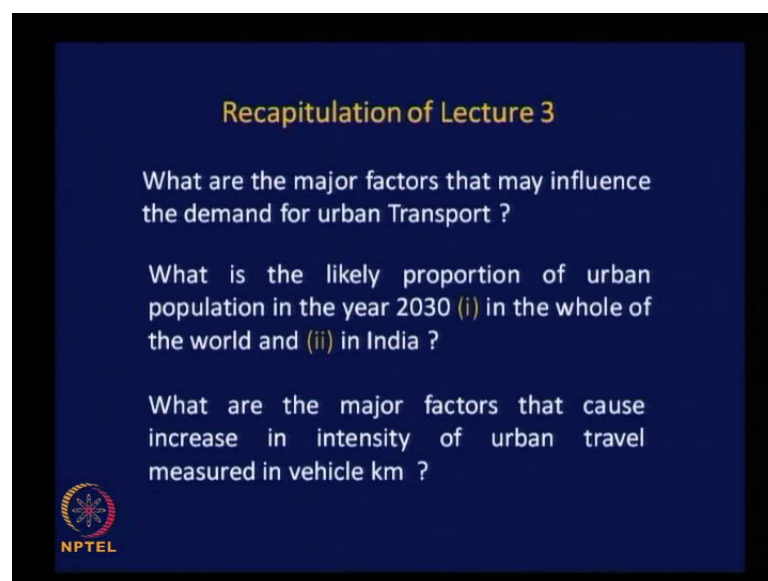**Urban Transportation Planning**
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Lecture No. # 04
Course Outline

This is the lecture 4 on Urban Transportation Planning. In this lecture, we will just have an over view of the outline of the course covering the contains of the course and the related peripheral issues. Before we do this, let us try to quickly recapitulate, what we did in the previous lecture, so that you have a feel of the continuity of the lectures. You may recall that we mainly discussed about the different factors that influence the demand for transportation in urban areas. We also had an idea about the way demographic, and economic factors changed in respect of the whole world as well as in respect of Chennai city.

And then finally, we had a look at the various factors which our influencing the travel intensity in an urban area based on the experience of developed countries. And finally, understood that all this factors lead to higher intensity of travel in terms of vehicle kilometers in cities and towns. This is what we saw in the previous lecture, still it is better that we specifically capture few important points of the previous lecture.

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As we normally do, let me post one question to you on recapitulation of lecture 3 and I hope some of will be able to answer. The first question is, what are the major factors that may influence the demand for urban transport? Answer please.

The population household, age, and the cultural aspects.

Good any other factor? Yes pass on the microphone there.

The demographic, and social factors.

Yes any other response, economic factors. So, put all things together, we can say that the factors can be categorized as demographic social and economic factors. Mainly involving population, household, age, cultural aspects, employment level, income and vehicle ownership is it not. So, that is how we need to understand the various factors normally influence the intensity of travel or demand for transportation in urban areas. The next question is this, what is the likely proportion of urban population in the year 2030, as per United Nations population statistics in the whole of the world, and in India? Based on your own prescription, any response?

60 percent, yes in the world and 47 to almost 50 percent in India, sir.

Good answer it is expected to be about 61 percent in the case of the whole of the world and as for as India is concerned about 45 to 50 percent of Indians are going to live in cities and towns in the year 2030. The next and the last question is what are the major factors that cause increase in intensity of urban travel measured in vehicle kilometer? This is related to the experience of developed countries that is a clue I can give to this question, any response. You may recall that we discussed about the gradual increase in per capital trip rate in developed countries over a period of time. Then increase in household vehicle ownership over a period of time resulting in increased driving license holders. Then parallel there was decrease in the household size due to economic independents of the people.

And also there was decrease in car occupancy to satisfy the desire of independents, privacy etcetera of the urban dwellers. Then on lando side there was migration of population people living in city center to the peripheral areas, mainly because of this suffocating congestion experienced in the city centers. And this migration led to

migration of employment centers also to the peripheral areas, resulting in wide spread urban transportation activity. Leading to increased travel in terms of trip length or passenger kilometer, all this factors put together led to use of more and more cars for making travel resulting in high level of travel intensity. When we measure it in terms of vehicle kilo meters so, that is the detailed answer to this question.

Now, what is the result of the higher travel intensity in terms of vehicle kilo meters, what do we experience practically in the field? This is what we experience in most urban areas resulting traffic and transportation problems because of increase travel intensity is as follows.

