Urban Transportation Planning
Prof. Dr. V. Thamizh Arasan
Department of Civil Engineering
Indian Institute of Technology, Madras

Lecture No. # 37
Urban Structure

This is lecture 37 on urban transportation planning. We will discuss on urban structure in this class. From the term structure, you may guess urban structure is something similar to a system or facility being constructed, structure is made out of construction. So, we just put smaller elements together to make a structure. While doing so we think of the requirements, and then fix the different facilities in appropriate locations. Even if you consider a small residential structure, we just identify various elements of the structure like living room, bed room, bath room, kitchen, and so on. And understand their functional requirements, and then provide appropriate location with respect to each other, so that as a system they function effectively.

The same thing should be taught of in the case of urban structure. When you have a city or town, you have different activities being carried out in an urban area. You identify the different types of activities and identify their requirements and the pattern, and then provide the required space in appropriate location and slowly formulate a (( )) the whole of the urban area in the form of an appropriate urban structure. So, that is how we need to understand the process of structuring an urban area.

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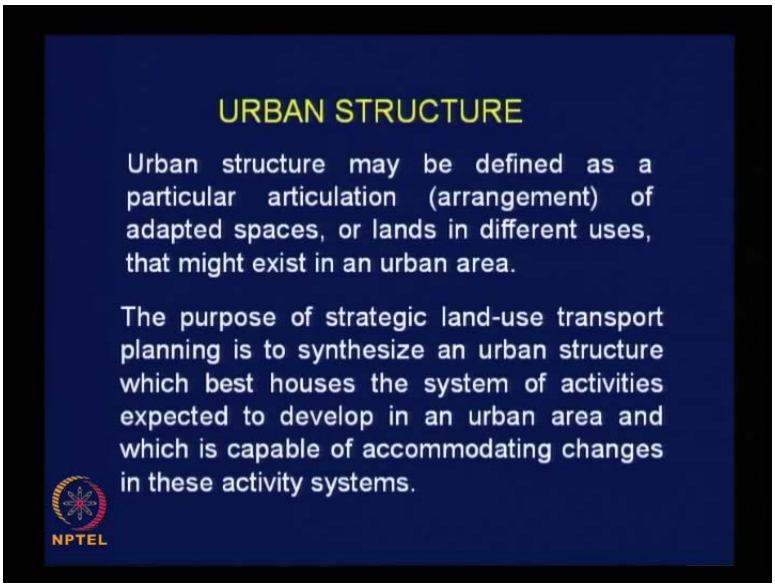

And we can define the urban structure as follows. Urban structure may be defined as a particular articulation or simply arrangement of adapted spaces or different types of land uses or lands in different uses that might exist in an urban area. As I said we have to identify the different types of land-uses - their requirements, and then fix them in different areas in the urban space so that they interact effectively, and overall the urban activity system is performed without any hindrance, that is the purpose of just planning for an urban structure.

This is the main purpose of objective of structuring an urban area. The purpose of strategic land-use transport planning is to synthesize an urban structure. What do you understand by the word term synthesize, an urban structure literal meaning of the word synthesize is putting smaller parts together to make a whole or to make a system that is the meaning of the word synthesize. Here what we do is we synthesize an urban structure; that means, we just put a different land-use parcels together to make the urban structure that is the meaning here, which best houses the system of activities expected to develop in an urban area and which is capable of accommodating changes in these activity systems that is the most important aspect.

It is not that you must think of the current activity system and fit different activities in different land-use parcels. You must anticipate possible changes in the form of increased

intensity of such activities or modification of the activities, all possible changes are to be predicted and you must provide for such changes in your urban structure.

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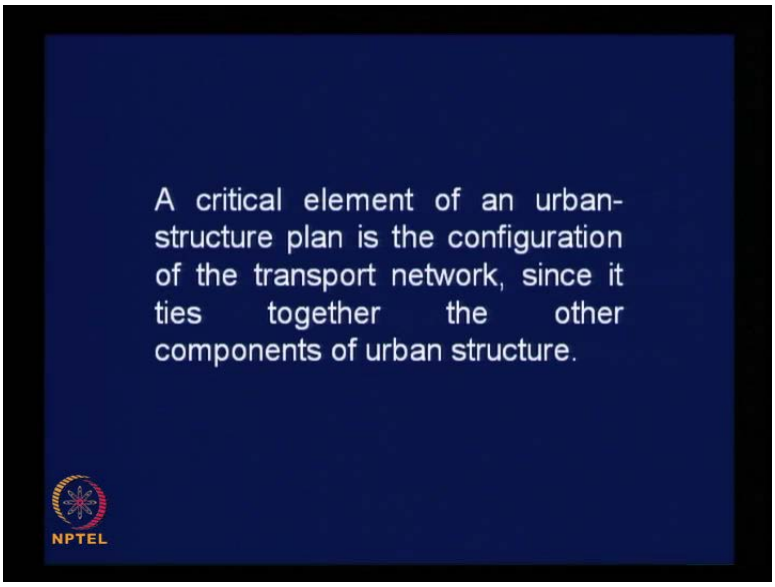

This is the most important aspect which is relevant to our course subject of study. A critical element of an urban-structure plan is the configuration of the transport network, since it ties together the other components of urban structure. Can you think of an urban structure without transport network? No activity can take place without your transportation system, activities need mobility unless you provide transport system in place you will not be able to connect different activity locations and make people to perform the desired activities that is how transport network is a basic frame work required to construct the urban space.

