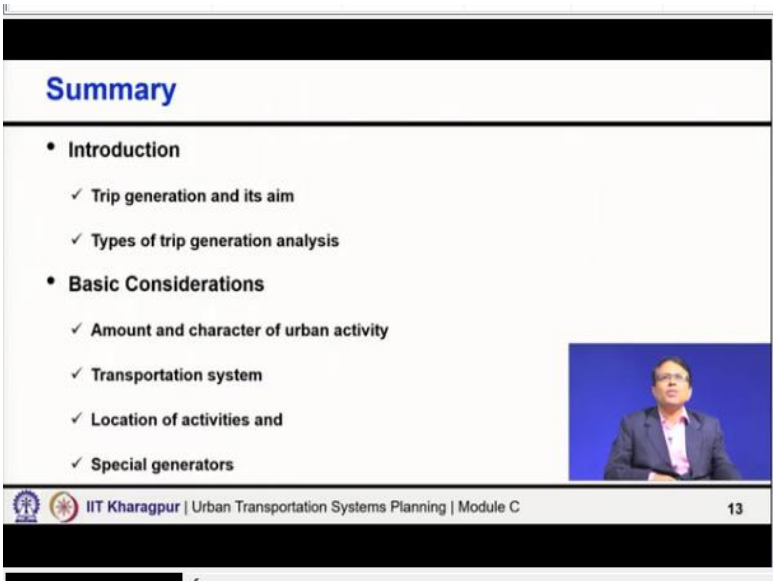

So, if I have to conclude this lecture, I would say we discussed about what is trip generation? It is basically translating activities into number of trips and in that process how we are translating in the base year we are translating. So, we have known activities, known trip making. So, we are building the relation, trying to understand the relationship and that relationship we are applying in the future.

And with inputs, what input? Input as the urban activity forecast. So, if my forecast is urban activity forecast is accurate or realistic, I would say realistic rather than accurate. Because forecast is always with subject to certain errors, that will happen bound to happen, both in independent variable, dependent variable everywhere, there will be some errors we cannot avoid completely.

So, if my relationship is fine, and if my activity forecasts are fine and if the relationships are also valid for the future, then I will be able to forecast the trips that are going to come up in the future or in the horizon year. Then, we discussed about basic considerations. So, he said that amount of activity is important, but also the character of activity both in the sense of residential land use and other types of land uses or non residential land uses.

Then we say that the transportation system is important because transportation system influence the trip generation, but I said that normally we do not consider trip generation as a function of transportation system. I say just more we considered the impact of transportation system on distribution and mode choice, on traffic assignment, but we do not link the transportation system influence on trip generation.

But actually that influence is there very much there. Maybe because of simplicity we do not consider and because of the impact of transportation system will be even much more on distribution, on mode choice and on assignment. Then we said the location of urban activity is also important, where it is located? So, geographically we are transferring the trip rates right one has to be very careful with that.

And as I said, there are certain special generators like stadium, hospital, large scale community centers and all those kinds of special generators, which may not be airports, which may not be large in number and you may not encounter such kind of generators in every project, but you have to be careful if there are special generators like this. They need separate consideration because normal activity forecast will not include such special generator. Thank you so much.