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Problem	Solutions	Conventional Approach	Operational Approach with ITS
Traffic Congestion	•Increase Roadway throughput	• New Roads • New Lanes	•Advanced traffic control •Incident Management •Corridor management •Advanced vehicle systems •Real-time ride matching •Integrating transit and feeder services •Flexible route transit •New personalized public transit •Telecommuting •Transportation pricing
	•Increase Passenger Throughput	•HOV Lanes •Carpooling • Fixed route transit	
	•Reduce Demand	• Flex. time Programs	

One problem is traffic congestion everywhere, over the whole of the transportation network. And possible solution in principle for this problem, as you may guess is to increase road way throughput or road way capacity. And conventional approach to increase roadway capacity could be by construction of new roads or constructing additional traffic lanes. Another possible solution to mitigate traffic congestion is to increase passenger throughput. The previous solution is to increase vehicle throughput by widening roads, instead you can think of increasing passenger's throughput by some means. It would be possible by means of the following measures, by providing HOV lanes, high occupancy vehicle lanes, exclusive lanes for high occupancy vehicles so that these vehicles move faster or encouraging carpooling.

Once you provide HOV lanes obviously, we will find that carpooling fix up mainly, because more and more people want to occupy single vehicle and take advantage of HOV lane, which facilitates faster movement. Or you can also think of providing fixed route transit service, good transit service, metro rail system, good trans-system, faster bus service and So on. And another possibility of reducing congestion is by reducing demand itself over space, as well as time. You may wonder whether it is possible to reduce demand it is not desirable also to reduce demand, we must encourage mobility in general, because mobility is a key for growth of socio economic activities.

So, our transportation planning process should not interpret curving mobility, here what is meant is to spread out the demand over time as well as space by some appropriate means. And the actual procedure which can be tried out is to try flextime programs, flexible timing of working hours in institutions, employing large number of employees, institution like educational institutions and so on. Instead of starting all the institutions simultaneously at a particular point of time spread out the start of work as well as finish up work in different institutions depending upon the intensity of development of these institutions over space. So, that will relief the congestion to a significant extent provided this kind of staggering is acceptable to these institutions.

We can convince and tell them that it is for their own convenience an interest the timings are staggering. And off course, you can think of various I T S measures related to this conventional approach. I will just quickly least all these measures, I am not going into the details of these measures, just for completion sake I am listing the related ITS measures starting from advanced traffic control, incident management, corridor management, advanced vehicle systems, real time ride matching, integrating transit and feeder services, flexible route transit and new personalized public transit.

It is a very interesting concept personalizing public transit it is like call a bus concept. People can record their demand for transport and an operator can send a mini bus to pick passengers based on the timing requirement as well as the destination requirement. That is what is meant here as new personalized public transit. Telecommuting transport, pricing, how do we reduce congestion by transport pricing? You can impose toll in highly congested areas, every vehicle as to pay a toll. In such a case, it will be a deterrent for the vehicle users resulting in reduced usage of those areas which are highly congested.

Problem	Solutions	Conventional Approach	Operational Approach with ITS
Lack of Mobility and Accessibility	•Provide user-friendly access to quality transportation services	•Expand fixed route transit and Para-transit services •Radio and TV traffic reports	•Multimodal pre-trip and en route traveler information services. •Real - time response to changing demand •Personalized public transportation services •Enhanced fare card

So, this is what we experience in practice, apart from traffic congestion we have other problems which are quite common to any urban area. For example, lack of mobility and accessibility we may have a system, but it may be difficult access the different modes of transportation restraining the mobility of urban dwellers. And the general approach to providing solution for this is, provide user-friendly access to quality transportation service, the general methodological approach for providing a solution. And how do we do it by conventional approach? This is the possible solution, just expand fixed route transit and Para transit services, para transit provide access to the main transit service. That is how you can simultaneously increase both availability of transit service and access to the available transit service.

And off course, the other related possibility of solving this problem is Radio and T V traffic reports, which will help the commuters to understand operational changes in the transit system. And level of congestion existing in different parts of the city so that is what is meant here, which will help them to plan their trip or modify their timings in such a way, that they do not get caught in traffic problems. And the related I T S operational approaches are like multi model pre-trip and en route traveler information services. Real-time response to changing demand as and when you travel, you will get information about the congestion level in different parts of the road network.

Then personalized public transportation services as I mention the previous case and enhanced fare card employing that a single fare card can be used for multiple modes which is quite common in developed countries, which makes your travel simplest and convenient.