Most of us or in general people understand road network as a facility mainly to provide mobility of people and goods. This is of course, the primary function of any road network and there are several secondary functions facilitated by or secondary functions of road network which we do not realize. For example, how do we take electricity to the different land-use parcels, which is the pathway for taking electric power to the required places. We erect electric poles along the road roadside.

So, roadway facilitates this service provision to the required places. How about water supply? Where do we lay the pipelines to supply water? By the side of the road, How about disposing of sewage from different types of land-uses? How do we just align the

sewages? Along the roads and how do we take the communication cables? Again along these roads.

So, that is how road network facilitates as indicated here since it ties together the other components of the urban structure. So, that is how we need to understand functionally road network plays a vital role and that is how a lot of planning has to go into the planning of transport network first and even if there is some minor variations in fixing of different types of land-uses that can be rectified in course of time. But once if you fix a transport network it is very difficult to change later because, once there is a facility there will be lot of developments on both sides of your transport network and it may be very difficult to change for the system later.

You would have heard about people going to court, when some land is acquired for construction of a flyover. It is a small element no transport network major transportation projects are delayed because, people are going to court. The adjoining building owners are not willing to part with their property on their path they are right. Because, they have invested a lot of money and they have been living there or using the facility for quite some time and suddenly we just asked them to vacate and go to other areas and had they are been proper system systematic planning of the entire transport system network at the beginning itself anticipating all these elements.

As well as their space requirements at the beginning there is no need to worry about land acquisition in the future and we can avoid thousands of court cases with regard to land acquisition for construction of transportation infrastructure in our country. That is how we need to understand the importance of planning for the transportation network first. So, that it provides or facilitates the whole of the activity system in any area whether it is an urban area or region or the country as a whole.

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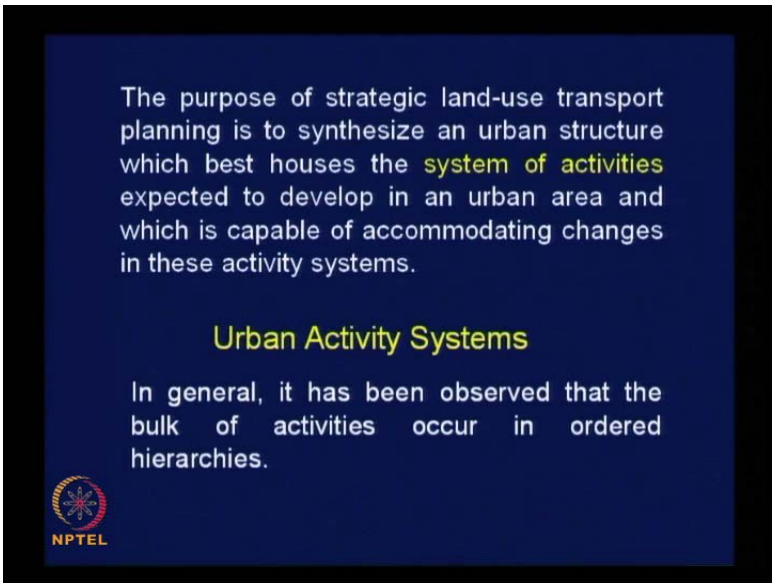

I am just repeating the same sentence here to emphasis one point. The purpose of strategic land-use transport planning is to synthesize an urban structure which best houses the system of activities. The system of activities expected to develop in an urban area and which is capable of accommodating changes in these activity systems. This implies the land-use planners and transport system planners should be very clear about the system of activities in an urban area. Unless we know something about system of activities we will not be able to provide the network or land-use parcels to accommodate this system of activities.

So, what are these systems of activities in an urban area? Is it possible to generalize the system or at least can we understand an ideal system of activities. So, that we have these activity systems in mind while planning for the transport network as well as land-use parcels in an urban area. Urban activity systems in general, it has been observed historically that the bulk of activities occur in ordered hierarchies by virtue of the nature of activities, that is some hierarchy already followed. The only requirement is we need to understand the hierarchy and then try to idealize or broadly classify the activities. So, that we can take those activity patterns as a reference for planning purpose.

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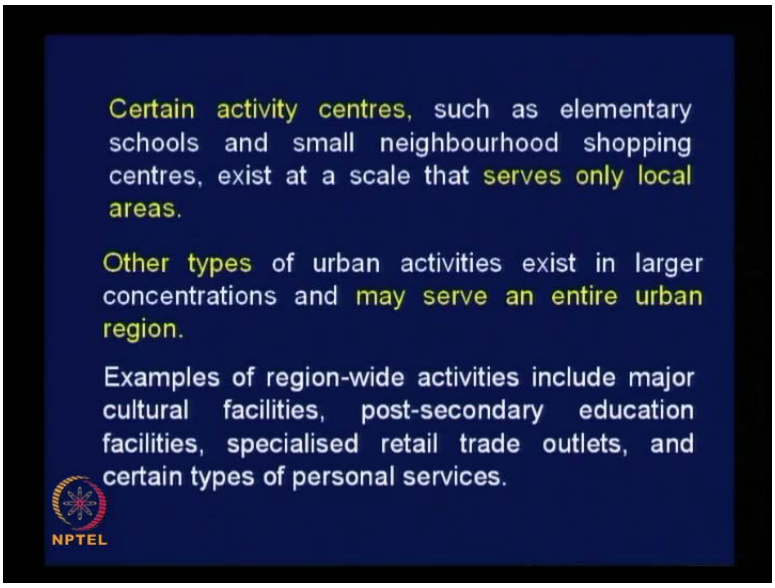

This is known to us certain activity centres such as elementary schools and small neighborhood shopping centres may be petty shops, exist at a scale that serves only Local areas. That is how we need to identify the activity system we should look at what we do on daily basis what is happening around us. So, this is what happening in any urban area and then we should also realize that other types of urban activities exist in larger concentrations and may serve an entire urban region. The spread of the area of influence of different activities varies depending upon the type of activity.

We have small scale activities whose influence is extending over a smaller part and there are large concentrated activities, whose influence covers part or even the whole of urban area. Can you think of examples of the other types of activities whose influence may cover major part of the urban area sometimes whole of the urban area. We say that the elementary schools and small shopping areas will have influence over a smaller region spread over few traffic zones. Can you think of such activities activity centres like let us say whose influence may cover a larger area of an urban space or the whole of the city or town.

Let us say major cultural facilities like music academy. Can you construct music academies in every zone? No these are all specialized major facilities which may be located in one or two locations in a city or town and major sports stadium to accommodate cricket matches.

For example, you cannot have so many or too many crickets match stadiums in a city normally one, whose influence will be covering the entire city sometimes beyond the city also covering the whole of the region. Some special retail facilities like jewellery shop. Can you have jewellery shops in every zone? There is no need. So, that is how you must think of the activity centres whose influence will be spreading over vast area. Example as I said of region wide activities include major cultural facilities, post secondary education facilities. What are post secondary education facilities? Colleges, you need not have to construct colleges in every alternate traffic zone colleges may be few in an urban area and whose catchment will cover major part or the whole of the city.

Specialized retail trade outlets as I said jewellery shop for example and certain types of personal services. Can you give examples for this category of activity? Certain types of personal services what do you understand by personal services? We have discussed about this earlier while discussing about trip purposes, trips made for personal business. What are the different kinds of a personal business? What do we do personally by making trips we go to hospital, post office, bank, as I said beauty parlor or whatever, these are all personal services and specialty clinics or hospitals may not be available in every traffic zones. These are facilities which may have wider coverage like that; you can think of similar personal service institutions banks, post offices they are not going to be located everywhere.

And so we are able to now perceive the type of activities. One set of activities which will cover a smaller area and another set of activities whose coverage is going to spread over larger urban space. This is a preliminary stage of understanding of the activity system. Let us proceed further and see whether we can identify some idealized activity set, which can be taken as bases for planning an appropriate urban structure.

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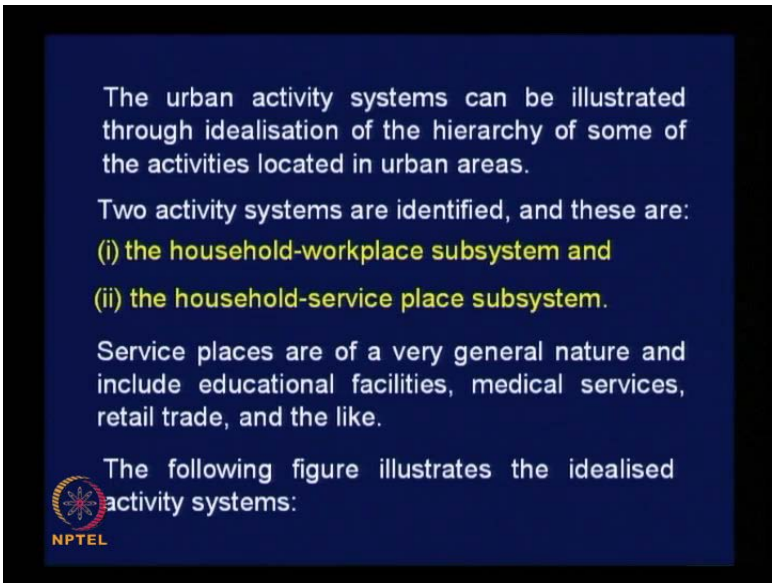

The urban activity systems can be illustrated through idealization of the hierarchy of some of the activities located in urban areas. The same statement in a systematic way is given here and this is one way of idealizing the activity systems. We can classify one type of activity as household-workplace subsystem activities or movements rating households and workplaces. Second, the household-service place subsystem. Do you understand? When we say service place it is a broad based definition. All kinds of activities other than going to work are coming under service that is how we derived.

So, broadly we can idealize all kinds of activities in urban area which necessitates the mobility of people and goods into two categories. One is simple the household workplace subsystem part of the whole system. Number two the household service place subsystem two subsystems. You will find later that this is good enough to really plan an urban area to provide for all these any kind of activity. In fact, service places are of a very general nature as I said earlier and include educational facilities, education is also considered to be coming under service.

Obviously, it is service medical services, retail trade and the like. All activities other than activity related to work are coming under service related activities. Let us try to understand this activity system with the aid of a sketch. So, that the concept is made very clear, which is a base for us to proceed further to really think about different types of urban structure.