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And other common problems, that you face in urban travel is disconnected transportation modes. We have different modes of transport available in some cities, but they operate isolation may be, because of the operational policies of different operators or for want of coordinating system to integrate these modes and operate the whole set of modes as one system. And the possible solution or methodology of providing solution is improve inter morality or improve connectivity between the existing modes. How do we do that in practice by conventional approach? We have to physically construct inter model connections. For example, provision of good temporary parking facility for buses at metro stations, buses can bring passenger drop at metro stations and live pick passengers and live, good parking facilities for two wheelers, bicycles and so on.

This connects the different modes of transport available for transportation so that the overall trip making becomes easier for the urban dwellers so, that is what is meant here by constructing inter model connection. And related ITS issues or regional transportation management of the system as a whole, we can divide the urban area into different regions and see that the whole of the region is connected well by transportation system.

Take a regional approach do not look at it in micro level so that is what is meant here by regional transportation management system. Similarly, regional transportation information clearinghouse, you answer any kind of question pertaining to a particular region to all the users, provide some window for them to get this information immediately.

Then, disseminate multi model information pre-trip and en route about connectivity between modes. You know while travelling, if they want to get some information about the availability of connecting mode, the traveler should able to get the information even during travel. So, that is what is meant by this system, these are all not just imaginary steps these are all steps which are actually being taken in several cities of developed countries. These system or in place they are all function.

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Problem	Solutions	Conventional Approach	Operational Approach with ITS
Crashes, Injuries, and Fatalities	•Improve Safety	•Improve roadway geometry and sight distance. •Grade- separate crossings •Driver training •Install traffic signals •Reduce speed limits •Post warnings in problem areas	•Partially and fully automated vehicle control systems •Vehicle condition monitoring •Driver condition monitoring •Advanced grade-crossing systems •Automated detection of adverse weather and road conditions, vehicle warning, and road view notification •Automated emergency notification

And finally, the most severe and important problem faced in urban contracts is crashes, injuries and fatalities. What is the approach to provide solution to this problem? Obviously, in one word or two words improve safety. How do we improve safety? The first major step could be improve road way geometry and sight distance. Then, grade-separate crossings or construct flyovers at major intersections. Driver training, install traffic signals wherever required, reduce speed limits if require, post warnings in problem areas, install post warning signs or signals when required. And related I T S

measures or partially and fully automated vehicle control systems. The vehicle should be automatically controlled in case of emergencies or crash like situations.

Vehicle condition monitoring system should be in place, if you want to have a safe transportation system. Similarly, driver condition monitoring system through proper driver licensing, continuous driver testing. Similarly, a good vehicle licensing system and then, continuous vehicle monitoring system, advanced grade crossing system, automated detection of adverse weather and road conditions, vehicle warning and road view notifications and automated emergency notifications. We have discussed about the common problems that we experience in the use of transport system in urban areas starting from traffic congestion, disconnected modes and lack of mobility and accessibility as well as traffic safety issues.

As a remedial measures, we discussed about construction of new roads, addition of new traffic lanes, construction of inter model facilities and improving road way geometry construction of fly over and So on. My question now is, how do we go about constructing this infrastructural facilities, which are highly capital intensive? How do you know that a new road that you are going to construct is going to meet the demand for the next 1 year, 2 years, 5 years or 10 years, do you have the answer? Let us say you are planning to add one traffic lane on a particular road are issued that it would be sufficient for next 20 years we do not know. When you are constructing a fly over, what is the basis on which you will fix the geometry, a width for different streams of traffic.

When you consider a four legged intersection with two way traffic movement on all the four legs, you will end up with 12 different traffic streams. And as a designer of this grade separation facility, you should know clearly the volume of each of these streams of traffic and the space requirement for this streams, is it enough if you provide a space for this streams, as we measure today the base year it is not. When you invest lot of money to construct a fly over, you must realize that it should serve at least for a minimum period of 50 years, it is a solid concrete structure. That means, you need to take into account, the traffic growth, transportation demand that will influence the traffic at that particular intersection for a 50 year period of time. Take that horizon year traffic as the basis for providing geometry for all these 12 streams of traffic.

How do we do that or in other words we should realize that, we cannot just observe today's problems in urban areas and immediately get into the process of providing solution without understanding comprehensively. The whole of the travel pattern and the possible feature growth there is no point in providing solution. In this regard, I will just tell you the story, there was a work shop held in this city on the topic of traffic and transportation problems of Chennai city, some 2 years ago. The participants were attending the work shop by invitation, all the stakeholders were invited about 50-60 people attend the work shop. It was a one day workshop the deliberations covered all aspects of traffic and transportation problems and possible solutions.

As you may anticipate there were different viewpoints, people talking about effective enforcement of traffic rules. And people talking about good educational measure to be taken to educate the road uses providing good pedestrian facilities, absence of cycle track, encouraging public transport widening of roads, construction of fly over and so on. There were various issues raised and finally, the chairman of the conference or the work shop wanted to minute important point so that you can send to be concerned authorities. He was looking for some solid tangible suggestions, implementable suggestions from the audience. He asked pointedly each one of them to give suggestions. Suggestions came as I pointed out related to various aspects and one gentle men seated in the front road was keeping quite not responding to the chairman request, but he appear to be quite learned persons.

The chairman pulled almost and requested him to give three important points, which can provide some mitigation to the transportation problem experience in this city. He stood up looked around and said my first suggestion is planning, chairman was appreciative fine please go ahead, give your second point. He said my second point is comprehensive planning ok acceptable please go ahead give your third point. He said continuous planning that drew the nail into the head of everyone and the chairman has highly appreciative. And the importance was the planning of the first point the minutes of the work shop, without planning noting should be done. It is like blind person doing something knowing the environment, if you get into providing solution to traffic and transportation problems without prior comprehensive planning.
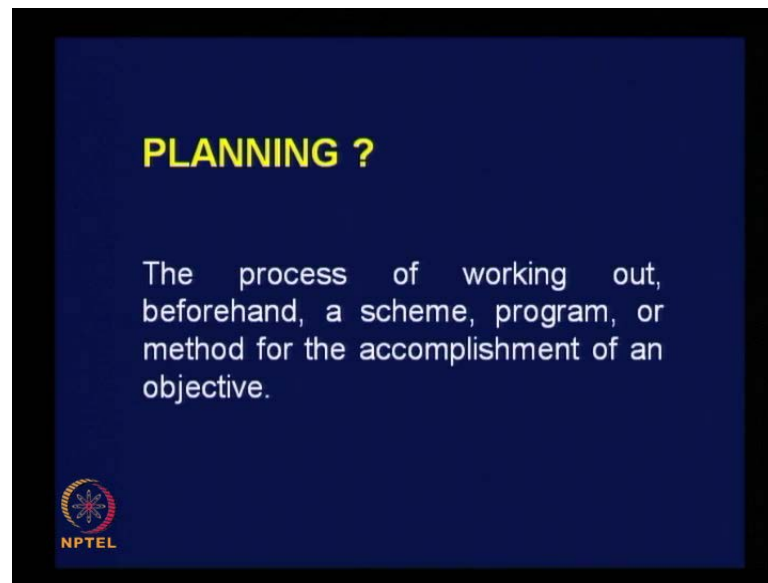
So, with this understand of the importance of the planning process, let us try to move forward and try to define the term planning in a very simple way. Anybody what is planning? This is the simple definition of planning, the process of working out beforehand, a scheme, program, or method for the accomplishment of an objective. it is a very important. There is an objective directing your planning process. Let us say a household is planning to make a weekend shopping trip, the objective is to buy our requirement for a week or month is the objective of household. Immediately the next step before making the trip could be to understand the requirement then, quantify the requirement. Identify the available locations of these quantified requirement say grocery, vegetables or textile items or jewelry items and So on.

Quantify and find out the transportation requirement should be have to go while transit or use your own vehicle and so on. And then plan the sequence of mobility, where to go fast then, where to go next and so on and finally, deciding about the timing, time of start and time of finish. This is what a household will do. What does a transportation system planner is doing or will do the same process for the city as a whole city comprises of household. So, one should understand the activity pattern of household, their desire, their travel pattern, aggregate the whole process you will automatically end up with understanding of the travel pattern in an urban area.

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That is what we mean by planning, comprehensive planning of various transportation requirements for the urban dwellers. With this understanding, let us try to define now the process of urban transportation planning. Urban transportation planning is the process of, understanding the factors influencing the demand for urban travel. Then development of relationships between the factors and the travel demand, third use of the relationships to predict the future demand for travel and the resulting transport infrastructure needs that is the end point. Ultimately we are interested know what is the transportation infrastructure requirement to meet future demand, that is the end product of any transportation planning process, clear.