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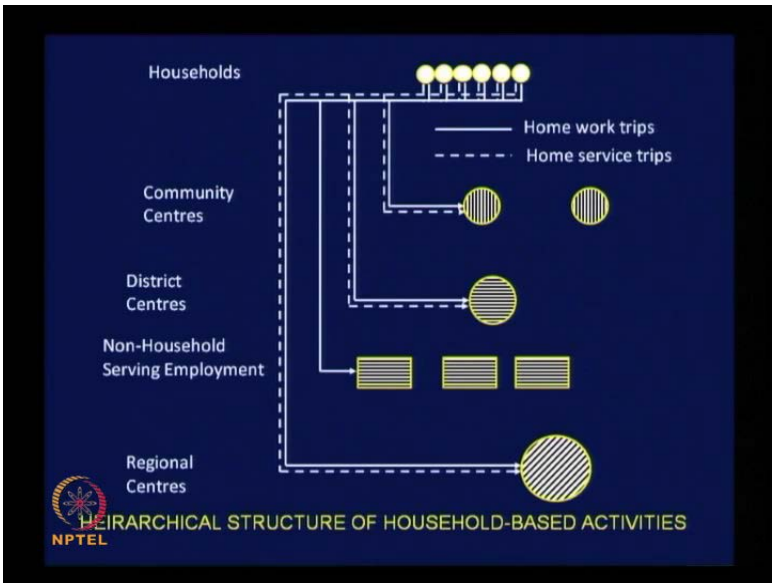

This is the conceptual frame work of the activity system in an urban area. Do not look at all the features at the same time, let us proceed from one end and try to understand what we have illustrated here. This smaller circle shown on top or schematically indicating the households residences of urban and the circles with vertical hatching with vertical lines of a particular size indicate schematically again the community centres. A little larger circle with hatching using horizontal lines indicate district centres and the rectangles hatched with the horizontal lines indicate the location schematically again of non household serving employment.

And the largest of the circles hatched with inclined lines indicates regional centres and the continuous unbroken line connecting all these circles and rectangles in nothing, but home work trips or the trip path connecting home and work place and the dotted line is home service trips indicates again trip path between home and all the service centres. Interestingly, you will find that both these lines are connected to all the circles as well as the rectangles and what are community centres or can you guess some hierarchy here in this illustration.

Because the size of the circles should give you some clue, obviously by these circles we mean the service centres closer to of smaller size closer to the households and these are again service centres of medium size little away from residential area and these are again service centres of larger size quite away from the households and you can imagine the

area of coverage by each of these service centres depending upon the intensity of activity and the size they will be covering smaller or larger areas.

So, this is what we mean by hierarchical structure of household based activities. Please remember we are talking about household based activities. Why household based activities? Why we are not talking about movement between the smaller circle and the medium size circle and the medium size circle to larger circle? There will be movements, but we have simplified the activity system to some extent. So, that we will have some base to understand at least 80 to 90 percent of the activity pattern clearly and based on that information we will be able to plan for the different types of land-uses and ultimately get a structure for the urban area.

It is not that we are taking into account all types of activities all types of movements 100 percent and then proceed with the urban structure process. It is very difficult because, these are all movements which might occur at random without in the regular pattern whereas, movements from households to any other activity will have some regular pattern and that is more important. Household based trips are to be provided for the required facilities, then other trips once you provide this automatically you would have provided for other kinds of movements between other activities centres and so on that is a philosophy.

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Let us try to understand what we really meant by these circles. The community centres shown in figure may be thought of as including junior schools, medical clinics and small size shopping facilities. That is how we need to understand the small circles shown as community centres. District centres the medium size circle in the figure might contain major retail trade outlets, high schools, personal services and certain types of cultural and entertainment facilities may be a small cinema theatre covering a smaller area of that part of city or town and so on.

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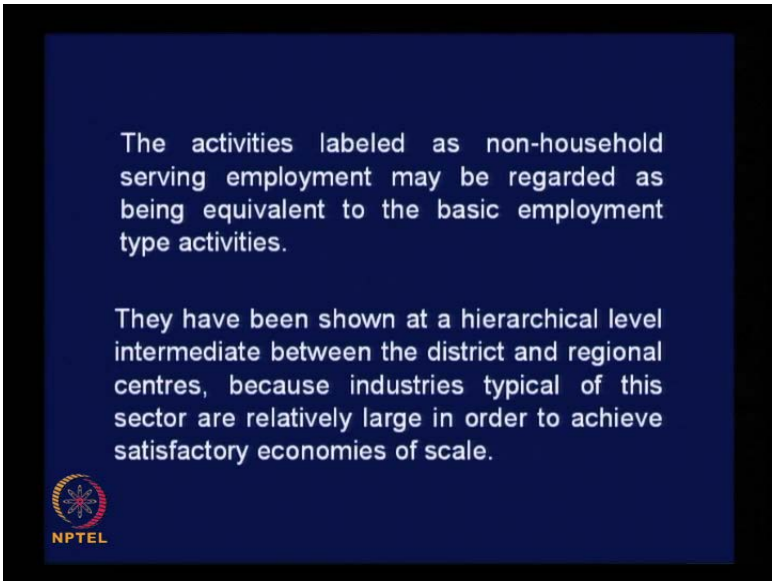

The activities labeled as non household serving employment the rectangular diagram that was shown in the figure. They are non-household serving employment and these may be regarded as being equivalent to the basic employment type activities. What do you mean by equivalent to basic employment type of activities? We have already understood the term basic employment while discussing Lowrys land-use model. The basic employment activity centres will have their markets not confined to the city alone, the market will extend beyond the city.

That is how the location of basic employment centres are not accessed or arrived at based on the process we just provide the location exogenously in Lowrys model. So, you can understand these employment centres as activity centres whose interest and market spreads beyond the urban area and the location of these activity centres are not based on the day to day needs of the households of the city that is the point.

And they have been shown at a hierarchical level intermediate between the district and regional centres, district centre is a medium size circle regional centre as you saw is the largest of the circles, these rectangles are shown in between a medium size circle and the largest of the circles why it is. So, because industries typical of this sector are relatively large why should they be relatively large, because their market is wider their activity will be intense they will be producing more.