Now, we are ready to look at the contents of this course, urban transportation planning contents starts with introduction which we have already completed for this course. Then we will discuss about transport planning process in the context of urban transport system planning. We will be discussing mainly about the various steps involved in the transportation planning process and integration of goals, objectives and standards related to the urban community into the transportation planning process that is what we will discuss under this topic. And third topic is trip generation analysis as the term implies, it is about understanding the trip generation rate in urban areas. There are two aspects of trip generation, trip production and trip attraction, as you can guess most of the trips are produced at home in an urban area.

So, we will be developing trip production relationship or models by relating the actual trip production with household characteristics. And trip attraction could be by various activity centers like major institutions, work places, educational institutions, shopping centers, recreational centers and so on. The characteristics of these activity centers will be the causal factor for trip attraction. So, we will formulate variables involving the characteristics of trip attraction centers to develop an equation or model to understand trip attraction process. So, we will discuss trip generation with two topics namely trip production and trip attraction. Fourth model split, when we talk about trips, it is very important to know the mode used by travelers, whether it is going to be a walk trip or bicycle trip or trip by transit or by car or motorized two wheeler and so on.

Unless this understanding is made clear, we will not be ultimately able to perceive the kind of travel intensity in terms of vehicle kilometers. How to analyze in the mode choice process? For that a clear understanding of the factors that influence mode choice of urban dwellers is very important. It is not difficult after all the socio economic characteristics of individuals and the transport system characteristics in terms of speed, cost, comfort, etcetera, will influence the choice of mode by any traveler. If a person is reasonably wealthy owning a car obviously, we can expect that person to make a trip by car. If a person belongs to middle class not owning a car, the likely mode is motorized two wheeler. If a person is owning only bicycle, if a household has only bicycle.

And if the trip length is considerable say about 20 kilometer or 15 kilometers then, the likely mode of transport is transit either bus or train bicycling 10-15 kilometers is very rare on a regular basis. So, understanding the socio economic characteristics of travelers and understanding of the transport system characteristics will help us to develop mode choice models, which ultimately will provide us information about the vehicular traffic that will be resulting out of the travel demand? Fifth trip distribution, it is very important that some knowledge about the trip distribution process is gained in the transportation planning process, distribution of trips over space. Can you guess the possible factors that might influence trip distribution in urban areas?

Yes, please congestion that is the result of traffic problem, cost yes I am trying to get some clue or answer from you, regarding the spatial distribution of trips in urban area. The basic factors that might influence distribution of trips, I will give you an example. Let us say one person is living in Adair area in the city and working in Annanagar, because the work place is in Annanagar, the person is travelling from Adair to Annanagar. Let us say a factory employing 10,000 people is located in particular area in a city. So, this work place will attract people from almost all over the city. Let us say there is a huge residential colony with 10,000 houses built in a particular locality because it is quite conducive for living.

So, this colony will generate produce trips, which will be spread all over the urban area because more people are concentrated in a particular locality. So, in general you can understand that the trip production and trip attraction capability of different localities in urban area are the major causal factors influencing the distribution of trips. So, we must find out some way to analyze the distribution of trips and then theoretically explain the

trip distribution so that we can predict trip distribution process for the future condition in the urban area. Then a sixth topic will be on route assignment, the previous three analytical steps we will be dealing with person trips. And to work on the fourth steps, we need to convert person trips into equivalent vehicular trips. Because we will be assigning traffic, vehicular traffic onto the transportation network in this particular step.

In fact, you can understand trip generation, models split, trip distribution and route assignment as a four important analytical steps in the transportation planning process. The seventh topic will be on transportation service. Transportation services are conducted to collect data to analyze and understand the travel pattern. I have deliberately fixed this topic after the analytical steps. So, that while we discuss about the analysis we think of the variables involved in the model development and the factors were from we just formulate this variables. Once we have clear understanding of the factors that influence trip generation, mode choice, trip distribution and route assignment we know, what we want, we want data related to all these factors. Once we know the requirement then we will clearly understand how to go about collecting this information in the field.

That is why just I wanted to have this particular topic after the completion of the four steps of analysis in this course. It is nothing but collection of information regarding travel pattern, land use pattern, socio economic characteristics and so on. That is what we will be discussing under this particular topic. Then transport related land use models, this is nothing but a topic dealing with prediction of the future condition of land uses in an urban area. Today a particular zone may be purely residential area, after 20 years may be 60 or 70 percent of that area might get converted into a commercial zone. We do not know, depending upon the kind of development that is taking place. Today, we may have just a barren land in part of the urban area and after 10 years there could be a big factory located in that area attracting lot of trips from different parts of the urban area.