So, unless it is of reasonable size they will not be able to produce more. In order to achieve satisfactory economies of scale because economies of scale those who are taking transportation economics course will be discussing on this particular aspect so very interesting topic economies and diseconomies of scale of production. As of now you understand economies of scale as a size of production, which will at least enable the producer to break even at least to achieve no loss no profit condition.

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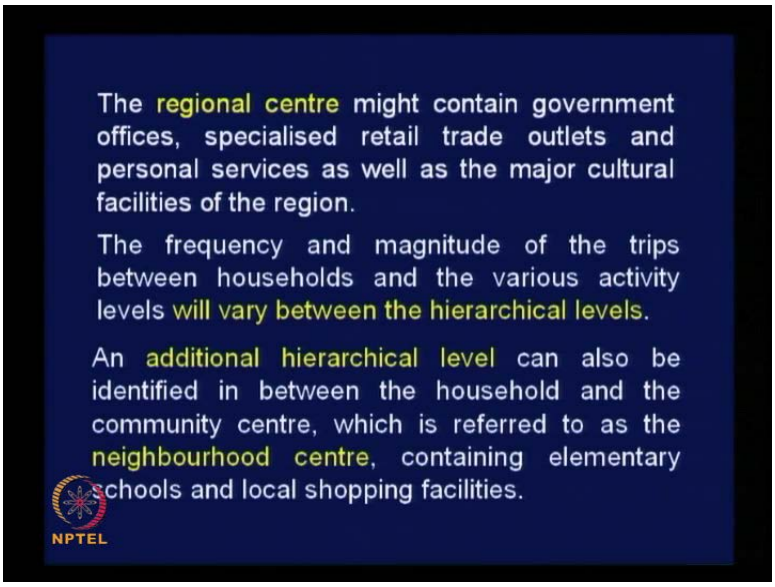

And the regional centre might contain government offices, specialized retail trade outlets, and personal services as well as major cultural facilities of the region. This is very important, the frequency and magnitude of trips, I repeat the frequency and magnitude of trips between households and the various activity levels will vary between the hierarchical levels.

Think of the frequency of trips between neighborhood centre or community centre to household, household to district centre, household to regional centre, it is going to be

totally different. So, that has to be understood clearly by the transportation system planner as well as land-use planner. An additional hierarchical level can also be identified in between the household and the community centre, we define community centre as an activity centre comprising services like middle school, and some minor shopping areas.

As I indicated you earlier, there could be another small size activity centre in between community centre and households providing still smaller size services of similar nature. Between the household and community centre, which is referred to as the neighborhood centre containing elementary schools or even kinder garden and Local shopping facilities is only an option and planners can design, whether to have this it depends upon the way the city develops. If you find that there is a need to identify these neighborhood centres also ,you have to provide for this and then plan for the structure of the urban area.

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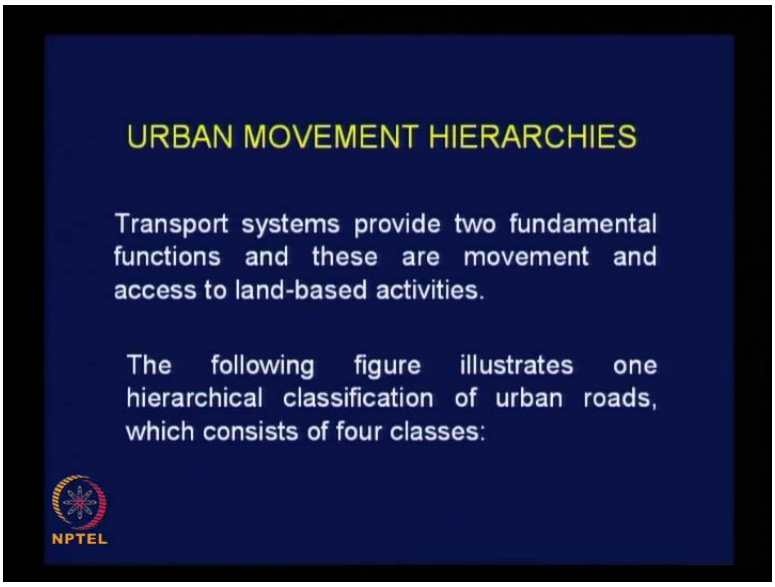

Then about urban movement hierarchies should we have to have hierarchy in urban mobility, the reason is given here itself. Transport systems provide two fundamental functions and these are movement and access to land-based activities. You can understand the functions of any transport system as two.

One, it facilitates faster movement it could be faster movement also and it provides access to all land-based activities and in urban areas these two functions are very important. Because activities are very intense and there is urgent need or demand is more

for accessing land-uses at frequent intervals. At the same time people who are moving in urban areas over relative longer distance would like to move faster to reach the places of interest and if you do both simultaneously provide access to all land-uses and try to move faster, is it possible?

These are two conflicting objectives going faster and accessing all types of land-uses on the way you cannot do both simultaneously. So, clearly we have two conflicting objectives and as planner and transport system planner and well as land-use planner, we must try to satisfy both the objectives or achieve both the objectives simultaneously. Is it possible? We have two conflicting objective and we want to achieve both simultaneously, is it possible or not? Yes or no. The answer is yes it is possible that is why, we exists as transport system planners and transport system planners must provide solution.

Because both the objectives are reasonable objectives one would like to move faster when they want to travel over longer distances in urban areas. The other one might would like to access land-uses. So, we have to provide for both we will see how. Of course, the following figure illustrates one hierarchical classification of urban roads, which consists of four classes of roads while we discuss about the hierarchy. We will understand that it is possible to achieve both the activities by providing an appropriate transport network.