So, we need to understand, the different kinds of land uses existing today. And then develop a kind of relationship between the different kinds of land uses and the mobility pattern of the people and then predict the future land use pattern and the resulting travel pattern. So, that is what we will be discussing under transport related land use model specifically focusing on relating land use with transportation. Our ninth topic will be urban structure. You may wonder why should a transportation planner worry about urban structure? The urban structure is already there and transportation planner is planning for

the existing city it is all fine. But we should remember that ideally transportation planning and land use planning for an urban area will go in parallel, side by side.

Land use planning is also a continuous process, transportation planning is also a continuous process, land use influences transportation and transportation influence land use. That is how a clear understanding of the basic components of an urban structure by a transport system planner is prerequisite for successful planning exercise. Different urban structures will develop or induce different types of travel demand. So, that possibility has to be understood very clearly by the transportation system planner. We will discuss about basic types of urban structure and the transportation implication related to each of these urban structures under this topic.

Lastly, urban goods transport, until we complete the ninth topic we will be focusing our attention on passengers transportation holding the goods transportation for the last chapter. And as you can appreciate, when you try to solve the urban transportation problem, you must solve the problem in such a way that it facilitates both passenger and goods movement. There is no passenger movement alone without goods movement in any transportation system. This implies that a transport system planner should have a clear understanding of the goods movement pattern in an urban area. And the related causal factors relationship between the causal factors and the quantity of goods moved from place to place and then possibility of prediction of the future pattern of goods movement in urban area.

And finally, we must aggregate with passenger travel demand and goods travel demand, together to get over all requirement of transportation infrastructure, that is the purpose of dealing with the last topic namely, urban goods transport.

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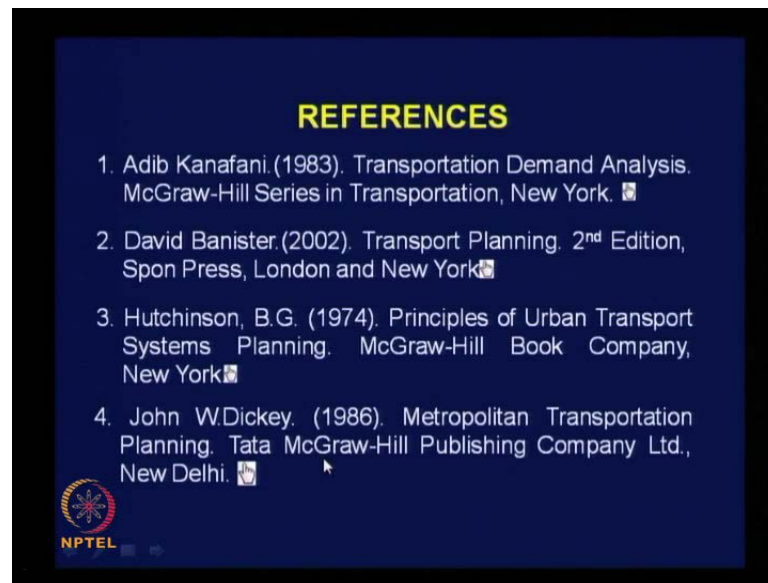
Now, let me give you some references for this course. I am listing the references in the alphabetical order of the author of the book, the first one by Adib Kanafani 1983. Transportation demand analyses, publishers name is given their published from New York. And I will simultaneously give a feel of the book also to you. I will just show you the contents of the book, so that you can understand the extent of utilization of each of these books to this particular course.
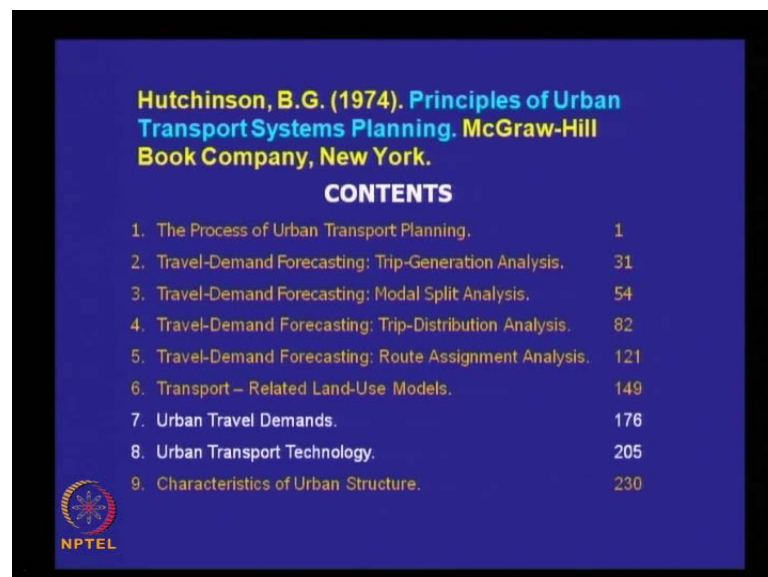
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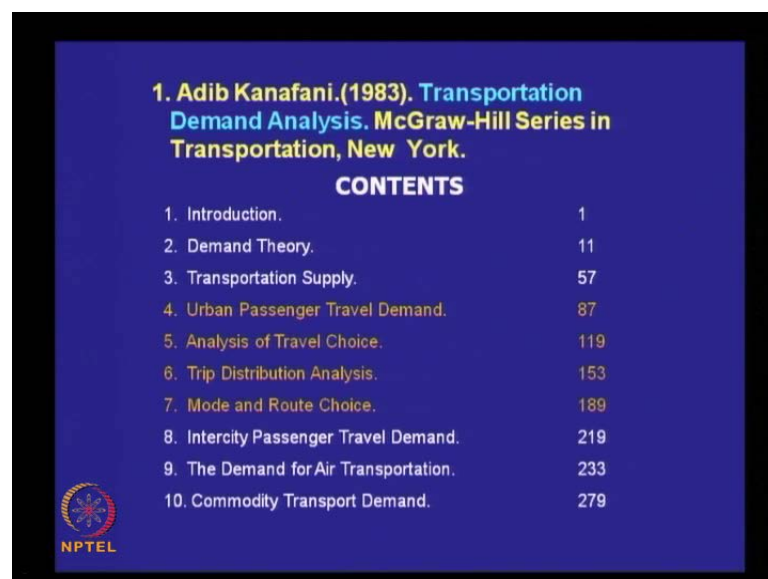
This is the contents of this course. There are 10 chapters in this book, starting from Introduction demand theory, Transportation supply, Urban passenger travel demand, Analysis of travel choice, Trip distribution analysis, Mode and route choice, Intercity passenger travel demand, The demand for air transportation, Commodity transport demand. I have just highlighted the relevant chapters for this course with orange color those chapters will be very relevant for this particular course in respect of this particular book. Then, David banister 2002 transport planning published from New York again and the contents of this book is given here. Banister deals with transportation aspects mostly related to UK, whereas other books deal with transport problems related to the US and some books deal with Canadian situation also.

And there are ten topics as you could see here, two chapters are relevant to this course chapters 5 and 6 namely Contemporary transport policy and the limitations of transport planning. You may find few aspects relevant to this course in other topics or chapter also you can just scan through and check. Next Hutchinson, B. G. 1974, it is a very old book, it was not revised subsequently, but it is a good book Principles of urban transport system planning and you can see the contents of this book.

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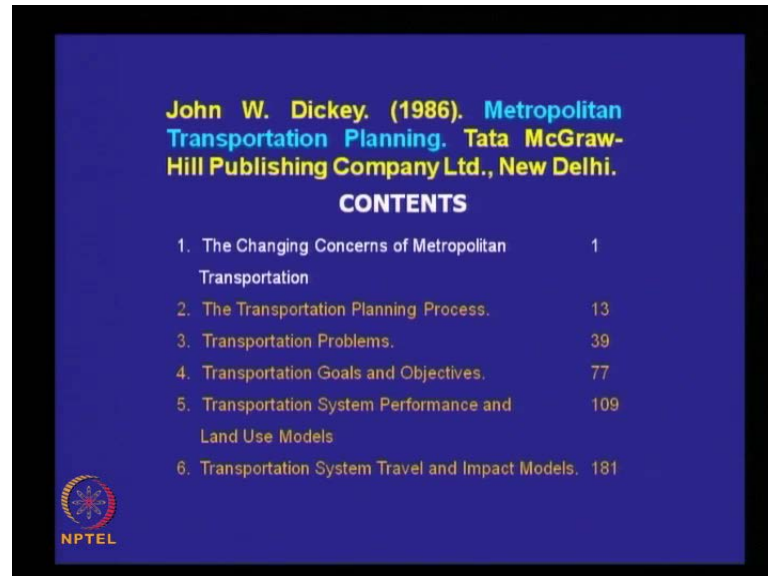
And I have given orange color to quite a good number of chapters of this book. Because I find it is quite relevant for this particular course, starting from the process of urban transport planning, Trip generation, Model split, Trip distribution analysis, Route

assignment analysis, Transport related land use models then urban travel demands, Urban transport technology, Characteristics of urban structure.