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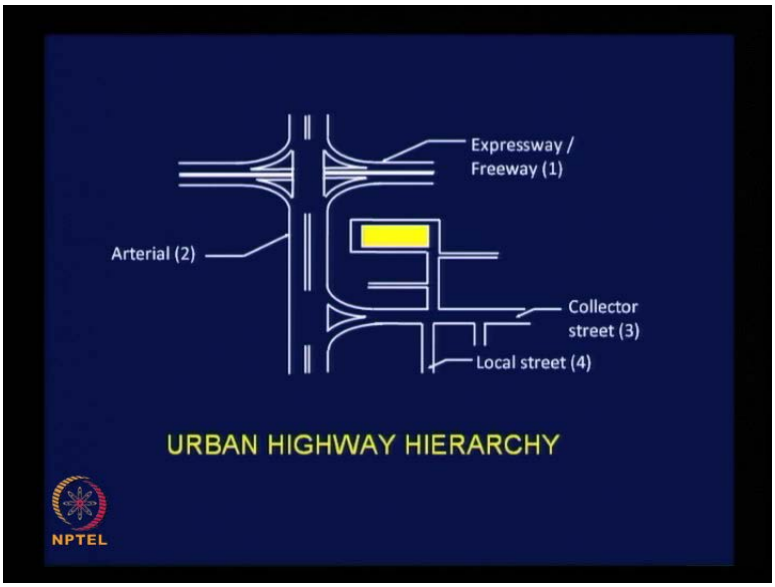

This is the urban highway hierarchy or you can say urban road hierarchy and you can see there are four different types of roads shown here. This is an express way or free way numbered as number one type of facility and you can see some kind of layout at this intersection this is nothing, but grade separation facility and this road is shown here as arterial road or type two road and you can see the intersection of an arterial with the express way is grade separated and then type three road is a Collector street. As its name implies its intended for collecting traffic and feeding to the higher level facility and the Collector street gets connected to the arterial not at a grade separation facility, it is just at grade at the ground level at the same level there are getting connected.

And the fourth level road is Local Street which is closer to the households and Local streets are connected only to the Collector Street. Are you able to visualize some hierarchy in the road network? Can you directly get connected from a Local street to arterial in this system? Local street arterial not possible. To get connected to an arterial you must go through Collector streets. So, Local streets are connected only to Collector street and do you find a connection between Collector street and express way, connection between Collector street and express way no, if you want to get connected from a Collector street to express way you must go through an arterial and arterial only gets connected to the express way.

And as their names implies in the case of express way as the name implies the objective or emphasis is what speed of movement and no provision for land access. If you want to move faster take the express way and then get down through interchanges, wherever you want to reach out to your destination at the ground level. And if you look at arterial obviously, it is not going to be as fast as the express way, but still it is the high type of facility still you can move faster on arterial may be have some limited access to roadside land-uses and Collector streets are going to be little inferior to arterial, but the extent of access to land-uses may be much more compared to the arterial, whereas in the case of Local streets the emphasis is going to be only land access.

It Local streets should provide access to all facilities on both sides speed is not emphasized. So, with Local streets no emphasis for speed and full emphasis for land access with the express way no emphasis for land access and full emphasis for only speed and the intermediate type of roads the proportion of emphasis varies with Arterials still relatively higher emphasis on speed and relatively lesser emphasis on land access

and with Collectors may be 50 50 speed as well as land access. So, if as system planners can manage to fix this kind of frame work in urban area, we will be able to achieve both these conflicting objectives. In developed countries and some other cities they have really achieve these objectives you will find that one will be able to move faster as well as one should be able to access land-uses as and when they like it is possible

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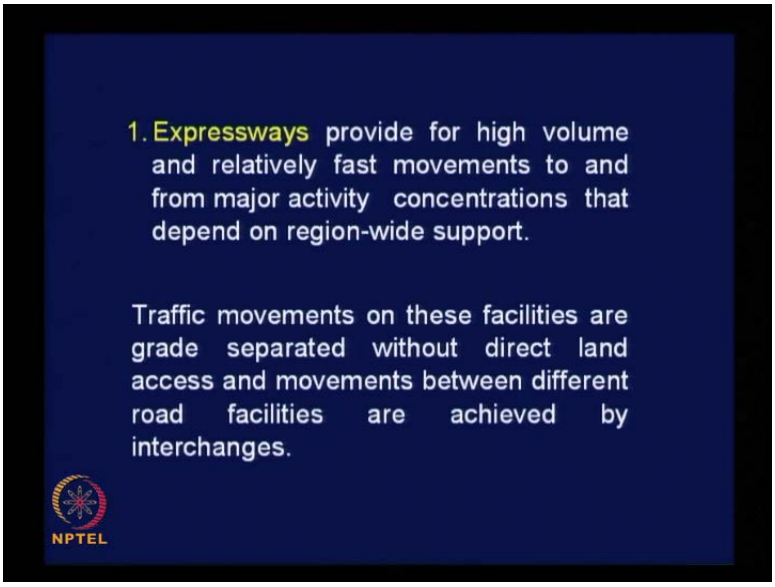

Let us just summarize what we discussed, what is Express way? Expressway provide for high volume and relatively fast movements. So, its capacity is more high volume lot of people can move faster simultaneously to and from major activity concentrations like the regional center the biggest of the circles that you have seen. Expressway should be mostly connected to those circles that depend on region wide support catchment area for such large activity centres will be more. So, unless people are able to move fast the activity cannot go on in such larger centres.

And traffic movements on these facilities are grade separated obviously, without direct land access, no direct land access from express ways or freeways and movements between different road facilities are achieved by interchanges only. If you want to come down you look for interchange and then take an arterial and then go further to take Collector Street and then finally, Local Street.

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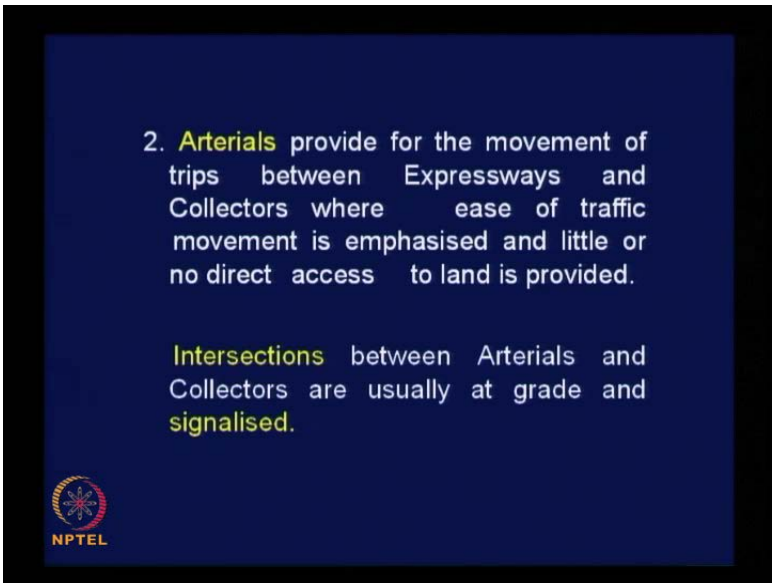

Arterials provide for the movement of trips between Expressways and Collectors where ease of traffic movement is emphasized again we emphasize ease of traffic movement and little or no direct access to land is provided, very limited emphasize on land access and intersections between Arterials and Collectors are usually at grade and signalized. There should not be any unsignalized intersection between Collectors streets and Arterials. So, that the movement on arterial is unaffected. They follow the signal and still move freely see every intersection of Collector Street and arterial should be signalized.

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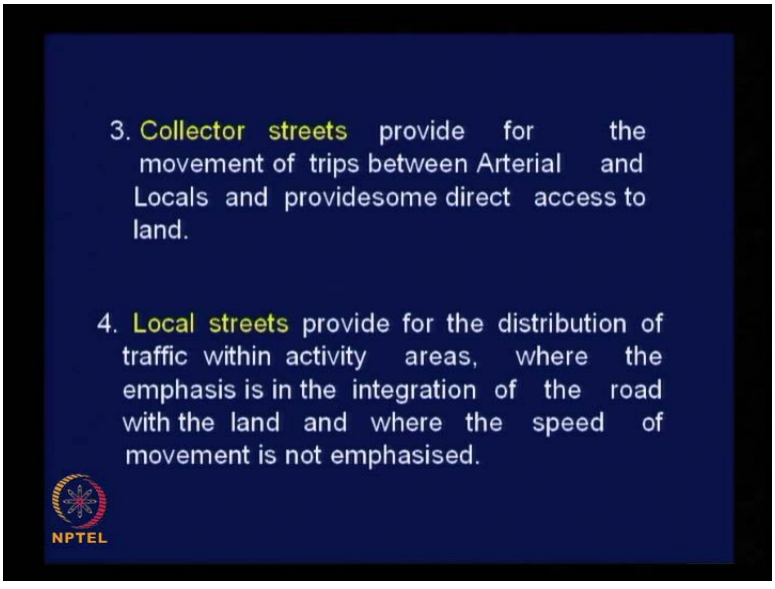

Collector streets provide for the movement of trips between Arterial and Locals and provide some direct access to land. Direct access to land from Collector is possible. Local streets provide for the distribution of traffic within activity areas, that is the primary function distribution of traffic within activity , where the emphasis is in the integration of the road with the land it is very clearly spelt out integration of the road with the land is the primary function of Local streets and where the speed of movement is not emphasized at all there is no emphasis on speed of movement. Now, with this understanding you think of Indian condition. So, there is no point in talking about something in sky without relating the concept to our realistic situations.

Do we have expressways in our cities and towns or freeways? As of now there are no well established expressways or freeways classified as urban roads. In certain cities, we are now developing an elevated roadway over considerable length like cities of Mumbai, Bangalore and few other cities are constructing elevated roadways over considerable length. But the problem with these facilities is that again because of the heterogeneity of the traffic with wide variation in the speed. We are unable to maintain your real high speed on these elevated roadways also. So, we can assume for all practical purposes as far as India is concerned in urban areas.

We can say that we have Arterials, the highest facility available even today are only Arterials. Probably we can have two types within Arterials major Arterials and minor Arterials. Major arterial roads providing some emphasis for speed and minor Arterials will provide for both speed and land access. And the Collector and Local streets are practically mixed up, there is no clear division between Collector and Local streets under our condition. That is how we find even on major city roads a small by lane is getting connected at a particular point there will be suddenly a two wheeler getting into a main stream of traffic disrupting the entire traffic flow.

So, it is mainly because of the absence of hierarchy of road system. So, once you have a hierarchy road users can easily anticipate the locations of conflict and mentally they can be very peaceful while driving compared to the situation existing today. That is how it is very important for the planners even now it is not too late. Even the existing road network can be modified incorporate this system, which provide for immense advantage of traffic regulation as well as ease of driving using any kind of vehicle as we have

today. In the point of view of traffic regulation also it is very important to introduce some hierarchy of road network in our cities and a town is one advantage.