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And there are few more chapters in this book, The Evaluation of urban transport investment may be relevant to transportation economics, a strategic transport planning process, Sequential type planning process, Urban information sources, Urban goods movement is dealt with by this author. And further development of the planning process itself and there is an appendix giving information about review of welfare theory, which is relevant for some of the modeling aspects related to transportation system planning. Next John W. Dickey 1986, title of the book is metropolitan transportation planning, Tata McGraw-Hill publishing company, New Delhi.

The contents are as shown here, first starting with Changing concerns of metropolitan transportation, then transportation planning process, Transportation problems, Transportation goals and Objectives, Transportation system performance and land use models, Transportation system travel and impact models. Most of them are related to U S transportation condition, but still some other basic aspects are relevant to our condition too.

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And few more chapters in the same book Transportation information system, Transportation evaluation and Decision making, Generation of alternate solutions, Solution specification some techniques; and examples, Implementation procedures, Transportation systems operation and maintenance.

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Then, you can also refer to this book Juan De Dios Ortuzar and Luis G Willumsen 1996 title of the book is Modeling Transport.

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Contents of this book, starting from Introduction, Mathematical prerequisites, Data space, Trip generation modeling, Trip distribution modeling, Model split and direct demand models, Discrete choice models, Specification and estimation of discrete choice.

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Models Aggregation and Transferability, Assignment, Equilibrium between Supply and Demand, Simplified transport demand models other important topics. As the title of this book implies, this book mainly deals with analytical aspects related to transportation planning process. Those who are interested in analytical aspects of transportation

planning can refer this book this is a very useful reason book. Then Kadiyali, Indian author, Traffic engineering and Transport planning some of you might be familiar with this book. But please note that this book deals with almost four different areas, Traffic engineering, Traffic flow theory, Transportation economics and Transportation planning.

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And he has given the information under almost more than 50 topics in this book. I will just quickly go through all these 8 topics are related to traffic engineering, as you could see starting from Traffic engineering administration and function to statistical methods.

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For Traffic engineering and then Traffic engineering studies continues starting from speed studies, miscellaneous traffic control aids street furniture and so on.

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It continuous Regulation of traffic, Transportation system management, Scope definition basic diagrams of traffic flows. Starting with traffic flow theory, light hill Witham's theory all related to traffic flow, Car following theory and so on.

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Queuing theory, Vehicle arrivals, Delay to traffic, Simulation of traffic all related to Traffic flow theory. Then starting from page 635, you have some information on

Transportation planning titled Transportation planning process, Transportation survey, Trip generation, Trip distribution, Traffic assignment, Model split, Evaluation, Land use transport models and so on.

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And it continuous under other topics like accidents costing all related to transportation economics. And it goes up to 51 different topics in this book, still I would say under transportation planning, you will find some useful information in this book too. Then Michael D. Meyer and Eric J. Miller 2001 titled urban transportation planning McGraw-Hill book company, New York. And contents of this book I will just quickly go through.

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First 6 topics are relevant to this course, starting from urban transportation planning to urban activity system analysis. The other topics like Supply analysis, Transportation system and project evaluation, Program and project implementation and few more topics, under appendix like chronology of selected federal activities related to Urban transportation planning, Determination of sample size. All these things might me interesting for research scholars and those who are interested in analytical aspect of transportation planning. Then lastly Papacostas, C. S., and Prevedouros, P. D. 2004, title is Transportation engineering and planning, deals with both engineering aspects as well as planning aspects. I will just show you the contents of this book, starts from Introduction, Roadway design, Traffic stream flow models, Capacity and level of service, Transportation models, Urban and intelligent transportation system.

Then, it takes up topics related to transportation planning, travel demand forecasting. And then again topics related to traffic, Traffic impact and parking studies, Air quality, Noise Evaluation choice, Elements of engineering economy, Probability and statistics, Queuing and simulation, Transportation software and so on, and there is an appendix also. So, these 8 references will be useful to you and those who are interested to go further, there are few more books available which you can find in library and refer. To summarize, in this class we first recapitulated the important points of the previous lecture, then we discussed mainly about the outline of this particular course. And we also

defined the term planning and then extended the definition to understand transportation planning process.

Now, you are very clear about the contents of this course. It is going to be dealt with using 10 different topics and you have now a set of 8 references for this course with this we will close our discussion for today. We will continue our lecture in the next class tomorrow.