Another advantage is that provision of traffic control devices and having a policy for road maintenance. All these things are based on the actual traffic volume and the design speed as you would have learnt in other courses. The design speed and traffic volume only provides you the input for construction maintenance of the road as well as provision of required traffic control devices. If you have this kind of hierarchy then you would have almost defined the traffic volume traffic speed and to some extent traffic composition also on all these roads. As the transport system planner, you would have segregated traffic based on the hierarchy and that will help you to understand the construction maintenance needs of the different categories of roads.

As well as you can have different types of signage and signals for these categories of roads design itself can be different, even location of the sign board depends upon the speed of the vehicle as you would have learnt in your geometric design of the highways. So, that is how it is very important to have some hierarchy in your road network and this will go a long way in regulating traffic flow as well as ultimately achieving the both the conflicting objectives of speed and access to land.

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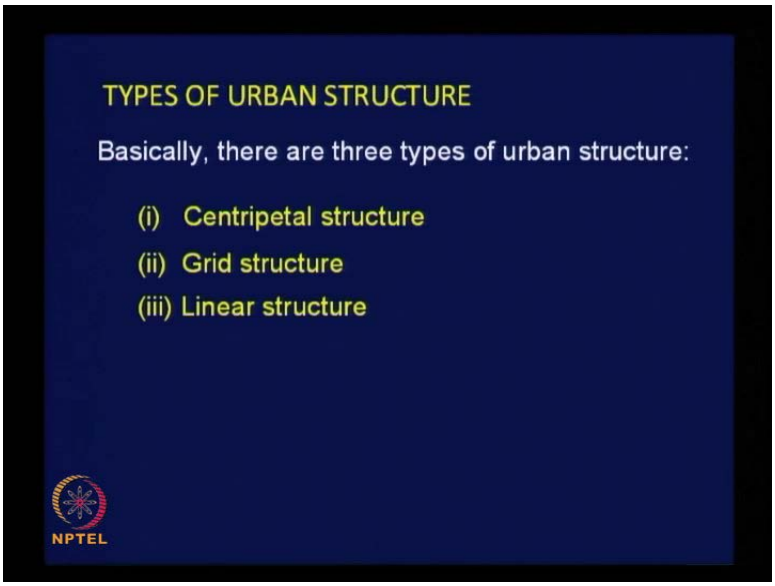

And different orders have come out with number of urban structure possibilities and if you put them all together and broadly classified them. There are basically three types of

urban structure. The first one is called or named as centripetal type of urban structure. The second one is grid type of urban structure. Third one is linear type of urban structure. You must think of the need for this kind of classification, why should we have different types of urban structure? Why not standardized urban structure into a single format? After all we have similar activities in any urban area people go to work and then reach out to service places are they different and different cities and towns. They are same isn't it we are able to idealize the activity system.

Once we are able to idealize the activity system, why not idealize the urban structure as a single unit, which can be followed by any city or town. Why there is a need to have different types of urban structure? Is it necessary? Yes.

Development of the area might be different in different places. So, it depends the surrounding land-use also depends on the development of the area it might be.

What exactly mean by development of the area?

There might be some new work places coming in coming in the IT sectors suddenly came so it is like everyone is tending towards the IT sector now. So, it depends on that development of that area.

Your response is there may be different patterns of development of the urban area and it may not be possible to stick to a particular urban structure. But we must realize the urban structure incorporates all the possible developments, that is land-use planning. As I might have told you earlier, we identify clearly different types of land-uses on urban space. We fix regions for different types of land-uses like residential commercial industrial all those activities are already fixed and while preparing the master plan, we provide for expansion of these activities.

If that is acceptable to us then you we can argue still we can have a single urban structure to be followed by every city. Because activity pattern is same and if you are able to provide for development or even changes in activities at the planning stage itself. Why not have a single urban structure for every town and city, which will be easier to manage and people migrating from one city to another city might feel at home, because things are same everywhere. Why it is not possible? that I would say, but still it is not possible to have one formula for urban structure to be adapted everywhere.

There is there are other valid reasons which necessitates the adaption of different types of urban structure or I will explain what is really meant by these three types of urban structure then you will be able to appreciate the need. In the case of centripetal urban structure as the word centripetal indicates centripetal is opposite of centrifugal, what is centrifugal force? Force tending to push the objects away from the centre of the circular path whereas, centripetal force is the force which is pulling everything from the periphery to the centre. If we have a situation where you have to manage most of the activities concentrated in one location, then you must plan the urban area in such a way that the activities oriented towards the city centre is performed smoothly.

In the case of grid type as the name implies you will have first your frame work of roads in the form of grid and that will be taken as a basis for structuring your urban area and in linear structure as the name implies it will be just a long linear structure which will be less and length is going to be relatively high, where there may be a need for this kind of linear type of urban structure think about these points we will get an appropriate answer for these questions in the next class.

To summarize what we have discussed today, we started our discussion with understanding of urban structure and the need for urban structure plan. In that context we discussed and found there is possible to put all the different kinds of activities that take place in urban area into two broad category categories namely activities related to movement from home to work place and activities related to movement from home to all kinds of service places. Then accepting this broad classification we identified different types of service centres - starting from community centre, district centre, deal centre and then places where the employment which has got its market beyond the urban area can be located.

And then we discussed about the hierarchy of transport network, and we now are convinced that it is possible to provide for both the conflicting objective, objectives of faster movement land access by having an appropriate hierarchy in the transport network. And finally, we find that there is need to be different types of urban structures to suit certain conditions, the conditions will be kept in mind and discuss in detail in the next class.